

Water System Plan - Appendices

March 2025 / DRAFT

Appendices

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APPENDIX A

NOTICE OF DETERMINATION OF NON-SIGNIFICANCE

~ To be included in a future submittal. ~

APPENDIX B SEPA CHECKLIST

State Environmental Policy Act Environmental Checklist

The State Environmental Policy Act (SEPA), chapter 43.21C RCW, requires all governmental agencies to consider the environmental impacts of a proposal before making decisions. An environmental impact statement (EIS) must be prepared for all proposals with probable significant adverse impacts on the quality of the environment. The purpose of this checklist is to provide information to help you and the agency identify impacts from your proposal (and to reduce or avoid impacts from the proposal, if it can be done) and to help the agency decide whether an EIS is required.

10.1 Checklist

The following sections contain the completed checklist. Checklist questions are in normal font and responses are in italic font.

10.1.1 Background

1. Name of proposed project, if applicable: *City of Bellingham Water System Plan*
2. Name of applicant: *Mike Wilson, Assistant Director - Engineering, City of Bellingham*
3. Address and phone number of applicant and contact person:

   104 W Magnolia St., Ste. 109
   Bellingham, WA 98225
   Phone: (360) 778-7700

4. Date checklist prepared: *02/20/2025*
5. Agency requesting checklist: *City of Bellingham*
6. Proposed timing or schedule (including phasing, if applicable):

   The Plan will take effect after adoption by the City Council, and approval by WADOH, which is expected in late 2025.

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain.

   The plan documents the City's strategy for providing safe and reliable potable water service to existing customers and increased service capacity. The proposal anticipates that growth based on the adopted population projections will result in increased demand for municipal water service. This demand will in turn create a need for extension of water distribution lines, storage, and treatment facilities. The plan is an element of the City Comprehensive Plan, and serves as a guide for the maintenance and expansion of the utility within the service area, in accordance with local, county, and state requirements.

This plan is a guidance document for planning and design of future water system facilities and to help the City use its water resources in the most efficient manner possible. The City's water system provides water for about 27,380 household and businesses. The plan addresses all aspects of the City's water system in compliance with state requirements. The plan documents the existing water resources available to the City and evaluates supply enhancement options, provides a water conservation strategy, as well as operations and maintenance recommendations. The plan provides a capital improvement program tied to the City's CIP that assures financial capability for phased implementation of the planning recommendations.

Projects listed in the capital improvement program are subject to review under WAC 197-11-704 and 197-11-800. While some projects might be categorically exempt, others will require preparation of a separate detailed checklist and SEPA threshold determination.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.

   Under the authority of Chapter 197-11-635 WAC, the SEPA documents prepared for Bellingham' Comprehensive Plan are incorporated by reference herein. Additional documents directly related to the proposed Water System Plan include:

   a. *The Bellingham Comprehensive Plan, 2016*
   b. *Whatcom County Comprehensive Plan, 2016*
   c. *Whatcom County Coordinated Water System Plan Update, 2016*

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain.

   No other applications are known.

10. List any government approvals or permits that will be needed for your proposal, if known.

    The Water System Plan needs the approval of the City Council and WADOH. Individual elements of the capital improvement plan and extension of water lines greater than 10-inch-diameter will be subject to project SEPA review, and Whatcom County, or Bellingham Critical Area Review.

    Some projects that involve work in surface waters likely would require Hydraulic Project Approval from the Washington State department of Fish and Wildlife. Separate SEPA checklists must be prepared for projects that are not categorically exempt under Chapter 197-11-800 WAC.

11. Give a brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page.

    The City proposes to update to its Water System Plan. The Plan is prepared to comply with the requirements of the WADOH as set forth in WAC 246-290-100. Adoption of this document is a

non-project action designed to improve and update the existing Plan that was adopted by ordinance effective in 1993. The plan will apply throughout the incorporated limits of the City, areas of unincorporated Whatcom County specified as the out-of-city service area and where applicable, to users of contractual water service or supply.

This checklist covers the potential significant environmental impacts resulting from the adoption of the plan described above. Following adoption of this plan, other detailed regulations which implement the plan may be developed. Future SEPA reviews may be required for project actions undertaken to implement the adopted Plan (that is, construction of capital facilities).

The City retains the authority to impose site-specific mitigation measures to address probable significant adverse environmental impacts within the City limits or on water system projects where the City assumes lead agency. Under the authority of Chapter 197-11-635 WAC, the SEPA documents prepared for Bellingham's Comprehensive Plan are incorporated by reference herein; these documents include the Bellingham Comprehensive Plan.

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist.

    SEPA review for this plan will apply to the entirety of the Bellingham Service Area. The service area is outlined in Figure 1-1 of the Water System Plan. The Water System Comprehensive Plan (the plan) applies to the water service utility of the City of Bellingham. In addition to serving commercial, residential and industrial connections within the city limits, the system provides water to the Whatcom County WD 2, Whatcom County WD 7, Lummi Water and Sewer District, Deer Creek Association, Glen Cove Water Co-Op, Lake Whatcom Water & Sewer District, California Street Water Association, and the Montgomery Road Water Association. The plan included under this SEPA review will apply to all areas within Bellingham's retail water service area and wholesale water service area.

10.1.2 Environmental Elements

1. Earth

    a. General description of the site: *Flat, rolling, hilly, steep slopes, and mountainous.*

        Bellingham rings the shore of Bellingham Bay to the west. It lies east of Mount Baker and Lake Whatcom. The water system planning area can be characterized as rolling with a series of east to west trending valleys formed by streams and rivers traveling through the area of the City.

    b. What is the steepest slope on the site (approximate percent slope)?

        Steep slopes greater than 30 percent represent a relatively small percentage of the City's total acreage. A majority of Bellingham's existing development has taken place in areas with

slopes of less than 15 percent. Areas of steep slopes are concentrated on the City's perimeter, adjacent to the saltwater bodies that surround the area as well as along the creeks and rivers that flow through the City.

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any prime farmland.

The soils within Bellingham reflect the region's glacial geologic history. Sedimentary rocks of the Chuckanut Formation with a metamorphic rock called phyllite and glacially derived sand and gravel are exposed at the far south end of Lake Whatcom. The Chuckanut Formation, often referred to as Chuckanut Sandstone, extends from the Cascade Range to Lummi Island and is a group of rocks that includes layers of sandstone, conglomerate, shale, and coal.

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe.

Areas with a history of unstable soils exist in a number of locations throughout the City, including the vertical bluffs along the creeks and rivers that flow through the City. These areas are relatively stable under ordinary conditions. However, seismic events of moderate to high magnitude could cause slope failures, or exacerbate erosion and landslide hazards in areas where the bluff is fractured, or where talus slopes are low.

e. Describe the purpose, type, and approximate quantities of any filling or grading proposed. Indicate source of fill.

As a non-project action, the proposal does not involve site alterations of any kind. Future project actions that are not categorically exempt pursuant to Chapter 197-11-800 WAC, and which require issuance of a City license or permit will be subject to review under the City and Whatcom County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

f. Could erosion occur as a result of clearing, construction, or use? If so, generally describe.

Because the proposal is a non-project action, it will not result in clearing or construction-related erosion. Future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City of Bellingham or Whatcom County may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?

The proposal is a non-project action that does not involve construction of impervious surfaces.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any:

Future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City of Bellingham or Whatcom County may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

2. Air

a. What types of emissions to the air would result from the proposal (that is, dust, automobile, odors, and industrial wood smoke) during construction and when the project is completed? If any, generally describe and give approximate quantities if known.

Because the proposal is a non-project action, it does not involve construction, and will not result in emissions to the air. It is acknowledged, however, that regardless of the proposed action reviewed herein, continued development activity will increase the amount of air pollution in the Bellingham Area (for example, through the location of new sources or through increases in automobile traffic).

Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe.

No. As a non-project action, the proposal will neither result in any emissions or odors, nor will it be affected by such emissions.

b. Proposed measures to reduce or control emissions or other impacts to air, if any:

Future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City or County may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

3. Water

a. Surface:

i. Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? If yes, describe type and provide names. If appropriate, state what stream or river it flows into.

Numerous named and unnamed streams flow through the water system's planning area into Bellingham Bay. Named streams include Whatcom Creek, Squalicum Creek, Chucukanut Creek, and Padden Creek.

ii. Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? If yes, please describe and attach available plans.

No. Because the action is a non-project proposal, it will not involve any work over, in, or adjacent to the waters described above. The City and County will continue to require either a shoreline substantial development permit or a shoreline permit exemption for any project-related work occurring within 200 feet of the jurisdictional waters described above. Operation of the municipal diversions and transmission pipeline will continue to require operation in, over and adjacent to various water bodies including the Middle Fork of the Nooksack River, Whatcom Creek, Anderson Creek, and Lake Whatcom.

iii. Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material.

Because the proposal is a non-project action, it does not involve fill and dredge material. Future project applications that involve the removal or placement of dredge or fill materials would be subject to review and mitigation under the City's Shoreline Management Master Program.

Future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City or County may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

iv. Will the proposal require surface water withdrawals or diversions? Give general description, purpose, and approximate quantities if known.

Bellingham water source is a diversion from the Middle Fork of the Nooksack River under the Safe Drinking Water Act.

v. Does the proposal lie within a 100-year floodplain? If so, note location on the site plan.

Portions of the water system plan's planning area lie within 100-year floodplains.

vi. Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge.

None. Because the proposal is a non-project action, it does not involve any discharges of waste materials.

b. Ground

i. Will ground water be withdrawn, or will water be discharged to ground water? Give general description, purpose, and approximate quantities if known.

No

ii. Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: Domestic sewage; industrial, containing the following chemicals…; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.

No

c. Water runoff (including stormwater)

Because the proposal is a non-project action, it will not result in additional sources of runoff. Development that is fostered by the availability of public water service could increase the City's cumulative total of impervious surfaces, leading to increases of stormwater flow. The potential increase of runoff in the City and County has not been assessed.

i. Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.

As a non-project action, the proposal does not include any measures designed specifically to reduce or control surface, ground, and runoff water impacts. Future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City or County may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

ii. Could waste materials enter ground or surface waters? If so, generally describe.

As a non-project action the proposal does not involve the discharge of waste materials. Discharge of treated wastewater to Bellingham Bay will increase in proportion to population growth. Future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City or County may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

d. Proposed measures to reduce or control surface, ground, and runoff water impacts, if any:

As a non-project action, the proposal does not include any measures designed specifically to reduce or control surface, ground, and runoff water impacts. However, future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City or County may determine that

mitigation measures are necessary to avoid probable significant adverse environmental impacts.

4. Plants

   a. Check or circle types of vegetation found on the site:

      X deciduous tree: alder, maple, aspen, other

      X evergreen tree: fir, cedar, pine, other

      X shrubs

      X grass

      X pasture

      X crop or grain

      X wet soil plants: cattail, buttercup, bullrush, skunk cabbage, other

      X water plants: water lily, eelgrass, milfoil, other

      X other types of vegetation

      Bellingham and the out-of-city service areas support a diversity of native and nonnative plants, including all of the species listed above. Native shrubs, herbs, grasses, and wetland plants also exist within the Planning Area. The shorelines support a variety of estuarine and marine aquatic vegetation.

   b. What kind and amount of vegetation will be removed or altered?

      Because the proposal is a non-project, programmatic action, it would not involve the removal or alteration of vegetation. Continued development activity will result in increased native vegetation removal.

   c. List threatened or endangered species known to be on or near the site.

      Documented habitats for endangered, threatened, and priority species are known to exist within Bellingham and the out-of-city service area. These areas have been designated on Whatcom County Critical Area maps.

   d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any:

      Because the proposal is a non-project, programmatic action, it does not directly involve landscaping or vegetation enhancement. Vegetation removal in Critical Areas is reviewed and conditioned under City and County ordinances.

      Future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08

WCC). After reviewing applications for such project actions, the City or County may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

5. Animals

   a. List any birds and animals which have been observed on or near the site or are known to be on or near the site:

      birds: hawk, heron, eagle, songbirds, other

      mammals: deer, bear, elk, beaver, other

      fish: bass, salmon, trout, herring, shellfish, other

      The water service area and the source watershed contains a variety of habitat types that provide shelter, feeding and breeding sites for a number of migrating and indigenous bird species. Rare and endangered species sighted in Whatcom County include the northern bald eagle and the peregrine falcon. Important bird species known to exist within the area include: great blue herons; common loon; brandt geese; harlequin ducks; pigeon guillemots; coots; ruddy ducks; hooded mergansers; red winged black birds; belted king fishers; and mallard ducks.

      Large and medium sized mammals such as deer, coyotes, skunks, and otters are found within the City limits. Bear, cougar, fox, beaver, and elk occur in the out-of-town service area and related watersheds. For further information, refer to the Comprehensive Plan.

      Puget Sound bull trout, chinook salmon and Hood Canal summer chum have been listed as threatened under Endangered Species Act. Additional fish in the vicinity of the service area include coho and pink salmon, steelhead and cutthroat trout and variety of saltwater species. Shorelines and creeks provide habitat for various life stages of these fish.

   b. List any threatened or endangered species known to be on or near the site.

      As noted above, rare and endangered species sighted in the service area and watersheds include bull trout, chinook and Hood Canal summer chum salmon, northern spotted owl, marbled murrelet, and the northern bald eagle. The Southern Resident orca whale, listed as an endangered species, range includes water in the vicinity of Bellingham.

   c. Is the site part of a migration route? If so, explain.

      The water service area and municipal watershed lie within the Pacific Flyway. Consequently, numerous waterfowl use the wetlands, ponds, and surrounding marine waters as a migratory rest stop, or as a permanent wintering area.

   d. Proposed measures to preserve or enhance wildlife, if any:

      Because the proposal is a non-project, programmatic action, it does not directly involve impacts to wildlife.

Future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City or County may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

6. Energy and natural resources

   a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.

      The principal energy sources associated with the planning area are electricity, propane, natural gas, and petroleum. Electrical power, propane, natural gas, and petroleum have historically all been provided for heating, lighting, operation of electrical appliances and manufacturing. Population growth is likely to occur regardless of this non-project proposal. As this growth and associated development occurs, the demand for sources of energy will increase. As a non-project action, the proposal would not create any additional needs for energy. Future water treatment requirements may require technologies such as ultraviolet light disinfection, which would increase the water system electric energy usage.

   b. Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe.

      As a non-project action, the proposal would not affect solar energy by adjacent properties.

   c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:

      Because the proposal is a non-project action, no specific energy conservation measures are proposed.

      Future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City or County may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

7. Environmental Health

   a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste that could occur as a result of this proposal? If so, describe.

      Because the proposal is a non-project action, no environmental health hazards are posed.

      i. Describe special emergency services that might be required.

Because the proposal is a non-project action, no emergency services will be required.

Future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City or County may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

ii. Proposed measures to reduce or control environmental health hazards, if any:

Because the proposal is a non-project action, no specific measures are proposed to reduce or control environmental health hazards.

b. Noise

i. What types of noise exist in the area which may affect your project (for example, traffic, equipment, operation, other)?

Because the proposal is a non-project action, it will not be affected by, noise.

ii. What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site.

Because the proposal is a non-project action, it will not generate noise on either a short or a long-term basis. However, noise levels will inevitably increase along with the overall increases in the City's population and employment base. Growth will increase the number of residential and business noise sources.

iii. Proposed measures to reduce or control noise impacts, if any:

None are proposed.

8. Land and shoreline use

a. What is the current use of the site and adjacent properties?

The proposal is to adopt a water system plan that includes strategies for providing future water service to land within the City of Bellingham and areas of unincorporated Whatcom County. The Water System Comprehensive Plan is a functional element of the City Comprehensive Plan that provides a more detailed report on existing conditions within the City. The plan implements the goals and policies of the City of Bellingham Comprehensive Plan and is consistent with land use regulations adopted in accordance with the Comprehensive Plan.

b. Has the site been used for agriculture? If so, describe.

Citywide, Bellingham does not have any land exclusively zoned for agricultural uses. There are areas in the UGA zoned for commercial forest and rural use that allow for a wide range of agricultural uses.

c. Describe any structures on the site.

Bellingham possesses a diverse range of residential, commercial, manufacturing, and public/institutional structures, including many Victorian era homes and downtown commercial and public buildings.

d. Will any structures be demolished? If so, what?

No. Because the proposal is a non-project action, it will not involve the demolition of any structures.

e. What is the current zoning classification of the site?

Zoning varies within City Limits as described in Title 20 of the BMC and within the UGA and other service areas according to WCC Title 20.

f. What is the current comprehensive plan designation of the site?

Bellingham Comprehensive Plan, was adopted in June, 1980 and last updated in 2005 designates the city's retail service area as Urban. The Whatcom County Comprehensive Plan was adopted in 1996 and last revised in 2008 established the Urban Growth Area that the City serves with potable water.

g. If applicable, what is the current shoreline master program designation of the site?

None of the proposed policy changes directly relate to shorelines.

h. Has any part of the site been classified as an "environmentally sensitive" area? If so, specify.

Yes. The City keeps a map of environmentally sensitive areas on file. An assessment of the Critical Areas in the out-of-city service area in Whatcom County is on file with Whatcom County.

i. Approximately how many people would reside or work in the completed project?

Because the proposal is a non-project action this question is inapplicable. The 2000 census estimated the population within Bellingham was 67,171.

j. Approximately how many people would the completed project displace?

Because the proposal is a non-project action no displacement impacts are anticipated.

k. Proposed measures to avoid or reduce displacement impacts, if any:

Because the proposal is a non-project action, no displacement impact mitigation is proposed.

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:

The proposal is a non-project action; however, it is a component of and consistent with the Bellingham Comprehensive Plan.

Future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City or County may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

9. Housing

   a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.

      No housing will be provided as part of this project.

   b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.

      No housing will be eliminated as part of this project.

      Future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City or County may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

   c. Proposed measures to reduce or control housing impacts, if any:

      None needed.

10. Aesthetics

   a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?

      As a non-project programmatic action, the proposal does not involve the construction of any structures.

   b. What views in the immediate vicinity would be altered or obstructed?

      As a non-project programmatic action, the proposal does not involve the alteration or obstruction of views.

   c. Proposed measures to reduce or control aesthetic impacts, if any:

      Future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City or County may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

11. Light and glare

    a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

    Because the proposal is a non-project programmatic action, it would not produce any light or glare. Levels of artificial lighting and glare will increase with population and business growth in the Planning Area.

    b. Could light or glare from the finished project be a safety hazard or interfere with views?

    Because the proposal is a non-project action, it would not create light or glare safety hazards or view obstructions. Future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City or County may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

    c. What existing off-site sources of light or glare may affect your proposal?

    None. As a non-project action, the proposal would not be affected by light or glare.

    d. Proposed measures to reduce or control light and glare impacts, if any:

    No measures are proposed. Future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City or County may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

12. Recreation

    a. What designated and informal recreational opportunities are in the immediate vicinity?

    The City has many parks, a waterfront trail, and a boat launch. Additional recreation opportunities abound in the mountains to the east of Bellingham.

    b. Would the proposed project displace any existing recreational uses? If so, describe.

    No, because the proposal is a non-project action it would not affect existing recreational uses.

    c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any:

    None required.

13. Historic and Cultural Preservation

a. Are there any places or objects listed on, or proposed for, national, state, or local preservation registers known to be on or next to the site? If so, generally describe.

Because the proposal is a non-project action, it would not directly affect historical sites. The City has a long history and many historic buildings.

b. Generally describe any landmarks or evidence of historic, archaeological, scientific, or cultural importance known to be on or next to the site.

Several Native American tribes populated the area well before the City was founded. There were also several small communities that developed and receded during the boom and bust cycles of the 1800s. This history indicates that archaeologically and historically important sites likely exist within the planning area.

c. Proposed measures to reduce or control impacts, if any:

Future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City or County may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

14. Transportation

a. Identify public streets and highways serving the site, and describe proposed access to the existing street system. Show on site plans, if any.

Because the proposal is a non-project action, it is not directly served by public streets.

b. Is site currently served by public transit? If not, what is the approximate distance to the nearest transit stop?

Because the proposal is a non-project action, it does not directly affect public transit operations.

The Whatcom Transit Authority provides service to the Planning Area.

c. How many parking spaces would the completed project have? How many would the project eliminate?

Because the proposal is a non-project action, it does not directly involve the creation or elimination of parking spaces.

d. Will the proposal require any new roads or streets, or improvements to existing roads or streets, not including driveways? If so, generally describe (indicate whether public or private).

Because the proposal is a non-project action, it does not directly involve the creation of new streets or improvement to existing roads.

e. Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.

The proposed action would not seek to employ water, rail, or air transportation facilities.

f. How many vehicular trips per day would be generated by the completed project? If known, indicate when peak volumes would occur.

Because the proposal is a non-project action, it would not directly generate any vehicle trips.

g. Proposed measures to reduce or control transportation impacts, if any:

None are proposed.

15. Public Services

a. Would the project result in an increased need for public services (for example: fire protection, police protection, health care, schools, other)? If so, generally describe.

Because the proposal is a non-project action, it will not generate a requirement for increased public services. The plan provides analysis of existing conditions with regard to water service available for potable use and fire protection. This analysis allows for development of improvement recommendations consistent with the goals and policies of the City Comprehensive Plan. The Plan defines the City's intended measures to reduce or control impacts of growth with regard to water service and related public services.

b. Proposed measures to reduce or control direct impacts on public services, if any.

Implementation of the Capital Improvement Element of the Bellingham Comprehensive Plan will reduce or control future impacts to public services. Future project-level actions which require issuance of any state or local permit or license; and that are not categorically exempt under Chapter 197-11-800 WAC will be subject to review under the City and County SEPA Ordinances (Chapter 16.20 BMC, Chapter 16.08 WCC). After reviewing applications for such project actions, the City or County may determine that mitigation measures are necessary to avoid probable significant adverse environmental impacts.

16. Utilities

a. The following utilities are currently available at the site: electricity, natural gas, water, refuse service, telephone, sanitary sewer, septic system.

All of the above utilities are found in the planning area. For more detailed information, please refer to the Comprehensive Plan.

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity which might be needed.

As growth and development occurs, demands for public services will increase. The Capital Facilities & Utilities Element of the Comprehensive Plan is intended to ensure that new

growth and development is provided with adequate public services and facilities concurrent with the approval of new development.

10.1.3 Signature

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

Signature: 

Date Submitted: 2/20/25

10.2 Supplemental Sheet for Non-Project Actions

Because these questions are very general, it may be helpful to read them in conjunction with the list of the elements of the environment.

When answering these questions, be aware of the extent the proposal, or the types of activities likely to result from the proposal, would affect the item at a greater intensity or at a faster rate than if the proposal were not implemented. Respond briefly and in general terms.

1. How would the proposal be likely to increase discharge to water; emissions to air; production, storage, or release of toxic or hazardous substances; or production of noise?

   The proposed adoption of the Water System Comprehensive Plan will not alter any existing requirements for environmental review under Chapters 16.20 BMC (that is, the SEPA Implementing Ordinance). Environmental review for plan related proposals in the UGA would be conducted under existing Whatcom County Ordinance. These provisions will continue to be employed in the review and mitigation of individual project applications. Possible indirect affects

of the proposed action relating to water, air, environmental health, and noise are summarized below:

Withdrawal and/or Discharges to Water: The City of Bellingham Water System Comprehensive Plan outlines a program to utilize the existing water rights. Growth in the City and UGA will cause an increase in the amount of wastewater discharged to Bellingham Bay.

Emissions to air, release of toxic or hazardous substances, and noise: The potential adverse environmental impacts of urban growth relating to increased emissions are not significant as discussed in the Bellingham Comprehensive Plan.

Proposed measures to avoid or reduce such increases are:

Withdrawals of Surface and Ground Water: The Conservation Chapter of the Water System Plan outlines the City's programs to promote the efficient use of water resources. As feasible opportunities are identified the City will also pursue wastewater reuse to reduce demands on the water system.

Emissions to air, release of toxic or hazardous substance, and noise: No measures are proposed beyond project specific environmental review and enforcement of implementing ordinances in compliance with the City Comprehensive Plan.

2. How would the proposal be likely to affect plants, animals, fish, or marine life?

The Plan will not directly affect plants, animals, fish, or marine life. Growth and development within the service area may negatively impact plant and animal populations. Surface water withdrawals could impact these resources through lower instream flows that affect the migration, spawning, and rearing habitat of fish.

Proposed measures to protect or conserve plants, animals, fish, or marine life are:

Adoption of this water system plan would not require inclusion of any specific measures to conserve plants, animals, fish, or marine life.

3. How would the proposal be likely to deplete energy or natural resources?

The proposal would not directly deplete energy or natural resources. Growth and development in the service area will consume energy and natural resources.

Proposed measures to protect or conserve energy and natural resources are:

The proposal does not require inclusion of any specific measures to conserve energy. The City's watershed management programs and water conservation programs conserve and protect a broad range of natural resources.

4. How would the proposal be likely to use or affect environmentally sensitive areas or areas designated (or eligible or under study) for governmental protection; such as parks, wilderness, wild and scenic rivers, threatened or endangered species habitat, historic or cultural sites, wetlands, floodplains, or prime farmlands?

   The proposal would not affect environmentally sensitive areas or areas designated for governmental protection.

   Proposed measures to protect such resources or to avoid or reduce impacts are:

   No specific measures have been proposed.

5. How would the proposal be likely to affect land and shoreline use, including whether it would allow or encourage land or shoreline uses incompatible with existing plans?

   Availability of water within the designated service area is consistent with the adopted land use plans of both the City of Bellingham and Whatcom County. The Water System Plan is also consistent with shoreline designations in the City of Bellingham Shoreline Master Program. Potential impacts of changes in land and shoreline use were assessed in the City of Bellingham's and Whatcom County's Comprehensive Plans.

   No specific measures have been proposed.

   Proposed measures to avoid or reduce shoreline and land use impacts are:

   No specific measures have been proposed. The plan contains policies that assure compatibility with adopted land use designations including those within the Shoreline Management Program jurisdiction within the City of Bellingham and in the unincorporated areas of Whatcom County.

6. How would the proposal be likely to increase demands on transportation or public services and utilities?

   The proposal provides mechanism to assure adequate public water service and supply to the adopted water service area.

   Proposed measures to reduce or respond to such demand(s) are:

   Upgrade of water system as proposed in Chapter 10 "Capital Improvement Plan"

7. Identify, if possible, whether the proposal may conflict with local, state, or federal laws or requirements for the protection of the environment.

   No aspect of the proposal is in conflict with local, state, or federal laws, or requirements for the protection of the environment. The proposal complies with the Washington State enforcement of the Federal Safe Drinking Water Act and the WADOH requirements under 246-290-100 WAC regarding water system plans.

California Street Water Assoc.
George Dodge
2500 California St.
Bellingham, WA. 98225

Chuckanut Trails Assoc.
Cary Ellison
PO Box 4358
Bellingham, WA. 98227

City of Ferndale
Public Works Department
Kevin Renz
2095 Main St.
Ferndale, WA. 98248

Deer Creek Water Assoc.
Douglas Wittinger, Business
Dave Olson, Operations
PO Box 30230
Bellingham, WA. 98228

Glenn-Cove Water Assoc.
Brian Plog
1703 Euclid Ave.
Bellingham, WA. 98229

Lake Whatcom Water & Sewer District
Justin Clary
1220 Lakeway Dr.
Bellingham, WA. 98229

Lummi Water and Sewer
(W)Victor Solomon
2156 Lummi View Dr.
Bellingham, WA. 98226

Whatcom County Public Works Dept.
Gary Stoyka
322 N Commercial St, 2nd Fl.
Bellingham, WA. 98225

Nooksack Indian Tribe
Ryan Lewis
PO Box 157
Deming, WA. 98244

Montgomery Road Water Assoc.
Paul Troutman
632 Montgomery Rd.
Bellingham, WA. 98226

Northwest Water Assoc.
John Mercer
6912 Hannegan Rd., #105
Lynden, WA. 98264

Whatcom County Water Dist. #2
Lori Whitfield
Dave Olson, Operations
1615 Bayon Rd
Bellingham, WA. 98225

Whatcom County Water Dist. #7
Deanna Dobbs
Dave Olson, Operations
PO Box 28700
Bellingham, WA. 98228

Spring Valley Community Well
Joe Den Hartog
PO Box 1072
Bellingham, WA. 98227

Yew Tree Acres Water Assoc.
Martin Brotnov
2086 Jefferson St.
Bellingham, WA. 98226

Cornwall Church of God
Larry Watts
6243 Mission Rd.
Everson, WA. 98247

Whatcom County Planning Dept.
Matt Aamot
5280 Northwest Ave.
Bellingham, WA. 98226

Northwest Regional Office
Department of Health
dw.nwro.wsprojects@doh.wa.gov

APPENDIX C

LOCAL GOVERNMENT CONSISTENCY DETERMINATION FORM

~ To be included in a future submittal. ~

APPENDIX D

AGENCY COMMENT LETTERS AND RESPONSES

~ To be included in a future submittal. ~

APPENDIX E ORDINANCES AND APPROVALS

~ To be included in a future submittal. ~

APPENDIX F

WATER SYSTEM PLAN SUBMITTAL FORM

Drinking Water

Project Approval Application (PAA) Form

331-149 F • Revised 11/2/2022

Please complete all appropriate sections of this application form and include it with your project.

WATER SYSTEM Information

Water System Name	PWS ID #
Bellingham-Water Division City of	05600

Submittal Description	County
2025 Water System Plan	Whatcom

Classification	# of Service Connections
A-Communinty	10,000 or more

OWNER Information

Name	Owner ID #
City of Bellingham	05600

E-mail address	Phone
askpw@cob.org	360-778-7700

Mailing address	City	State	Zip
2221 Pacific St	Bellingham		

PROJECT CONTACT Information

Name/Position	
Mike Wilson	Assist PW Dir.

E-mail address	Phone
mlwilson@cob.org	360-778-7910

Mailing address	City	State	Zip
104 W Magnolia St	Bellingham	WA	98225

CONSULTING/DESIGN ENGINEER Information

Name/Firm	
Carollo Engineers, Inc	Enter text

E-mail address	Phone
lkammereck@carollo.com	260-353-2938

Mailing address	City	State	Zip
1200 5th Ave, Suite 900	Seattle	WA	98101

SMA Information

Name/SMA	SMA #
Enter text	Enter text

E-mail address	Phone
Enter text	Enter text

Mailing address	City	State	Zip
Enter text	Enter text	WA	Zip

BILLING Information*

Name	
Mike Wilson	

E-mail address	Phone
mlwilson@cob.org	360-778-7910

Mailing address	City	State	Zip
104 W Magnolia St	Bellingham	WA	98225

GENERAL Submittal Information

☒ Check here if you need a Box.com folder set up for transferring your project to us electronically. (You will receive an invite by email after we have received the PAA form.)

Do you have projects currently under review by us? ☐ Yes ☒ No

☐ This is a new water system (if so, include a completed Water Facilities Inventory Report Form with your project).

☐ DWSRF Loan
Application # Enter Number
Loan # Enter Number

☐ Enforcement
Docket # Enter Number
Type Enter Text

☒ Water System Plan (complete Planning Information)

☐ Small Water System Management Program (complete Planning Information)

☐ Engineering (complete Engineering Information)

☐ Group B (complete Engineering Information)

☐ Satellite Management Agency Plan (complete SMA Information)

☐ Alternate Technology (complete Engineering Information)

ENGINEERING Information

Choose Project Report
Project Report Type

Choose Special Report or Plans
Special Report or Plans

Choose Predesign Study
Predesign Study

Choose Existing System Approval
Existing System Approval

Choose Construction Documents

Choose Waiver

Construction Documents

Choose Other

Other

Waiver

PLANNING Information

How many connections does system currently have?	26981
If system is private-for-profit, is it regulated by UTC?	☐ Yes ☐ No
Is system expanding?	☒ Yes ☐ No
Expanding service area?	☒ Yes ☐ No
Increasing number of approved connections?	☒ Yes ☐ No
If the number of connections is expected to increase, how many *new* connections are proposed in the next ten (10) years?	4,200 new connections between 2022 and 2034
Is your system pursuing additional water rights from Department of Ecology in the next 20 Years?	☐ Yes ☒ No
Is a new intertie proposed?	☐ Yes ☒ No
Is the system located in a Critical Water Supply Service Area (is there a Coordinated Water System Plan)?	☒ Yes ☐ No
If yes, have you sent a copy of the plan to the county or responsible agency for the CWSP?	☒ Yes ☐ No
Are you requesting distribution main project report and construction document submittal exception?	☒ Yes ☐ No
If so, does the WSP contain standard construction specifications for distribution mains?	☒ Yes ☐ No
The water system/purveyor is responsible for sending a copy of the plan to:	☒ Yes ☐ No
• Adjacent utilities for review or a letter notifying them that a copy is available for their review and where it is located.	☒ Yes ☐ No
• All local governments within the service area.	☒ Yes ☐ No
• County and city planning departments, one or both if applicable, adjacent water systems, etc..	☒ Yes ☐ No
List who have you sent the WSP to for review other than ODW?	List attached list, and included in Appendix B
Are you proposing a change in the place of use of your water right?	☐ Yes ☐ No
If "yes," the purveyor must send a copy of the WSP or SWSMP to all local governments within the service area (county and city planning departments) for a local consistency determination. Has this been completed?	☐ Yes ☒ No
What are the years of the requested plan approval period (for example 2022 to 2032)?	2024 to 2034
Does your plan follow your preplan checklist?	☒ Yes ☐ No

SMA Information

☐ Ownership only ☐ Management and Operations only ☒ Ownership, Management & Operations

Where can we find the *SMA Notice of Intent* 331-590, in your plan..... N/A

Please submit all documents electronically. We request one paper copy of planning documents be submitted to the address for your regional office below.

☐ **Eastern Regional Office**
Department of Health
eroadmin@doh.wa.gov
Phone: 509-329-2100

☒ **Northwest Regional Office**
Department of Health
dw.nwro.wsprojects@doh.wa.gov
Phone: 253-395-6750

☐ **Southwest Regional Office**
Department of Health
swro.admin@doh.wa.gov
Phone: 360-236-3030

Washington State Department of Health

To request this document in another format, call 1-800-525-0127. Deaf or hard of hearing customers, please call 711 (Washington Relay) or email civil.rights@doh.wa.gov.

APPENDIX G DOH WATER SYSTEM PLAN CHECKLIST

√Required	Content Description	WSP Page #
Chapter 1	**Description of Water System**	
(√)	Ownership and management	39
(√)	System history and background	39
(√)	Inventory of existing facilities	45
(√)	Related plans: Coordinated Water System Plan (CWSP), Comp./Community	41
(√)	Information & Maps: Service area, retail service area, designated land use and zoning, future comprehensive plan request for changes to land use, & agreements for plan approval period	69
(√)	Policies: Service area, SMA, conditions of service, annexation	66
(√)	**Duty to serve☆** requirement: identify process, timeframes, conditions, appeals	72
(√)	**Consistency** from **local planning☆** agency (new LGC form to use)	294
Chapter 2	**Basic Planning Data**	
(√)	Current water use: Population, customer classes, & ERUs	85
(√)	Demand forecast **for plan approval period and a minimum of a 20-year period*** for population, service connections & demand forecasts **with & w/o expected efficiency savings**	111
(√)	Monthly and annual production. Totals per source. **Water Supply Characteristics & Demand Characteristics (see Ch.4). Add subtitles with description & discussion on effect of water use**	88
(?)	Annual usage for water supplied to other systems	116
(√)	Annual usage by customer class.	94
(√)	Historical total water loss **(DSL) – percent and volumes**	99
(√)	**>1000, seasonal variations in consumption by customer class**	
Chapter 3	**System Analysis**	
(√)	Capacity analysis with **water right self-assessment** (3 forms DOH/ECY per MOU): Existing, **plan approval period*** and 20th year projections	132
(√)	System design standards	83
(√)	Water quality analysis	177
(√)	System inventory, description and analysis	
(√)	Source	129
(√)	Treatment	205
(√)	Storage	160
(√)	Distribution system/hydraulics	141
(√)	Summary of system deficiencies	142
(√)	Analysis of possible improvement projects	170
Chapter 4	**Water Use Efficiency Program and Water Resource Analysis**	
(√)	**Water Use Efficiency Program per WAC 246-290-810** >1,000 Estimate water savings from measures past six years.	123
(√)	**If DSL is > 10%, water loss control action plan required for compliance with a schedule & activities to minimize leakage in budget**	124
(?)	Source of supply analysis and evaluation of supply alternatives	129
(?)	Interties	63
( )	**≥1,000 connections explore reclaimed water opportunities**	
Chapter 5	**Source Water Protection (Check One or Both)**	
(√)	Wellhead protection program	
( )	Watershed control program	

	√Required	Content Description	WSP Page #
Chapter 6		**Operation and Maintenance Program**	
	(√)	Water system management and personnel	217
	(√)	Operator certification	232
	(√)	Routine operating procedures and preventive maintenance	233
	(√)	Water quality sampling procedures & program – Identify **WQ PN Requirements**	308
	(√)	CMP plan/map. **Add RTCR*** and Ground Water Rule (GWR) **narrative, actions**	234
	(√)	Emergency program, water shortage plan, service reliability per WAC 246-290-420	234
	(√)	Address sanitary survey findings	
	(√)	Cross-connection control program – Summarize **next actions to address**	235
	(√)	Recordkeeping, reporting, and customer complaint program	236
	(√)	Summary of O&M deficiencies	237
Chapter 7		**Distribution Facilities Design and Construction Standards**	
	(?)	Standard construction specification for distribution mains	317
Chapter 8		**Improvement Program**	
	(√)	Capital improvement schedule **for the identified planning period and within a 20-year planning period at a minimum***	255
Chapter 9		**Financial Program**	
	(√)	Balanced budget for **the planning period*** and demonstrating financial viability	289
	(√)	Revenue and cash flow stability to fund capital and emergency improvements	278
	(√)	**Evaluation of affordable rate structure that encourages water demand efficiency. Budget line item if Water Loss Control Action Plan is required☆**	287
Chapter 10		**Miscellaneous Documents**	
	(√)	Meeting of the consumers (documentation). Approval by EGB prior to DOH approval	304
	(√)	County/Adjacent Utility Correspondence	299
	( )	≥1000 connections - State Environmental Policy Act (SEPA) Determination	
	(?)	Agreements (intertie, service area, franchise, etc.)	
	(?)	Satellite Management Program	

APPENDIX H

SERVICE AREA AND INTERLOCAL AGREEMENTS

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INTERLOCAL AGREEMENT
LUMMI TRIBAL WATER AND SEWER DISTRICT
WATER SERVICE

WHEREAS, the **City of Bellingham** (the "City") is a municipal corporation formed under the laws of the State of Washington and a first class city which maintains a water supply serving the area within its corporate limits and certain areas outside those limits; and,

WHEREAS, the **Lummi Tribal Water and Sewer District** (the "District") is a municipal corporation, duly chartered by the Lummi Indian Tribe, which has duly applied for and received City approval of the provision of water for resale by it to its customers pursuant to Bellingham Municipal Code Chapter 15.36; and,

WHEREAS, the foregoing parties are authorized by RCW 39.34 to enter into an Interlocal Agreement finalizing the terms and conditions of the provision of water as herein agreed to;

NOW, THEREFORE, in view of the above recitals and in consideration of the mutual covenants and promises set out below, the parties hereby agree as follows:

1. Provision of water supply. The City agrees to provide to the District up to a maximum of 1000 gallons per minute of uninterrupted daily potable water service, at a minimum of 30 psi, for resale by the District to its customers residing within the District boundary as it exists as of the date hereinbelow. The District boundary is presently co-extensive with that of the Lummi Indian Reservation. Service to areas other than within the existing boundary will be as agreed to by the parties and by amendment to this agreement, except that the District may serve the area between the end of the City of Bellingham line at Marietta Slough and the Reservation boundary.

2. Construction of facilities. The District agrees to construct a transmission main ten (10") inches in diameter, from the City's existing water main on Curtis Road to a point approved by the City along Country Lane near the Marietta Slough, and there to construct a vault, water meter and backflow device(s); all costs shall be solely borne by the District. Such construction shall be in accordance with City standards, and subject to approval by the City Public Works Department. The District shall reimburse the City for its necessary costs of inspection, testing and acceptance of the main and meter assembly.

3. Ownership and maintenance of facilities. Upon approval of construction by the City and commencement of the service provided herein, the District shall forthwith transfer to the City ownership of the main, vault, meter, and backflow device(s). Thereafter, the City will be responsible for maintenance of the portion of the system it owns, and the District for the portion it owns.

City of Bellingham
CITY ATTORNEY
210 Lottie Street
Bellingham, Washington 98225
Telephone (206) 676-6903

4. Rates and billing. The City will charge the District, and the District agrees to pay, for water service herein provided at its usual rates for service out of the city as set forth in BMC 15.08.250(C)(2). It is understood that the cost of such service represents the costs of withdrawal, diversion, treatment, transmission and return on investment. The City will bill the District monthly, and payment thereon shall be due within thirty (30) days of receipt of billing. Failure to so remit in a timely fashion constitutes a breach of this Agreement entitling the City, at its option, to immediately discontinue service hereunder.

5. Latecomer agreement. The City agrees that, for any new sales of water by it to customers connecting to the transmission main described above, it will obtain "latecomer payments" from any party so connecting for reimbursement to the District of a pro rata portion of its construction costs.

6. Hold harmless. The District agrees to defend the City and hold it harmless as to any claims or lawsuits, well-founded or not, arising out of (a) the construction herein, (b) use of the facilities the District owns or maintains, and (c) provision of water services to District customers. The District understands, and will advise its customers as necessary, that no legal relationship exists between them and the City, and that the District is solely responsible for provision of water service to such customers and billing for same.

7. Rights preserved. Nothing in this agreement compromises or adversely affects the Tribe's reserved water rights under the Winters doctrine or other applicable law; provided, however, that by execution of this agreement, the City neither admits nor denies the existence of the Tribe's reserved water rights.

DATED this 2 day of MARCH, 1990, by the LUMMI TRIBAL WATER & SEWER DISTRICT, and the LUMMI INDIAN BUSINESS COUNCIL:

LUMMI TRIBAL WATER & SEWER DISTRICT

Clayton D. Finkbonner
CHAIRMAN

Mary D. Julius
MANAGER

LUMMI INDIAN BUSINESS COUNCIL

Tribal Chairman

DATED this 12th day of January, 1990, by the CITY OF BELLINGHAM:

Attest: Linda L. Storck
Finance Director

Tim Douglas
TIM DOUGLAS, Mayor

Approved as to form:

City Attorney's Office

Departmental Approval:

Public Works Director

City of Bellingham
CITY ATTORNEY
210 Lottie Street
Bellingham, Washington 98225
Telephone (206) 676-6903

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INTERLOCAL AGREEMENT
CITY OF BELLINGHAM - CALIFORNIA STREET WATER ASSOCIATION
PROVISION OF WATER SERVICE

WHEREAS California Street Water Association ("Association") consists of properties whose existing water systems are failing and present a health hazard; and,

WHEREAS, although these properties are within city limits, unique topographic conditions make in impractical to provide water service in the normal manner; and,

WHEREAS the Association desires to have the City of Bellingham ("City") provide water service to the Association for distribution to its customers; and,

WHEREAS the Association applied for such service, pursuant to Bellingham Municipal Code section 15.36.100, and its application was reviewed by the Departments of Public Works and Planning and Community Development; and,

WHEREAS the City Council, on November 8, 1993, found (a) that existing water service to customers of the Association was failing and a health hazard, (b) that customers of the Association were so uniquely situated, both as a matter of geography and hydrology, so as to not have any other source of safe water than to purchase it from the City and (b) that requiring such customers to construct a full-standard water main extension to serve their properties would be extremely and unduly expensive; and,

WHEREAS the Council thereupon duly approved providing the requested service to the Association and authorized the Mayor to enter into this Interlocal Agreement; and,

WHEREAS RCW 39.34 permits governmental agencies to enter into agreements for the purposes set forth herein,

NOW, THEREFORE, IT IS AGREED AS FOLLOWS:

1. The City of Bellingham shall provide water to the California Street Water Association upon the terms and conditions contained herein.

City of Bellingham
CITY ATTORNEY
210 Lottie Street
Bellingham, Washington 98225
Telephone (206) 676-6903

2. The Association will timely pay to the City all charges for such water at rates from time to time assessed upon persons or entities not receiving direct City water service.

3. The Association will distribute water it receives from the City to the dwelling units on the properties indicated on Exhibit "A", attached hereto and incorporated by this reference, and to no others.

4. Properties on Exhibit "A" shall not be further subdivided and shall continue to contain only single family residences.

5. Should the City decide to provide direct services to any property listed on Exhibit "A", such property shall participate pro rata in the costs of construction of such City water service.

6. Owners of properties within the Association specifically understand and agree that the water service provided hereunder is <u>not</u> sufficient to meet applicable fire flow requirements, and that such requirements would otherwise apply to individual properties receiving direct water service from the City. To this end, the Association and its members, and their successors and assigns, waive any and all requirements, rights, or privileges relating to adequate fire flow. Further, the Association and its members, and their successors and assigns, and each of them agree to defend, indemnify, and hold the City harmless as to any claims or liabilities of any sort arising out of this Agreement or operations of the Association, or the provision of water service to the Association or to them individually.

7. The City shall use reasonable diligence to provide regular and uninterrupted service to the Association. The City shall not be liable for damages, breach of contract, or otherwise, for failure, suspension, or diminution of service occasioned by or in consequence of any cause beyond its control, including but not limited to acts of God or of the public enemy, fires, floods, earthquakes or other catastrophes, strikes, or failure of breakdown of transmission facilities.

8. The provisions of this Agreement shall be interpreted as a covenant running with the land and therefore binding on the Association and its members, and their successors and assigns. The Association shall require and cause to be duly recorded covenants embodying the terms of this Agreement.

City of Bellingham
CITY ATTORNEY
210 Lottie Street
Bellingham, Washington 98225
Telephone (206) 676-6903

9. The water distribution system and other assets of the Association shall be security for any financial obligations of the Association to the City arising hereunder. The Association hereby grants to the City a lien upon such system and other assets and shall timely cause to be recorded appropriate documents perfecting the City's security interest. Upon dissolution of the Association, whether voluntarily or by operation of law or otherwise, if requested to do so by the City, the Association will promptly transfer to the City at no cost its water distribution system, easements, franchises and rights-of-way free and clear of all encumbrances.

DATED this 1st day of December, 1993.

CALIFORNIA STREET WATER ASSOCIATION

Director

Director

Director

[Manager]

CITY OF BELLINGHAM

Mayor

Attest:

Finance Director

Department approval:

Public Works Department

Approved as to form:

Office of the City Attorney

City of Bellingham
CITY ATTORNEY
210 Lottie Street
Bellingham, Washington 98225
Telephone (206) 676-6903

PROPERTY #1 - 2500 CALIFORNIA STREET

Lots 19 to 27, inclusive, Block 12, "ADSIT AND ZEDNICK'S ADDITION TO FAIRHAVEN, WASH.," now a part of the consolidated City of Bellingham, Whatcom County, Washington, as per the map thereof, recorded in Book 3 of Plats, page 42, in the Auditor's office of said county and state.

ALSO, that portion of Government Lot 2, Section 18, Township 37 North, Range 3 East of W.M., described as follows:

BEGINNING at a point of 30 feet South of the Southwest corner of Lot 35, Block 13, "ADSIT AND ZEDNICK'S ADDITION TO FAIRHAVEN, WASH.," thence South 150 feet, thence West to the East boundary of a tract conveyed to A.L. Bean by Warranty Deed recorded December 9, 1915, under Whatcom County Auditor's File No. 188745; thence South to where said East line intersects a creek which flows Northwesterly across Government Lot 2 in said Section 18; thence Northwesterly along said creek to the South line of California Street; thence East along the South line of California Street to the point of beginning.

PROPERTY #2 - 2400 CALIFORNIA STREET

Lots 28 to 36, inclusive, Block 12, "ADSIT AND ZEDNICK'S ADDITION TO FAIRHAVEN, WASH.," now a part of the consolidated City of Bellingham, Whatcom County, Washington, according to plat thereof recorded in volume 3 of plats, page 42, in the Auditor's office of said county and state.

Situate in County of Whatcom, State of Washington.

PROPERTY #3 - 2800 CALIFORNIA STREET

Lots 11 through 30, inclusive, Block 13, "ADSIT AND ZEDNICK'S ADDITION TO FAIRHAVEN," according to Book 3 of Plats, page 42, AND Lots 1 through 12, inclusive, and Lots 29 through 40, inclusive, Block 14, "ADSIT AND ZEDNICK'S ADDITION TO FAIRHAVEN," now a part of the consolidated City of Belligham.

EXH A p. 3

PROPERTY #4 - 2700 CALIFORNIA STREET

Lots 3 to 10 and 31 through 38, inclusive, Block 13, "ADSIT AND ZEDNICK'S ADDITION TO FAIRHAVEN, WASHINGTON," now a part of the consolidated City of Bellingham, Whatcom County, Washington, as per the map thereof recorded in Book 3 of Plats, page 42 in the Auditor's office of said county and state.

CONTRACT / AGREEMENT

Number *(Assigned by FINANCE)* 10nn-0440

Interlocal Agreement

Originating Department: PW

Contract With: Whatcom County #2 Water District

Contract Name/Project #: Water Service

Termination Date:

Modification of Contract #:
(Attach Copy of Original Contract)

Contract Name/Project #:

If Contract is Extended, New Termination Date:

☐ Certificate of Insurance Attached

Signatures:

☐ Contracting Party

☐ Department Head

Date Executed:

☐ Property Index Form

☐ Record Document

SPECIAL INSTRUCTIONS:

Sue Hodges (JMG)
12/16/nn Note / Cheryl
cc:

Distribution ***Original:*** Attach to Contract ***Copy:*** Return to Originating Department

INTERLOCAL AGREEMENT
CITY OF BELLINGHAM-WHATCOM CO. WATER DISTRICT #2

AGR—0440

I. RECITALS

The CITY OF BELLINGHAM (the "City") is a municipal corporation formed under the laws of the State of Washington and a first-class city. It maintains a water supply system serving the area within its corporate limits and certain areas outside those limits.

WHATCOM COUNTY WATER DISTRICT NO. 2 (the "District") is a water district formed under Title 57 of the Revised Code of Washington, which provides water service within its boundaries. Water District 2 is located within an area adjacent to the City of Bellingham. The District currently provides water service within a portion of its District boundary and may wish to serve additional areas within its boundaries.

WHEREAS, pursuant to the Bellingham Municipal Code 15.36, the City is willing and able to sell treated water to the District through metered connections at the common boundary between the City and the District for a limited service area and under certain terms and conditions.

WHEREFORE, in view of the above recitals and in consideration of the mutual covenants and promises set out below, the parties agree as follows:

1. Provision of water supply. The City agrees to provide to the District up to a maximum of 1100 gallons per minute of potable water service, at a minimum of 20 psi, for resale by the District to its customers residing within the District boundary as it exists as of the date hereinbelow. The City further agrees to provide fire flow as it is available from the City's system. The District boundary is shown in Exhibit "A." The District agrees to not resell water beyond the limits of the

City of Bellingham
CITY ATTORNEY
210 Lottie Street
Bellingham, Washington 98225
Telephone (360) 676-6903

district. The District further agrees to not resell said water in areas annexed to the District after January 1, 1997 without the express written approval of the City.

2. Quality of Water. The water provided to the District shall be of the same standard and quality as shall be distributed through the City's system, and the City shall comply with all State and County health regulations in regard to testing and sampling said water up to, but not beyond the District's meter.

3. The District shall pay for all water passing through the meters at the points of delivery at the rate established by the City of Bellingham for service outside the Bellingham corporate city limits. The District shall pay the City promptly when billed for all water passing through the meter.

4. Interruptions of Service. The obligation of the City to furnish water as above described may be subject to temporary interruptions of service caused by necessary repairs to the City's distribution system or other causes beyond the control of the City. In the event the City anticipates a shut down the distribution system for planned repairs, it shall notify the District at least twenty-four (24) hours in advance.

5. Hold harmless. The District shall defend, indemnify and hold harmless the City, its officers, employees, principals and agents from any and all injury or damage to the City or its property, and also from all claims, demands, causes of action, or suits of any kind that arise directly or indirectly out of, are incident to or are due to any actual or alleged negligence, intentional act, or breach of duty by the District, its agents, employees, representatives or subcontractors arising out of this Agreement. In the event of any claim against the City or against both the City and the District involving an allegation

City of Bellingham
CITY ATTORNEY
210 Lottie Street
Bellingham, Washington 98225
Telephone (360) 676-6903

of negligence, intentional act, or breach of duty on the part of the District, the District shall be responsible for promptly providing a defense to the City. In the event of an ultimate finding of sole negligence by the City, its officers, employees, principals, or agents, the City shall reimburse the District for its defense costs and shall satisfy any judgment against it. In the event of an ultimate finding of concurrent negligence by the District and the City, the District's and the City's responsibility for defense costs and for satisfying any judgment shall be proportionate to the percentage of each party's negligence or that of its agents, employees, representatives and subcontractors. In the event of an ultimate finding of no negligence by the City, the District shall have total responsibility for defense costs and for satisfying any judgment.

The District understands, and will advise its customers as necessary, that no legal relationship exists between them and the City, and that the District is solely responsible for provision of water service to such customers and billing for same.

6. This Agreement replaces all earlier agreements between the parties and constitutes the entire agreement of the parties and shall not be altered or amended except in writing, signed by an authorized representative of each of the parties.

DATED this 1st day of December, 1997.

WHATCOM COUNTY WATER DISTRICT NO. 2

Commissioner

City of Bellingham
CITY ATTORNEY
210 Lottie Street
Bellingham, Washington 98225
Telephone (360) 676-6903

CITY OF BELLINGHAM

Mark Asmundson, Mayor

ATTEST:

Finance Director

CERTIFICATION

As Secretary of Whatcom County Water District No. 2, I certify that the above Interlocal Agreement was adopted at a regular meeting of the Commissioners held on the 25th day of November 1997, at which time a quorum of 3 was present, and was adopted by a vote of 3 FOR, Ø AGAINST, and Ø ABSTENTIONS.

Secretary
Whatcom County Water District
No. 2

~~APPROVED~~ AS TO FORM:
City of Bellingham

City Attorney's Office

DEPARTMENTAL APPROVAL:

Director of Public Works

City of Bellingham
CITY ATTORNEY
210 Lottie Street
Bellingham, Washington 98225
Telephone (360) 676-6903

Whatcom County Water Dist. #2

Lorrie Whitfield
Office Manager
1615 Bayon Rd.
Bellingham, WA 98225

Telephone 360-733-5770
Fax 360-671-4912

RECEIVED
DEC 4 1997
Dept. of Public Works

4 December 1997

Sue
Pls route for signature.

Jack Garner
Dept. of Public Works
210 Lottie St.
Bellingham, WA 98255

Dear Jack,

Please find the signed contract for water supply.

Thank you for working with us.

Sincerely,

Greg Christensen
Commissioner

lw

CITY OF BELLINGHAM
CONTRACT#
2005-0231

AGREEMENT
CITY OF BELLINGHAM - DEER CREEK WATER ASSOCIATION

THIS AGREEMENT is entered into by and between the City of Bellingham, a municipal corporation of the State of Washington, and Deer Creek Water Association, a private water association incorporated under the laws of the State of Washington.

Recitals

Whereas, the Washington State Department of Transportation ("WSDOT") is widening the Guide Meridian ("SR539") between the general vicinity of Horton Road and Smith Road in Whatcom County, Washington; and,

Whereas, the City of Bellingham ("City"), as a regional purveyor of water, wants to place a transmission water main in SR539 during the SR539 widening project construction in order to serve future customers and minimize present and future disruption; and,

Whereas, the Deer Creek Water Association ("DCWA") provides water in the area adjacent to the location of the SR539 widening project and owns a water main that requires relocation during the SR 539 improvements; and,

Whereas, in order to facilitate future water service needs in the area along the SR539 widening project, the City wishes to buy and DCWA wishes to sell certain water association assets; and,

Whereas, WSDOT will be providing a certain amount in reimbursement for the costs of relocating water mains because of the SR539 widening project; and,

Whereas, appropriate regional water system planning is a goal of the City, DCWA and the Washington State Department of Health ("DOH"); and,

Whereas, the City, DCWA, DOH and WSDOT have determined that the City's transmission water main should be installed during the SR539 widening project to reduce future disruptions to the public and that the water main should provide service, through an agreement, to DCWA's customers in order to reduce the number of water system purveyors in the area;

NOW, THEREFORE, in consideration of the mutual covenants contained herein, the parties agree as follows:

1. Purchase and Sale of Assets. The City agrees to buy from DCWA and DCWA agrees to sell to the City the following specific assets used in connection with DCWA's provision of water ("Assets"):

   1.1. One water main as further described and shown in Exhibit A, which is attached hereto and incorporated herein by this reference.

   1.2. All easements, licenses, and other authorizations or permissions for the water main described in section 1.1.

   1.3. All plans, specifications, maps, diagrams, or other technical documents relating to the water main described in section 1.1.

2. Purchase Price.

   2.1. The parties recognize that WSDOT will be providing reimbursement funding associated with the SR 539 widening project for costs to relocate the existing water facilities that are affected by the project, which include the Assets ("Reimbursement Amount"). The parties agree that the City, as

ORIGINAL

owner of the Assets, is the eligible party to receive the entire WSDOT Reimbursement Amount.

2.2. The City shall pay DCWA the sum of $459,598.00 for the Assets. This represents approximately 50% of the Reimbursement Amount as currently estimated on the date of this Agreement's execution, which is $919,196.06. DCWA agrees that the City shall receive any increase in the actual Reimbursement Amount as calculated at the time of construction.

2.3. The DCWA shall pay any taxes that may be owing as a result of the transaction contemplated by this Agreement.

3. Closing.

3.1. This transaction shall close on a date mutually agreed to by the parties but, in no event later than June 3, 2005. The City shall be entitled to sole possession of the Assets upon closing, subject to the provisions of paragraph 3.4 below.

3.2. At the time of closing, DCWA shall deliver to the City:

3.2.1. A notarized Bill of Sale covering assets described in paragraph 1 above.

3.2.2. An assignment of all DCWA easement rights, both recorded and prescriptive.

3.2.3. All plans, specifications, maps, diagrams, or other technical documents relating to the water main.

3.3. At the time of closing, the City shall deliver to DCWA:

3.3.1. Full payment as provided in section 2.2.

3.4. Following closing and until such time as the City's 16 inch water main is completed and operational the parties agree as follows:

3.4.1. DCWA agrees to maintain and operate at its sole expense the 10 inch water main purchased by the City until such time as the 16 inch water main is constructed and put into service.

3.4.2. DCWA will operate the said 10 inch water main as follows:

3.4.2.1. DCWA will furnish all water from DCWA sources. The 10 inch water main will not be connected to the City for service, other than an emergency intertie unless a separate agreement is reached between DCWA and the City per paragraph 4.1.2 below. An emergency intertie may be constructed only upon joint approval of both parties.

3.4.2.2. DCWA will retain their existing members and service connections and may add additional members and service connections to said 10 inch water main at DCWA's discretion.

3.4.2.3. DCWA agrees to defend, indemnify and hold harmless the City, its officers and employees from any and all action other than the City's negligence arising from DCWA's operation, maintenance and use of the 10 inch water main.

3.4.2.4. The City will not charge DCWA for use of the 10 inch water main.

3.4.2.5. When the City's 16 inch water main is completed and placed in service DCWA will transfer their members' service connections to the City's 16 inch water main and will cease to have any interest in or responsibility for the 10 inch water main. The transfer of connections will be at no cost to DCWA and will be performed by the City or the City's designated construction contractor.

4. Responsibilities of the Parties.

4.1. The City's responsibilities shall be:

4.1.1. The City, in its discretion and at its cost, shall plan, design, finance and construct a 16-inch diameter water main along SR539 from Horton Road to Smith Road including all appurtenances necessary to provide water service and fire flow to all property located within the "Area to be Transferred" as depicted in Figure 1, which is attached hereto and incorporated herein by this reference ("City Water main Project"). This shall include connection to the DCWA water main on Larson Road, west of Guide Meridian.

4.1.2. The City Water main Project design shall include and accommodate a future metered emergency inter-tie between the City and DCWA facilities in the vicinity of SR539 and Smith Road; however, the parties agree to negotiate the specific terms and conditions of this inter-tie in good faith under a separate agreement and that this separate agreement shall be completed and signed no later than December 31, 2005. If the parties can not reach agreement by that date, they agree to retain a mutually agreeable arbiter to resolve the matter. The parties further agree to split the costs of such arbitration evenly and to be bound by the arbiter's decision.

4.1.3. The City Water main Project shall be coordinated with the WSDOT project schedule.

4.2. The DCWA's responsibilities shall be:

4.2.1. Purchase water from the City at a rate as provided for in the Bellingham Municipal Code ("BMC") and to continue to serve their existing members in the "Area to be Transferred".

4.2.2. Ensure that all existing DCWA Members have individual service lines connected to the City water main. The City will not assess any additional charges, fees or connection costs to existing DCWA customers. For purposes of this section 4.2, "existing DCWA customers" shall mean those DCWA Members in the "Area to be Transferred" as of the date the City Water main Project is operational.

4.2.3. Conduct water meter reading for all existing DCWA customers and provide a combined monthly consumption amount of all existing DCWA customers to the City for billings. DCWA shall be billed bi-monthly based upon the most current established rates for single family customers as defined by the BMC.

4.3. In the event DCWA should add additional members or service connections in the "Area to be Transferred" after the 16 inch water main is operational and such members take water directly from the City, each

additional member or service connection shall pay the City a System Development Charge based upon the most current rate for Single Family Residential metered customers or Commercial metered customers outside the City limits as defined by the BMC at the time of connection.

4.4. DCWA represents and warrants (1) that it has good and marketable title to the Assets free and clear of any and all mortgages, liens, pledges, charges or encumbrances of any kind, nature, and description; and, (2) that the Assets are in good operating condition in all material respects, reasonable wear and tear excepted considering the age of the Assets or as otherwise disclosed in writing to the City at least thirty (30) days before Closing ("Disclosure"). The Disclosure shall list any issues regarding the Asset's condition or liabilities arising therefrom including, by way of example and not limitation, known leaks, mechanical failures, or claims of damage and shall be a condition precedent to Closing. After receiving the Disclosure, the City shall have fifteen (15) days to accept the disclosed conditions or to terminate this Agreement, in which case neither party will have any further rights or obligations hereunder. If the City does not respond within fifteen (15) days, the City shall be deemed to have accepted the disclosed conditions.

5. Kline Road DCWA Customers. In the event DCWA should desire water service from the City to serve existing customers along and around the Kline Road (see Figure 2 which is attached hereto and incorporated herein by this reference), DCWA agrees that it will install a master meter and pay the City a system development fee in the amount of $40,384 at the time of installation. The Association will pay, in a bi-monthly billing cycle, all charges and fees for receiving such water through the master meter at a rate set through the BMC.

6. Declared Service Area. The City and DCWA agree to having an overlapped and shared declared service area covering the Area to be Transferred and will coordinate their service areas in accordance with the Whatcom County Coordinated Water Service Plan provisions.

7. Transfer of Service Responsibilities. Responsibility for new customers after the new 16 inch water main becomes operational by the City shall be as follows:

7.1. At such time as the City is willing to accept new customers within the Area to be Transferred, and so notifies DCWA in writing, existing DCWA Members will be allowed the option of discontinuing their Membership in DCWA and becoming City customers subject to paying the City a System Development Charge based upon the most current rate for Single Family Residential metered customers or Commercial metered customers outside the City limits as defined by the BMC at the time of connection.

7.2. DCWA will cease offering new Memberships in the Area to be Transferred at such time as the City is willing to accept new customers in said area.

8. Service Disruption.

8.1. The City agrees to notify DCWA and affected DCWA Members at least 24 hours in advance of a planned temporary curtailment or other disruption of water service to DCWA or its members. DCWA will provide the City with a current address list of Members in the Area to be Transferred.

8.2. The City shall use reasonable diligence to provide regular and uninterrupted service to DCWA. The City shall not be liable for any damages, breach of contract, or otherwise, for failure, suspension or diminution of service occasioned by or in consequence of any cause

beyond its control, including but not limited to acts of God, or of the public enemy, fires, floods, earthquakes, or other catastrophes, strikes, or failure of breakdown of transmission facilities.

9. Notices. All notices, demands, requests, consents and approvals which may, or are required to, be given by any party to any other party hereunder, shall be in writing and shall be deemed to have been duly given if delivered personally, sent by facsimile, sent by a nationally recognized overnight delivery service, or if mailed or deposited in the United States mail and sent by registered or certified mail, return receipt requested, postage prepaid to:

City: City of Bellingham Public Works Department
Attn: Geoff Smyth
2221 Pacific Street
Bellingham, WA 98226
(360) 676-7799 (Fax)

DCWA: Deer Creek Water Association
Attn: Tom Schoen
P.O. Box 1010
Lynden, WA 98264
(360) 354-0836

or to such other address as the foregoing parties hereto may from time-to-time designate in writing and deliver in a like manner. All notices shall be deemed complete upon actual receipt or refusal to accept delivery. Facsimile transmission of any signed original document, and retransmission of any signed facsimile transmission shall be the same as delivery of an original document.

10. Miscellaneous Provisions.

10.1. Amendment. No modification, termination or amendment of this Agreement may be made except by written agreement signed by authorized representatives of the parties.

10.2. Waiver. No failure by any of the parties to insist upon the strict performance of any covenant, duty, agreement, or condition of this Agreement or to exercise any right or remedy consequent upon a breach thereof shall constitute a waiver of any such breach or any other covenant, agreement, term or condition. No waiver shall affect or alter this Agreement, and each and every covenant, agreement, term and condition of this Agreement shall continue in full force and effect with respect to any other then existing or subsequent breach thereof.

10.3. Captions. The captions of this Agreement are for convenience and reference only and in no way define, limit, or describe the scope or intent of this Agreement.

10.4. Severability. In case any one or more of the provisions contained in this Agreement shall for any reason be held to be invalid, illegal or unenforceable in any respect, such invalidity, illegality or unenforceability shall not affect any other provision hereof, and this Agreement shall be construed as if such invalid, illegal or unenforceable provision had never been contained herein.

10.5. Further Required Action. At any time before, on or after closing, the parties agree to execute, acknowledge and deliver any further conveyances, deeds, assurances, instruments or other documents as may reasonably be required by the other party to effectuate the transaction contemplated in this Agreement.

10.6. Authority to Enter Agreement. The parties acknowledge that the individuals signing this Agreement below are authorized representatives of the parties and are authorized to bind their respective parties to this Agreement. At or prior to closing, DCWA shall provide the City with an appropriate corporate resolution authorizing DCWA to execute this Agreement and designating corporate officers to execute said Agreement on behalf of DCWA.

10.7. Binding Agreement. This Agreement shall be binding upon and inure to the benefit of the parties and their respective successors only and shall not benefit any third party not a party hereto. Neither party may assign or transfer its rights or obligations hereunder without the prior written consent of the other party.

10.8. Construction of Agreement. This Agreement is the result of good faith negotiations between the parties and their respective representatives. This Agreement shall be given a fair and reasonable construction in accordance with the intention of the parties and without regard to the identity of the party drafting the Agreement or any provision hereof.

10.9. Entire Agreement. The entire agreement between the parties hereto is contained in this Agreement and the exhibits hereto; and this Agreement supersedes all of their previous understandings and agreements, written and oral, with respect to this transaction. In the event of any dispute arising out of this Agreement, the prevailing party shall be entitled to its reasonable attorney's fees.

EXECUTED this 3RD day of JUNE, 2005, for Deer Creek Water Association:

Name: L.J. Rothlander

Title: PRESIDENT

EXECUTED this 2ND day of JUNE, 2005, for the City of Bellingham:

Mark Asmundson, Mayor

Departmental Approval:

Attest:

Therese Hohn
Finance Director

Richard E. McCluskey
Public Works Director

Approved as to form:

Lee E. Beardsley
Office of the City Attorney

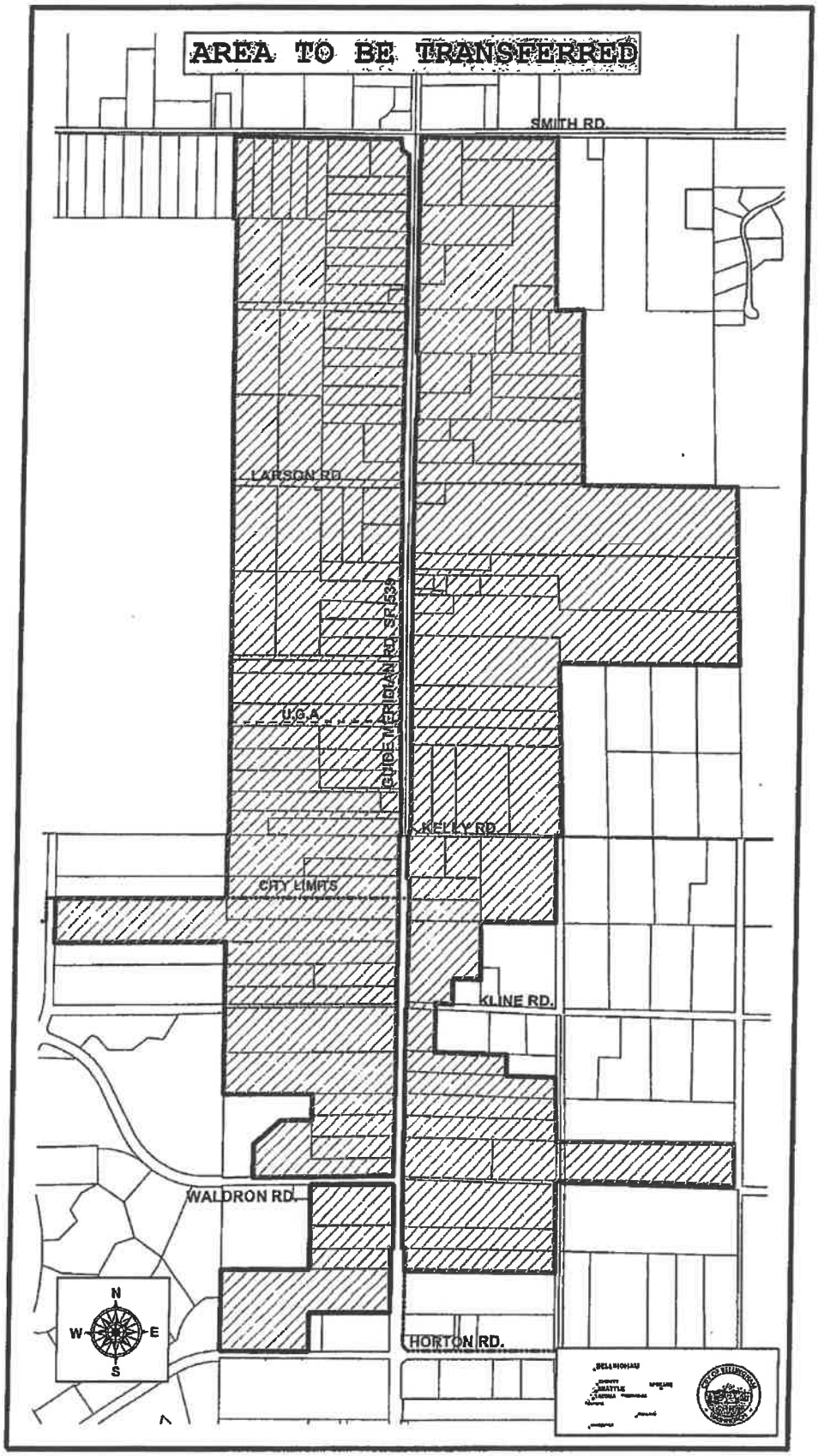

AREA TO BE TRANSFERRED
SMITH RD.
LARSON RD.
GUIDE MERIDIAN RD. SR 539
U.G.A.
KELLY RD.
CITY LIMITS
KLINE RD.
WALDRON RD.
HORTON RD.
N
W
E
S

FIGURE 1

KLINE ROAD SERVICE AREA
N. KING MOUNTAIN RD
WALDRON RD.
GRANT ST.
KLINE RD.
GROVE ST
HORTON RD.
VALLETTE ST.
CITY LIMITS
KELLY RD.
GUIDE MERIDIAN RD. SR 53

FIGURE 2

EXHIBIT "A"
AGREEMENT CITY OF BELLINGHAM - DEER CREEK WATER ASSOCIATION

This Exhibit "A" consists of this cover page, a list of the Assets being sold, a set of 3 sheets of engineering drawings depicting the assets being sold, a list of signed utility easements being transferred, copies of the 29 signed easements and a set of 3 sheets of engineering drawings with colored markings indicating the properties with signed easements and the properties with prescriptive easements.

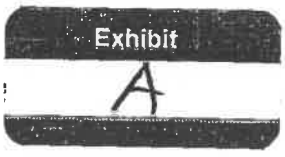
NOTE: DRAWINGS AND 29 SIGNED EASEMENTS ARE MAINTAINED AT PUBLIC WORKS.

Exhibit
4

Exhibit "A"

List of Facilities on SR 539 South of Smith Road

8,428 lineal feet of 10 inch diameter Water Distribution Main.
7 Fire Hydrants
Associated valves, blowoffs and appurtenances.



ASSIGNMENT OF EASEMENT RIGHTS

FOR VALUABLE CONSIDERATION, receipt of which is hereby acknowledged, DEER CREEK WATER ASSOCIATION hereby grants, assigns and transfers unto the City of Bellingham, a municipal corporation, all of its right, title and interest in the easements described in the attached Exhibit "A". The Assignment contained herein is intended as absolute and constitutes an assignment of all of the GRANTOR'S recorded easement interest together with any prescriptive easement interest to GRANTOR.

DATED this 3rd day of JUNE, 2005

DEER CREEK WATER ASSOCIATION

T. J. Fahrlender

BY: Ted Fahrlender, President

STATE OF WASHINGTON)
) ss.
COUNTY OF WHATCOM)

On this day personally appeared before me, Ted Fahrlender, to me known to be the President of DEER CREEK WATER ASSOCIATION, a Washington corporation, described in and who executed the within and foregoing instrument, and acknowledged that he signed the same as his free and voluntary act and deed, for the uses and purposes mentioned in the instrument.

DATED this 3rd day of June, 2005.

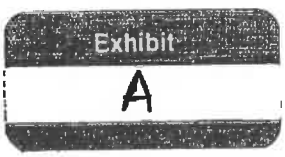
KERRY L. MESSER
NOTARY PUBLIC
STATE OF WASHINGTON
COMMISSION EXPIRES
SEPTEMBER 30, 2007

Kerry L. Messer Kerry L. Messer

NOTARY PUBLIC in and for the
State of Washington

EXHIBIT "A"
ASSIGNMENT OF EASEMENT RIGHTS

This Exhibit "A" consists of this cover page, a list of signed utility easements being transferred, copies of the 29 signed easements and a set of 3 sheets of engineering drawings with colored markings indicating the properties with signed easements and the properties with prescriptive easements.

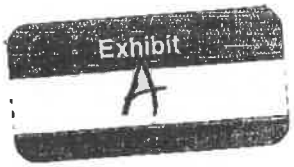


ASSIGNMENT OF EASEMENT RIGHTS

Exhibit "A"

List of signed utility easements

Address	Name	AF#	Parcel#
4735 Guide Meridian	Harwood	1181192	380201-501308
4739 Guide Meridian	Haehnel	1181183	380201-501324
4740 Guide Meridian	Jones	1181187	380201-501324
4781 Guide Meridian	Muzzy	1176687	380201-468384
4809 Guide Meridian	Downing	1181188	380201-459411
4815 Guide Meridian	Barter	1176679	380201-499425
4833 Guide Meridian	Wade	1181196	380201-467447
XXXX Guide Meridian	Hunt	1181181	380201-469476
4800 Guide Meridian	Burkhart	1181189	380201-490507
4905 Guide Meridian	Sundean	1176714	390236-484007
4921 Guide Meridian	Martinsen	1176665	390236-520026
4933 Guide Meridian	Larsen		390236-434041
4935 Guide Meridian	Foster	1176705	390236-503042
4945 Guide Meridian	White	1176708	390236-502058
4961 Guide Meridian	Schuyler	1176701	390236-502075
4979 Guide Meridian	Janitscheck	1176674	390236-467113
4999 Guide Meridian	Willett	1181178	390236-465131
5009 Guide Meridian	Stambaugh	1181197	390236-500146
5021 Guide Meridian	Wiggins	1181185	390236-500160
5029 Guide Meridian	Reddick	1176688	390236-503173
5041 Guide Meridian	Burkhart	1181184	390236-498187
5051 Guide Meridian	Sprague	1181193	390236-501204
XXXX Guide Meridian	Martin Jr.	1176696	390236-508252
5141 Guide Meridian	Baldwin	1181190	390236-500324
5163 Guide Meridian	Hawkins	1181186	390236-500353
5171 Guide Meridian	Dwight	1181179	390236-500368
5183 Guide Meridian	Erickson	1181182	390236-500383
5183 Guide Meridian	Erickson	1181180	390236-500396
5207 Guide Meridian	Sandmann	1181195	390236-518415



ASSIGNMENT OF RIGHTS EASEMENT

BILL OF SALE

KNOW ALL MEN BY THESE PRESENTS, that DEER CREEK WATER ASSOCIATION, of Whatcom County, Washington, for and in consideration of the sum of Ten Dollars ($10.00) lawful money of the United States, and other valuable consideration the receipt whereof is hereby acknowledged, does by these presents grant, bargain, sell and convey unto THE CITY OF BELLINGHAM, the following assets:

SEE EXHIBIT "A" ATTACHED

The Seller herein covenants, agrees and warrants that it is the owner of said property and that the same is free from all liens and encumbrances and that it will defend the sale of said property hereby made, against all and every person or persons whomsoever, lawfully claiming the same or any part thereof.

EXECUTED at Bellingham, Washington, this 3rd day of JUNE, 2005.

DEER CREEK WATER ASSOCIATION

BY: Ted Fahrlender

STATE OF WASHINGTON)
) ss.
COUNTY OF WHATCOM)

On this day personally appeared before me, Ted Fahrlender, to me known to be the President of DEER CREEK WATER ASSOCIATION, a Washington corporation, described in and who executed the within and foregoing instrument, and acknowledged that he signed the same as his free and voluntary act and deed, for the uses and purposes mentioned in the instrument.

DATED this 3rd day of June, 2005.

KERRY L. MESSER
NOTARY PUBLIC
STATE OF WASHINGTON
COMMISSION EXPIRES
SEPTEMBER 30, 2007

Kerry L. Messer
NOTARY PUBLIC in and for the
State of Washington
My Commission Expires: 9-30-07

EXHIBIT "A"
BILL OF SALE

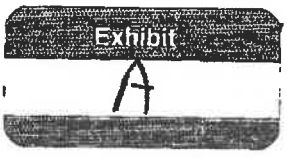
This Exhibit "A" consists of this cover page, a list of the Assets being sold and a set of 3 sheets of engineering drawings depicting the assets being sold.

Exhibit
A
BILL OF SALE

Exhibit "A"

List of Facilities on SR 539 South of Smith Road

8,428 lineal feet of 10 inch diameter Water Distribution Main.
7 Fire Hydrants
Associated valves, blowoffs and appurtenances.



BILL OF SALE

CITY OF BELLINGHAM
CONTRACT#

Contract Authorization Routing

Number (Assigned by FINANCE): 2005-0231A

Tracking Number: KANN-6KJPJA
Type: Contract
Dept: Public Works

Contracting Party	Deer Creek Water Association	Original Cont #	2005-0231
Name/Project #	Modification to Agreement		
Termination Date		If Contract is Extended, New Termination Date:	
City Project Mgr	Geoff Smyth		

Certificate of Insurance ○ Attached ○ Waived ● N/A

Is Notary required? No

P.O. Required? No Maximum Payable $$ ☐ See Contract

Exhibits Attached: ○ Yes ● No

Special Instructions: PLEASE RUSH.
PLEASE NOTIFY LES REARDANZ AND GEOFF SMYTH WHEN COMPLETED - THANKS!

Distribution: Original - Attach to Contract, Copy: Return to Originating Dept.
Modification of Contract - Attach Copy of Original Contract to Physical document

Approval Cycle Settings

(2)	Approval conditions:	100 % approval
(2)	Routing method	Serial (one at a time)
(2)		Grp_eRouter
(2)	Allow Approver comments	Yes
(2)	Automatically Delegate to Assistant...	● Yes ○ No
(2)	Automatically Skip Approvers...	● Yes ○ No
(2)	Days until skipped/delegated	
	Notification	
	Access	

12/30/05 Rec'd Finance
1/4/06 Scan

Approval Cycle by Workflo Systems Inc.

CITY OF BELLINGHAM
CONTRACT#
2005-0231A

MODIFICATION TO AGREEMENT
DEER CREEK WATER ASSOCIATION AND
THE CITY OF BELLINGHAM

The **CITY OF BELLINGHAM**, a first-class municipal corporation of the State of Washington (hereinafter the "City") and **DEER CREEK WATER ASSOCIATION**, a private water association incorporated under the laws of the State of Washington (hereinafter "DCWA"), in consideration of the mutual covenants herein, agree as follows:

I. **EXISTING AGREEMENT MODIFIED:** The City and DCWA previously entered into an Agreement, which is expressly incorporated herein and made a part hereof, in June 2005 whereby the City purchased DCWA assets (hereinafter the "Agreement"). The parties hereby expressly modify that Agreement as delineated herein.

II. **MODIFICATIONS TO EXISTING AGREEMENT:** The Agreement is modified in the following respects:

2.1 Section 4.1.2 of the Agreement is hereby modified such that the emergency intertie agreement contemplated there under shall be required to be completed by January 31, 2006 instead of December 31, 2005.

III. **TERMS AND CONDITIONS OF EXISTING AGREEMENT REMAIN THE SAME:** The parties agree that, except as specifically modified hereinabove, the terms and conditions of the Agreement shall continue in full force and effect.

EXECUTED this 29th day of December, 2005, for DCWA:

Thomas R. Schoen
Name: Thomas R. Schoen
Title: Business Manager, Secretary &Treasurer

EXECUTED this 30th day of DECEMBER, 2005, for the City:

Mark Asmundson, Mayor

Attest:

Therese Hola
Finance Director

Departmental Approval:

Richard E McKinley
Department Head
GMS

Approved as to Form:

Lisa G. Reardanz
Office of the City Attorney

City of Bellingham
CITY ATTORNEY
210 Lottie Street
Bellingham, Washington 98225
Telephone (360) 676-6903

CITY OF BELLINGHAM
CONTRACT#

Contract Authorization Routing

Number (Assigned by FINANCE): 2006-0035

Tracking Number KANN-6LJMFH
Type Contract
Dept: Public Works

Contracting Party	Deer Creek Water Association	Original Cont #	
Name/Project #	Emergency Intertie Agreement, City of Bellingham		
Termination Date		If Contract is Extended, New Termination Date:	
City Project Mgr	Geoff Smyth		

Certificate of Insurance ○ Attached ○ Waived ● N/A

Is Notary required? No

P.O. Required? No Maximum Payable $$ ☐ See Contract

Exhibits Attached: ○ Yes ● No

Special Instructions: Note two originals. Please send one fully executed original to Kjerstie Nelson; PW Engineering.

2-1-06 lc

Distribution: Original - Attach to Contract, Copy: Return to Originating Dept.
Modification of Contract - Attach Copy of Original Contract to Physical document

Contract eRouter: In Process

Approvers	Title	Assigned	Notified	Received	Status Changed	Status
Kerry L Messer	Legal Administrative Assistant	01/30/2006	01/30/2006	-	-	-
Kristina J Bowker	Office Technician	-	-	-	-	-
Marc L Hagen	Office Assistant I/PT	-	-	-	-	-

Approval Cycle Settings

Approval conditions:	100 % approval
Routing method	Serial (one at a time)
Approvers	Grp_eRouter
Allow Approver comments	Yes
Automatically Delegate to Assistant...	Yes
Automatically Skip Approvers...	Yes
Days until skipped/delegated	12 Weekdays 12 Weekdays

Notification
Access

2/1/06 Read Finance
Jean

Approval Cycle by Workflo Systems Inc.

CITY OF BELLINGHAM
CONTRACT#
2006-0035

EMERGENCY INTERTIE AGREEMENT
CITY OF BELLINGHAM – DEER CREEK WATER ASSOCIATION

THIS AGREEMENT is entered into by and between the City of Bellingham, a municipal corporation of the State of Washington ("City"), and Deer Creek Water Association, a private water association incorporated under the laws of the State of Washington ("DCWA").

Recitals

Whereas, the City and DCWA are both public water systems that provide water in their respective regions; and,

Whereas, the City and DCWA entered into a separate agreement whereby the City purchased certain DCWA assets ("Asset Purchase Agreement"); and,

Whereas, the City and DCWA agreed in the Asset Purchase Agreement to negotiate an emergency intertie between the City and DCWA facilities; and,

Whereas, this Emergency Intertie Agreement ("Agreement") details the terms and conditions of the emergency intertie between the parties' facilities as required in the Asset Purchase Agreement; and,

NOW, THEREFORE, in consideration of the mutual covenants contained herein, the parties agree as follows:

1. Intent.

1.1 The parties intend for this Agreement to satisfy the requirements of the following:

1.1.1 Section 4.1.2 of the Asset Purchase Agreement; and,

1.1.2 RCW 90.03.390 and WAC 246-290-132 regarding emergency interties.

1.2 The parties intend for the emergency intertie between their two water systems, as contemplated herein, to be limited to the conditions contained in this Agreement, namely to an emergency intertie to permit the exchange of water during short-term emergency situations.

1.3 The City and DCWA covenant and represent that they are public water systems as defined by state law, including WAC Chapter 246-290.

2. Definitions. The parties agree that, for the purposes of this Agreement, the following terms shall mean as indicated herein:

2.1 "Emergency" shall mean an unforeseen event that causes damage or disruption to normal DCWA operations that requires immediate action to protect the public health and safety. By way of example and not limitation, emergency shall include earthquake, fire, flood, building collapse, well contamination, etc.

2.2 "Short term" or "Temporary" shall mean a limited time period of short duration not to exceed sixty (60) calendar days.

3. Authority. The parties are authorized under the laws of the State of Washington to enter into this Agreement, including under RCW 90.03.390 and WAC 246-290-132.

4. Conditions.

4.1 *Construction.* The emergency intertie contemplated by this Agreement shall be constructed by the Washington State Department of Transportation ("DOT") contractor during the DOT SR 539 road widening project. The parties will work cooperatively and in good faith with each other and DOT during the design and construction of the emergency intertie.

4.2 *Location.* The emergency intertie shall be located at the southwest corner of Smith Road and SR 539 on the City's water line.

4.3 *Costs, Ownership, and Maintenance.*

4.3.1 DCWA shall bear the full costs and expenses of the emergency intertie's construction and installation. The City shall pay for the emergency intertie's design.

4.3.2 Upon the completion of the emergency intertie's construction and installation, the City shall inspect it and accept ownership of it, provided it meets City standards as determined in the City's discretion.

4.3.3 After acceptance by the City, the City shall be responsible for the emergency intertie's maintenance and repair. DCWA agrees to allow the City access to its facilities as may be necessary to properly maintain and repair the emergency intertie upon reasonable notice and at reasonable times.

4.3.4 DCWA shall be authorized to open the emergency intertie contemplated hereunder pursuant to the terms and conditions contained herein.

4.3.5 DCWA shall pay the water rate existing at the time any water is used by DCWA through the emergency intertie. DCWA shall be responsible for providing the City with a good faith and reasonable estimate of their total water consumption for the period of withdrawal, including providing the City with a reasonable figure for billing purposes. This estimate shall be provided after each use of the emergency intertie has ended.

4.4 *Use.*

4.4.1 The parties intend that DCWA shall only be authorized to use the emergency intertie when required by an emergency situation and only on a short term or temporary basis. If a DCWA emergency requires use of the emergency intertie for longer than a short term or temporary basis, the parties shall enter into a separate written agreement.

4.4.2 During DCWA's use of the emergency intertie, DCWA agrees to correspondingly reduce its water usage if such is necessary to remain within the limits of its Department of Ecology authorized water rights limits.

5. Duration. This Agreement shall begin after the City accepts the emergency intertie and water is accessible through the waterline feeding the emergency intertie. This Agreement shall continue until terminated in writing pursuant to the terms contained herein.

6. Termination.

6.1 This Agreement may not be terminated except for cause until five (5) years has elapsed from the date the City accepts ownership of the emergency intertie under section 4.3.2. The intent of this five (5) year provision is to allow DCWA to reallze a reasonable return on its investment of constructing and installing the emergency intertie. However, at the time this Agreement is being executed, the final construction and installation costs are unknown to the parties. Therefore, if the foregoing five (5) year period does not allow DCWA the ability to realize a reasonable return on its investment as demonstrated by a reasonable depreciation schedule once the construction and installation costs are known, the parties may reopen negotiations on this sole provision to establish a time period that better reflects a reasonable rate of return. This five (5) year time period may be increased or decreased.

6.2 After the five (5) year period described in section 6.1 above (or such other period as may be agreed upon by the parties thereunder), either party may terminate this Agreement for any reason upon 60 days written notice to the other. Upon termination, the City shall render the emergency intertie unserviceable for further use by DCWA. The City may use any commercially reasonable method to render the emergency intertie unserviceable and, thereafter, will retain ownership of the emergency intertie. Any costs associated with rendering the emergency intertie shall be borne equally by the parties.

7. Notices. All notices, demands, requests, consents and approvals which may, or are required to, be given by any party to any other party hereunder, shall be in writing and shall be deemed to have been duly given if delivered personally, sent by facsimile, sent by a nationally recognized overnight delivery service, or if mailed or deposited in the United States mail and sent by registered or certified mail, return receipt requested, postage prepaid to:

City: City of Bellingham Public Works Department
Attn: Geoff Smyth
2221 Pacific Street
Bellingham, WA 98226
(360) 676-7799 (Fax)

DCWA: Deer Creek Water Association
Attn: Tom Schoen
P.O. Box 1010
Lynden, WA 98264
(360) 354-0836

or to such other address as the foregoing parties hereto may from time-to-time designate in writing and deliver in a like manner. All notices shall be deemed complete upon actual receipt or refusal to accept delivery. Facsimile transmission of any signed original document and retransmission of any signed facsimile transmission shall be the same as delivery of an original document.

8. Miscellaneous Provisions.

8.1 *Amendment.* No modification, termination or amendment of this Agreement may be made except by written agreement signed by authorized representatives of the parties.

8.2 *Waiver.* No failure by any of the parties to insist upon the strict performance of any covenant, duty, agreement, or condition of this Agreement or to exercise any right or remedy consequent upon a breach thereof shall constitute a waiver of any such breach or any other covenant, agreement, term or condition. No waiver shall affect or alter this Agreement, and each and every covenant, agreement, term and condition of this Agreement shall continue in full force and effect with respect to any other then existing or subsequent breach thereof.

8.3 *Captions.* The captions of this Agreement are for convenience and reference only and in no way define, limit, or describe the scope or intent of this Agreement.

8.4 *Severability.* In case any one or more of the provisions contained in this Agreement shall for any reason be held to be invalid, illegal or unenforceable in any respect, such invalidity, illegality or unenforceability shall not affect any other provision hereof, and this Agreement shall be construed as if such invalid, illegal or unenforceable provision had never been contained herein.

8.5 *Further Required Action.* At any time before, on or after this Agreement's signing, the parties agree to execute, acknowledge and deliver any further conveyances, deeds, assurances, instruments or other documents as may reasonably be required by the other party to effectuate the transaction contemplated in this Agreement.

8.6 *Authority to Enter Agreement.* The parties acknowledge that the individuals signing this Agreement below are authorized representatives of the parties and are authorized to bind their respective parties to this Agreement.

8.7 *Binding Agreement.* This Agreement shall be binding upon and inure to the benefit of the parties and their respective successors only and shall not benefit any third party not a party hereto. Neither party may assign or transfer its rights or obligations hereunder without the prior written consent of the other party.

8.8 *Construction of Agreement.* This Agreement is the result of good faith negotiations between the parties and their respective representatives. This Agreement shall be given a fair and reasonable construction in accordance with the intention of the parties and without regard to the identity of the party drafting the Agreement or any provision hereof.

8.9 *Entire Agreement.* The entire agreement between the parties hereto is contained in this Agreement and the exhibits hereto; and this Agreement supersedes all of their previous understandings and agreements, written and oral, with respect to this transaction. In the event of any dispute arising out of this Agreement, the prevailing party shall be entitled to its reasonable attorney's fees.

EXECUTED this 20 day of January, 2006, for Deer Creek Water Association:

Thomas R. Schoen

Name: Thomas R. Schoen

Title: Secretary/Treasurer/Business Manager

EXECUTED this 31st day of January, 2006, for the City of Bellingham:

John B. Watts

~~Mark Asmundson~~, Mayor - Pro-Tem

Attest:

Theresa Hohn

Finance Director

Departmental Approval:

Richard E. McKinley

Public Works Director GMS

Approved as to form:

Lee G. Russell

Office of the City Attorney

CITY OF BELLINGHAM
CITY ATTORNEY

WATER SUPPLY SERVICE AGREEMENT

CITY OF BELLINGHAM - WHATCOM COUNTY WATER DISTRICT NO. 10

THIS AGREEMENT, made and executed this 13th day of May, 1970, between the CITY OF BELLINGHAM, a Municipal Corporation of the State of Washington, hereinafter referred to as "City", and WHATCOM COUNTY WATER DISTRICT NO. 10, a Municipal Corporation of the State of Washington, hereinafter referred to as "District".

W I T N E S S E T H:

WHEREAS, that certain territory which is within the established boundaries of the District, and in proximity to the established boundaries of the City, has not heretofore been served by a Public Water Utility; and

WHEREAS, the District is not now in a position to finance, construct, and operate a municipal water supply system to furnish water supply service to such new developments, but intends to so serve emerging service areas in the future by contract with the City; and

WHEREAS, residential and other type developments have created service areas which now require the District to make arrangements to obtain conventional public water supply service on phase-by-phase when actually requested by the District procedure within said territory; and

WHEREAS, the City is in a position to supply and sell water and water supply service to the District to service a water distribution system within a service area within such territory as

hereafter described upon certain rates and conditions; and the District desires to purchase water and water supply service from the City in order to supply a certain water distribution system or systems; and

WHEREAS, it is necessary that a contract be entered into establishing the rights and duties of the parties;

NOW, THEREFORE, in consideration of the mutual covenants contained herein, IT IS HEREBY AGREED AS FOLLOWS:

1. Definition - Water Service Area. For the purpose of this agreement, "water service area" shall mean that area within the District which area is described in Exhibit A and by reference made a part hereof.

2. Water Supply and Service. The City agrees to furnish the District with potable water, for domestic and fire protection uses only, to the best of its ability within the limits of its present water treatment facilities, but not so as to impair service to the water consumers within the City, or existing consumers outside the City. The number and types of services, or consumers, to be supplied must be approved by the City. City approval of services will not constitute a guarantee that the City will meet peak demands or specific hydrant pressures.

3. Delivery points. Delivery points will be determined by future agreement between the City and the District, and must meet the approval of the City. The City will cooperate with the District in providing a reasonable number of delivery points. The cost of constructing such delivery points, including the cost of meters and necessary extensions, enlargements or improvement of City lines, will be borne by the District.

hereafter described upon certain rates and conditions; and the District desires to purchase water and water supply service from the City in order to supply a certain water distribution system or systems; and

WHEREAS, it is necessary that a contract be entered into establishing the rights and duties of the parties;

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2. Water Supply and Service. The City agrees to furnish the District with potable water, for domestic and fire protection uses only, to the best of its ability within the limits of its present water treatment facilities, but not so as to impair service to the water consumers within the City, or existing consumers outside the City. The number and types of services, or consumers, to be supplied must be approved by the City. City approval of services will not constitute a guarantee that the City will meet peak demands or specific hydrant pressures.

3. Delivery points. Delivery points will be determined by future agreement between the City and the District, and must meet the approval of the City. The City will cooperate with the District in providing a reasonable number of delivery points. The cost of constructing such delivery points, including the cost of meters and necessary extensions, enlargements or improvement of City lines, will be borne by the District.

4. Payment to City. The District agrees to pay the City for water delivered at the rate and according to the terms established, or to be established, by ordinance, for comperable water consumers outside the City.

WHATCOM COUNTY
WATER DISTRICT NO. 10

CITY OF BELLINGHAM

Mayor

Comptroller

EXHIBIT A

Beginning at the meander corner on the section line between Sections 26 and 27, Township 38 North, Range 3 East, Willamette Meridian, said corner being also the city limits of the City of Bellingham.

Thence Northerly along the West line of Sections 26 and 23, Township 38 North, Range 3 East to the Southwest corner of Blackburn's 1st Addition to Schome; thence Easterly to the center of the Southeast quarter of the Southwest quarter of Section 23, said Township and Range; thence Northerly to the center of the Northeast quarter of the Southwest quarter of said Section 23; thence Easterly to the Southeast corner of the Northeast quarter of the Northeast quarter of the Southwest quarter of said Section 23; thence Northerly to the center of said Section 23; thence Easterly along the East-West quarter section line to the quarter corner between Sections 23 and 24, said Township and Range; thence continuing Easterly through Section 24, said Township and Range, and Section 19, Township 38 North, Range 4 East to the quarter corner between Sections 19 and 20; Township 38 North, Range 4 East. Thence Southerly along the East section lines of Sections 19 and 30 to the quarter corner between Sections 29 and 30, said Township and Range; thenoe Easterly along the East-west quarter line of Section 29 to the center of Section 29, said Township and Range; thence Southerly along the North-south quarter section line of said Section 29 to the South East-west 1/16 line of said Section 29; thence Easterly on said South 1/16 line to the South 1/16 corner between Sections 28 and 29, said Township and Range; thence Southerly along the West Section lines of Section 28 and 33 to the South 1/16 corner between Sections 32 and 33, said Township and Range; thence Easterly along the South East-west 1/16 line of said Section 33 to the West 1/16 line of said Section 33; thence Southerly along the West North-south 1/16 line of said Section 33 to the Township line of Township 38 and 37 North; thence Easterly along said Township line to the Northeast Section corner of Section 4, Township 37 North, Range 4 East; thence Southerly along the East section lines of Sections 4, 9 and 16 to the quarter corner between Sections 15 and 16, said Township and Range; thence Easterly along the East-west quarter line of said Section 15 to the center of said Section 15; thence Southerly along the North-south quarter line of said Section 15 to the quarter corner between Sections 15 and 22, said Township and Range; thence Easterly along the North Section line of said Section 22 to the Northeast section corner of said Section; thence Southerly on the Section line between Sections 22 and 23, said Township and Range to the quarter corner between said Sections; thence Easterly on the East-west quarter line of Section 23 to the center of Section; thence Southerly on North-

south quarter line of Section 23 to the quarter corner between Sections 23 and 26, said Township and Range; thence Easterly on the North Section lines of Sections 26 and 25 to the Range line between Ranges 4 and 5 East; thence Southerly along said Range line to the quarter corner between Section 25, said Township and Range and Section 30, Township 37 North, Range 5 East, Willamette Meridian; thence Easterly along East-west quarter line of said Section 30 to the center of said Section; thence Southerly along the North-south quarter line to the South quarter corner of said Section 30; thence Westerly along the South Section line of said Section 30 to the Range line between Ranges 4 and 5 East; thence Northerly along said Range line to the South 1/16 corner between said Section 30 and Section 25, Township 37 North, Range 4 East; thence Westerly along the South East-west 1/16 line to the North-south quarter line of said Section 25, thence Northerly along the North-south quarter line to the center of said Section 25; thence Westerly along the East-west quarter lines of Sections 25, 26, 27, 28 and 29 to the center of Section 29, said Township and Range; thence Northerly along the North-south quarter line of Sections 29 and 20 to the center of Section 20, said Township and Range; thence Easterly along the East-west quarter line of Section 20 to the East North-south 1/16 line of said Section 20; thence Northerly along the East North-south 1/16 lines of Sections 20 and 17 to the North East-west 1/16 line of Section 17, said Township and Range; thence Westerly on said North East-west 1/16 line to the North-south quarter line of said Section 17; thence Northerly along the North-south quarter line to the quarter corner between Sections 17 and 8, said Township and Range; thence Westerly along the North Section lines of Sections 17 and 18 to the Range line of Ranges 3 and 4 East; thence Northerly along said Range line to the Southeast Section corner of Section 1, Township 37 North, Range 3 East, Willamette Meridian; thence Westerly along the South Section line of said Section 1 to the Southwest Section corner of said Section 1; thence Northerly along the Section line between Sections 1 and 2 to the quarter corner between said Sections 1 and 2; thence Westerly on the East-west quarter lines of Sections 2 and 3 to the center of Section 3; thence Northerly along the North-south quarter line of said Section 3 to the quarter corner between said Section 3 and Section 34, Township 38 North, Range 3 East; thence Westerly along the South Section line of said Section 34 to the Southwest section corner of said Section 34; thence Northerly along the West Section lines of Sections 34 and 27 to the quarter corner between Sections 27 and 28, said Township and Range; thence Easterly along the East-west quarter line of said Section 27 to the harbor line of Lake Whatcom; thence Northeasterly along Bellingham City Limit line across Lake Whatcom to the point of beginning.

REVISED
INTERLOCAL AGREEMENT - NORTH SHORE WATER SERVICE

I. RECITALS

The CITY OF BELLINGHAM (the "City") is a municipal corporation formed under the laws of the State of Washington and a first-class city. It maintains a water supply system serving the area within its corporate limits and certain areas outside those limits.

WHATCOM COUNTY WATER DISTRICT NO. 10 (the "District") is a water and sewer district formed under Title 57 of the Revised Code of Washington, which provides water and sewer services within its boundaries. Water District 10 is located within an area adjacent to the City of Bellingham. The District currently provides no water service on the north shore of Lake Whatcom, and has no facilities for the delivery of such service in that area.

The City is willing and able to sell treated water to the District through a metered connection at the common boundary between the City and the District on North Shore Drive for a limited service area and under certain terms and conditions.

WHEREFORE, in view of the above recitals and in consideration of the mutual covenants and promises set out below, the parties agree as follows:

1. The City has upgraded certain water transmission and service lines within the city limits in order to provide a constant flow of at least 750 gallons per minute to the District at the point of delivery. The specific lines upgraded by the City are set out in Exhibit A, a copy of which is attached to this agreement and incorporated herein by this reference.

2. The District, at its expense, will install a vault and water meter at an agreed-upon location at or near the point of delivery. The City shall approve the design of the vault and the type and installation of the meter. Upon completion of the installation, the District shall transfer ownership of the vault and meter to the City without charge, and shall also provide the City with legal access to the location of the

City of Bellingham
CITY ATTORNEY
210 Lottie Street
Bellingham, Washington 98225
Telephone (206) 676-6903

vault and the meter. Thereafter, the City shall be the owner of the meter and shall be responsible for all maintenance, repair and replacement of the meter. The District will install, own, maintain, repair and replace as necessary an approved backflow prevention device on the District's side of the water meter.

3. A. Upon transfer of the vault and meter, above, the District shall pay the sum of $35,000 to the City as its share of the cost of upgrading the water transmission lines within the City. After the District has made the payments required by this agreement, the District shall have no further obligation to the City for future improvements or betterments to the lines, regardless of whether those improvements benefit the District directly or indirectly, unless the parties specifically so agree in the future in writing. By making the payments called for in this agreement, the District will not acquire any ownership interest in any portion of the City's water service or delivery system.

B. Should the District construct (or have constructed) a water pumping station having a cost exceeding $35,000 prior to the transfer to the City of the vault and meter referred to in Paragraph 2, above, then the $35,000 payment to the City under this section shall be waived.

4. The District shall pay the City a fee of $300 per connection for each connection made to the District's system on the north shore of Lake Whatcom in the area covered by this agreement. Such payments shall be made within sixty (60) days of the date of actual connection by District customers and the District shall annually provide to the City a listing of such new customers. This $300 fee shall apply to all of the lots within the "Eagle Ridge Plat" and to all additional connections in District 10's North Shore Service Area until the District builds its own reservoir sufficient to allow water delivery at a constant rate throughout a peak day to connections in that service area.

5. The City shall supply water service to the District at the rate of 150 gallons per minute for domestic flow and 750 gallons per minute fire flow at the point of delivery. All water will be supplied at a minimum 26 psi pressure as measured on the City's side of the meter at

City of Bellingham
CITY ATTORNEY
210 Lottie Street
Bellingham, Washington
Telephone (206)

North Shore Drive. The District shall pay for all water passing through the meter at the point of delivery at the rate established by the City of Bellingham for service outside the Bellingham corporate city limits. The District shall pay the City promptly when billed for all water passing through the meter.

6. The District agrees it will not sell or resell water for any use other than single-family dwellings on lots of record as of June 10, 1988, without the specific approval of the City of Bellingham.

7. This agreement constitute the entire agreement of the parties and shall not be altered or amended except in writing, signed by an authorized representative of each of the parties.

DATED this 8th day of June, 1989.

WHATCOM COUNTY WATER DISTRICT NO. 10

Erik Ungern, President

CITY OF BELLINGHAM

Attest: Lynn Carpenter, Finance Director

Tim Douglas, Mayor

CERTIFICATION

As Secretary of Whatcom County Water District No. 10, I certify that the above Revised Interlocal Agreement was adopted at a regular meeting of the Commissioners held on the 12th day of May, 1989, at which time a quorum of 3 was present, and was adopted by a vote of 3 FOR, 0 AGAINST, and 0 ABSTENTIONS.

Secretary
Whatcom County Water District No. 10

Approved as to form:
CITY OF BELLINGHAM

City Attorney's Office

0180L - 3

City of Bellingham
CITY ATTORNEY
210 Lottie Street
Bellingham, Washington 98225
Telephone (206) 676-6903

Approved as to form:
WHATCOM COUNTY WATER DISTRICT NO. 10

Harry L. Johnsen
Attorney for Whatcom County Water
District No. 10

Departmental Approval:

Director of Public Works

City of Bellingham
CITY ATTORNEY
210 Lottie Street
Bellingham, Washington 9822
Telephone (206) 676-69

ADDENDUM

WHEREAS, the City of Bellingham, hereinafter referred to as "City" and Water District No. 10 of Whatcom County, hereinafter called "District" have an existing contract for the provision of sewer services effective January 1, 1974 covering the District Lake Whatcom South Shore system, and

WHEREAS, the parties now desire to enter into an agreement covering the District Lake Whatcom North Shore system and replacing the agreement between the parties covering the "Edgewater Lane" are of the District, and

WHEREAS, many of the terms and conditions placed in the January 1, 1974 contract are acceptable to both parties with minor modification, and

WHEREAS, it is the intention of the parties to add certain additional terms to the January 1, 1974 agreement to cover the District Lake Whatcom North Shore system and the sewer service to Edgewater Lane,

NOW, THEREFORE, the parties agree as follows:

1. That all terms of the January 1, 1974 agreement between the parties shall be effective as if part of this agreement and the same are hereby incorporated herein, unless hereby amended.

2. The City agrees to accept a peak flow of one hundred fifty (150) gallons per minute from the District Lake Whatcom North Shore system and Edgewater Lane which is part of that system.

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Bellingham, Washington 98225
Telephone (206) 676-6903

3. The District will pay charges for use of the City's trunk system based on the 150 gallons per minute flow rate or maximum peak flow whichever is the greater, which volume shall be stablsihc by meter readings. The District will pay charges for treatment based on the total annual flow as established by meter readings.

4. The City reserves and the District hereby acknowledges the right of the city to require the District to remove the 150 gallon per minute flow from the city's trunk facilities in the event that such facilities ever reach capacity flow. In such eventuality the District agrees that it will build its own sewer trunk to the Whatcom Creek trunk line or enter into a joint arrangement with the City to build such a line.

5. The District agrees to pay a pro-rata share of the costs to provide replacement facilities as needed from the District to the Whatcom Creek trunk.

6. The District agrees to assume all responsibility for the maintenance of Edgewater Lane and the parties agree that the previous agreement covering this area of the District dated the 10th day of October, 1974 is hereby rescinded.

7. A metering station similar to that used for the South Shore system shall be placed at the city limits by the District for the purpose of measuring the flow from the North Shore system.

8. The District must agree to adopt a rate structure for this system and for areas already served, which will meet the requirements of any future grants which may be obtained for treat-

City of Bellingham
CITY ATTORNEY
210 Lottie Street
Bellingham, Washington 98225
Telephone (206) 676-6903

ment or transportation of wastes by the City of Bellingham.

9. The District shall pay a pro-rata share based on flow of the costs to operate and maintain the Martin Street and North Shore pump stations based upon the following formula and upon the basis of the contribution by the District of 150 gallons per minute flow rate:

$$\frac{\text{Total City pumping costs - Oak Street cost}}{\text{Total number of stations - Oak Street}} = \text{Cost/Pump station}$$

IN WITNESS WHEREOF, the parties by their signatures below have executed this agreement this 1st day of August, 1977.

CITY OF BELLINGHAM

Mayor

Attest: D. K. Hoffman
Finance Director

Approved as to form:

Bellingham City Attorney

WATER DISTRICT NO. 10

By
Chairman of Commissioners

Attest:
Secretary of Board of Commissioners

City of Bellingham
CITY ATTORNEY
210 Lottie Street
Bellingham, Washington 98225
Telephone (206) 676 6903

Contract Coversheet

Contract: C2000866

Amendment: N/A

Supplier	Department	Originator
Lake Whatcom Water and Sewer District	Public Works	Mary Newby

Classification	Project Name	Project Manager
Interlocal Agreement	ILA - Intertie - COB & Lk Whatcom Wtr & Swr Dist.	

Original Amount	Maximum Amount	Total Agreement Change	Current Amendment Amount
$0.00			

Type	Structure	Agreement Type
NF - Non-Financial	ST - Standard	NONFIN - Non-Financial Contract

Termination Date	Amended Termination Date	Compliance Type
9/28/2040		

Retainage %	Retainage Comments

Renewal Date	Renewal Notes

9/28/20

Additional Contract Notes:

Lake Whatcom Water & Sewer District
Please return one (1) original to Mary Newby.

Contacts:

Debi Denton - debi.denton@lwwsd.org
Michael Olinger - molinger@cob.org

9/29/20 Finance

10/1/20 Sew

CONTRACT #
C2000866

INTERLOCAL AGREEMENT FOR AN EMERGENCY USE INTERTIE BETWEEN WATER SYSTEMS
between
The CITY OF BELLINGHAM
and
The LAKE WHATCOM WATER AND SEWER DISTRICT

THIS INTERLOCAL AGREEMENT FOR EMERGENCY WATER SERVICES ("**Agreement**") is entered into by and between the City of Bellingham, a Washington municipal corporation (the "**City**"), and the Lake Whatcom Water and Sewer District, formerly Whatcom County Water District No. 10, a Washington municipal corporation and special purpose district (the "**District**"). Hereinafter, the City and the District may be referred to individually as "Party" and collectively as the "Parties."

RECITALS

WHEREAS, the District provides water service to customers within its service boundaries, which are located outside of the City's corporate limits; and

WHEREAS, the District shares boundaries with the City's corporate limits; and

WHEREAS, the City's water distribution infrastructure and Whatcom Falls Water Treatment Plant have excess capacity above that which is needed to serve customers located within the City's corporate limits; and

WHEREAS, the District's South Shore water distribution infrastructure and Sudden Valley Water Treatment Plant have excess capacity above that which is needed to serve customers located within the District's South Shore system service area; and

WHEREAS, Chapter 39.34 Revised Code of Washington (RCW) allows governmental entities to enter into interlocal agreements to perform services for one another on the basis of mutual advantage; and

WHEREAS, Bellingham Municipal Code Chapter 15.36 authorizes the City to provide water service outside its corporate limits subject to certain conditions; and

WHEREAS, under the provisions of a separate interlocal agreement dated June 10, 1988, which was revised on June 8, 1989, the District purchases water from the City to serve District customers within its Eagleridge Water System located on the north shore of Lake Whatcom, which agreement is not affected by this Agreement; and

WHEREAS, the City and the District previously entered into a contract dated May 13, 1970, pursuant to which the District purchased water from the City for distribution to District

customers in the area commonly referred to as the Geneva community (Geneva Community) located on the south shore of Lake Whatcom; and

WHEREAS, water purchased from the City to serve District customer's in the Geneva Community passed through a distribution point located at the intersection of Lakeway Drive and Scenic Avenue (the "**South Lake Whatcom Distribution Point**"), which is on the boundary of the City's corporate limits and the District's service area; and

WHEREAS, the South Lake Whatcom Distribution Point consisted of a booster station that supplied increased pressure to the water being supplied by the City to the District for service to District customers located in the Geneva Community ("Booster Station"); and

WHEREAS, the District constructed a water main in 2002 that connected its South Shore Water System serving the Sudden Valley community to its distribution system in Geneva, thereby negating the need for a continuous supply of City-provided water to the District's Booster Station at the South Lake Whatcom Distribution Point; and

WHEREAS, the District desires to repurpose the South Lake Whatcom Distribution Point from a Booster Station for the routine supply of water to the District to an emergency use intertie that will provide a short term or temporary supply of water to the District during emergencies that result in the District's permanent supply of water being unavailable or inadequate for use; and

WHEREAS, the City is amenable to the establishment of an emergency use intertie at this location, provided it allows for use by both parties in event of emergency; and

WHEREAS, normal operational City water system pressures have increased since the time of operation of the Booster Station such that pumps are no longer required at the South Lake Whatcom Distribution Point; and

WHEREAS, the Washington State Department of Health, in a letter dated August 27, 2019, has approved the conversion of the Booster Station into an emergency use intertie; and

WHEREAS, the District has physically converted the Booster Station into an emergency use intertie; and

WHEREAS, the purpose of this Agreement is to provide the terms and conditions upon which the Parties may utilize the emergency use intertie; and

WHEREAS, the Parties intend for this Agreement to replace and supersede all previous agreements related to the City's supply of water through the South Lake Whatcom Distribution Point and/or to the District's South Shore Water System; and

WHEREAS, this Agreement does not alter or amend any previous agreements related to providing water services to the District for service to District customers located on the north shore of Lake Whatcom, including the Eagleridge neighborhood.

NOW, THEREFORE, in consideration of the mutual benefits and consideration to be obtained by each Party, the receipt and sufficiency of which is hereby acknowledged, the Parties hereby agree as follows:

TERMS AND CONDITIONS

1. PURPOSE.

1.1 The purpose of this Agreement is to establish the terms and conditions upon which the Parties will establish, maintain and use an emergency use intertie connection between the District's South Shore Water System and the City's water system. This intertie is located at the southeast corner of the intersection of Lakeway Drive and Scenic Avenue ("**Emergency Intertie**") and is intended to provide the Parties with water system supply redundancy and resiliency to minimize impacts to City and District customers in the event of an emergency loss or degradation of permanent water supply sources.

1.3 The parties intend for the Emergency Intertie between their two water systems, as contemplated herein, to be limited to the conditions contained in this Agreement; namely, to an Emergency Intertie to permit the short term or temporary exchange of water during emergencies.

1.4 The parties intend for this agreement to satisfy the requirements of RCW 90.03.390 and WAC 246-290-132 regarding emergency use intertie connections between water systems.

2. DEFINITIONS.

2.1. "Emergency" means an unforeseen event that causes damage or disrupts normal operations and requires immediate action to protect public health and safety.

2.2. "Short term" or "temporary" mean a limited time period of short duration not to exceed sixty (60) calendar days.

3. ADMINISTRATION. No new or separate legal or administrative entity is created to administer the provisions of this Agreement.

4. TERM OF AGREEMENT. The term of this Agreement shall commence upon its execution by the Parties and shall remain in effect for twenty (20) years from the date of mutual execution. The Parties may extend the term of this Agreement by mutual written consent.

5. TERMINATION. This Agreement may be terminated by either Party upon the giving of ninety (90) days written notice to the other Party, at which time any remaining financial obligations shall be paid in full according to the provisions of this Agreement.

6. INFRASTRUCTURE

6.1. Prior to execution of this Agreement, the District installed the Emergency Intertie. The District shall properly maintain and repair the Emergency Intertie at its sole expense, except as otherwise provided herein.

6.2. The District shall install and replace at its sole expense a flow measuring device and recording instruments at the Intertie which device shall be capable of measuring flows in both directions. These devices and instruments will be owned and maintained by the City upon completion of construction.

6.3. The City's water system will be protected from backflow by a Department of Health-approved Reduced Pressure double check valve assembly that is installed, owned, maintained, repaired and, if necessary, replaced by the District. In the event the City requires water, the City will temporarily reverse the backflow assembly and make other temporary system revisions to allow water flow to the City's water system at its expense, and following coordination with the District.

7. USE.

7.1. The Parties are authorized to use the Emergency Intertie only in the event of emergency and only on a short term or temporary basis. If an emergency requires use of the Emergency Intertie for longer than short term or temporary basis, the receiving party shall promptly notify the supplying party in writing and the Parties shall promptly enter into good faith negotiations for a separate written agreement, provided that nothing herein shall be construed to require the Parties to enter into such separate written agreement or to otherwise supply water beyond a short term or temporary basis.

7.2. The receiving party shall notify the suppling party prior to operation of the Emergency Intertie.

7.3. Use of the Emergency Intertie is at all times subject to the supplying party's determination that sufficient water is available for such purpose. The supplying party's determination of adequate water supply is solely with the supplying party's discretion and is not subject to challenge.

8. RESERVED CAPACITY & FLOW MEASUREMENT

8.1. **Reserved Capacity**. As the intent of this Agreement is to provide temporary water service on an emergency as needed basis only; no reserved capacity within either party's system will be allocated to this purpose.

8.2. **Future Temporary Supply Agreements**. The City agrees to timely negotiate with the District in good faith to execute temporary supply agreements, each term lasting at least

one (1) year. The intent of each temporary supply agreement is to the enable the District to temporarily decommission its Geneva Reservoir located at 1010 Lakeview Street for replacement and/or reconditioning, or to perform significant repair and/or replacement of other District water system infrastructure. This clause shall be construed as a non-binding statement of intent and not a contractual commitment.

9. RATES AND PAYMENT TERMS.

9.1 The District shall pay solely for water passing through the meter at the Emergency Intertie at the rate established by the City for service outside of City corporate limits. Service shall be solely for use on a temporary basis; therefore, monthly base rates shall not apply. Payment shall be made to the City of Bellingham, 210 Lottie Street, Bellingham, WA 98225, or at a different place as designated by the City in writing.

9.2 The City shall pay solely for water passing through the meter at the Emergency Intertie at 150% of the rate established by the District for residential water customers. Service shall be solely for use on a temporary basis; therefore, monthly base rates shall not apply. Payment shall be made to the District at 1220 Lakeway Drive, Bellingham, WA 98225, or at a different place as designated by the District in writing.

9.3 Missed or late payments shall accrue interest at the rate of twelve percent (12%) per annum.

10. COMPLIANCE WITH REGULATIONS. The Parties shall comply with all relevant state and local laws, regulations and approvals pertaining to the conversion and operation of the Intertie, including, but not limited to RCW 90.03, WAC Sections 246-290-132 and 246-290-131, and the Washington State Department of Health's letter, dated August 27, 2019, approving the conversion of the District-owned booster station located at the intersection of Lakeway Drive and Scenic Avenue into the Intertie contemplated in this Agreement.

11. INDEMNIFICATION. Each Party agrees to be responsible and assume liability for its own wrongful and/or negligent acts or omissions or those of its officials, officers, agents, employees or contractors to the fullest extent required by law, and further agrees to save, indemnify, defend and hold the other Party harmless from any such liability. It is further provided that no liability shall attach to the Parties by reason of entering into this Agreement except as expressly provided herein.

12. ASSIGNMENT. Neither Party shall assign or delegate any or all interests in this Agreement without first obtaining the prior written consent of the other Party.

13. SUCCESSORS OR ASSIGNS. All of the terms, conditions, covenants and agreements of this Agreement shall extend to and be binding upon each Party and their successors and permitted assigns.

14. RESPONSIBLE PERSONS - ADMINISTRATION. The persons responsible for the administration of this Agreement shall be the City of Bellingham Public Works Director and the Lake Whatcom Water and Sewer District General Manager or their designees.

15. NOTICE. Any notice required to be given under the terms of this Agreement shall be directed to the Party at the address set forth herein below:

City:

City of Bellingham
210 Lottie Street
Bellingham, WA 98225

Attn: Public Works Director
With copy to: Mayor
With copy to: City Attorney

District:

Lake Whatcom Water and Sewer District
1220 Lakeway Drive
Bellingham, WA 98229

Attn: General Manager
With copy to: District Legal Counsel

Any notice given pursuant to this Agreement shall be delivered personally, sent by overnight courier or mailed by registered or certified mail to the addresses above or to such other address as a Party shall from time to time advise in writing. If mailed, a notice shall be deemed received three (3) business days after the postmark affixed on the envelope by the United States Post Office.

16. APPLICABLE LAW AND VENUE. This Agreement shall be governed by, and construed in accordance with the laws of the State of Washington without recourse to any principle of conflicts of laws. Any action in law or equity, or judicial proceeding for the enforcement of this Agreement or any of the provisions contained therein, shall be instituted and maintained only in Whatcom County Superior Court, Bellingham, Washington.

17. MODIFICATION. This Agreement may be changed, modified, amended or waived only by written agreement executed by the Parties hereto. Waiver or breach of any term or condition of this Agreement shall not be considered a waiver of any prior or subsequent breach.

18. ENTIRE AGREEMENT. This Agreement constitutes the entire Agreement between the parties hereto and supersedes all other prior written or oral understandings with regard to the City's provision of sewage services to the District. This Agreement may only be amended, supplemented, modified, or cancelled by a duly executed document in writing pursuant to this Agreement.

19. SEVERABILITY. Should any part of this Agreement be rendered or declared invalid by a court of competent jurisdiction of the State of Washington, such invalidation of such part or portion of this Agreement shall not invalidate the remaining portions thereof, and they shall remain in full force and effect.

20. HEADINGS. The headings in this Agreement are for convenience only and do not in any way limit or affect the terms and provisions hereof.

21. RECORDING. The City shall record this Agreement with the Whatcom County Auditor in accordance with the Washington Interlocal Cooperation Act, Title 39.34 RCW.

EXECUTED this 28 day of September, 2020 for the **CITY OF BELLINGHAM**.

Mayor

Director of Public Works

ATTEST:

Finance Director

APPROVED AS TO FORM:

Office of the City Attorney

EXECUTED this 25th day of August, 2020 for **LAKE WHATCOM WATER AND SEWER DISTRICT**.

District Board President

District General Manager

ATTEST:

Debi Denton
Finance Manager

APPROVED AS TO FORM:

District Legal Counsel

STATE OF WASHINGTON)
) ss.
COUNTY OF WHATCOM)

On this day personally appeared before me SETH FLEETWOOD, to me known to be the MAYOR of CITY OF BELLINGHAM, a first class city of the State of Washington that executed the within and foregoing instrument, and acknowledged the said instrument to be the free and voluntary act and deed of said county for the uses and purposes therein mentioned, and on oath stated that he is authorized to execute said instrument.

GIVEN under my hand and official seal this 1 day of October, 2020.



Elisabeth A. Oakes
Print Name: Elisabeth A. Oakes
NOTARY PUBLIC in and for the State of Washington, residing at Bellingham.
My commission expires 6/19/2023

STATE OF WASHINGTON)
) ss.
COUNTY OF WHATCOM)

On this day personally appeared before me LAURA ABELE, to me known to be the DISTRICT BOARD PRESIDENT of LAKE WHATCOM WATER AND SEWER DISTRICT, that executed the within and foregoing instrument, and acknowledged the said instrument to be the free and voluntary act and deed of said corporation for the uses and purposes therein mentioned, and on oath stated that she is authorized to execute said instrument.

GIVEN under my hand and official seal this 25th day of August, 2020.



Print Name: Rachael Hope
NOTARY PUBLIC in and for the State of Washington, residing at Bellingham, WA
My commission expires 1/31/2023

INTERLOCAL AGREEMENT
CITY OF BELLINGHAM-WHATCOM CO. WATER DISTRICT #7

I. RECITALS

The CITY OF BELLINGHAM (the "City") is a municipal corporation formed under the laws of the State of Washington and a first-class city. It maintains a water supply system serving the area within its corporate limits and certain areas outside those limits.

WHATCOM COUNTY WATER DISTRICT NO. 7 (the "District") is a water district formed under Title 57 of the Revised Code of Washington, which provides water service within its boundaries. Water District 7 is located within an area adjacent to the City of Bellingham. The District currently provides water service within a portin of its District boundary and may wish to serve additional areas within its boundaries.

WHEREAS, pursuant to the Bellingham Municipal Code 15.36, the City is willing and able to sell treated water to the District through a metered connection at the common boundary between the City and the District on Britton Road for a limited service area and under certain terms and conditions.

WHEREFORE, in view of the above recitals and in consideration of the mutual covenants and promises set out below, the parties agree as follows:

1. Provision of water supply. The City agrees to provide to the District up to a maximum of 500 gallons per minute of potable water service, at a minimum of 20 psi, for resale by the District to its customers residing within the District boundary as it exists as of the date hereinbelow. The District boundary is shown in Exhibit "A." The District agrees to not resell water beyond the limits of the district. The District further agrees to not resell said water in areas annexed to the District after July 1, 1991 without the express written approval of the City.

Appendix "C"

City of Bellingham
CITY ATTORNEY
210 Lottie Street

2. The District agrees to provide throughout the life of this Agreement reservoir capacity sufficient to allow water delivery by the City at a constant rate throughout a peak day and to operate its system in that manner.

3. The District shall pay for all water passing through the meter at the point of delivery at the rate established by the City of Bellingham for service outside the Bellingham corporate city limits. The District shall pay the City promptly when billed for all water passing through the meter.

4. The District agrees it will not sell or resell water for any use other than single-family dwellings on lots of record as of July 1, 1991, without the specific approval of the City of Bellingham.

5. The City may, at some time in the future, wish to install a water line along Britton Road to eliminate dead end water mains. The District agrees to cooperate with the City and support the City's future plans for such a water main and agrees to allow City service to properties within the Districts that lie west of Britton Road.

6. Hold harmless. The District agrees to defend the City and hold it harmless as to any claims or lawsuits, well-founded or not, arising out of use of the facilities the District owns or maintains, and provision of water services to District customers. The District understands, and will advise its customers as necessary, that no legal relationship exists between them and the City, and that the District is solely responsible for provision of water service to such customers and billing for same.

7. This Agreement replaces the earlier agreement between the parties dated September 18, 1967 and constitutes the entire agreement of the parties and shall not be altered or amended except in writing, signed by an authorized representative of each of the parties.

City of Bellingham
CITY ATTORNEY

A.P.
C.

DATED this 13 day of APRIL, 1993.

WHATCOM COUNTY WATER DISTRICT NO. 7

Tom Anderson

CITY OF BELLINGHAM

Tim Douglas 4/2/93

Tim Douglas, Mayor

ATTEST:

Finance Director

CERTIFICATION

As Secretary of Whatcom County Water District No. 7, I certify that the above Interlocal Agreement was adopted at a REGULAR meeting of the Commissioners held on the 13 day of APRIL, 1993 at which time a quorum of 2 was present, and was adopted by a vote of 2 FOR, 0 AGAINST, and 0 ABSTENTIONS.

Secretary
Whatcom County Water District No. 7

APPROVED AS TO FORM:
City of Bellingham

City Attorney's Office

APPROVED AS TO FORM:
Whatcom County Water District No. 7

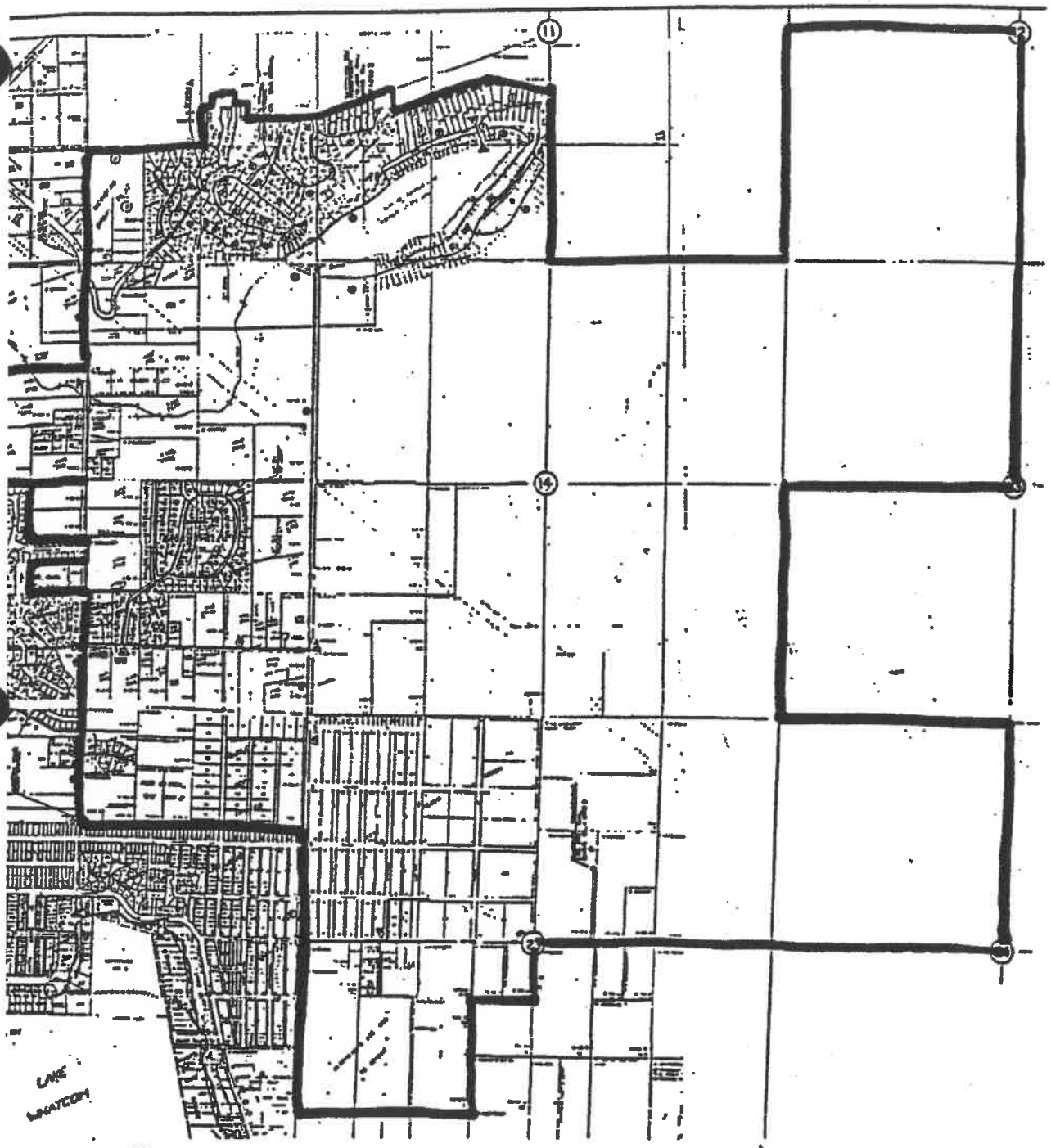
DEPARTMENTAL APPROVAL:

Director of Public Works

1496w (3)

City of Bellingham
CITY ATTORNEY

AP
C



WHATCOM COUNTY WATER DISTRICT #7
SERVICE AREA BOUNDARY

SCALE: 1" = 800'

10/19/91

ATTACHMENT "A"

AP. C

Public Works Department
City of Bellingham

February 28, 2019

Whatcom County Water District #7
P.O. Box 28700
Bellingham, WA 98228

District 7 Commissioners,

The City has reviewed your request to amend the District's service area boundary, as shown in Exhibit A to the existing water supply contract with the City of Bellingham dated April 13, 1993. Per your request, the City approves modifying the District's service area boundary to include two additional parcels for single-family residential service connections as follows:

- One new service for Parcel Number 380311 195245 0000 (single lot triangle)
- One new service for all of the southeast quarter of section 11, Township 38, Range 3E

The land as described, now included in the District's service area, will be treated as all other areas in the District, subject to conditions in the existing water supply contract, including restricting new service connections to lots of record as of July 1, 1991 unless otherwise approved by the City of Bellingham. The City requests that the District continue to submit each request for new water service to the City's Public Works Department for confirmation that the lot was created on or before July 1, 1991.

Please feel free to contact me if you have any questions.

Ted Carlson
Public Works Director
City of Bellingham

CC: Dave Olsen
Brent Baldwin
Alan Marriner

Engineering
104 W. Magnolia Street, Suite 109
Bellingham, WA 98225
Phone: (360) 778-7900
Fax: (360) 778-7901
TTY: (360) 778-8382
Email: pw@cob.org

Natural Resources
Physical: 2200 Nevada Street
Mailing: 2221 Pacific Street
Bellingham, WA 98229
Phone: (360) 778-7800
Fax: (360) 778-7801
Email: pw@cob.org

Operations
2221 Pacific Street
Bellingham, WA 98229
Phone: (360) 778-7700
Fax: (360) 778-7701
Email: pw@cob.org

APPENDIX I

WATER FACILITIES INVENTORY FORM

WATER FACILITIES INVENTORY (WFI) FORM

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

ONE FORM PER SYSTEM

Quarter: 1
Updated: 08/30/2021
Printed: 6/29/2022
WFI Printed For: On-Demand
Submission Reason: Contact Update

RETURN TO: Central Services - WFI, PO Box 47822, Olympia, WA, 98504-7822 or email wfi@doh.wa.gov

1. SYSTEM ID NO.	2. SYSTEM NAME	3. COUNTY	4. GROUP	5. TYPE
05600 3	BELLINGHAM-WATER DIVISION CITY OF	WHATCOM	A	Comm

6. PRIMARY CONTACT NAME & MAILING ADDRESS	7. OWNER NAME & MAILING ADDRESS
STEVEN R. BRADSHAW [PW OPERATIONS] 2221 PACIFIC ST. BELLINGHAM, WA 98229	BELLINGHAM, CITY OF DIRECTOR OF PUBLIC WORKS 2221 PACIFIC ST. BELLINGHAM, WA 98229
STREET ADDRESS IF DIFFERENT FROM ABOVE	**STREET ADDRESS IF DIFFERENT FROM ABOVE**
ATTN	ATTN
ADDRESS	ADDRESS
CITY STATE ZIP	CITY STATE ZIP

9. 24 HOUR PRIMARY CONTACT INFORMATION		10. OWNER CONTACT INFORMATION	
Primary Contact Daytime Phone: (360) 778-7850		Owner Daytime Phone: (360) 778-7900	
Primary Contact Mobile/Cell Phone: (425) 299-4867		Owner Mobile/Cell Phone:	
Primary Contact Evening Phone: (xxx)-xxx-xxxx		Owner Evening Phone: (xxx)-xxx-xxxx	
Fax:	E-mail: xxxxxxxxxxxxxxxxxxx	Fax: (360) 778-7901	E-mail: xxxxxxxxxxxxxxxxxxx

11. SATELLITE MANAGEMENT AGENCY - SMA (check only one)

- [x] Not applicable (Skip to #12)
- [ ] Owned and Managed
- [ ] Managed Only
- [ ] Owned Only

SMA NAME: _____ SMA Number:

12. WATER SYSTEM CHARACTERISTICS (mark all that apply)

- [x] Agricultural
- [x] Commercial / Business
- [x] Day Care
- [x] Food Service/Food Permit
- [ ] 1,000 or more person event for 2 or more days per year
- [x] Hospital/Clinic
- [x] Industrial
- [x] Licensed Residential Facility
- [x] Lodging
- [x] Recreational / RV Park
- [x] Residential
- [x] School
- [ ] Temporary Farm Worker
- [ ] Other (church, fire station, etc.): _____

13. WATER SYSTEM OWNERSHIP (mark only one)

- [ ] Association
- [ ] County
- [ ] Investor
- [ ] Special District
- [x] City / Town
- [ ] Federal
- [ ] Private
- [ ] State

14. STORAGE CAPACITY (gallons): 29,375,000

15	16	17	18 SOURCE CATEGORY									19 USE			20	21 TREATMENT						22	23	24 SOURCE LOCATION			
Source Number	SOURCE NAME LIST UTILITY'S NAME FOR SOURCE AND WELL TAG ID NUMBER. Example: WELL #1 XYZ456 IF SOURCE IS PURCHASED OR INTERTIED, LIST SELLER'S NAME Example: SEATTLE	INTERTIE SYSTEM ID NUMBER	WELL	WELL FIELD	WELL IN A WELL FIELD	SPRING	SPRING FIELD	SPRING IN SPRINGFIELD	SEA WATER	SURFACE WATER	RANNEY / INF. GALLERY	OTHER	PERMANENT	SEASONAL	EMERGENCY	SOURCE METERED	NONE	CHLORINATION	FILTRATION	FLUORIDATION	IRRADIATION (UV)	OTHER	DEPTH TO FIRST OPEN TERVAL IN FEET	CAPACITY (GALLONS PER MINUTE)	1/4, 1/4 SECTION	SECTION NUMBER	TOWNSHIP	RANGE
S01	NOOKSACK/LAKE WHATCOM									X			X					X	X			X		25000	SW SW	26	38N	03E
S02	InAct 02/28/1993 LAKE WHATCOM OLD									X					X			X	X					0	SW SW	26	38N	03E
S03	InAct 02/28/1993 MIDDLE FORK NOOKSAC									X				X			X							0	SW NW	19	38N	06E

WATER FACILITIES INVENTORY (WFI) FORM - Continued

1. SYSTEM ID NO.	2. SYSTEM NAME	3. COUNTY	4. GROUP	5. TYPE
05600 3	BELLINGHAM-WATER DIVISION CITY OF	WHATCOM	A	Comm

	ACTIVE SERVICE CONNECTIONS	DOH USE ONLY! CALCULATED ACTIVE CONNECTIONS	DOH USE ONLY! APPROVED CONNECTIONS
25. SINGLE FAMILY RESIDENCES (How many of the following do you have?)		22479	Unspecified
A. Full Time Single Family Residences (Occupied 180 days or more per year)	19790		
B. Part Time Single Family Residences (Occupied less than 180 days per year)	0		
26. MULTI-FAMILY RESIDENTIAL BUILDINGS (How many of the following do you have?)			
A. Apartment Buildings, condos, duplexes, barracks, dorms	0		
B. Full Time Residential Units in the Apartments, Condos, Duplexes, Dorms that are occupied more than 180 days/year	2689		
C. Part Time Residential Units in the Apartments, Condos, Duplexes, Dorms that are occupied less than 180 days/year	0		
27. NON-RESIDENTIAL CONNECTIONS (How many of the following do you have?)			
A. Recreational Services and/or Transient Accommodations (Campsites, RV sites, hotel/motel/overnight units)	0	0	
B. Institutional, Commercial/Business, School, Day Care, Industrial Services, etc.	2499	2499	
28. TOTAL SERVICE CONNECTIONS		24978	

29. FULL-TIME RESIDENTIAL POPULATION

A. How many residents are served by this system 180 or more days per year? 90000

30. PART-TIME RESIDENTIAL POPULATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. How many part-time residents are present each month?												
B. How many days per month are they present?												

31. TEMPORARY & TRANSIENT USERS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. How many total visitors, attendees, travelers, campers, patients or customers have access to the water system each month?												
B. How many days per month is water accessible to the public?												

32. REGULAR NON-RESIDENTIAL USERS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. If you have schools, daycares, or businesses connected to your water system, how many students, daycare children and/or employees are present each month that are NOT already included in the residential population?												
B. How many days per month are they present?												

33. ROUTINE COLIFORM SCHEDULE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	90	90	90	90	90	90	90	90	90	90	90	90

34. NITRATE SCHEDULE	QUARTERLY	ANNUALLY	ONCE EVERY 3 YEARS
(One Sample per source by time period)			

35. Reason for Submitting WFI:

☐ Update - Change ☐ Update - No Change ☐ Inactivate ☐ Re-Activate ☐ Name Change ☐ New System ☐ Other _____

36. I certify that the information stated on this WFI form is correct to the best of my knowledge.

SIGNATURE: _____ **DATE:** _____

PRINT NAME: _____ **TITLE:** _____

WS ID	WS Name
05600	BELLINGHAM-WATER DIVISION CITY OF

Total WFI Printed: 1

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

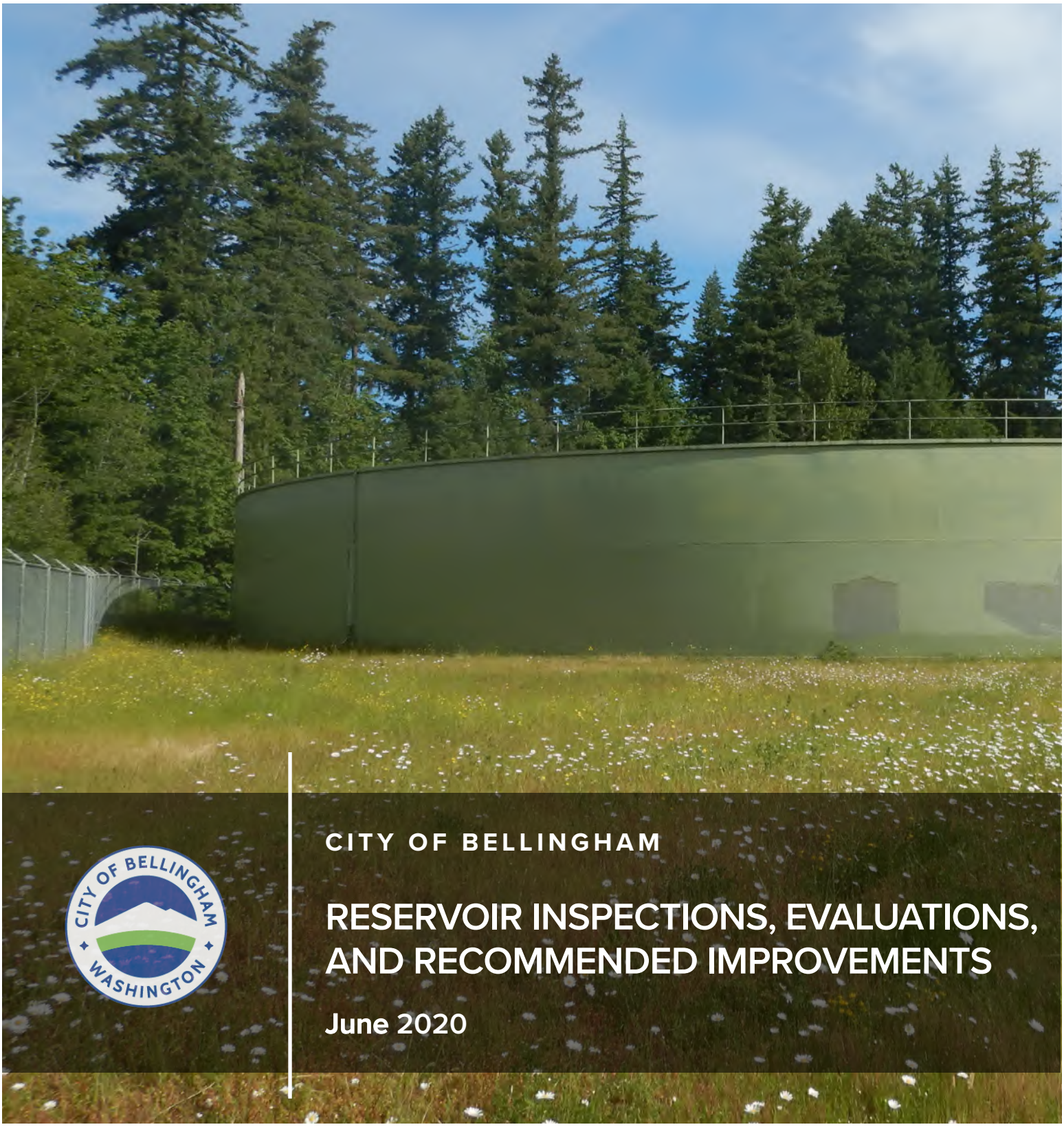
Water Facilities Inventory (WFI)

Report Create Date:	6/29/2022		
Water System Id(s):	ALL		
Print Data on Distribution Page:	Yes		
Print Copies For:	DOH Copy		
Water System Name:	Bellingham		
County:	-- Any --		
Region:	ALL		
Group:	A		
Type:	ALL		
Permit Renewal Quarter:	ALL		
Water System Is New:	ALL		
Water System Status:	ALL		
Water Status Date From:	ALL	**To**	ALL
Water System Update Date	ALL	**To**	ALL
Owner Number:	ALL		
SMA Number:	ALL		
SMA Name:	ALL		
Active Connection Count From:	ALL	**To:**	ALL
Approved Connection Count	ALL	**To:**	ALL
Full-Time Population From:	ALL	**To:**	ALL
Water System Expanding	ALL		
Source Type:	ALL		
Source Use:	ALL		
WFI Printed For:	On-Demand		

APPENDIX J

RESERVOIR INSPECTIONS, EVALUATIONS, AND RECOMMENDED IMPROVEMENTS REPORT

murraysmith



CITY OF BELLINGHAM

RESERVOIR INSPECTIONS, EVALUATIONS, AND RECOMMENDED IMPROVEMENTS

June 2020

Reservoir Assessments

The City of Bellingham

June 2020



Murraysmith

2707 Colby Avenue
Suite 1110
Everett, WA 98201

Acronyms & Abbreviations

AC	Alternating Current
ACI	American Concrete Institute
AMSL	Above mean sea level
ASCE	American Society of Civil Engineers
AWWA	American Water Works Association
bgs	below ground surface
CBD	Central Business District
City	City of Bellingham
CMU	Concrete masonry unit
Code	2015 International Building Code
DFT	dry film thickness
DOH	Washington State Department of Health
Domed RC	reinforced domed concrete tanks
DOSH	Division of Occupational Safety and Health within L&I
EPA	United States Environmental Protection Agency
FRP fabric	Fiberglass reinforced polymer fabric
L&I	Department of Labor and Industries
MCE	maximum considered earthquake
MGD	million gallons per day
MG	million gallons
mils	thousandths-of-an-inch
NWC	Northwest Corrosion
OSHA	Occupational Safety and Health Administration
PAHs	Polycyclic Aromatic Hydrocarbons
PCA	Portland Cement Association
PSE	Peterson Structural Engineers
PSC	Prestressed concrete
psf	pounds per square foot
RC	reinforced concrete
RCC	roller compacted concrete
Score Matrix	Condition Assessment Score Matrix
TCLP	Toxic Characteristic Leaching Procedure
Type 2 gauge	portable electromagnetic dry film thickness gauge
USGS	United States Geological Survey
WAC	Washington Administrative Code
WISHA	Washington Industrial Safety and Health Act
WTP	water treatment plant

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Executive Summary

Introduction

In December 2018, Murraysmith was authorized by the City of Bellingham (City) to provide engineering services for the City's Reservoir Inspection/Development of Bid Specifications for Reservoir Repairs and Repair Oversight Project. Phase 1 of this project is to perform a thorough, comprehensive evaluation of the City's 13 reservoirs including condition assessments and structural/seismic evaluations. This phase generally includes the following steps:

- Field Inspections – perform inspections of drained reservoirs, and conduct floating inspections as needed
- Condition Assessments – prepare condition scoring system and summarize deficiencies
- Recommended Improvements – identify improvements to resolve deficiencies

Future phases of this project include prioritizing recommended improvements and developing bid documents to complete the improvements.

Field Inspection and Assessment Methods

The Murraysmith team performed inspections to determine the overall condition of the facilities. This included completing geotechnical investigations and physical inspections of each reservoir. The geotechnical investigation at the reservoir sites includes a description of the general subsurface conditions, foundation design parameters and seismic design criteria to aid the structural analysis.

The physical inspections of the reservoirs were completed by a multi-disciplinary team including engineers from Murraysmith and subconsultants Peterson Structural Engineers and Northwest Corrosion Engineering. In addition to the overall condition of each reservoir, the team reviewed coatings, appurtenances and completed corrosion and structural inspections.

Murraysmith developed a condition assessment score matrix to uniformly assesses the condition of each reservoir. Twenty-eight reservoir individual system/structures were identified for scoring and grouped into the seven following System Groups:

- Site/Security
- Walls
- Floor/Foundation
- Roof
- Appurtenances
- Piping/Valving
- Miscellaneous

Each System Group was evaluated on seven assessment categories (and subcategories):

- Cleanliness and Coatings
- Material Deterioration (Concrete Deterioration/Metal Corrosion)
- Structural Performance (Static, Seismic)
- Water Quality/Sanitary
- Safety
- Operations and Maintenance (Site and Security, Roof Drainage, Appurtenances, Valving and Piping, Misc.)
- Obsolescence

Scores were assigned to each System Group ranging from one (1), implying that the component is deficient, to five (5), implying that it meets criteria completely. A weighting system was used to determine an overall score for each reservoir. This weight was developed with input from City staff and accounts for the risk associated with each assessment category, shown in Table ES-1. For example, a seismic event-induced issue would likely cause a major disruption to service and be very time-consuming and expensive to rectify.

Table ES-1: The weighting system used in determining reservoir scores.

Category	Weight (out of 100)
Cleanliness and Coatings	5
Material Deterioration	10
Static Structural Performance	20
Seismic Structural Performance	30
WQ/Sanitary	10
Safety	10
O&M	10
Obsolescence	5

Condition Assessments and Recommend Improvements

The City has done a superb job at delivering high quality water to its customers over the years. While areas for improvement were identified on the reservoir systems, they are all completely operational and previous problems have been addressed proactively by the City. The assessments and recommendations are based on current and planned code requirements and standards.

Some common operational-type issues appeared on many or all the reservoirs, such as vegetation clearances, air gaps, and dechlorination systems. A summary of some of the reservoir specific deficiencies are provided below.

Marietta: The currently empty reservoir shell and roof supports are in good condition, likely due to coating materials that prevent corrosion and do not deteriorate. However, the coatings are archaic, and the City can consider a modern coating system. If used, the maximum operating level is recommended to be reduced, anchors removed, and flexible couplings installed on the piping to increase seismic resiliency of the reservoir. Safety, drain, overflow, and vent improvements are also recommended.

Padden: The reservoir is in fair condition given the observed corrosion, coating failure, and potential seismic issues. Significant corrosion was noted the interior roof and supports. The exterior and interior coating systems are at the end of their service life; interior and exterior recoating is recommended. To alleviate seismic event slosh damages, the maximum operating level is recommended to be lowered from 24.5 to 19.75 feet or alternately, retrofit/replacement should be considered. The foundation will also require retrofits if operated higher than 22.25 feet.

Whatcom Falls I: The reservoir is in generally good condition. However, to alleviate seismic event slosh damages, the maximum operating level is recommended to be lowered from 16.5 to 14 feet or alternately, retrofit/replacement should be considered. Depending on the new operating level, the corrosion on the interior roof and its supports needs to be addressed. The exterior coating needs only coating touch ups. The cathodic protection system's breaker was not functioning, which needs immediate attention.

Dakin II: While in good condition, a roof drainage problem is potentially negatively affecting the structure. Organic material accumulates on the roof and blocks drains; the stagnant water's freeze-thaw cycles are likely causing observed cracking. Roof drainage is recommended to be improved and concrete repaired.

Kearney: The 14-year old reservoir is in very good condition. However, the roof appears to be draining onto the exterior walls, which potentially is causing delamination of the outer shotcrete layer in two specific areas and staining in others. These areas should be monitored, and potential roof drainage modifications should be considered to reduce the risk of damage to the exterior shotcrete and underlying wire strand.

Whatcom Falls II: The Whatcom Falls II Reservoir is an almost 30-year old prestressed concrete tank that is still in very good condition. One major issue that the City is unable to draw down the reservoir while meeting chlorine contact time requirements. This will likely be problematic in the future if the City needs to conduct inspections or maintenance. The roof is subjected to heavy organic loads that the reservoir cannot shed that is exacerbated by unsuitable drains and the roof being very flat. The roof drainage deficiencies do not yet appear to be inducing major roof curb, roof slab, or wall shotcrete issues, but the reservoir should continue to be monitored.

40th Street/College Way/Consolidation/Dakin I/Reveille (Reinforced Concrete Domes): The reservoirs are in fair to poor condition. The water-tight seals that allow the reservoirs to hold water above the roof-to-wall interface do not allow differential thermal movement between the roof and walls; this has caused concrete cracking over time. In order to ensure continued long-term,

sustained operation, we recommend conducting a detailed evaluation weighing the option of roof replacement or retrofit compared to potentially complete structure replacement. These reservoirs also have valve vaults that are connected to the reservoirs, which during seismic events, could potentially lead to pipe failure. Seismic valves and flexible piping connections are recommended. Although a similar style reservoir as the others, the 40th Street reservoir's reinforcing was found to be inadequate for static and seismic loads. To alleviate structural risk, we recommend reducing the maximum operating level from 23 to 16 feet if possible.

Sehome: At almost 100 years old, this reservoir does not meet current structural or seismic codes due to minimal/missing wall reinforcement. The adjacent sloping ground surface appears to allow organic material-laden surface runoff to drain to the roof. Operationally, it was noted that the roof drain passes through the reservoir interior and vents are undersized. Rehabilitation is not feasible; therefore, replacement of the reservoir is recommended.

Parkhurst: This reservoir is in good condition. The observed exterior efflorescence can likely be addressed by the addition of an interior coating. A new interior ladder is also recommended.

Conclusion

This comprehensive study of the City of Bellingham's water holding structures shows the City's commitment to providing water to its constituents. The City is recognized as a leader in this field. With the average age of the City's reservoirs being around 50 years, it is time to consider options for rehabilitation and/or replacement.

Recommended improvements were developed to address noted deficiencies on the condition assessments. The preference to rehabilitate or replace the Padden, Whatcom Falls I, and 40th Street Reservoirs is reliant on if the City can lower maximum operating levels. Rehabilitation of the Seahome Reservoir does not appear to be feasible. For the other reservoirs, it appears that rehabilitation options will be the most cost effective. Improvements can be weighed with replacement costs and lifespans and prioritized in the next phase of this work program. Special attention should be given to the site selection and improvements as the City moves into the design phase of this project.

Table ES-2 summarizes the details of the reservoirs assessed, results from the condition assessments, and estimated costs to rehabilitate the structures.

One-sheet summaries that outline the reservoir details, condition scoring, and improvement budgetary cost estimates for each reservoir are provided on pages ES-6 to ES-18.

Table ES-2: Summaries of reservoir Information, condition assessments, and recommend improvements: The first four columns show the names, year of construction, capacity in mega gallons, and construction material. The materials are welded steel (Steel), prestressed concrete (PSC), and reinforced concrete (RC). Condition assessment scores are shown in Column 5 and the primary deficiency areas are shown in columns 6 through 10. Estimated costs to fully rectify reservoirs and written explanations of deficiencies are presented in the last two columns.

Reservoir	Year Constructed	Capacity (MG)	Material	Score[1]	Cleanliness & Coatings, Concrete Deterioration/Corrosion	Static	Seismic	Safety	Operations & Maint.	Estimated Cost to Correct Deficiencies[2]	Deficiency Notes
Marietta	1969	3.0	Steel	3.3		X				$410,000	Seismic slosh damages roof and anchor straps
Padden	1967	0.5	Steel	3.6	X	X				$0.85-1.2M	Seismic slosh damages roof and foundation; coatings failure (interior and exterior) and corrosion (interior)
Whatcom Falls I	1984	4.0	Steel	3.8	X	X				$2.1-3.6M	Seismic slosh damages roof; coatings failure and corrosion (interior)
Dakin II	1990	0.5	PSC	4.5	X				X	$740,000	Roof drains clogged and subsequent cracking
Kearney	2006	2.5	PSC	4.6					X	$210,000	Roof draining onto exterior walls
Whatcom Falls II	1993	15.6	PSC	4.2						$840,000	Unable to draw down reservoir and baffles cannot resist seismic load
40th Street	1958	0.5	RC	3.6		X	X			$0.96-1.7M	Walls under-reinforced; roof and walls cannot independently expand and contract; seismic event induced pipe failure (no flex couplings)
College Way	1968	0.5	RC	3.9		X	X			$1.1M	Roof and walls cannot independently expand and contract; seismic event induced pipe failure (no flex couplings)
Consolidation	1959	0.5	RC	3.3		X	X			$1.1M	Roof and walls cannot independently expand and contract; seismic event induced pipe failure (no flex couplings)
Dakin I	1987	0.5	RC	3.7		X	X			$1.1M	Roof and walls cannot independently expand and contract; seismic event induced pipe failure (no flex couplings)
Reveille	1958	0.3	RC	3.7		X	X			$1.3M	Roof and walls cannot independently expand and contract; seismic event induced pipe failure (no flex couplings)
Sehome	1920	0.7	RC	2.6			X		X	$3.4M	Seismic event structure failure (lack of reinforcing); operational deficiencies (slope drains to roof, vents undersized, poor roof drainage)
Parkhurst	1997	0.2	RC	4.1	X			X		$330,000	Efflorescence on exterior, interior ladder corrosion

[1] Scoring (1-5, Low to High)

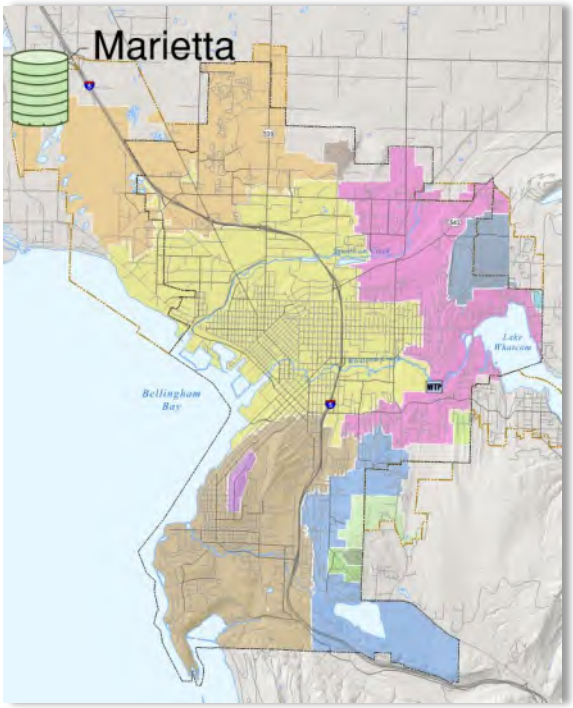
[2] Includes 30% contingency, 8.7% tax, & 35% engineering, rounded

Marietta Reservoir



Date Inspected:
January 24, 2019

Address:
1404 Marietta Avenue
Bellingham, WA 98226



Reservoir Details	
Zone Served	276 North
Storage Volume	3.0 MG
Type	Welded steel
Year Constructed	1969
Dimensions	100’ dia, 55’-3” tall
Inlet	12”
Outlet	16”
Overflow	8” at 276’ (50’ Abv floor)
CP System	Constant voltage

Category	Score[1]	Planning Level Improvement Costs[2]
Cleanliness and Coatings	4.4	$ 23,000
Material Deterioration	4.5	$ -
Structural Performance - Static	4.0	$ 86,000
Structural Performance - Seismic	2.2	
Water Quality / Sanitary	4.1	$ 2,000
Safety	2.0	$ 126,000
Operations & Maintenance	3.7	$ 172,000
Obsolescence	4.3	$ -
Overall	**3.3**	**$ 410,000**

Current max operating level:
50 ft

Updated max operating level, no structural repairs:
44.5 ft

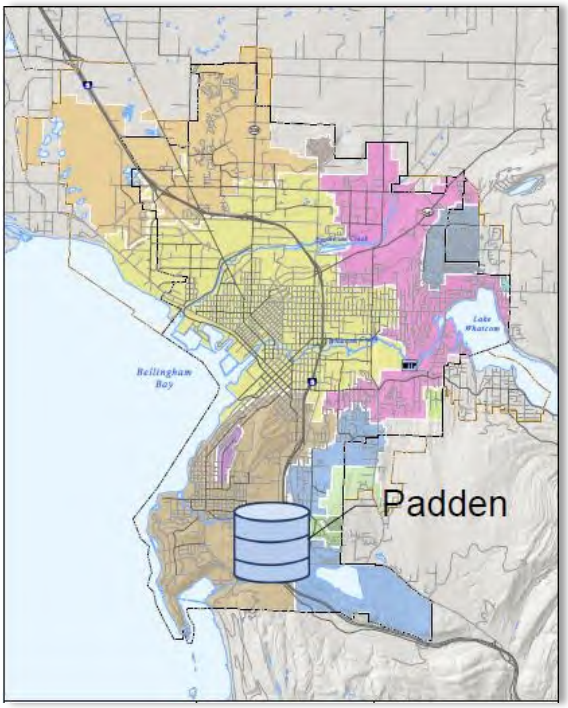
[1] Scoring (1-5, Low to High)
[2] Includes 30% contingency, 8.7% tax, & 35% engineering, rounded

Padden Reservoir



Date Inspected:
April 9, 2019
April 30, 2019

Address:
3820 Broad Street
Bellingham, WA 98229



Reservoir Details	
Zone Served	457 South
Storage Volume	0.5 MG
Type	Welded steel
Year Constructed	1967
Dimensions	59’ dia, 22’-3” tall
Inlet	16”
Outlet	Combined w/ inlet/drain
Overflow	8” at 457’ (25’ Abv floor)
CP System	Constant voltage

Category	Score[1]	Planning Level Improvement Costs[2]
Cleanliness and Coatings	3.3	$ 399,000
Material Deterioration	3.7	$ 29,000
Structural Performance - Static	5.0	$ 225,000 min –
Structural Performance - Seismic	2.8	$ 572,000 max
Water Quality / Sanitary	4.3	$ 8,000
Safety	2.3	$ 126,000
Operations & Maintenance	4.2	$ 65,000
Obsolescence	3.0	$ -
Overall	**3.6**	**$ 850,000 min – $1,200,000 max**

Current max operating level:
24.5 ft

Updated max operating level, no structural repairs:
19.75 ft

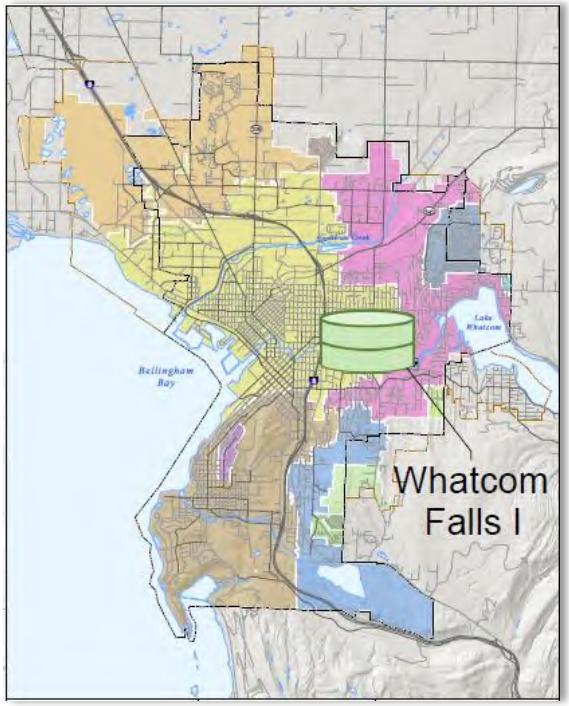
[1] Scoring (1-5, Low to High)
[2] Includes 30% contingency, 8.7% tax, & 35% engineering, rounded

Whatcom Falls I Reservoir



Date Inspected:
June 12, 2019
November 30, 2019

Address:
3201 Arbor Street
Bellingham, WA 98229



Reservoir Details	
Zone Served	276 North
Storage Volume	4.0 MG
Type	Welded steel
Year Constructed	1984
Dimensions	201’ dia, 17’-6” tall
Inlet	24”
Outlet	Combined w/ inlet/drain
Overflow	N/A
CP System	Autopotential

Category	Score[1]	Planning Level Improvement Costs[2]
Cleanliness and Coatings	3.5	$ 59,000
Material Deterioration	4.2	$ 34,000
Structural Performance - Static	4.0	$1,328,000 min -
Structural Performance - Seismic	3.5	$2,862,000 max
Water Quality / Sanitary	2.5	$ 443,000
Safety	4.5	$ -
Operations & Maintenance	4.1	$ 195,000
Obsolescence	4.7	$ -
Overall	**3.8**	**$2,100,000 min – $3,600,000 max**

Current max operating level:
16.5 ft

Updated max operating level, no structural repairs:
14 ft

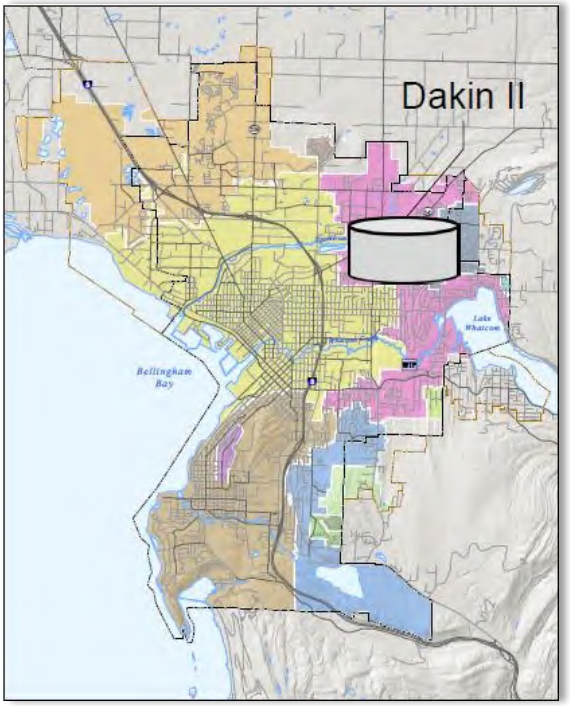
[1] Scoring (1-5, Low to High)
[2] Includes 30% contingency, 8.7% tax, & 35% engineering, rounded

Dakin II Reservoir



Date Inspected:
April 30, 2019

Address:
3819 Balsam Lane
Bellingham, WA 98226



Reservoir Details	
Zone Served	519 Dakin & Yew
Storage Volume	0.5 MG
Type	Prestressed Concrete
Year Constructed	1990
Dimensions	68' dia, 19'-6" tall
Inlet	12"
Outlet	Combined w/ inlet/drain
Overflow	8" at 519' (18'-6" Abv floor)
CP System	N/A

Category	Score[1]	Planning Level Improvement Costs[2]
Cleanliness and Coatings	3.8	$ 4,000
Material Deterioration	3.8	$ 221,000
Structural Performance - Static	5.0	$ -
Structural Performance - Seismic	5.0	
Water Quality / Sanitary	3.5	$ 258,000
Safety	3.8	$ 141,000
Operations & Maintenance	4.4	$ 114,000
Obsolescence	5.0	$ -
Overall	**4.5**	**$ 740,000**

Current max operating level:
15.5 ft

Updated max operating level, no structural repairs:
15.5 ft

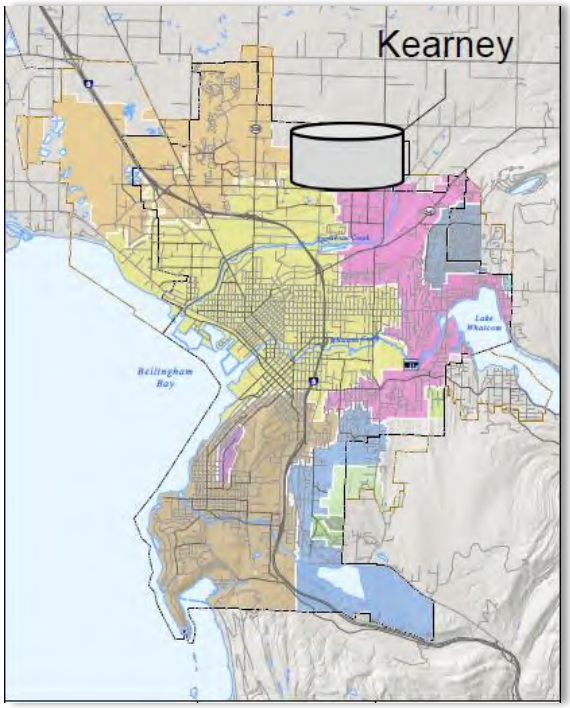
[1] Scoring (1-5, Low to High)
[2] Includes 30% contingency, 8.7% tax, & 35% engineering, rounded

Kearney Reservoir

Date Inspected:
March 14, 2019

Address:
465 Kearney Street
Bellingham, WA 98226





Reservoir Details	
Zone Served	276 North
Storage Volume	2.5 MG
Type	Prestressed Concrete
Year Constructed	2006
Dimensions	130' dia, 27' tall
Inlet	20"
Outlet	30"
Overflow	N/A
CP System	N/A

Category	Score[1]	Planning Level Improvement Costs[2]
Cleanliness and Coatings	4.6	$ 6,000
Material Deterioration	4.5	$ 2,000
Structural Performance - Static	4.4	$ -
Structural Performance - Seismic	5.0	
Water Quality / Sanitary	4.4	$ 6,000
Safety	4.5	$ 15,000
Operations & Maintenance	4.3	$ 177,000
Obsolescence	5.0	$ -
Overall	**4.6**	**$ 210,000**

Current max operating level:
22 ft

Updated max operating level, no structural repairs:
22 ft

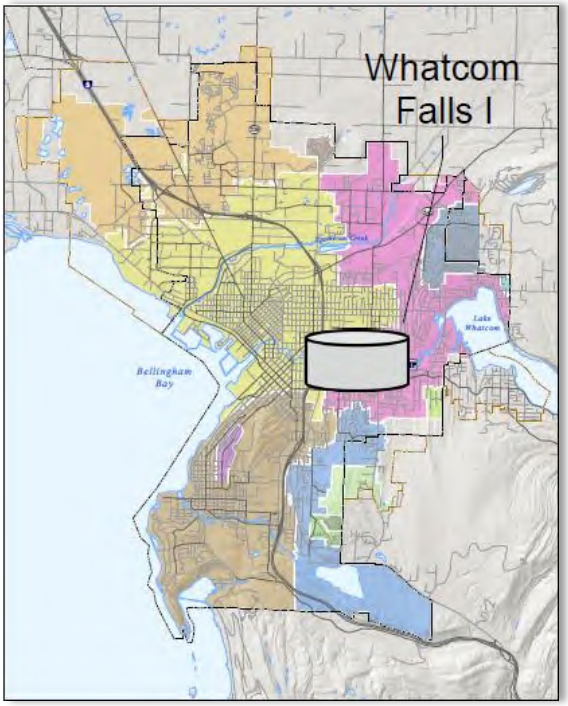
[1] Scoring (1-5, Low to High)
[2] Includes 30% contingency, 8.7% tax, & 35% engineering, rounded

Whatcom Falls II Reservoir



Date Inspected: June 12, 2019
November 30, 2019

Address:
3201 Arbor Street
Bellingham, WA 98229



Reservoir Details	
Zone Served	276 North
Storage Volume	15.6 MG
Type	Reinforced concrete
Year Constructed	1993
Dimensions	350’ dia, 23’ tall
Inlet	72”
Outlet	60”
Overflow	N/A
CP System	Constant voltage

Category	Score[1]	Planning Level Improvement Costs[2]
Cleanliness and Coatings	3.6	$ 109,000
Material Deterioration	4.0	$ 31,000
Structural Performance - Static	4.3	$ 286,000
Structural Performance - Seismic	4.3	
Water Quality / Sanitary	4.4	$ 4,000
Safety	4.5	$ 92,000
Operations & Maintenance	3.8	$ 322,000
Obsolescence	4.3	$ -
Overall	**4.2**	**$ 840,000**

Current max operating level:
21 ft

Updated max operating level, no structural repairs:
21 ft

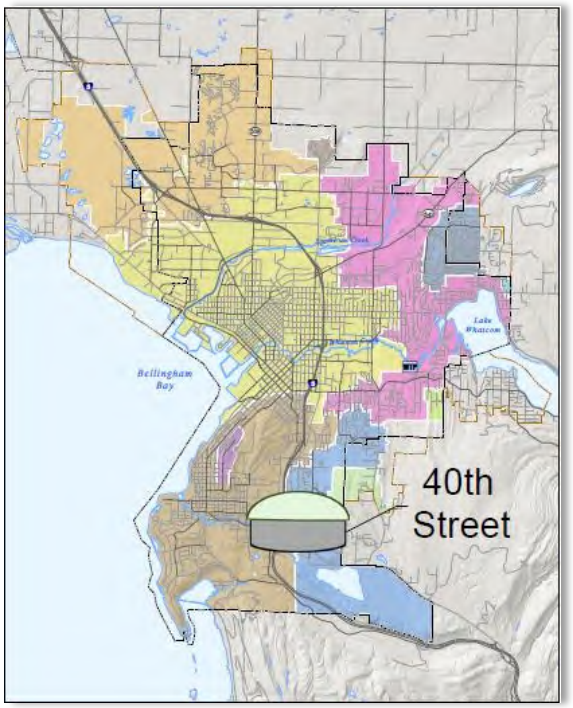
[1] Scoring (1-5, Low to High)
[2] Includes 30% contingency, 8.7% tax, & 35% engineering, rounded

40th Street Reservoir



Date Inspected:
April 30, 2019

Address:
1399 40th Street
Bellingham, WA 98229



Reservoir Details	
Zone Served	696 Padden Yew
Storage Volume	0.5 MG
Type	Reinforced concrete
Year Constructed	1958
Dimensions	60’ dia, 22’-5” tall
Inlet	10”
Outlet	10” combined w/ inlet/drain
Overflow	6” at 696’ (26’-8” Abv floor)
CP System	N/A

Category	Score[1]	Planning Level Improvement Costs[2]
Cleanliness and Coatings	4.4	$ 15,000
Material Deterioration	3.9	$ 40,000
Structural Performance - Static	4.0	$ 691,000 min -
Structural Performance - Seismic	3.2	$1,463,000 max
Water Quality / Sanitary	3.9	$ 8,000
Safety	3.0	$ 153,000
Operations & Maintenance	4.1	$ 57,000
Obsolescence	3.0	$ -
Overall	**3.6**	**$ 960,000 min – $1,700,000 max**

Current max operating level:
23 ft

Updated max operating level, no structural repairs:
16 ft

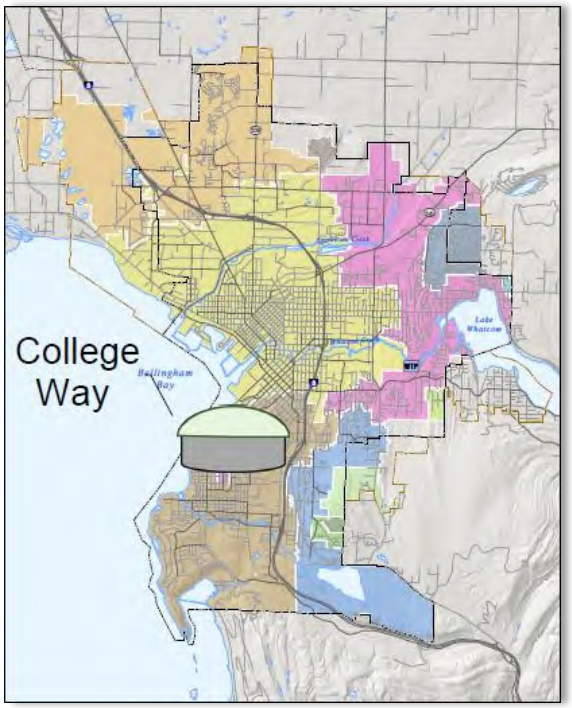
[1] Scoring (1-5, Low to High)
[2] Includes 30% contingency, 8.7% tax, & 35% engineering, rounded

College Way Reservoir



Date Inspected:
March 14, 2019

Address:
231 Highland Drive
Bellingham, WA 98225



Reservoir Details	
Zone Served	457 South
Storage Volume	0.5 MG
Type	Reinforced concrete
Year Constructed	1968
Dimensions	64’ dia, 19’-6” tall
Inlet	10”
Outlet	16” to College Way Pump Station
Overflow	6” at 457’ (23’-6” Abv floor)
CP System	N/A

Category	Score[1]	Planning Level Improvement Costs[2]
Cleanliness and Coatings	3.8	$ 15,000
Material Deterioration	3.7	$ 6,000
Structural Performance - Static	4.1	$ 692,000
Structural Performance - Seismic	3.7	
Water Quality / Sanitary	4.5	$ 183,000
Safety	3.3	$ 156,000
Operations & Maintenance	4.1	$ 71,000
Obsolescence	5.0	$ -
Overall	**3.9**	**$1,100,000**

[1] Scoring (1-5, Low to High)
[2] Includes 30% contingency, 8.7% tax, & 35% engineering, rounded

Current max operating level:
19 ft

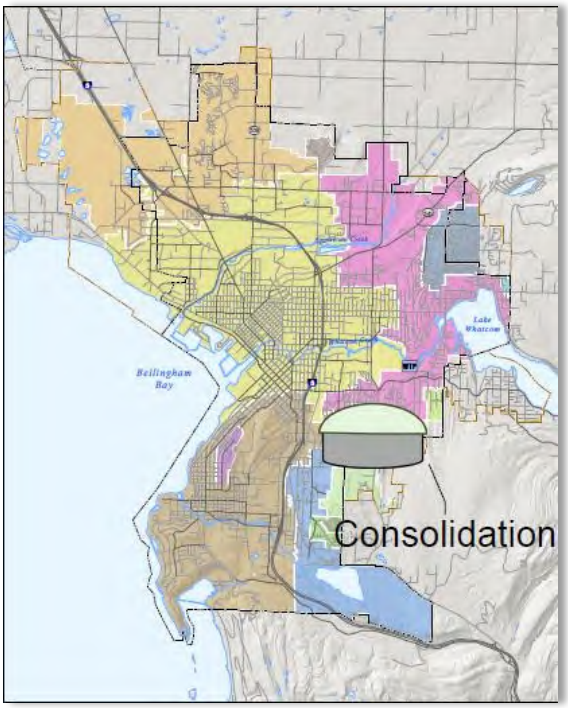
Updated max operating level, no structural repairs:
19 ft

Consolidation Reservoir



Date Inspected:
November 7, 2019

Address:
2500 Yew Street Road
Bellingham, WA 98229



Reservoir Details	
Zone Served	519 Dakin & Yew
Storage Volume	0.5 MG
Type	Reinforced concrete
Year Constructed	1959
Dimensions	64’ dia, 18’-9” tall
Inlet	10”
Outlet	10” combined w/ inlet/drain
Overflow	6” at 519’ (23’ Abv floor)
CP System	N/A

Category	Score[1]	Planning Level Improvement Costs[2]
Cleanliness and Coatings	2.9	$ 10,000
Material Deterioration	2.6	$ 296,000
Structural Performance - Static Structural Performance - Seismic	4.1 3.0	$ 647,000
Water Quality / Sanitary	3.6	$ 8,000
Safety	4.0	$ 71,000
Operations & Maintenance	3.6	$ 86,000
Obsolescence	1.0	$ -
Overall	**3.3**	**$1,100,000**

[1] Scoring (1-5, Low to High)
[2] Includes 30% contingency, 8.7% tax, & 35% engineering, rounded

Current max operating level:
19.5 ft

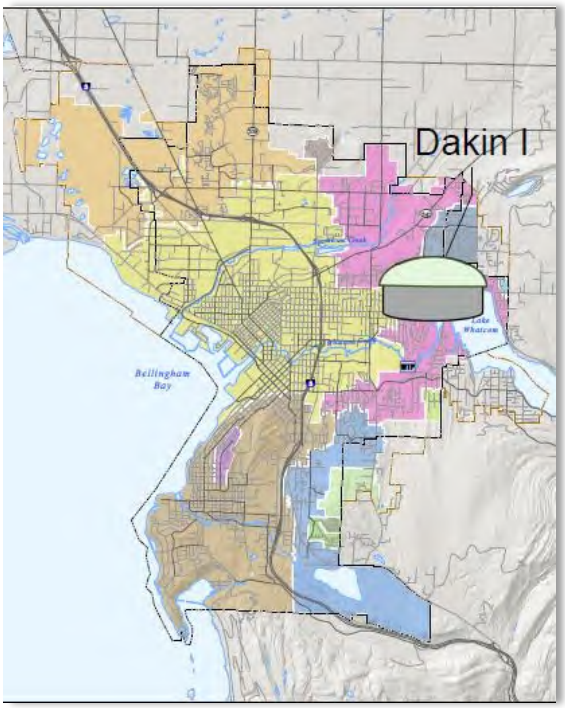
Updated max operating level, no structural repairs:
19.5 ft

Dakin I Reservoir



Date Inspected:
April 8, 2019

Address:
3819 Balsam Lane
Bellingham, WA 98226



Reservoir Details	
Zone Served	519 Dakin & Yew
Storage Volume	0.5 MG
Type	Reinforced concrete
Year Constructed	1987
Dimensions	66'-8" dia, 17'-8" tall
Inlet	10"
Outlet	10" combined w/ inlet/drain
Overflow	6" at 519' (21'-11" Abv floor)
CP System	N/A

Category	Score[1]	Planning Level Improvement Costs[2]
Cleanliness and Coatings	4.1	$ 17,000
Material Deterioration	4.2	$ 2,000
Structural Performance - Static	4.1	$ 692,000
Structural Performance - Seismic	3.3	
Water Quality / Sanitary	4.1	$ 221,000
Safety	4.0	$ 118,000
Operations & Maintenance	4.2	$ 25,000
Obsolescence	1.0	$ -
Overall	**3.7**	**$1,100,000**

Current max operating level:
17 ft

Updated max operating level, no structural repairs:
17 ft

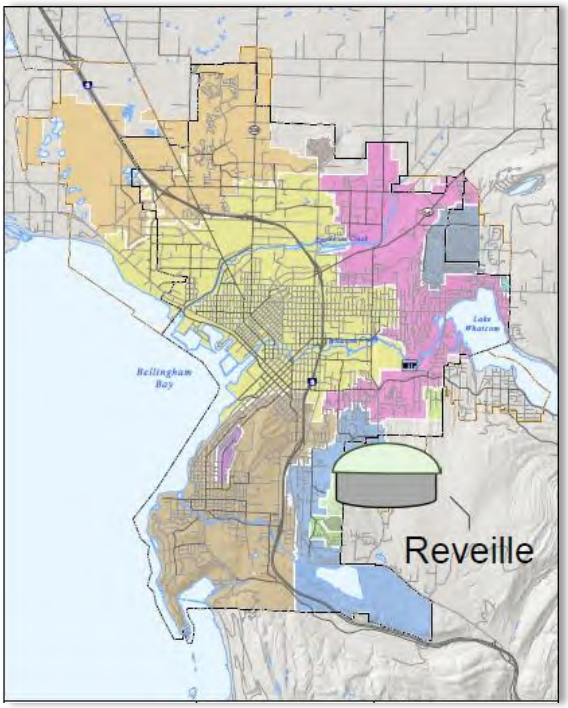
[1] Scoring (1-5, Low to High)
[2] Includes 30% contingency, 8.7% tax, & 35% engineering, rounded

Reveille Reservoir



Date Inspected:
May 21, 2019

Address:
2400 Yew Street Road
Bellingham, WA 98225



Reservoir Details	
Zone Served	696 Padden Yew
Storage Volume	0.3 MG
Type	Reinforced concrete
Year Constructed	1958
Dimensions	50’ dia, 19’-3” tall
Inlet	10”
Outlet	Combined w/ inlet/drain
Overflow	6” at 696’ (20’ Abv floor)
CP System	N/A

Category	Score[1]	Planning Level Improvement Costs[2]
Cleanliness and Coatings	4.4	$ 4,000
Material Deterioration	3.9	$ 198,000
Structural Performance - Static Structural Performance - Seismic	4.1 3.3	$ 610,000
Water Quality / Sanitary	3.8	$ 259,000
Safety	2.3	$ 122,000
Operations & Maintenance	3.8	$ 65,000
Obsolescence	5.0	$ -
Overall	**3.7**	**$1,300,000**

Current max operating level:
19 ft

Updated max operating level, no structural repairs:
19 ft

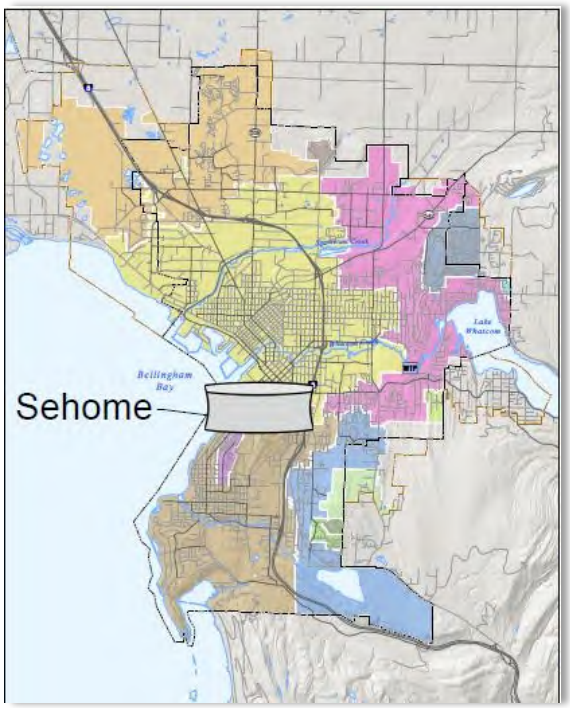
[1] Scoring (1-5, Low to High)
[2] Includes 30% contingency, 8.7% tax, & 35% engineering, rounded

Sehome Reservoir

Date Inspected:
January 24, 2019

Address:
600 25th Street
Bellingham, WA 98225





Reservoir Details	
Zone Served	457 South
Storage Volume	0.7 MG
Type	Reinforced concrete
Year Constructed	1920
Dimensions	100x73' rectangle, 16' tall
Inlet	12"
Outlet	12" combined w/ inlet
Overflow	6" at 457' (14' Abv floor)
CP System	N/A

Category	Score[1]	Planning Level Improvement Costs[2]
Cleanliness and Coatings	2.9	$ -
Material Deterioration	3.4	$ -
Structural Performance - Static	3.3	$ -
Structural Performance - Seismic	1.7	
Water Quality / Sanitary	1.6	$ -
Safety	4.5	$ -
Operations & Maintenance	2.9	$ -
Obsolescence	1.0	$ -
Overall	**2.6**	$3,400,000†

Current max operating level:
13 ft

Updated max operating level, no structural repairs:
13 ft

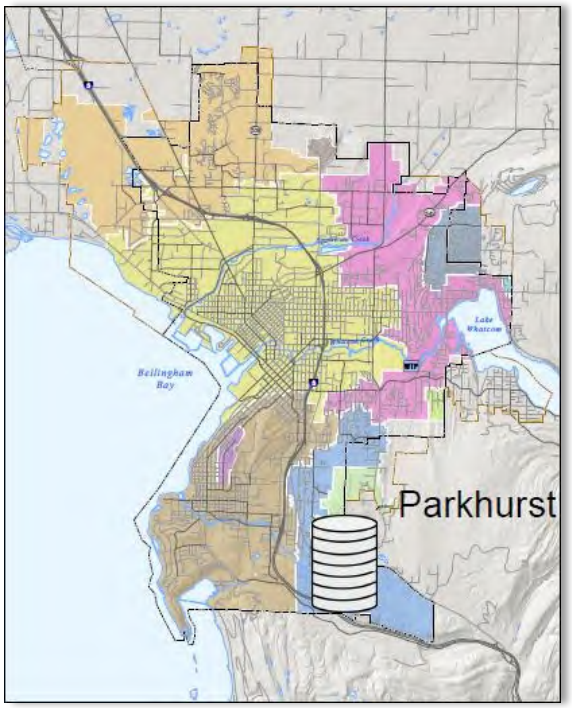
[1] Scoring (1-5, Low to High)
[2] Includes 30% contingency, 8.7% tax, & 35% engineering, rounded
†New reservoir recommended

Parkhurst Standpipe



Date Inspected:
May 21, 2019

Address:
4329 Samish Crest Drive
Bellingham, WA 98229



Reservoir Details	
Zone Served	873 Governor Road
Storage Volume	0.185 MG
Type	Reinforced concrete
Year Constructed	1997
Dimensions	30’ dia, 35’ tall
Inlet	6”
Outlet	10” w/ anti-vortex device
Overflow	6” at 873’ (34’-6” Abv floor)
CP System	N/A

Category	Score[1]	Planning Level Improvement Costs[2]
Cleanliness and Coatings	4.4	$ 120,000
Material Deterioration	3.8	$ 11,000
Structural Performance - Static	4.8	$ -
Structural Performance - Seismic	4.0	
Water Quality / Sanitary	4.4	$ 4,000
Safety	2.5	$ 149,000
Operations & Maintenance	4.0	$ 46,000
Obsolescence	5.0	$ -
Overall	**4.1**	**$ 330,000**

Current max operating level:
24 ft

Updated max operating level, no structural repairs:
24 ft

[1] Scoring (1-5, Low to High)
[2] Includes 30% contingency, 8.7% tax, & 35% engineering, rounded

Section 1

Introduction

1.1 Authorization and Objective

In December 2018, Murraysmith was authorized by The City of Bellingham (City) to conduct a thorough condition assessment of 13 storage reservoirs. The objectives of this condition assessment are to:

- perform site visits to each reservoir,
- establish a detailed condition scoring system to assess the conditions of each reservoir, determining deficiencies
- Outline recommended improvements to resolve deficiencies

1.2 Background

The City's water system is comprised of an 11-million gallons per day (MGD) water treatment plant (WTP), 13 water holding structures, and nine pump stations. Water is sourced from the Middle Fork of the Nooksack River and Lake Whatcom. Total storage capacity is 28.43 million gallons (MG) (CH2MHill 2009). A map of the City's system is provided in Figure 1-1 in the end of this section.

The City wishes to assess the condition of reservoirs, determine necessary repairs/replacements, develop bid specification documents, and oversee upgrades. This project has following phases:

- Phase 1: Condition Assessments and Structural Evaluations
- Phase 2: Development of Bid Documents
- Phase 3: Construction Support Services

This report includes the findings and conclusions from Phase 1. A description of the 13 reservoirs that were assessed is provided in Table 1-1.

1.3 Project Team and approach

To evaluate the condition of each reservoir, Murraysmith gathered a team of technical experts to work with City staff. The consultant team included:

- Murraysmith - General interior and exterior reservoir condition; valving, piping, and appurtenance evaluation; and project management
- Geoengineers - Geotechnical investigations, conducted on separate site visits

- Northwest Corrosion Engineering (NWC) - Coating systems, corrosion evaluations, cathodic protection systems
- Peterson Structural Engineers (PSE) - Structural and seismic evaluations and assessments

Table 1-1: City of Bellingham reservoirs Inspected and assessed by Murraysmith

Reservoir Name	Year Built	Capacity (MG)	Construction	Configuration	Dimensions
Marietta	1969	3.0	Welded Steel	Circular; Above-grade	Diameter: 100 ft Spill Height: 50 ft
Padden	1967	0.5	Welded Steel	Circular; Above-grade	Diameter: 59 ft Spill Height: 25 ft
Whatcom Falls I	1984	4.0	Welded Steel	Circular; Above-grade	Diameter: 201 ft Spill Height: N/A
Dakin II	1990	0.5	Prestressed Concrete	Circular; Partially buried	Diameter: 68 ft Spill Height: 18.5 ft
Kearney	2006	2.5	Prestressed Concrete	Circular; Partially buried	Diameter: 130 ft Spill Height: N/A ft
Whatcom Falls II	1993	15.6	Prestressed Concrete	Circular; Partially buried	Diameter: 350 ft Spill Height: N/A
40th Street	1958	0.5	Reinforced Concrete	Circular; Partially buried	Diameter: 60 ft Spill Height: 26.7 ft
College Way	1968	0.5	Reinforced Concrete	Circular; Mostly Buried	Diameter: 64 ft Spill Height: 23.5 ft
Consolidation	1959	0.5	Reinforced Concrete	Circular; Mostly buried	Diameter: 64 ft Spill Height: 23 ft
Dakin I	1987	0.5	Reinforced Concrete	Circular; Mostly buried	Diameter: 66.7 ft Spill Height: 21.9 ft
Reveille	1958	0.3	Reinforced Concrete	Circular; Mostly buried	Diameter: 50 ft Spill Height: 20 ft
Sehome	1920	0.7	Reinforced Concrete	Football-shaped; Partially buried	L*W: 107*73 ft Spill Height: 14 ft
Parkhurst	1997	0.185	Reinforced Concrete	Circular; Partially buried	Diameter: 30 ft Spill Height: 34.5 ft

The project team conducted field inspections of each reservoir, taking detailed notes and photographs to document the condition of each reservoir. Inspections included drained inspection of all reservoirs (except Whatcom falls II) and floating inspections of the Padden and the Whatcom Falls I and II reservoirs. During these inspections, all aspects of the reservoirs were examined in detail with each member of the team focusing on their area of experience.

To objectively assess the condition of each reservoir, Murraysmith created a Condition Assessment Score Matrix (Score Matrix). The Score Matrix provides a numerical system and associated criteria to rate the condition of each tank component which can be used in future criticality modeling, condition comparisons over time and other analyses. Score definitions were developed with input from NWC and PSE. The score sheet and definitions were presented to the City for refinement.

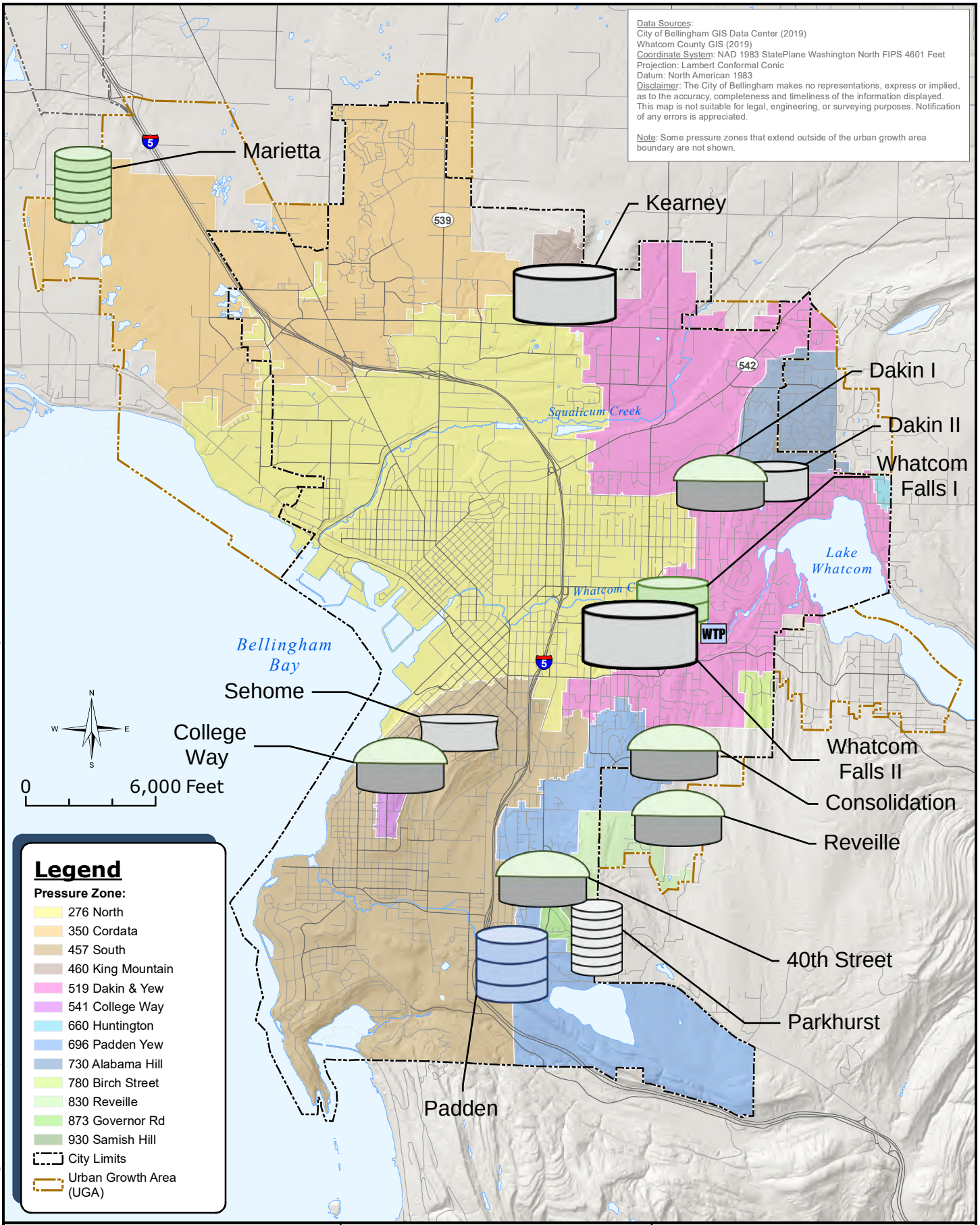
The finalized score sheet was then used to score and establish a baseline condition of each reservoir.

1.4 Technical Report Format

This report is organized into 16 sections. The Introduction, Section 1, provides background information for the report and a general introduction to the project team, project approach, and report format. Section 2 outlines the procedure for inspection and assessment of the reservoirs. Sections 3 to 15 are reports for each tank, containing general overviews of the reservoirs, observations from field observations, condition assessments, and lists of recommended improvements with planning level cost estimates. Specifically, Sections 3 to 5 are the steel tanks, Sections 6 to 8 are the prestressed concrete tanks (PSC), Sections 9 to 13 are the Bellingham typical reinforced domed reinforced concrete tanks (Domed RC), and Sections 14 and 15 are the other reinforced concrete tanks. Section 16 is the conclusion.

- Section 1 – Introduction
- Section 2 – Inspection and Assessment Methods
- Section 3 – (Steel) Marietta
- Section 4 – (Steel) Padden
- Section 5 – (Steel) Whatcom Falls I (Forthcoming)
- Section 6 – (PSC) Dakin II
- Section 7 – (PSC) Kearney
- Section 8 – (PSC) Whatcom Falls II (Forthcoming)
- Section 9 – (Domed RC) 40th Street
- Section 10 – (Domed RC) College Way
- Section 11 – (Domed RC) Consolidation (Forthcoming)
- Section 12 – (Domed RC) Dakin I
- Section 13 – (Domed RC) Reveille
- Section 14 – (RC) Sehome
- Section 15 – (RC) Parkhurst
- Section 16 – Conclusion
- Works Cited

Each reservoir has its own appendix, which includes the geotechnical report, coatings/corrosion report and cathodic protection checkout report (if applicable), structural report with inspection notes, general inspection notes, and the full Score Matrix. The general inspection notes do not include photos, as these photos are included in the body of this report and subconsultant reports.



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murraysmith

CITY OF BELLINGHAM WASHINGTON

City of Bellingham Reservoir Inspections

Figure 1-1 Pressure Zones and Reservoirs

Section 2

Inspection and Assessment Methods

2.1 Introduction

A standard methodology was developed to inspect and assess each reservoir. The team analyzed provided drawings and materials and then conducted field investigations. Assessments of observations and additional coating, structural, and vent assessments were performed. The Score Matrix was developed to uniformly assess each reservoir and make comparisons. Based on the assessments, codes, and best practices, recommended improvements with associated costs were developed for each reservoir.

2.2 Field Inspection Methods

2.2.1 Geotechnical Investigations

After preliminary site visits were conducted to determine boring locations at each of the reservoir sites, a geotechnical investigation was conducted. Subsurface soil and groundwater explorations were performed at each site by drilling one boring to refusal on bedrock or 100 feet, whichever was shallower. The material encountered was systematically logged and samples were taken for laboratory testing to obtain physical and engineering characteristics.

Based on the geotechnical investigations, the following were attributed to each site:

1. Foundation Conditions - the general type of soils the structure is founded on
2. General Seismicity – All reservoirs sites are located within the Puget Sound area, which is known to be seismically active.
3. Surface Fault Rupture – an offset in the ground resulting from a fault rupture that extends to the earth's surface. This is based on United States Geological Survey (USGS) fault line mapping.
4. Liquefaction Potential – a phenomenon where soils experience a rapid loss of internal strength because of strong ground shaking. Ground settlement, lateral spreading and/or sand boils may result from soil liquefaction. Structures supported on liquefied soils could suffer foundation settlement or lateral movement that could be severely damaging to the structures. Conditions favorable to liquefaction occur in loose to medium dense, clean to moderately silty sand that is below the groundwater level. The estimated liquefaction induced subsidence is determined using the soil type and groundwater level.

5. Seismic design criteria – information about the maximum considered earthquake (MCE) that is used in the design and evaluation of structures. The MCE is a seismic event that has a 2 percent probability of being exceeded in a 50-year timeframe. Another way to think about this event is that, on average, an event of at least this magnitude occurs once every 2,500 years. This estimate is based on seismic data, mapped faults, and geologists' projections. The parameters are based on American Water Works Association (AWWA) and American Society of Civil Engineers (ASCE) 7-10 design criteria. The seismic parameters for each reservoir are used in the structural evaluations.

6. Allowable bearing pressure – a measurement of the amount of force per area, in pounds per square foot (psf), that the soil is expected to be able to support. This should be greater than the pressure exerted by the reservoir structure's foundation and water held within it. A value is given for the long term but can be increased by up to one-third for wind or seismic loads.

7. Lateral Resistance and Design Parameters – (concrete tanks) values used to determine the effect of soils on the buried foundation and/or walls of the reservoir. These values are not discussed in this report but are included in the appendices.

8. Global Stability – risk of slope failure or landslides in the vicinity of the reservoir.

2.2.2 Reservoir Inspections

Except for Whatcom Falls II, each reservoir was inspected in a drained condition. Steel reservoirs were also inspected in a partially full condition to investigate roofs and their supports. The visual conditions of structures, components, appurtenances, valving, and piping were noted in the field. Where relevant, the material thicknesses, coating thicknesses, and cracking or corrosion extents were carefully measured. Photographs were taken and conversations were also conducted with City staff to aid in identifying operational and water quality issues. The inspection summaries are broken into exterior, interior, and piping and valving sections.

The exterior inspection summaries include the site and security, exterior walls, foundation, roof, and appurtenances. The inspection team walked around the site, examining nearby vegetation and site drainage conditions. The walls, foundation, and associated appurtenances were inspected from the ground. The roof and associated appurtenances were examined from the roofs. Exterior appurtenances include side hatches, ladders, railings, roof hatches, vents, and vaults. Reservoir vents and access hatches were visually inspected to identify potential water quality concerns such as sizes and condition of screens and gaskets, condition and location of locks and alarms, and any evidence of ponding which can cause contamination or other reservoir deficiencies.

The interior inspection summaries include the walls, floor, roof, and appurtenances. The team accessed the interior, inspected the condition, and took measurements. The piping and valving inspection summaries includes the inlet, outlet, overflow, and drain piping. The valving was also

inspected, as was any washdown piping on site. The piping and valving were assessed from the interior, within the valve vaults, and from the exteriors where relevant/possible.

To inspect the coating systems on structures and appurtenances, a visual inspection was first conducted. Then measurements were taken of the diameter/size of blister or areas of missing coating. Measurements of dry film thickness (DFT), which indicates the amount of coating, were taken at multiple locations and carefully noted using a portable electromagnetic dry film thickness gauge (Type 2 gauge). This gauge measures the thickness of the coating between the gauge probe and the metallic substrate. A model 200 transducer was used to measure polyurea coatings on concrete structures.

A field lead check swab was used to test for the presence of lead on the exterior of steel tanks. If lead was detected, a coating sample was collected and submitted to an analytical laboratory to test for the presence of leachable lead using the Toxic Characteristic Leaching Procedure (TCLP). This test is conducted to determine if the coating material is classified as hazardous, requiring specialized handling, containment, and disposal when removed from the tank.

Steel plate thickness was measured using a General Electric model DM5E ultrasonic thickness gauge calibrated for carbon steel. When measuring steel thickness, this unit uses an echo-echo function that allows for measurement of the steel without removing the coating material.

Corrosion was inspected by observing and measuring the corrosion extent. Pitting depth (surface depressions that form in corroded metal and indicate the extent of corrosion damage) was measured with a surface gauge. The conditions of steel plates, rafters, girders, joists, columns, and appurtenances were also noted in the field. For concrete reservoirs, extent and size of cracking and general condition of concrete were noted.

2.3 Condition Assessment Score Matrix Development

The Condition Assessment Score Matrix (Score Matrix) is a tool that uniformly assesses the condition of each reservoir in the City's system. The Score Matrix provides a numerical system to rate the condition of multiple components of each reservoir. These ratings can be used in future criticality modeling, condition comparisons over time, and other analyses. The complete Score Matrices for all the City's reservoirs are included in each reservoir's appendix.

2.3.1 System/Structure Groups

Individual components of the reservoir were identified for scoring. In order to provide a comprehensive, detailed evaluation of all reservoirs, 28 reservoir system/structures were used. Not all components are applicable for each reservoir. In order to provide a higher-level understanding of the reservoir condition, individual components were grouped into System/Structure Groups. These Groups allow for efficient assessment of the condition of areas or sections of the reservoirs. The seven Groups are:

- Site/Security – includes reservoir components that keep the site secure such as fencing, intrusion alarms, and locks; site drainage and vegetation separation are also assessed.
- Walls – includes reservoir wall surface condition and structural components such as joints, rivets or welds.
- Floor/Foundation – includes reservoir foundation, interior floor, and anchoring systems for steel reservoirs or seismic cables for prestressed reservoirs.
- Roof – includes roof structure and support system, specifically roof slope, plates/concrete slabs, plate/section joints, rafters, joists, beams, columns, and knuckles.
- Appurtenances – includes non-pipe related appurtenances such as ladders, hatches, railings, vents, and landings/grating.
- Piping/Valving – includes all pipes and related appurtenances on the site, including the inlet, outlet, drain, and overflow, and washdown piping, valving and valve vaults. Checks for the presence of flexible couplings or seismic valves are conducted in this section.
- Misc. – includes cathodic protection system, level sensors, and hydraulic mixing system.

2.3.2 Assessment Categories

Each component of the reservoir is assessed and scored on the following seven categories, with associated subcategories in parentheses:

- Cleanliness and Coatings
- Material Deterioration (Concrete Deterioration and Metal Corrosion)
- Structural Performance (Static and Seismic)
- Water Quality/Sanitary
- Safety
- Operations and Maintenance (Site and Security, Roof Drainage, Appurtenances, Valving and Piping, Misc.)
- Obsolescence

Scores range from one (1) to five (5) and are assigned based on how well each reservoir component meets the stated criteria for that scoring category. A score of 5 implies that the component meets the criteria completely; 1 implies that the component is deficient. Not all scoring categories or subcategories are relevant for each reservoir component. If this is the case, a zero (0) is assigned to the Score Matrix and does not factor into the numerical scoring. The written explanation of numerical scores for each category is shown in Table 2-1.

Table 2-1: Condition Assessment Scoring Definitions

Criteria	5	4	3	2	1
Cleanliness and Coatings	Good condition (<1% exposed); Recently Cleaned / No growth or debris	5% loss of any coating layer or visual blistering. Spot repair defects. OR: Has organic growth or debris and will need cleaning soon	10% loss of any coating layer. Repair coating damage within 5 years. Or: Needs cleaning	20% loss of any coating layer, most likely full recoat within 5 years. May also need cleaning	> 20% coating loss, Poor Condition / Full Recoat within 3 years. May also need cleaning
Concrete Deterioration/ Corrosion	Good condition. Steel has isolated rust staining, no pitting (<1% exposed). Concrete has no visible signs of wear and cracks are limited to crazing.	Steel has rust staining and general surface corrosion between 1 and 5% of surface area; pitting depth < 5% of nominal wall thickness. Concrete has cracking is limited to a few locations and jointing is still tight. Large scale cracking is limited to crazing. Point instances of efflorescence observed.	Steel has widespread rust staining and general surface corrosion between 5 and 20% of surface area; pitting depth between 5 and 10% of nominal wall thickness. Concrete has pattern cracking at joints or along boundary indictive of operational loads in exceedance of capacity or constrained thermal movement. Efflorescence is occurring along cracks.	Steel has heavy rust staining and widespread general surface corrosion over 20% of surface area; pitting between 10 and 20% of nominal wall thickness. Concrete has significant cracking in which separation of the joint has occurred (< 1/16"), efflorescence build-up is occurring along joints and cracks, and/or delamination of concrete (incident size < 0.5ft^2) is occurring due to underlying reinforcing expansion	Steel has rust staining and general surface corrosion over 20% of surface area; pitting > 20% of nominal thickness. Concrete has major widespread cracking (> 1/16") with significant efflorescence build-up along cracks and joints, delamination of concrete surfaces (incident size >0.5 ft^2), subsidence cracks, slab and /or curling
Structural Performance	Major structural components meet the current design codes and standards, minor deficiencies noted that can be repaired during standard maintenance. No operational changes are needed to improve performance.	Design meets code but moderate deficiencies are noted repairs are more complex than can be handled by standard maintenance. Non-code compliant issues might be present but have already been corrected through operational changes (e.g. the reservoir is overstressed at the max operating level but based on the actual operating level the problems noted have been alleviated).	Design does not meet current code but no structural failure appears imminent and no structural systems require repairs (due to factors like age, damage, or corrosion). Deficiencies noted can be corrected thru minimal operational changes (e.g. an acceptable lowering of the operating level). Generally the tank is in good condition but of an older design.	Structural issues noted and 1) a failure of a structural system is anticipated or 2) any deficient members that were identified will require extensive retrofit when repair is initiated and operational changes cannot easily be implemented. Issues noted here are not likely to require the reservoir to stop operation while waiting for repair.	Failure imminent due to issues like corrosion (with significant section loss) or the anticipated design loads greatly exceed allowable structural capacity based on analysis. Operational changes cannot be implemented and retrofit is necessary. Issues noted here could require taking the reservoir offline until repair is conducted.
Water Quality/ Sanitary	Meets DOH best practices.	Meets DOH best practices, but minor maintenance or modifications recommended.	Doesn't meet DOH best practices, minor maintenance or modifications required.	Doesn't meet current DOH requirements, potential health risk.	Imminent health risks.
Safety	Meets current OSHA / WISHA requirements	Meets current OSHA / WISHA requirements but minor maintenance or modifications recommended	Doesn't meet current OSHA/WISHA requirements, but in compliance	Doesn't meet current OSHA/WISHA requirements; upgrades recommended	Doesn't Meet Current OSHA / WISHA requirements, not in compliance
Operations and Maintenance	System/Structure functions as designed. No maintenance required.	System/Structure exhibits some wear, but is fully functional. No maintenance required.	System/Structure is operational, but does not function optimally. Maintenance/ replacement recommended in the near future.	System/Structure minimally functions. Maintenance/replacement required in the near future.	System/Structure is not functioning and needs immediate maintenance/replacement.
Obsolescence	Still manufactured; parts available	(Not used)	No longer manufactured; parts available	(Not used)	No longer manufactured; no parts available

2.4 Reservoir Condition Assessment Methods

To arrive at a condition score for each component, operating information provided by the City, design and construction drawings, field measurements, observed conditions, and additional assessments were compiled. The score with a definition that best matched the component's condition was assigned. Deficiencies are compiled in this section.

2.4.1 Cleanliness and Coatings

To assess cleanliness, the timeline for cleaning is approximated based on the level of organic growth noted. The need for cleaning portion of the score can only cause the score to drop to 3 and no lower.

Coatings provide corrosion and/or leak prevention system to reservoirs or appurtenances. Coatings on steel tanks are assessed according to AWWA D102-17 "Coating Steel Water-Storage Tanks." To assess the coatings, the measured thickness was compared to specified thicknesses or common thicknesses of other high-performance coatings on similar structures. The estimated remaining life of the coating systems are provided.

2.4.2 Material Deterioration

On concrete tanks, the overall patterns of concrete cracking are amalgamated and a likely explanation of why concrete is cracking is presented. The thickness of concrete and associated deterioration was compared against design drawings.

To assess corrosion on the steel tanks, the results of the inspection were compiled. The percent of the material that exhibited corrosion was estimated, using ASTM D610 Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces (2019). Any material loss from corrosion is found in variations in steel thicknesses in the course or deviations from the as-built drawings. The observed corrosion's impact on the structure is estimated. A timeline for when the corrosion needs to be addressed is estimated.

2.4.3 Structural Performance

The Structural Performance scoring category includes two subcategories. The Static Score is the structural condition under day-to-day loads (Section 2.4.3.1). The Seismic Score is structural condition during earthquake loads (Section 2.4.3.2). These analyses differ between the various reservoir types (welded steel, prestressed concrete, and reinforced concrete).

Collected measurements were used in the development of structural calculations and to evaluate conformance to applicable codes, standards and best practices. While on site, discrepancies between the observed structures and the construction documents were identified. As-built (or

plan) details were incorporated into the analysis. Relevant seismic and soils data were taken from the geotechnical reports.

For the structural evaluation, a code analysis was conducted for each structure using the current 2015 International Building Code (Code) as amended by the State of Washington and ASCE 7-10 'Minimum Design Loads and Associated Criteria for Buildings and Other Structures'. The AWWA standards D110-13 'Wire and Strand-Wound, Circular, Prestressed Concrete Water Tanks' and AWWA D100-11 'Welded Carbon Steel Tanks for Water Storage', along with other associated reference standards were used to further improve the accuracy of the evaluation.

For the reinforced concrete tanks, the American Concrete Institute (ACI) Standards ACI 350.3-06 "Seismic Design of Liquid-Containing Concrete Structures and Commentary" and ACI 318-14 "Building Code Requirements for Structural Concrete" were used. Also, The Portland Cement Association (PCA) references "Design of Liquid-Containing Structures for Earthquake Forces", published 2002, "Circular Concrete Tanks without Prestressing", published 1993, and "Rectangular Concrete Tanks", Revised 5th Edition, published 1998, were also utilized. Because AWWA does not have a current standard for non-prestressed reinforced tanks, modern standards have been adopted from AWWA D110-13.

To assess the structural performance, material thickness, reinforcement and supports (including pre-stressing bars and seismic cables for pre-stressed reservoirs), and foundations are assessed related to the governing codes. Please note that the overflow height is recommended to be used as the maximum operating level Per AWWA D100-11 and D110-13 as maximum reported operating heights can change throughout time. If the reservoir assessed at the overflow level does not pass requirements, the City's reported maximum operating level is also assessed for reference.

2.4.3.1 Static Analysis

The static analysis consists of evaluating non-seismic related forces on the reservoir structure and foundation. For all tanks, total weight of the reservoir, roof loads, and water held within is determined and applied to the foundation footprint. This pressure is compared to the allowable bearing pressure that was determined in the geotechnical reports.

2.4.3.1.1 Steel Tanks

For steel tanks in the system, the roof framing is assessed to determine if it can withstand self-weight, roof live load (from people or equipment during construction or renovation), and snow load. Structures include the columns, girders (girders support the rafter beams on the foundation), rafters, and roof plates. Based on the operating or overflow levels, the reservoir shell is assessed to determine if the steel is thick enough to withstand the forces of the water held within it.

2.4.3.1.2 Prestressed Concrete

First, the roof slab is assessed for thickness over the span length and reinforcement. If a dome, the thickness and reinforcing are assessed. During temperature fluctuations and solar gain, the roof expands and contracts radially which results in stress on the roof and/or walls. In modern prestressed reservoirs, a feature called a shear can allows this differential movement to occur at the roof-to-wall interface without damaging the reservoir. These features are checked to ensure they meet design requirements.

Based on provided plans and field measurements, the size and spacing of pre-stressing wire and strand wrap are assessed to determine if they are adequate to support the structure, roof with loads, and water held within it. Columns are assessed to determine if they can support forces induced from the roof. A roof with a curb must be able to support the live load and any water or materials that could collect on it.

2.4.3.1.3 Reinforced Concrete Dome Roof

The domed roofs are assessed on modern requirements for prestressed concrete dome roofs, outlined in D110-13. For reinforced concrete reservoirs with clear span concrete domes, the roof is assessed to determine if it meets design criteria for rise-to-span, thickness versus buckling, and edge reinforcing. The roof-to-wall interface is assessed to see if it can account for any hydrostatic forces acting on it and if it can handle differential thermal movement between the roof and wall. This can be accomplished with bearing pads or brackets. Wall reinforcement is also assessed to find if it can handle the loads from water held within the reservoir.

2.4.3.1.4 Other Concrete Structures

The Sehome Reservoir and Parkhurst Standpipe are assessed in a similar method to Section 2.4.3.1.2. Without any known reinforcing on Sehome, the walls are assessed assuming no reinforcement. The columns at Sehome are assessed in a manner similar to Sections 2.4.3.1.2.

2.4.3.2 Seismic Analysis

A seismic load analysis was also conducted. The Code currently requires structures be able to withstand the seismic event that has a 2 percent chance of occurring in 50 years at the site. For each reservoir, based on the maximum operating level (and overflow height), diameter/shape, and seismic design parameters, a different slosh wave will be induced. The slosh and its effects potential on reservoir roofs and foundations are much better understood today than when many of the tanks were designed and built.

The freeboard height is the distance between the overflow and base of the rafters or bottom of the roof (where rafters are not present). If adequate freeboard is not present, the slosh wave will be constrained by roof, which would stress the roof and support system. Significant damage may occur. The analysis determines if the current freeboard is suitable, or if the slosh wave will cause

the roof to exceed the load capacity, overstressing it. As stated above, if the reservoir fails requirements at the overflow level, the reported maximum operating level is also assessed. The slosh wave may also cause the foundation to be overburdened, resulting in possible tipping.

The columns, if present, are assessed based on if they can withstand the deflection induced by the design seismic event.

Many of the reservoirs have valve vaults the pipes run though. Pipes must also be able withstand movement and differential settlement between the reservoir structure and vaults that may occur in the design seismic event. Reservoirs with an attached vault are also assessed to determine if the attachment is suitable to limit differential movement and impact during aseismic event. The pipes should be protected from being crushed during the event as well.

2.4.3.2.1 Steel Tanks

For the steel tanks, the reservoir shell was assessed to determine if it can withstand forces acting upon them induced by the design seismic event. The impact of the slosh wave may cause damage the roof and rafters and dislodge roof plates. Overturning and anchorage were also assessed. The slosh wave may induce a soil bearing pressure that exceeds the temporarily allowable bearing pressure, which indicates the structure would overturn.

Steel reservoirs may be anchored with straps, but current ACI standards require them to be ductile relative to their connection. In other words, the anchor straps should be somewhat flexible with a system such as anchor chairs. During a seismic event, improper anchors can negatively impact the foundation by being pushed into concrete (breakout) or being pulled out. Alternatively, the welded attachment may rupture causing damage to the steel shell.

2.4.3.2.2 Prestressed Concrete

For prestressed concrete reservoirs, the seismic joints and strand wrap are assessed as to if they meet code requirements. These reservoirs are also checked to see if the roof-to-wall interface accounts for the different movement of the roof and walls that is projected to occur during the seismic event. Anchorage of the concrete reservoirs is accomplished through the seismic joint connection between the wall and floor and is assessed as part of the wall system.

2.4.3.2.3 Reinforced Concrete Dome Roof

The reservoirs are assessed to determine if the wall reinforcement is suitable for the design seismic event. The roof-to-wall connection is assessed to determine if it can withstand the seismic event.

2.4.3.2.4 Other Concrete Structures

These reservoirs are assessed to determine if the walls are adequately reinforced against seismic events. The roof to wall connection is assessed to determine if it can withstand the seismic event.

2.4.4 Water Quality/Sanitary

The Water Quality/Sanitary scoring category relates to conditions of the reservoir that may affect hygiene and health, and therefore, its scores are based on how well the component meets Washington State Department of Health (DOH) best practice recommendations. The structure itself is also assessed for if it likely to cause water quality issues, such as a leaky roof that has organic material accumulation.

The ability of the facility to promote high water quality is based on current recommendations from the DOH, the AWWA, and the United States Environmental Protection Agency (EPA). Problems that can affect this section are inlet/outlet/drain piping configurations, and screens or hatches that can be conduits for contamination.

The piping should be configured to facilitate adequate mixing within the reservoir. Inlet pipes can be higher in the reservoir or on opposite sides or hydraulic mixing systems can be implemented to facilitate adequate mixing.

Screens need to be present on openings to the reservoir, such as the vent(s). Screens must be capable of preventing bird and insect intrusion into the reservoirs. A #24-mesh noncorrodible screen is recommended by DOH (2016) and EPA (2014). The DOH also recommends backing the #24-mesh with a 4-mesh screen for added protection.

Drain piping must follow recommendations from The AWWA Water System Design Manual (2019), which states "Reservoir designs must include drain facilities that drain to daylight or an approved alternative that is adequate to prevent cross-connection contamination," per Washington Administrative Code (WAC) 246-290-235(1) The must be an "air gap or other feature to prevent cross contamination." A drywell may hold the drained reservoir water if it has backflow prevention. If the reservoir cannot be drained by gravity, a system such a sump pump can be used. Also, "the reservoir drain should be separate from the outlet pipe to minimize the risk of a cross connection and prevent sediment from entering the distribution system." Daylight drains should be properly screened with screens that can be removed during cleaning events (EPA 2014).

Overflow piping must follow recommendations from The AWWA Water System Design Manual (2019) as well. "Every reservoir design must include an overflow pipe with atmospheric discharge and suitable means to prevent cross-connection contamination per WAC 246-290-235(1)." Overflows should be:

1. properly screened or otherwise secured (with a screen or duckbill valve),
2. easy to observe and maintain… extending "to an elevation of 12 to 24 inches above ground level," and
3. protected against cross connections

Air gaps are also assessed in this section, which prevent backups from sanitary and storm sewers from entering the reservoirs. To be an approved air gap, the DOH (2011) requires a minimum

vertical gap between the drain or overflow pipe outlet and the overflow rim of the receiving storm or sanitary sewer. For free standing pipes, this vertical distance must be at least twice the diameter of the overflow/drain pipe. The vertical gap must at least three times the diameter of the overflow/drain pipe if there is a wall within a distance equal to three times the diameter of the pipe. This gap minimum is also required if a corner is within four times the diameter of the pipe.

Hatches present a possible conduit for reservoir contamination. The DOH outlines good and poor roof hatch design, as well as high maintenance designs (2017). A good hatch design is "A cast-in-place hatch frame is framed at least 4 [inches] above the roof and has a continuous neoprene seal along all four sides." These hatches have watertight covers that overlap the frame. A good hatch design for steel tanks is a bolted access hatch lid with rubber seals or gaskets. One example of a high maintenance design is an access hatch where the drainage from the lid collects in a gutter. Another example is a thin steel frame that frequently caused seal issues with the lid.

Vent design is also considered to reduce risk of water quality issues (DOH 2019). Other than having proper screens, vents should have downturned openings that have a venting surface at least 24 inches from the horizontal surface below (EPA 2016 And DOH 2016). Mushroom or hooded vents on taller reservoirs should be made from noncorrodible steel, have downward or sideways openings, and have a cover that extends at least down to the mesh. The EPA also requires the bottom of the mesh be at least 8 inches from the horizontal surface below it. Vents should be easy to observe, access, and maintain as well (DOH 2019).

2.4.5 Safety

The Safety Score is based on how well the reservoir component meets current occupational safety and health requirements. While the Occupational Safety and Health Administration (OSHA) governs workplace safety in the United States, Washington is one of twenty-two states that have a state plan in place that cover both private sector and state and locate government workers. The Washington Industrial Safety and Health Act (WISHA) gives power to the Division of Occupational Safety and Health (DOSH) in the Department of Labor and Industries (L&I) to govern occupation safety and health within the State. This assessment follows L&I requirements, but also checks to make sure requirements are met in OSHA standards, if they are stricter.

2.4.5.1 Ladder Safety

Per WAC 296-876-60065, fixed or permanent ladders that are 24 feet or taller are required to have ladder safety devices. Ladder safety devices are defined "as any device, other than a cage or well, designed to arrest the fall of a person using a fixed ladder." They are commonly referred to fall protection. Per WAC 296-876-60065, the maximum ladder length is 50 feet, or landing platforms need to be provided at a maximum interval of 50 feet.

Per WAC 296-876-60030, the maximum spacing between ladder rungs is 12 inches. These rungs are to be at least 1-inch wide on reservoir interior ladders, as they are "subject to unusually corrosive exposures," while ladders on the exterior must be at least 3/4-inch in diameter. Rungs

need to be 16 inches wide. Per WAC 296-876-60050, the ladder side railing must extend at least 42 inches above the roof.

Per the definition of a ladder safety device in the WAC, cages do not serve as fall protection for ladders higher than 24 feet. However, it is unclear in the WAC when cages need to be upgraded. Instead, we default to OSHA requirements; 29 CFR 1910.28(b)(9)(i)(D) states that ladders installed after November 19, 2018 cannot use cage systems for fall protection. Further, it states that for ladders installed before this date, the cage systems alone as fall protection are being phased out. The fall protection on all ladders will need to be upgraded by 2036 at the latest. If ladder-related rehabilitation is occurring, the fall protection must be upgraded at that time.

2.4.5.2 Roof Safety

Per WAC 296-155-246, falls of 10 feet or more require a Fall Protection Work Plan. Per WAC 296-155-24609, Fall protection is required at 4 feet or more. "You must ensure that the appropriate fall protection system is provided, installed, and implemented according to the requirements in this part when employees are exposed to fall hazards of 4 feet or more to the ground or lower level when on a walking/working surface." A standard guardrail system that meets requirements of WAC 296-155-24615(2) has a height of 42 inches (+/- 3 inches), has a mid-rail, and has a toe board that is 3.5 inches high.

Fall protection requirements are loosened for some professions. On concrete and masonry work, fall protection is required for falls above 6 feet. For roofing work, it is required at 10 feet. Per WAC 296-155-24603, "Roofing work means the hoisting, storage, application, and removal of roofing materials and equipment, including related insulation, sheet metal, and vapor barrier work, but not including the construction of the roof deck."

A "steep pitched roof" is one "with a pitch greater than 4 in 12." A low-pitched roof has a slope less than or equal to 4 in 12. This ratio corresponds to a slope of 18.4 degrees.

For low sloped roofs with falls of 4 feet or more, several options are available:

- Fall restraint system;
- Fall arrest system;
- Positioning device system;
- Safety monitor and warning line system; or
- Safety watch system.

For steep pitched roofs with falls of 4 feet or more, the following options are available:

- Fall restraint system;
- Fall arrest system;
- Positioning device system;

Additionally, "Employees exposed to falls of 4 feet or more while working on a hazardous slope must use personal fall restraint systems or positioning device systems." Per WAC 296-155-24603,

a hazardous slope is defined as "a slope where normal footing cannot be maintained without the use of devices due to the pitch of the surface, weather conditions, or surface material." For our analysis, we assume the definition of a steep roof applies reservoir roofs.

For reference, the following definitions are provided, per WAC 296-155-24603:

- Fall restraint system: A system in which all necessary components function together to restrain/prevent an employee from falling to a lower level. Types of fall restraint systems include standard guardrail systems, personal fall restraint systems, warning line systems, or a warning line system and safety monitor.
- Fall arrest system: A fall protection system that will arrest a fall from elevation. Fall arrest systems include personal fall arrest systems that are worn by the user, catch platforms, and safety nets.
- Positioning device system: A full body harness or positioning harness that is worn by an employee, and is rigged to allow an employee to be supported on an elevated vertical or inclined surface, such as a wall, pole or column and work with both hands free from the body support.
- Safety monitoring system: A type of fall restraint system in which a competent person whose only job responsibility is to recognize and warn employees of their proximity to fall hazards when working between the warning line and the unprotected sides and edges, including the leading edge of a low pitch roof or other walking/working surface.
- Safety watch system: A fall protection system as described in WAC 296-155-24615(6), in which a competent person monitors one worker who is engaged in repair work or servicing equipment on low pitch roofs only.

2.4.5.3 Hatch Safety

Per WAC 296-155-24609, "you must guard floor openings by one of the following fall restraint systems:

- A standard guardrail system…
- A warning line system…
- If it becomes necessary to remove the cover, the guardrail system, or the warning line system, then an employee must remain at the opening until the cover, guardrail system, or warning line system is replaced. The only duty the employee must perform is to prevent exposure to the fall hazard by warning persons entering the area of the fall hazard."

Also, per WAC 296-809-60004, for entrances into confined spaces (i.e. reservoirs), "when entrance covers are removed, promptly guard the opening with a railing, temporary cover, or other temporary barrier to prevent accidental falls through the opening and protect entrants from objects falling into the space." (L&I, n.d.).

Also, per WAC 296-876-60055, roof hatches where ladders are accessed should be at least 30 inches wide.

For steel tanks, AWWA D-100 Section 7.4.4 requires two access hatches in the lower level for emergency ingress and egress. “At least one manhole shall be circular with a minimum diameter of 30 inches. Other manholes may be circular, 24 inches in diameter… minimum size.”

2.4.6 Operations and Maintenance

In the Operations and Maintenance Section, the reservoir structure and appurtenances are assessed to see if they function as designed or affect the other systems. Any operational difficulties noted by City staff is noted in this section, as well as issues noted during the inspection.

2.4.6.1 Site and Security

Site and security components are assessed in the Operations and Maintenance section since if standards are not met, the reservoir may not function optimally. Are the components operating in a fashion similar to current design standards? The fence and security devices such as intrusion alarms, motion detectors, and cameras are assessed. Graffiti is indicative of poor site security.

Vegetation separation is assessed. Generally, trees should be no closer to the reservoir than their height (i.e. a 10-foot tall tree should be no closer than 10 feet to the reservoir). This will limit damage when these trees fall, increase soil water evaporation near the structure, and protect the foundation from root damage. Also, it will reduce the amount of organic material buildup on the exterior. For partially buried reservoirs, DOH (2019) recommends a 50-foot minimum spacing between the reservoir and trees to prevent root penetration. The area that is recommended to be cleared around each reservoir was approximated for the cost estimate.

Site drainage must also facilitate drainage away from the reservoir. Generally, on modern reservoirs, a 2 percent slope away from the structure is called out to limit rainwater draining to the reservoir or its foundation, which present water quality risks. The soils should also be drained near the structure, not pooling or waterlogged during the inspection.

2.4.6.2 Roof Drainage

The roof is assessed to determine if can drain properly. Adjacent structures, such as valve vaults, are examined to check if they have drainage or design issues that could cause water to enter the reservoir.

2.4.6.3 Appurtenances

Exterior appurtenances (ladders, hatches, and manways) are assessed if they can be used by staff or function as designed. In the event of a failure in the largest pipe (inlet, outlet, or drain) or accounting for the design inflow rate, the vents are checked to ensure they allow for adequate air movement to alleviate vacuum or positive per DOH (2019). First, the roof penetration area is assessed to determine if it is large enough. Then the screened area is assessed, as air can only flow through the open areas of the screens. Both the existing and required #24 mesh are assessed.

Finally, if there are any retrofitted collars, airflow through the existing available area is also evaluated.

2.4.6.4 Valving and Piping

The inlet, outlet, drain, and overflow piping are assessed to if they function properly. City staff reports on if there are problems operating the reservoir. Then any daylight drains are assessed if they have adequate energy dissipation and dechlorination. Dechlorination systems should stay in place and have the capacity to treat all water before being drained to a storm sewer or the environment.

2.4.6.5 Misc.

Assessed in this category are the cathodic protection system, level sensors, and hydraulic mixing systems, if applicable. Cathodic protection systems are assessed to determine if they can control corrosion without negatively impacting the coating below the waterline. As the water level changes, the cathodic protection system output should change, known as auto-potential systems.

2.4.7 Obsolescence

The Obsolescence Score is based on how current the component is and how easy it would be to replace it if it. Murraysmith's knowledge of current products are utilized in this section.

2.4.8 Overall Scores

To determine the overall score of each reservoir, first a Category score is found by averaging the assessed, relevant components. Then a weight system, shown in Table 2-2, is implemented to determine the overall scores. Each of the categories provide a weighted score, which add up to 100. These are applied to the mean system scores to determine the overall score. This weighting system was implemented based on the associated risk from the categories. A structural issue would likely take the reservoir out of service for a considerable time and would induce a high risk for the City's supply.

Table 2-2: Overall score weighting system

Category	Weight
Cleanliness and Coatings	5
Material Deterioration	10
Static Structural Performance	20
Seismic Structural Performance	30
WQ/Sanitary	10
Safety	10
Operational	10
Obsolescence	5

2.5 Recommended Improvements

An improvement is recommended to rectify each deficiency noted in the Condition Assessments. In some cases, there are multiple options to select from. Because the static and seismic recommendations often involve similar retrofits, they are combined in the recommended improvement section. Although coatings and corrosion issues are often addressed simultaneously on steel tanks though abrasive blasting and coating, these categories are kept separate. Recoating is addressed in the coating section on steel reservoirs.

Most planning level cost estimates are based on unit costs, derived from previous projects Murraysmith or subconsultants have received contractor bids on. As some of these recommended improvements are unique to the City, there is estimation involved with some of the recommended improvements. Once summed, a 30 percent contingency is applied to the subtotal. Then the current Bellingham tax rate, 8.7 percent is applied to the subtotal and contingency. Then a 35 percent engineering rate is applied to the total cost of the project (subtotal, contingency, and tax), which accounts for design services, administration, and construction management. We believe that these planning-level estimates are appropriate for the City to begin preparing for rehabilitation and/or replacement.

2.6 Conclusions

Each reservoir's conclusions are wrapped up. Major deficiencies and recommended improvements are summarized.

The next inspection time is also proposed. For steel tanks AWWA D100-11 states "inspection of the interior and exterior of the entire tank with corrective maintenance at three-year intervals is recommended." However, AWWA recommends "where water supplies have sediment problems, annual washouts are recommended (2013). "Annual inspection and maintenance of the exposed side of the tank shell-to-bottom connection" is also recommended. For prestressed concrete structures, AWWA D110 states routine inspections should take place every 5 to 10 years. Concrete structure inspections are recommended to begin with a watertightness test.

Section 3

Marietta Reservoir

3.1 Tank and Site Overview

The Marietta Reservoir is a 100-foot diameter above-ground welded steel cylinder with a 2.5-MG capacity, shown in Figure 3-1. It was constructed in 1969. It is 50 feet, 3 inches tall, consisting of five 8-foot plates, one 10-foot plate, and a 3-inch angle to the roof. The overflow is located at the base of the angle at a height of 50 feet which is 3 inches below the roof plate. The roof is supported by one central and eight additional 10-inch diameter columns. The 8-foot by 20-foot roof plates are approximately 0.204 inches thick and sloped at an angle of 0.75:12. According to the provided plans, a 12-inch wide by 4-foot deep footing supports the reservoir to which the shell is anchored with 33 6-inch wide anchor straps.

A 10-foot by 10-foot concrete masonry unit (CMU) block building with a wood-frame roof and a concrete slab is situated next to the reservoir. It houses the electrical systems associated with the reservoir's corrosion protection system. A 12-foot by 7-foot below-grade concrete equipment vault houses the outlet and water main lines.



Figure 3-1: The Marietta Reservoir, viewed looking northeast

The reservoir is not currently in operation, but would be operated between 45 and 50 feet, as noted by the City. It is situated in a rural neighborhood that is forested, about 5 miles northwest

of the Bellingham Central Business District (CBD). If operating, the reservoir serves the 276 North Zone.

The geotechnical investigation indicated that the reservoir is founded on very dense glacially consolidated soils. These soils were encountered from the surface to the extent of the boring, 40.5 feet below the existing ground surface (bgs). Groundwater seepage was not observed at the final depth of boring.

With the nearest mapped faults being 5 and 10 miles away, there is not a significant risk of ground rupture at the site. Soils encountered at this site have an allowable bearing pressure of 5,000 psf and are not at risk of liquification. This site is not expected to have issues with slope instability.

3.2 Inspection Summary

A drained inspection was conducted January 24, 2019.

3.2.1 Exterior Inspection Summary

3.2.1.1 Site and Security

To limit unauthorized access to the site, a chain link fence with barbed wire encompasses the property that is 10 to 15 feet from the walls. The site is generally well-graded, directing runoff away from the reservoir. However, standing water was noted in the northwest side of the reservoir (Figure 3-2). The reservoir was clear of the drip line of trees, but a few trees were found just beyond the fence (Figure 3-1).



Figure 3-2: Standing water along foundation edge

3.2.1.2 Exterior Walls

The reservoir exterior was overcoated in 2013 according to documents provided by the City. Lead is noted in the original specification's prime coat. Coating DFT was measured to be 8–16

thousands-of-an-inch (mils) thick. Typical high-performance coatings for the exterior surfaces of water storage tanks are on the order of 12 to 16 mils. Overall, steel pitting and coating chips were minimal (Figure 3-3 Left). Heavy organic growth was noted where water drained from the roof (Figure 3-3 Right).



Figure 3-3: Exterior ladder and wall staining/scratching

3.2.1.3 Foundation

The reservoir is supported on a concrete ring foundation, which did not exhibit settlement or major cracking. No grout layer was noted between the shell and top of concrete ring foundation. While the provided plans indicate a 12-inch wide by 4-foot deep footing, the exposed portion of this footing was measured to be 15.5 inches wide on site. This footing is likely to be closer to 30 inches wide since anchors are generally centered on footings.

3.2.1.4 Exterior Roof

The roof's plates did not appear to be lapped correctly as water was ponding at the margins of many of the plates. The coating was failing at the locations and near the perimeter (Figure 3-4).



Figure 3-4: The exterior roof's ponding and damage

3.2.1.5 Exterior Appurtenances

This tank has one circular side manway that had a 24-inch diameter (Figure 3-5). Corrosion was noted on the hatch.



Figure 3-5: The singular 24-inch side entry hatch.

The exterior ladder is caged and had a cable fall protection system. This system did not appear to be operational during our inspection (Figure 3-3 Left and Figure 3-6 Left). The roof entry hatch is a 2-foot by 2-foot clam style and had an intrusion alarm (Figure 3-6). Beehives were noted on the lid and an encompassing gasket as missing. Some corrosion was noted throughout the hatch lid.



Figure 3-6: The roof entry hatch and caged ladder

The roof vent did not exhibit corrosion (Figure 3-7). The penetration and hood diameters are approximately 16 inches and 30 inches, respectively. The meshed areas are approximately 4 inches x 6 inches, and the screen has approximately 0.25-inch openings with 0.04-inch wire.



Figure 3-7: The roof vent and screen

3.2.2 Interior Inspection Summary

3.2.2.1 Interior Walls

The interior coal tar enamel coating, ranging in thickness from 100–300 mils, was tightly adhered to the walls (Figure 3-8). It is likely that this material is the original coating applied during construction. No corrosion was noted on the walls. To protect the walls from corrosion, a constant voltage model cathodic protection system is installed. Measurements of plate thicknesses are shown in Table 3-1.



Figure 3-8: The interior roof and walls

Table 3-1: Steel plate thicknesses

Location	Design Thickness (in)	Measured Thickness (in)
Roof	0.188	0.200-0.208
Sixth Course	0.250	0.249
Fifth Course	0.250	0.240
Fourth Course	0.375	0.378
Third Course	0.469	0.443
Second Course	0.568	0.558
Bottom Course	0.688	0.663-0.667

3.2.2.2 Floor

The floor coating is brittle and cracks in places when walked on. At sound coating locations, the material continues to be tightly adhered to the floor. No corrosion was noted on the floor, but dirt has accumulated (Figure 3-9).



Figure 3-9: Interior floor

3.2.2.3 Interior Roof and Columns

The roof and roof support members show minor areas of rust staining, particularly on the edges of the beams and rafters (Figure 3-8 Right). However, when viewed from the roof access hatch, there was no observed significant metal deterioration. The columns still have good coating adhesion and are not corroding.

3.2.2.4 Interior Appurtenances

The Marietta Reservoir does not have an interior ladder.

3.2.3 Piping and Valving Inspection Summary

The inlet piping to the Marietta Reservoir has been upgraded to facilitate mixing within the reservoir (Figure 3-10 Left). This system is braced against a column, which appears to have impacted the column coating at this location (Figure 3-10 Right). The outlet (Figure 3-11 Left) and drain (Figure 3-11 Right) piping exhibited little to no coating loss and/or corrosion. The overflow pipe was very close to the roof plate (Figure 3-12 Left). The outlet of the overflow pipe did not extend to the ground surface and did not have energy dissipation (Figure 3-12 Right). The drain piping connects to a drainage ditch, but the outlet was unable to be found during our inspection.



Figure 3-10: Retrofitted inlet pipe



Figure 3-11: Outlet (Left) and drain (Right) pipes.



Figure 3-12: Overflow piping inside (Left) and outside (Right) the reservoir

The piping and valving were updated in 2012 and still looked new (Figure 3-13). This configuration includes check valves and isolation valves. A level transmitter is in the adjacent pump building.



Figure 3-13: Retrofitted piping and valving in the Marietta Reservoir

Washdown piping was not observed during our inspection.

3.3 Condition Assessments

3.3.1 Cleanliness and Coatings

The exterior surface of the tank is dirty and has several areas of organic material accumulation on the roof and sidewalls. If cleaned and spot treated, the exterior coating will remain viable for many years to come. Although extensive organic growth was observed where water drains from the roof, the coating itself on the exterior walls was still found to be in generally good condition. However, the exterior roof's coating was in poor condition in a few areas due to ponding affecting the topcoat. Lead is present in the prime coat of the exterior, which is not approved under AWWA D102-17.

Overall, the interior coating is in very good visual condition and when coupled with the cathodic protection system, would provide a minimum of 10 years of additional service life. Coal Tar Enamel was once widely used due to its exceptional corrosion performance and resistance to organic growth. However, this coating is known to leach alkyl benzenes and polycyclic aromatic hydrocarbons (PAHs) into drinking water supplies (EPA 2002, National Research Council Safe Drinking Water Committee 1982). Although the leaching of these chemicals reduces overtime, this coating is currently not approved for use as an interior reservoir coating under AWWA D102-17.

3.3.2 Material Deterioration

The visible portion of the concrete foundation is in good condition. Also, there was no observed significant corrosion on the structure or appurtenances, On the interior, the rust staining and coating loss of the roof, rafters, and girders are considered minor. Marietta is good condition from a corrosion perspective.

3.3.3 Structural Performance

3.3.3.1 Static Analysis

The roof framing, the roof plate thicknesses, rafters, columns, and girders (which support the rafters from the column) were all sized appropriately. The reservoir shell was measured to be slightly thinner than the design. Because of this, the walls are overstressed by 1 to 3 percent at the overflow operating level. Based on the field measurements of the foundation, the bearing pressure is likely 3,100 psf. This is acceptable based on the allowable soil bearing capacity of 5,000 psf noted in the geotechnical report.

3.3.3.2 Seismic Analysis

Shell plates can temporarily exceed their capacity during seismic events. If operated at the overflow level of 50 feet, all shell courses other than the fifth from the bottom (second from the top) meet this design requirement. The failing course exceeded its capacity by 1 percent, which is relatively small. Operating at 50 feet, the design seismic event is estimated to induce a slosh wave that is 4.5 feet high which would significantly damage the roof. The maximum operating level to save the roof from slosh impact is 44.5 feet. At the 45.5-foot operating level, only the outer part of the roof would be impacted. The temporary maximum allowable bearing pressure would be exceeded if operated above 45.5 feet.

Based on current code, the existing anchor straps are not adequate to resist overturning at the 50-foot operating level. The current code calls for anchor straps to be ductile, relative to their connections, which the installed straps are not. If the maximum operating level is lowered to 45.5 feet or lower, the anchor straps are not needed. However, with the anchor straps removed, the horizontal displacement of the pipes increases from 0.5 inches to 2 inches. With this displacement, flexible pipe couplings are required on the reservoir's piping that run through the vault.

3.3.4 Water Quality/Sanitary

The retrofitted inlet appears to be suitable to facilitate mixing within the reservoir. The outlet, drain, and overflow piping also appeared to facilitate high quality water within the reservoir. Possible contamination sources include the roof hatch and vent system, which do not prevent insect intrusion and were found to be deficient. The roof hatch would be classified as a "high-maintenance design" because the gaskets often fail to provide a tight seal against the relatively small surface area of the frame. Overall, the hatch is in poor condition and the vent is in fair condition related to water quality.

3.3.5 Safety

The exterior ladder fall protection system was not operating during the inspection, which needs further investigation. If the City is relying on the cage system alone as fall protection, it will not

meet code in 2036, when cage systems are being phased out as fall protection. On the low-slope roof, the lack of any fall protection, warning system, or safety railing was noted, which presents a safety risk for workers on the roof. The roof hatch requires a roof hatch railing or temporary barrier. Another safety consideration is that the reservoir only has one side entry hatch, that does not meet best practices in AWWA D100 Sect 7.4, which requires two entry manways, one of which is at least 30 inches in diameter. Although the reservoir is currently not in use, the safety condition of the reservoir is poor.

3.3.6 Operations and Maintenance

3.3.6.1 Site and Security

Based on the inspection, the fence appeared suitable to deter vandalism. An intrusion alarm is installed on the roof's access hatch. However, tall trees were observed to be too close, particularly on the north side of the reservoir. Nearby trees endanger the structure, slow evaporation from the soil by the structure, and can cause organic material accumulation problems. This can be identified on the Google aerial image (Figure 3-14). Standing water was observed on the surface near the foundation. The site/security is in fair condition.



Figure 3-14: An aerial image of the Marietta Reservoir

3.3.6.2 Roof Drainage

The roof's steel plates were lapped in a fashion the allows water to pond and has damaged coating.

3.3.6.3 Appurtenances

The side hatch has a 24-inch diameter, which made it difficult to get in and out of the reservoir. The vent was found to be undersized, not meeting requirements in the DOH Water Systems Design Manual (2019). Assuming a rapid draining during failure of the 16-inch outlet pipe at a 50-foot reservoir operating level, the existing roof vent failed to provide adequate venting. The roof penetration would need be increased to approximately 21 inches in diameter with a properly sized

screened area to allow for the rapid draining scenario. The appurtenances' operational condition is poor because of the difficulty using the hatch and the undersized vent.

3.3.6.4 Valving and Piping

The staff did not note any difficulties associated with operating of the reservoir. However, the DOH Water System Design Manual recommends the overflow to "extend down to an elevation of 12 to 24 inches above ground level and discharge into a splash plate or rocked area." Also, these pipes must "be located where they can be inspected as part of routine maintenance (WAC 246-290-235(1)(c))." The outlet of the drain could not be located. It is possible the screen, dechlorination, and energy dissipation systems do not meet recommendations. While the inlet and outlet pipes are operationally in good condition, the overflow and drain pipes are in poor operational condition.

3.3.6.5 Misc.

The existing cathodic protection system transformer rectifier is a constant voltage model. Rectifier units for water tanks should be auto-potential in order to account for fluctuations in water level.

3.3.7 Obsolescence

Overall, the equipment on site appeared to be modern and easily replicable other than the cathodic protection system. The reservoir has a favorable obsolescence score.

3.3.8 Condition Scoring

Overall, the condition score of the Marietta Reservoir was fair, at 3.3. It was primarily affected by the seismic score. Operated at 50 feet, the roof would be affected by the slosh wave, the reservoir is susceptible to overturning, and the anchors may induce structural damage. Should the reservoir be operated at the recommended height, anchors removed, and flexible couplings installed, the score would increase considerably. Other issues include the safety of exterior ladder and roof, the undersized vent with too coarse mesh, evidence of insects in the roof hatch, and cathodic protection system being of a constant voltage model. A summary of the scoring is shown in Table 3-2 and the full Score Matrix is included in Appendix A.

Table 3-2: Condition Scoring of the Marietta Reservoir

Categorical Scores	
Cleanliness and Coatings	4.4
Material Deterioration	4.5
Structural Performance - Static	4.0
Structural Performance - Seismic	2.2
WQ/ Sanitary	4.1
Safety	2.0
Operations & Maintenance	3.7
Obsolescence	4.3
Overall	**3.3**

3.4 Recommended Improvements

3.4.1 Cleanliness and Coatings

First, the exterior surfaces need to be pressure washed to remove dirt and other debris which will help extend the life of the coating. Then repair of the areas of topcoat damage, particularly near the roof access hatch where water ponds are recommended. This will preserve the life of the prime coat material and keep the underlying steel from corroding. The City should consider removing the exterior lead-containing coating and applying an AWWA D102-17-compliant coating.

Up-to-date requirements on coal tar enamel coatings should be consulted prior to this reservoir returning to service. The City should consider removing the coal tar enamel coating and applying an AWWA D102-17-compliant coating to the interior in advance of the reservoir returning to service.

3.4.2 Material Deterioration

There are no recommended improvements for concrete deterioration and corrosion at the Marietta Reservoir.

3.4.3 Structural

Because the Marietta reservoir is currently not needed for storage, the option to perform no structural upgrades and lower the maximum operating level to 44.5 feet is recommended. At this level, slosh effects, foundation loads, and shell issues are all addressed. Other options are discussed in the structural analysis in Appendix A. The anchor straps will need to be removed from the reservoir to prevent damage to either the reservoir shell or foundation during the design seismic event. The City can expect to spot repair coating at these locations. Inlet and outlet pipes will then need flexible couplings installed to account for the increased horizontal movement of the pipes. The foundation width also needs to be verified in the design phase of reservoir retrofits.

3.4.4 Water Quality/Sanitary

To rectify deficiencies in water quality/sanitary, the beehives in the roof hatch should be removed and new neoprene gaskets applied to both the hatch frame and lid. If the reservoir comes back into normal service, a better option would be replacing the hatch. Additionally, the vent screen is too coarse. It should be replaced with a #24-mesh and a 4-mesh screen backing. However, the vent should be replaced, as outlined in Section 3.4.6.

3.4.5 Safety

The exterior ladder's fall protection needs to be repaired or replaced. If the fall protection is not functioning, either it or the entire ladder will need to be replaced by the 2036 deadline. Furthermore, the roof needs suitable fall protection, such as a railing. While the reservoir does not have an interior ladder, and one is not required, the City can consider the installation of an interior ladder to facilitate future floating inspections or other access needs. The roof hatch would likely need to be upsized to 30 inches if used for access. At any rate, a safety railing is recommended around the roof hatch. The installation of a 30-inch hatch in the lower course, opposite the existing hatch, is also recommended.

3.4.6 Operations and Maintenance

3.4.6.1 Site and Security

Trees that are closer to the reservoir than they are tall should be removed or transplanted. The cleared areas can be replanted with shorter growing shrubs on the perimeter to shield the reservoir from view. Some of the trees may be on the adjacent property, 4585 Wynn Rd, so coordination with the property owner will be required. Installation of a French drain system is also recommended where water is ponding adjacent to the foundation. Adjusting the grading in this area to direct water away from the reservoir may be a possibility as well.

3.4.6.2 Roof Drainage

The most appropriate means for lessening the effect of the poor roof plate lapping is to have City personnel perform an annual inspection on the roof and complete any minor coating repair work at that time, as outlined in Section 3.4.1.

3.4.6.3 Appurtenances

The vent penetration and screened area should be increased to allow adequate airflow, bringing the reservoir into compliance with the DOH requirements (2019). The penetration diameter should be increased from 16 inches to approximately 21 inches. Alternatively, a new vent can be installed on the reservoir with a penetration area of at least 1-square foot. In such a case, the existing mesh should be replaced with #24 mesh with 4-mesh backing. Before being brought back

online, the vent improvements should be implemented so air exchange is not further reduced with a finer mesh. Recommendations for the side entry hatch were discussed in Section 3.4.5.

3.4.6.4 Valving and Piping

The City should carry out an inspection to locate the outlet of the drain piping. This location should be permanently marked, and the trail maintained so it can be easily found in the future. Any issues with the screen, dechlorination, and/or energy dissipation of the outlet should be investigated and corrected. Because the overflow is too close to the ceiling and does not extend near the ground level, installation of a new overflow is recommended. The level of the overflow should keep the maximum operating level below 44.5 feet.

3.4.6.5 Misc.

To extend the life of the coating below the waterline in the interior, the existing constant voltage rectifier should be replaced with an auto-potential unit.

3.4.7 Capital Improvements Plan Table

Planning level costs for the retrofits to the Marietta Reservoir are shown in Table 3-3.

Table 3-3: Marietta deficiencies, recommended improvements, and estimated costs

Category	Deficiency	Recommended Improvement	Estimated Cost
CLN & COAT	Organic material buildup on exterior	Pressure wash exterior	$ 2,000
	Intermittent exterior coating failure and roof plates lapping causing ponding	Spot Repair Coating	$ 10,000
	Exterior coating contains lead and interior coating is coal tar enamel. Both are not AWWA-approved.	Consider removal of coating and application of AWWA-approved coating systems	$ -
STRUCT	Wall overstressed & roof impacted by slosh; Reservoir overturns	Lower max operating level to 44.5 ft; remove anchors.	$ 13,000
	Without anchors, pipe horizontal displacement increased from 0.5 inches to 2 inches	Install flexible coupling(s)	$ 32,000
WQ	Roof hatch has evidence of insects and is a high-maintenance design (small contact area)	Remove beehives & replace gasket w/ neoprene seals; consider upgrades	$ 1,000
	Vent screen non-compliant	Replace vent screen (addressed with new vent)	$ -
SAFETY	Exterior ladder fall protection is not functioning, but has cage	Repair exterior ladder fall protection or replace cage by 2036	$ 6,000
	Lacks roof fall protection and roof hatch railing	Install roof fall protection and roof hatch railing	$ 44,000
	Missing second side access hatch	Install new 30" side access hatch	$ 16,000
O&M	Tree spacing recommendation not met	Tree removal and restoration	$ 12,000
	Site not draining	Install French drain	$ 3,000
	Vent undersized	Replace roof vent	$ 15,000
	Unable to locate drain pipe	Locate; replace screen, retrofit energy dissipation & dechlorination system if needed	$ 6,000
	Overflow non-compliant	Replace overflow	$ 44,000
	Cathodic protection system is constant voltage model and lacks stationary reference electrode	Install automatically controlled potential rectifier and stationary reference electrode	$ 10,000
		Subtotal	$ 214,000
		30% Contingency	$ 64,200
		8.7% Tax	$ 24,203
		Engineering, Administration, and Construction Management	$ 105,841
		Total Project Costs Estimate	$ 408,245
		Total Project Costs Estimate (rounded)	**$ 410,000**

3.5 Conclusion

The Marietta Reservoir is currently out of service and the City is unsure if the Reservoir's storage will be required in the future. The City should begin by assessing how this reservoir's lower maximum operating level would affect the 276 North Zone. If this level is not feasible, other options outlined in the structural report in Appendix A should be implemented. If the City wishes to keep the reservoir up to code, the anchor straps should be removed, and flexible couplings installed on the piping. Regardless of timing of these structural retrofits, pressure washing and spot repairing the exterior coating is recommended in the near future to avoid degradation of the steel shell. The City may also wish to promptly address safety issues associated with the reservoir to facilitate future inspections.

While the reservoir remains empty, the roof should be inspected every 3 years and coating reapplied to areas that are failing. Cathodic protection inspections by a qualified engineer should occur annually if the reservoir is brought back into service. General inspections should take place every 3 years regardless the operating state of the reservoir.

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Section 4

Padden Reservoir

4.1 Tank and Site Overview

The Padden Reservoir is a 59-foot diameter above-ground welded steel cylinder with a 0.5-MG capacity, shown in Figure 4-1. It was constructed in 1967. The reservoir shell plates consist of three courses and are a total height of 22 feet, 3 inches. The overflow is located at the base of the angle and within the rafter line. The overflow is at a height of 25 feet which is 3 inches below the roof plate. The roof is supported by one centrally located 6-inch diameter column. The 6-foot by 18-foot roof plates are approximately 0.189 inches thick and sloped at an angle of 1:12. According to the provided plans, a 12-inch wide by 3.5-foot deep footing supports the reservoir without any anchors. Outlet piping is shown to run approximately 2 feet below the base of the footing rather than through the footing. The reservoir is operated between 16.5 and 24.5 feet, as noted by the City.



Figure 4-1: The Padden Reservoir, viewed looking northwest

It is situated at the southern part of the distribution area. It is in a forested area about three miles southeast of the Bellingham CBD. The two nearby structures are a 10-foot by 12-foot concrete altitude valve vault and a 513-square foot pump station. The reservoir serves the 457 South Zone. The geotechnical investigation indicated that the reservoir is founded on fill to 6.5 feet and undifferentiated glacial drift soil below 6.5 feet to the boring termination depth of 71.5 feet. The glacial drift soil was quite variable, comprised of sand with silt and gravel and silty sand. A layer of stiff silt was found from 14 to 19 feet bgs. Groundwater seepage was found at 19 feet.

With the nearest mapped faults being 5 and 10 miles away, there is not a significant risk of ground rupture at the site. Soils encountered at this site have an allowable bearing pressure of 3,000 psf and are not at risk of liquification. This site is not expected to have issues with slope instability.

4.2 Inspection Summary

Drained and floating inspections were conducted on April 9 and April 30, 2019, respectively.

4.2.1 Exterior Inspection Summary

4.2.1.1 Site and Security

To limit unauthorized access to the site, a chain link fence with barbed is located about 10 feet from the shell. The site is generally well-graded, directing runoff away from the reservoir. Tall trees were found growing just beyond the fence and were contacting the shell (Figure 4-2).



Figure 4-2: Exterior walls organic material accumulation

4.2.1.2 Exterior Walls

Heavy organic buildup was noted on the exterior walls throughout the reservoir (Figure 4-1 and Figure 4-2), and the topcoat was chipped and peeling in many areas (Figure 4-3). The reservoir exterior was overcoated at some point after construction, according to conversations with the City. Coating DFT was measured to be 6.6–14.3 mils. Typical high-performance coatings for the exterior surfaces of water storage tanks are on the order of 12–16 mils.



Figure 4-3: Exterior wall coating is peeling has been damaged

4.2.1.3 Foundation

The reservoir is supported by a concrete ring foundation, which did not exhibit settlement or major cracking. However, the grout layer was failing between the floor plate and top of footing, especially on the north side (Figure 4-4).



Figure 4-4: Failure of grout at base (multiple locations noted)

4.2.1.4 Exterior Roof

Like the walls, significant buildup of organic material was noted on the roof. There was very little ponding (Figure 4-5); it appears roof lapping was done correctly. Roof coating DFT measurements ranged from 3.5 to 9.6 mils.



Figure 4-5: Exterior roof

4.2.1.5 Exterior Appurtenances

This tank has one circular side manway that had a 24-inch diameter opening (Figure 4-6). The exterior ladder is caged above the lockable enclosure (Figure 4-6 and Figure 4-7 Left). Corrosion was noted on the hand rail (Figure 4-7 Left) and rungs of the ladder (Figure 4-7 Right). No railing or fall protection is present on the roof.



Figure 4-6: The singular 24-inch side entry hatch and exterior ladder



Figure 4-7: Exterior ladder roof hatch lid

The roof entry hatch is a 2-foot by 2-foot clam style and had an intrusion alarm (Figure 4-7 Left and Figure 4-8). Corrosion was noted on the lid and interior of the hatch.



Figure 4-8: Interior of roof hatch corrosion

The roof vent, located near the perimeter of the reservoir, had organic debris on the overhang (Figure 4-9). The screen system installed appeared to prevent both bird and insect intrusion. The roof penetration is approximately 20 inches in diameter and the vent screen is approximately 15 inches tall. A 28-inch collar with an overhang was also installed.

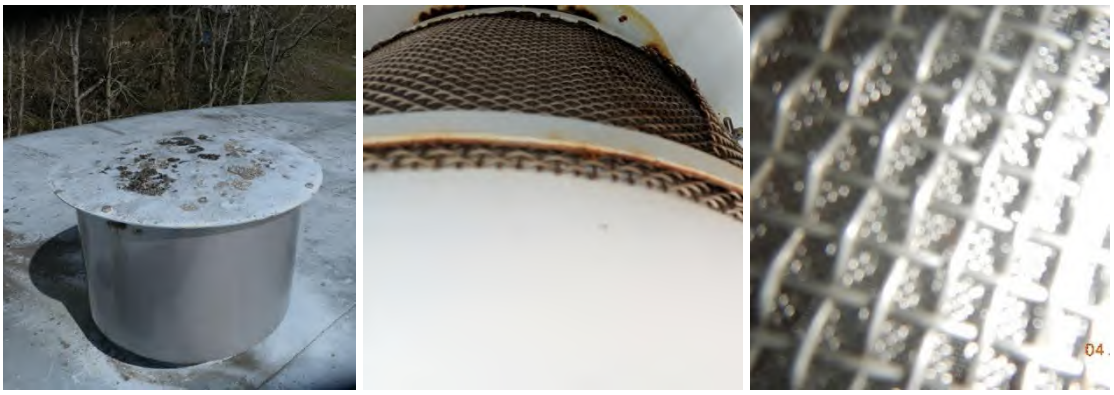


Figure 4-9: Roof vent and screen.

4.2.2 Interior Inspection Summary

4.2.2.1 Interior Walls

On the interior (Figure 4-10 Left), blistering was noted on the bottom 4 inches of the walls (Figure 4-10 Right). To protect the walls from corrosion, a constant voltage model cathodic protection system is installed. On-site testing indicated that the corrosion protection criteria was not being met at all testing locations. Therefore, the rectifier output was increased to bring it into compliance. A full report of the rectifier and structure-to-electrolyte potential data is included in

the Appendix B. Exposed steel locations below the waterline did not exhibited pitting. This is likely due to the operation of the cathodic protection system. The interior coating DFT measurements ranged from 5.5 to 10 mils; typical high-performance coating DFT ranges are 12 to 20 mils. Measurements of plate thickness are shown in Table 4-1.



Figure 4-10: Interior walls, roof, column, and overflow

Table 4-1: Steel Plate Thicknesses

Location	Design Thickness (in)	Measured Thickness (in)
Roof	N/A	0.189
Knuckle	N/A	0.276
Third Course	N/A	0.258
Second Course	N/A	0.262
Bottom Course	N/A	0.307-0.311
Interior Floor	N/A	0.250

4.2.2.2 Floor

The coating on the floor and weld seams was found to be bubbling under the anodes, which is likely due to running the cathodic protection system at a higher-than-required voltage (Figure 4-11). Measurements of coating DFT ranged from 5.5 to 14.5 mils on the floor. Some sediment was accumulating near the base of the column. There was topcoat wear near the inlet/outlet/drain pipe.



Figure 4-11: Interior floor coating

4.2.2.3 Interior Roof and Column

On the ceiling panels at roof plate overlaps, coating was failing, and significant corrosion was observed (Figure 4-12). Areas of sound coating, such as the middle of roof plates, are moderately adhered. The roof knuckle and support members also had significant coating loss and corrosion (Figure 4-13). Near the access hatch, heavy corrosion was also found, and a nut was found to be missing (Figure 4-14).

The column still has good coating adhesion and is not corroding.



Figure 4-12: Interior roof seam corrosion



Figure 4-13: Roof knuckle (Left) and support members (Right) corrosion.

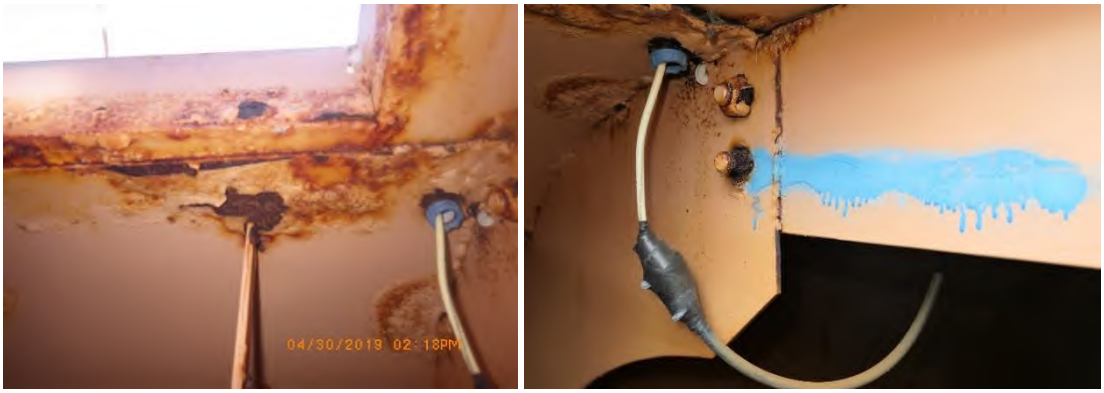


Figure 4-14: Roof hatch corrosion (Left) and missing nut (Right).

4.2.2.4 Interior Appurtenances

The interior ladder did not have any fall protection devices. It also was found to have corrosion near the roof connection point and bubbling in the lower extent (Figure 4-15).



Figure 4-15: Interior ladder corrosion and bubbling

The vent penetration, as viewed from the interior, was missing coating and was severely corroded (Figure 4-16).



Figure 4-16: Roof vent penetration corrosion

4.2.3 Piping and Valving Inspection Summary

The inlet, outlet, and drainpipes are combined in a single 16-inch diameter pipe (Figure 4-17). This pipe is equipped with a silt stop, which was removed during the inspection and replaced after completion. It did not appear to sit flush with the floor. The interior of the pipe appeared to be very corroded. The overflow pipe is only a few inches from the roof plate (Figure 4-18 Left), is braced to the wall, and has a wall penetration in the first course (Figure 4-19 Left). It drains to a storm drain structure without a compliant screen (Figure 4-19 Right), and eventually discharges to Padden Creek with the drain (Figure 4-18 Left). The outlet of the drainpipe did not have a screen or energy dissipation. Dechlorination is reported to take place within a storm drain manhole on site.

The reservoir has an altitude valve and isolation valves, which exhibited minor exterior corrosion (Figure 4-20).

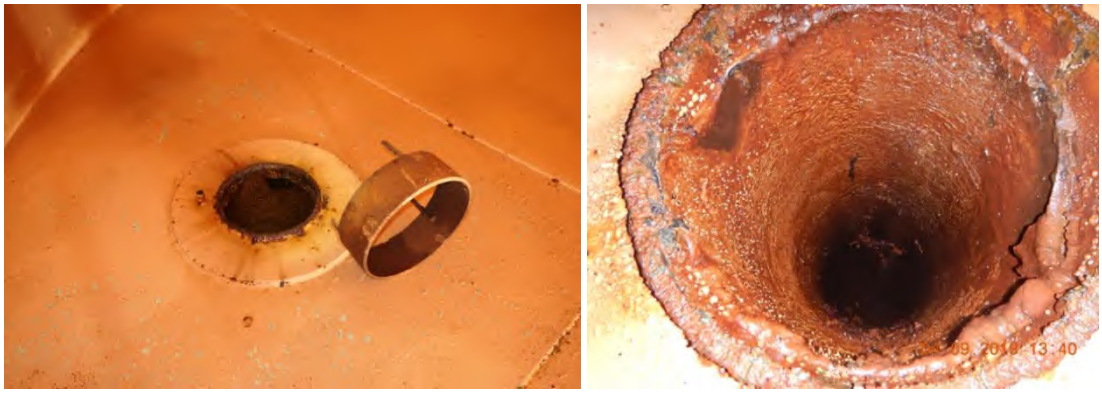


Figure 4-17: The common inlet/outlet/drain with retrofitted silt stop



Figure 4-18: The overflow inlet (Left) and drain/outlet pipe outlet without a screen or energy dissipation (Right).



Figure 4-19: Overflow piping (Left) and screen (Right)



Figure 4-20: The valving includes an altitude valve and isolation valves.

Washdown operation can occur via a fire hydrant near the exterior ladder (Figure 4-1).

4.3 Condition Assessments

4.3.1 Cleanliness and Coatings

The exterior surface of the tank is dirty and has several areas of organic material accumulation on the roof and sidewalls. Based on field observations, the exterior coating is expected to be viable only until 2025 if pressure washed. It is in poor condition.

The interior blistering below the waterline does not appear to be impacting the structure. However, the coating DFT measurements and blistering indicate the interior needs recoating. Above the waterline, the coating is experiencing major failure, especially at the panel seams and on the structural support members. Overall, the interior coating is in poor condition.

4.3.2 Material Deterioration

The seal between the foundation and tank was found to be in poor condition, at the end of its useful life. Even without an intact coating system, the exterior of the structure is free of significant corrosion.

The interior roof is in poor condition; its corrosion problems are significant, particularly in between roof plates and in overlap areas between the beams and plates. The corrosion (and related coating loss) should be addressed within the next 2 years. The pipe's condition related corrosion in assessed to be fair.

4.3.3 Structural Performance

4.3.3.1 Static Analysis

Based on drawings and measurements, the roof framing, the roof plate thicknesses, rafters, and column were all sized appropriately. However, major corrosion issues can jeopardize roofs. All plates are acceptable for the anticipated hydrostatic stresses. Based on the 12-inch footing, the bearing pressure is estimated to be 2,700 psf. This is acceptable based on the allowable soil bearing capacity of 3,000 psf determined in the geotechnical report.

4.3.3.2 Seismic Analysis

The reservoir's shell is adequate for the site's anticipated seismic loads. The slosh wave in this reservoir is estimated to be 4.0 feet high based on the design seismic event. Since damage to the roof would occur below the 25-foot overflow level at 23.75 feet, operating level would need to be lowered to 19.75 feet to reduce confined slosh risk to an acceptable level. A 20.5-foot operating level's slosh wave would only affect the roof knuckle, not the rafters and main plates. This would incur less substantial retrofit requirements than maintaining the 24.5-foot operating level.

This reservoir structure itself was determined to be stable against overturning, even without anchors. However, based on the design seismic event's constrained slosh wave, the seismic bearing on the relatively narrow foundation footing would increase to 6,600 psf. This is higher than the 4,000 psf allowable bearing pressure during a seismic event. A maximum operating height of 22.25 feet would bring the increased bearing pressure to acceptable level. It should be noted that if operated at this level without retrofits, the roof problems would still exist.

4.3.4 Water Quality/Sanitary

Although the common inlet/outlet/drainpipe configuration can cause problems with water quality issues, none have been reported. A functioning silt stop is also a current DOH best practice; this reservoir's silt stop appears to need some modification. No drain air gap is needed since this reservoir drains to Padden Creek. However, the screen on the overflow and drainpipes were found to be out of compliance as they were not #24 mesh. The roof hatch would be classified as a "high-maintenance design" because of issues getting the gaskets to provide a tight seal against the relatively small surface area of the frame. Overall, the condition of the reservoir related to water quality/sanitary is fair.

4.3.5 Safety

The exterior ladder fall protection is a cage system, which alone as fall protection will not meet code in 2036, when cage systems are being phased out as fall protection. On the roof, the lack of any fall protection or safety railing was noted, which also presents a safety risk. The roof hatch requires a roof hatch railing or temporary barrier. The hatch is undersized for entry if it is to be used. There is also no fall protection on the interior ladder, which would need to be added if workers are to enter from the roof hatch. Due to the heavy corrosion on the ladder, it is not recommended to be used. Another safety consideration is that the reservoir only has one side entry hatch, that does not meet best practices in AWWA D100 Sect 7.4, which requires two entry manways, one of which is at least 30 inches in diameter. The safety of the reservoir is in fair to poor condition.

4.3.6 Operations and Maintenance

4.3.6.1 Site and Security

Based on the inspection, the fence was suitable to deter vandalism and the soils adjacent to the reservoir were draining properly. An intrusion alarm is installed on the roof's access hatch. However, tall trees were found to be too close to the reservoir. Nearby trees endanger the structure, slow evaporation from the soil by the structure, and can cause organic material accumulation problems. The site/security is in fair condition.

4.3.6.2 Roof Drainage

There did not appear to be issues with roof drainage at the Padden Reservoir.

4.3.6.3 Appurtenances

The side hatch has a 24-inch diameter, which made it difficult to get in and out of the reservoir. No difficulties were found using the exterior ladder. Padden's vent passed design requirements for roof penetration and free area. However, the vent is not centrally located on the reservoir, which does not meet the requirements of D100-11 Section 5.5, which requires one tank vent to be located near the center of the roof. Other than difficulty using the hatch, the reservoir's appurtenances are in good operational condition.

4.3.6.4 Valving and Piping

The staff did not note any difficulties associated with operating of the reservoir. However, the dechlorination system was a bag that could be easily pushed out of the way with the force of drained water. The energy dissipation system on the drain/overflow outlet may not prevent erosion in Padden Creek.

4.3.6.5 Misc.

The existing transformer rectifier is a constant voltage model. Rectifier units for water tanks should be auto-potential in order to account for fluctuations in water level.

4.3.7 Obsolescence

Overall, the equipment on site appeared to be older but could be replaced in the event of failure.

4.3.8 Condition Scoring

Overall, the condition score of the Padden Reservoir was fair to good, at 3.6. It was primarily affected by the seismic score. Operated at 24.5 feet, the roof would be affected by the slosh wave and the allowable bearing pressure would be exceeded. Other issues include the failing coating throughout the exterior and above the waterline on the interior, the corrosion above the waterline, and cathodic protection system being of a constant voltage model. A summary of the scoring is shown in Table 4-2 and the full Score Matrix is included in Appendix B.

Table 4-2: Condition Scoring of the Padden Reservoir

Categorical Scores	
Cleanliness and Coatings	3.3
Material Deterioration	3.7
Structural Performance - Static	5.0
Structural Performance - Seismic	2.8
WQ/ Sanitary	4.3
Safety	2.3
Operations & Maintenance	4.2
Obsolescence	3.0
Overall	3.6

4.4 Recommended Improvements

4.4.1 Cleanliness and Coatings

First, the exterior surfaces need to be pressure washed to remove dirt and other debris which will help extend the life of the coating approximately five more years. In some locations, the topcoat is expected to be removed during pressure washing operations due to low adhesion qualities. A full exterior recoat should be completed by 2025. The walls will need to have existing coating removed, proper surface preparation, and application of a new coating. Exterior roof coating recommendations are dependent on the structural retrofits, outlined in Section 4.4.3. The instances of coating failure on the exterior ladder can be dealt with by spot treating or addressed at the time of recoating.

On the interior, numerous instances of coating failure have been noted. Removal of all existing coating with abrasive blasting, proper surface preparation, and application of a new protective coating is recommended within the next 2 years. The improvement for coating issues on the interior roof is dependent on the selected maximum operating level, discussed in Section 4.4.3.

4.4.2 Material Deterioration

Between the foundation and the tank, the failing grout should be removed back to either competent grout or the compacted oil sand base under the reservoir. Once the gap is cleared, it should be refilled with a non-shrink grout mixture, which meets the minimum thickness requirements as outlined by the manufacturer. Where grout cannot be placed, the gap should be packed with a backer material and sealed using an exterior grade elastomeric flexible caulking.

Shell wall corrosion issues will be addressed with during recoating process, outlined in Section 4.4.1. During this process, repairs of corrosion-induced pits and weld failures throughout the reservoir are also expected. We noted jagged welds near the hatch which will be ground down and repaired during this process. The improvement for corrosion issues on the interior and exterior roof is dependent on the selected maximum operating level, discussed in Section 4.4.3.

As the inlet/outlet/drain pipe has a bend, pigging and relining options are limited. Instead, the City can consider removing the corrosion with mechanical agitation to the extent possible from the floor of the reservoir and the recoating interior of the pipe. Although it was not possible to view deep into the pipe during the inspection, the extent of the corrosion appears to be limited, so this improvement is a consideration rather than a recommendation.

4.4.3 Structural

To address the roof and foundation issues resulting from the design seismic event, the City has four options. The scale of the required retrofits varies depending on if/how far the maximum operating level of 24.5 feet is reduced. Options 1a and 1b involve leaving the existing roof in place. Option 1b should only be considered if no other options are possible. For each of the following maximum operating levels, the following improvements are needed:

Option 1a (19.75 feet): Options 1a and 1b would first involve an inspection to ensure the roof is able to be retrofitted as corrosion may render retrofits unfeasible. If repairs are feasible, Option 1a would involve removing the existing interior and exterior roof coatings; seal welding the roof plates; repair of roof support joint connections, pits, and weld failures; proper surface preparation; and recoating the interior and exterior roof along with the rest of the reservoir. This work is recommended to be conducted within the next 2 years if the roof is to remain.

Option 1b (20.5 feet): The code-level seismic slosh would impact the knuckle only. Under this maximum operating level, retrofit roof knuckle is required in addition to the requirements of Option 1a. Only the rafter ends would need retrofitting. It should be noted this will not meet current code since there will not be enough freeboard. However, the potential for damage would be reduced.

Option 2 (22.25 feet): This option involves replacement of the existing roof. As the reservoir is relatively narrow, a new self-supported dome roof is recommended. Although roof retrofits may be possible, the corrosion extent on the interior has likely rendered the roof unfit for any such retrofit. Should full roof retrofits warrant further investigation, an in-depth structural analysis of the roof would first need to be conducted. Reinforcing may be possible, or the City could add another shell course and raise the existing roof. These options are projected to be more expensive and have less longevity, compared to a new roof. Installation of new roof eliminates the need to seal weld, blast, and recoat the exiting roof.

Option 3 (24.5 feet): Above the 22.25-foot operating level, foundation retrofits are also required. In addition to the requirements of Option 2, if the City retains the 24.5-foot operating level, the foundation will need to be expanded to handle to increased bearing loads from the slosh induced by the design seismic event. Further geotechnical investigation is needed to confirm the additional foundation area. For budgetary purposes, a foundation expansion and micropiles are explored to meet these requirements.

To be commensurate with the 65 percent (4,000 to 6,600 psf) exceedance of the bearing pressure, the foundation footprint can be expected to be increased by about this percentage. The 12-inch wide ring footing centered on the tank has an area of approximately 185 ft^2. A 65 percent increase in the area would equate to an additional 120 ft^2 of footing area, totaling 306 ft^2. Similar seismic retrofit projects have used micropiles at 5 feet on center throughout the reservoir's circumference.

During any retrofits, the City may consider lowering the overflow to ensure the water level in the reservoir does not surpass the maximum allowable water level.

4.4.4 Water Quality/Sanitary

Water quality should continue to be monitored as common inlet/outlet/drain configurations can cause water stagnation in the reservoir. Only a minor adjustment, such as a gasket, is needed to remedy the silt stop on the Padden Reservoir. Water quality risks can also be reduced by updating the drain and overflow pipes screens to a #24-mesh with a 4-mesh screen backing. The gasket on the roof access hatch can be replaced with neoprene seals on both the frame and the lid or replaced with a hatch with better contact area.

4.4.5 Safety

To address the safety concerns of the Padden Reservoir, the exterior fall protection should be upgraded before the 2036 deadline. The City may consider upgrading the exterior ladder concurrently with other retrofits. Furthermore, the roof perimeter and roof entry hatch need suitable fall protection. If the interior ladder is to be used, an OSHA-complaint fall protection system will need to be installed and the entry hatch increased in size to 30 inches. Given the condition of the ladder, replacement would likely be necessary. It does not appear the ladder is currently in use. Finally, a new 30-inch manway should be installed on the reservoir's first course to meet AWWA best practices.

4.4.6 Operations and Maintenance

4.4.6.1 Site and Security

Trees that are closer to the reservoir than they are tall should be removed or transplanted. The cleared areas can be replanted with shorter growing shrubs on the perimeter to shield the reservoir from view.

4.4.6.2 Roof Drainage

There are no recommendations on roof drainage on this reservoir.

4.4.6.3 Appurtenances

The air exchange through the vent should continue to be monitored as the vent is not centered. Updating the location can be considered during future upgrades of the reservoir to follow current AWWA recommendations.

4.4.6.4 Valving and Piping

The energy dissipation and dechlorination systems should be updated before the next time the reservoir is drained. Proper dechlorination at the Padden site could consist of a weighted system that is set in the manhole on site or a sturdy system that could be installed on the outlet pipe at Padden Creek. An example of a basket system is shown in Figure 4-21.

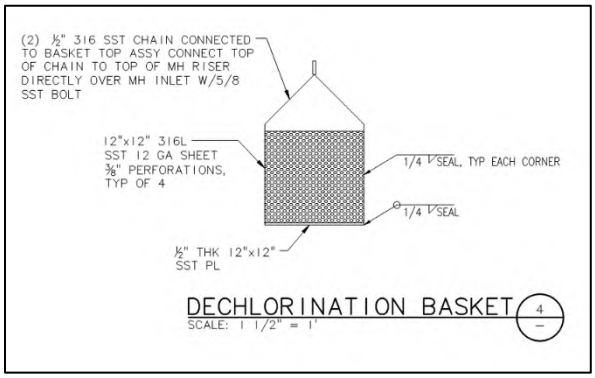


Figure 4-21: An example of a dechlorination system

4.4.6.5 Misc.

To extend the life of the coating below the waterline in the interior, the existing constant voltage rectifier should be replaced with an auto-potential unit.

4.4.7 Capital Improvements Plan Table

Planning level costs for the retrofits to the Padden Reservoir are show in Table 4-3. This table is organized such that any roof repairs coincide with structural repairs, dependent on the updated maximum operating level. Wall and floor costs are assumed to be independent of the roof retrofits, so are included in the Cleanliness and Coating and Material Deterioration Sections.

Table 4-3: Padden deficiencies, recommended improvements, and estimated costs

Category	Deficiency	Recommended Improvement	Estimated Cost
CLN & COAT	Organic material buildup on exterior	Pressure wash exterior	$ 2,000
	Exterior coating failure (walls)	Abrasively blast exterior and recoat	$ 89,000
	Interior coating thin (walls and floor)	Abrasively blast interior and recoat	$ 118,000
DETERIOR-ATION	Grout layer failure	Remove, fill gaps w/ non-shrink grout. Non-grout-able areas: fill w/ backer & caulking	$ 6,000
	Unforeseen corrosion-related pits and weld failures (walls and floor)	Unforeseen corrosion-induced pit and weld failure repairs (walls and floor)	$ 9,000
	Corrosion on interior of piping	Monitor. Consider cleaning and recoating	$ -
STRUCT & ROOF	Interior and exterior roof coating is failing and structural members are corroding. Roof impacted by seismic slosh and soil bearing capacity is exceeded	OPTION 1: Retain Existing Roof	
		a. Roof structural inspection	$ 3,000
		b. Abrasively blast exterior roof and recoat after repairs	$ 52,000
		c. Abrasively blast interior roof and recoat after repairs	$ 44,000
		d. Seal weld roof plates	$ 9,000
		e. Unforeseen roof joint connection repairs	$ 6,000
		f. Unforeseen roof pit and weld failure repairs	$ 4,000
		(1a) Lower max operating level from 24.5 to 19.75 ft	
		Subtotal for Option 1a	**$ 118,000**
		(1b) Lower max operating level from 24.5 to 20.5 ft	
		g. Retrofit roof knuckle.	$ 60,000
		Subtotal for Option 1b	**$ 178,000**
		OPTION 2: Lower max operating level from 24.5 to 22.25 ft	
		Demo/remove existing roof. Install new self supported dome roof	$ 140,000
		Subtotal for Option 2	**$ 140,000**
		OPTION 3: Maintain 24.5 ft operating level	
		a. Demo/remove existing roof. Install new self supported dome roof	$ 140,000
		b. Foundation improvements	$ 160,000
		Subtotal for Option 3	**$ 300,000**
WQ	Inlet and outlet are combined	Continue to monitor water quality; consider upgrades	$ -
	Silt-stop not functioning	Retrofit silt-stop	$ 1,000
	Drain pipe screen non-compliant	Replace drain pipe screen	$ 1,000
	Overflow pipe screen non-compliant	Replace overflow pipe screen	$ 1,000
	Roof hatch is a high-maintenance design (small contact area)	Replace gasket w/ neoprene seals; consider replacement	$ 1,000
SAFETY	Exterior ladder fall protection is cage	Replace exterior ladder fall protection by 2036	$ 6,000
	Lacks roof fall protection and roof hatch railing	Install roof fall protection and roof hatch railing	$ 44,000
	Lacks interior ladder fall protection. Corrosion on interior ladder renders it unsafe.	If used, replace ladder	$ -
	Missing second side access hatch	Install new 30" side access hatch	$ 16,000
O&M	Tree spacing recommendation not met	Tree removal and restoration	$ 20,000
	Energy dissipation and dechlorination non-compliant	Update energy dissipation and dechlorination system	$ 4,000
	Cathodic protection system is constant voltage model and lacks stationary reference electrode	Install automatically controlled potential rectifier and stationary reference electrode	$ 10,000

	Max operating Level (ft)			
	19.75	20.5	22.25	24.5
Subtotal	$ 446,000	$ 506,000	$ 468,000	$ 628,000
30% Contingency	$ 133,800	$ 151,800	$ 140,400	$ 188,400
8.7% Tax	$ 50,443	$ 57,229	$ 52,931	$ 71,027
Engineering, Administration, and Construction Management	$ 220,585	$ 250,260	$ 231,466	$ 310,599
Total Project Costs Estimate	$ 850,828	$ 965,289	$ 892,797	$ 1,198,026
Total Project Costs Estimate (rounded)	**$ 850,000**	**$ 970,000**	**$ 890,000**	**$ 1,200,000**

4.5 Conclusion

The Padden Reservoir has major issues that include coating failure on both the interior and exterior, heavy interior corrosion above the waterline, and a foundation and roof that do need meet seismic code at the current operating level. With the reservoir being built in 1958, it is likely nearing the end of its service life. The City should determine what maximum level the reservoir can be operated at while meeting requirements and needs of the 457 South Zone. If the maximum operating level the reservoir cannot be reduced, the estimated costs of retrofits appear to approach the cost of building a new reservoir.

As the corrosion is recommended to be dealt with within two years, we recommend this tank be inspected next after this work is complete. It is recommended the cathodic protection system be inspected by a corrosion engineer on a yearly basis. The cathodic protection system inspections entail checking the rectifier output and measuring the structure-to-electrolyte potential in the water at 2-foot increments from the roof hatch while the reservoir is in operation.

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Section 5

Whatcom Falls I Reservoir

5.1 Tank and Site Overview

The Whatcom Falls I Reservoir is a 200-foot diameter above-ground welded steel cylinder with a 4.0-MG capacity, shown in Figure 5-1. Construction was completed in 1982 and as-built plans were published in 1984. The reservoir shell plates consist of two courses and are a total height of 17 feet, 6 inches. There is no overflow on the reservoir, and it runs on gravity with the Whatcom Falls II Reservoir. The roof's rafters are supported by two rows of girders. The girders are supported by one centrally located 8-inch diameter column and two rings of (16) 5-inch diameter columns at radii of 38 and 71 feet. The 6-foot by 30-foot roof plates are approximately 0.188 inches thick and are sloped at an angle of 0.75:12. According to the provided drawings, a 24-inch wide by 3.5-foot deep ring wall footing supports the reservoir without any anchors. The piping is shown to run below the base of the footing and encased in lean concrete fill. The reservoir is operated between 7 and 16.5 feet the summer and between 6.5 and 15.5 feet in the winter, as noted by the City.



Figure 5-1: The Whatcom Falls I Reservoir, viewed looking northwest.

The site is centrally located within the distribution area, about two miles east of the Bellingham CBD. The site also includes the Whatcom Falls II reservoir and a pump station, which are not close enough to impact the structure during a seismic event. The reservoir serves the 276 South Zone.

The geotechnical investigation indicated that the site has 1.5 to 3 feet of forest duff/topsoil, glacial till, and Chuckanut sandstone. The foundation extends to the sandstone layer. Perched groundwater seepage was found above the till layer.

With the nearest mapped faults being 5 and 10 miles away, there is not a significant risk of ground rupture at the site. The bedrock the reservoir is founded on has an allowable bearing pressure of 6,000 psf and bedrock is not at risk of liquification. This site has a low risk of slope instability.

5.2 Inspection Summary

Floating and drained inspections were conducted on June 12 and November 30, 2019, respectively.

5.2.1 Exterior Inspection Summary

5.2.1.1 Site and Security

To limit unauthorized access to the site, a chain link fence with barbed wire encompasses the Whatcom Falls I and II Reservoirs. The fence is 15 to 16 feet from the shell on the east, west, and north sides of the reservoir. The site is generally well-graded, directing runoff away from the reservoir. Tall trees were found growing just beyond the fence.

5.2.1.2 Exterior Walls

Heavy organic buildup was noted on the exterior walls throughout the reservoir (Figure 5-2), especially on the northeast side. There were areas of graffiti that had been covered up. Some of these areas are peeling. There were scratches (Figure 5-3 Left) and small areas of missing coating (Figure 5-3 Center). Heavier organic staining was noted near the roof drains (Figure 5-3 Right). The coating system consists of a red primer and green topcoat. Coating DFT was measured to be 5.8–11.5 mils, averaging 7.6 mils. Typical high-performance coatings for the exterior surfaces of water storage tanks are on the order of 12–16 mils. A field lead check swab tested negative for the presence of lead on the exterior walls.

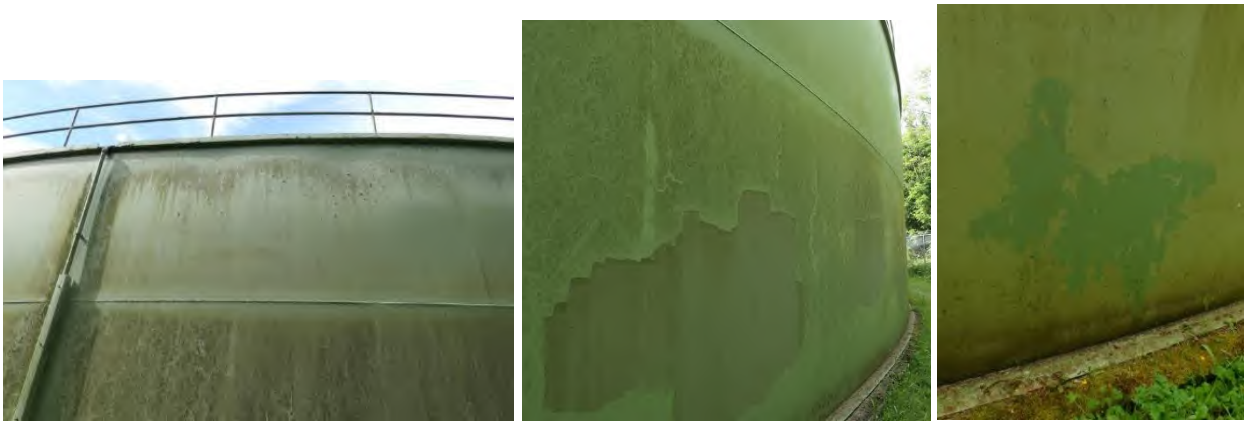


Figure 5-2: Exterior wall topcoat is dirty. Areas of graffiti cover are peeling. Underlying coating is sound.



Figure 5-3: The exterior walls has scratches (Left), areas of missing coating (Center), and heavier organic staining near the roof drains (Right).

5.2.1.3 Foundation

The reservoir's concrete ring foundation exhibited no visible settlement issues or major cracking. However, the grout layer was missing between the floor plate and top of footing, allowing for plants to grow between the structure and the foundation (Figure 5-4). There was some coating loss on the chime.

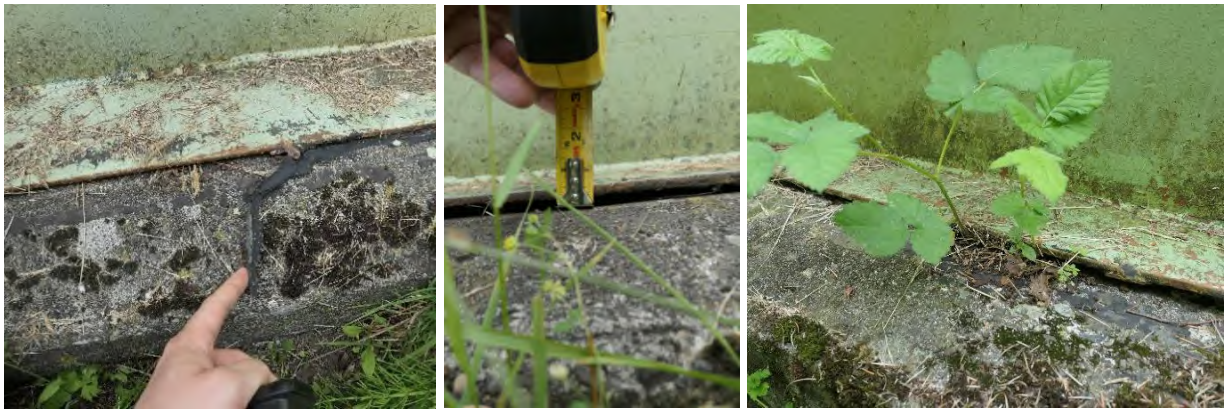


Figure 5-4: Missing grout at base and plants growing

5.2.1.4 Exterior Roof

Like the walls, significant buildup of organic material was noted on the roof. Larger tree debris was building up especially near the toeboard (Figure 5-5). There were areas of ponding noted where roof plates lapping inhibited drainage. Roof coating DFT measurements ranged from 5.4 to 11.1 mils, averaging 8.0 mils.



Figure 5-5: The roof of the reservoir's minor instances of ponding at the perimeter.



Figure 5-6: Areas of ponding were noted at the margins of roof plates.

5.2.1.5 Exterior Appurtenances

The roof drainage holes are approximately 2 inches in diameter. These drains have accumulated debris (Figure 5-7 Left). The pipes of the downspouts were corroding in a few instances (Figure 5-7 Right).



Figure 5-7: Some roof drains are clogged (Left) and the downspout is corroding (Right).

This tank has two circular side manways with 30-inch diameter openings (Figure 5-8). The exterior ladder has a lockable enclosure (Figure 5-9 Left). The roof railing is 42 inches tall and has a mid-rail 24 inches from the bottom and 18 inches from the top railing. Corrosion and peeling coating were noted on the handrail (Figure 5-10)



Figure 5-8: The 30-inch diameter manways



Figure 5-9: The exterior ladder's lockable enclosure's coating was peeling



Figure 5-10: Coating failure and rusting on the roof handrail

The roof entry hatch is a 30-inch by 36-inch clam style and had an intrusion alarm (Figure 5-11). This lid has an opening that is used for reservoir ventilation. The vented area is approximately 24 inches by 20 inches, and 6 inches tall. The screen openings are about 1/4-inch. The coating was failing on the exterior of the lid.

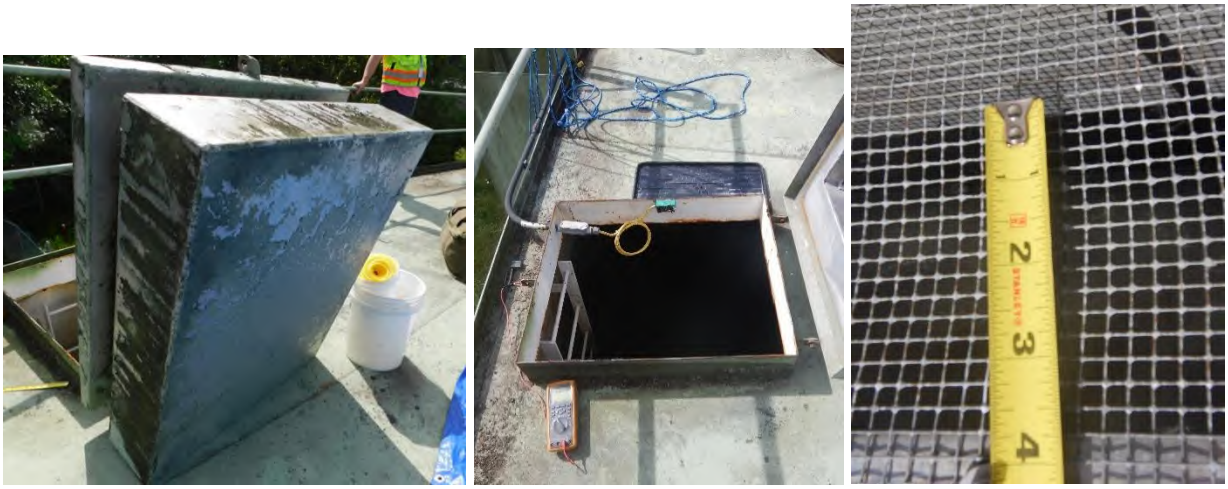


Figure 5-11: The roof hatch coating is peeling.

The roof vent is centrally located and has a roof penetration has a diameter of 8 inches (Figure 5-12). The hood is approximately 16 inches above the roof surface and is 24 inches in diameter. A frame holds the screen in place, reducing the free area air can travel through. The coating was failing on the exterior side of the hood. Heavy corrosion was noted on the underside of the hood and light corrosion was found on the roof below the vent. The screen has 1/4-inch openings.



Figure 5-12: The roof vent has corrosion on the underside and a coarse screen.

5.2.2 Interior Inspection Summary

5.2.2.1 Interior Walls

The interior walls had water staining below the waterline (Figure 5-13). There were minor, isolated instances of blistering (Figure 5-13 and Figure 5-14). The interior coating DFT measurements ranged from 7.3 to 20 mils with only a few small areas of low coating; typical high-performance coating DFT ranges are 12 to 20 mils. Measurements of plate thickness are shown in Table 5-1. Exposed steel locations below the waterline are in very good condition with no observed pitting.

To protect the walls from corrosion, a constant voltage model cathodic protection system is installed. On-site testing indicated that the corrosion protection criteria was being met at all testing locations. However, the stationary reference electrode used to operate the rectifiers auto potential circuitry appears to be failing as its readings are significantly more positive than normal.

It was noted that the rectifier was not functioning. Troubleshooting resulted in noting that the alternating current (AC) breaker for the unit was defective. As a temporary measure, the AC conductors for the rectifier were landed on an adjacent breaker in order to test the cathodic protection equipment. After testing, the rectifier was left terminated to the operating breaker.

A full corrosion report and report of the rectifier and structure-to-electrolyte potential data is included in Appendix C.

Above the waterline, the walls appeared to be impacted by general surface corrosion and crevice corrosion.

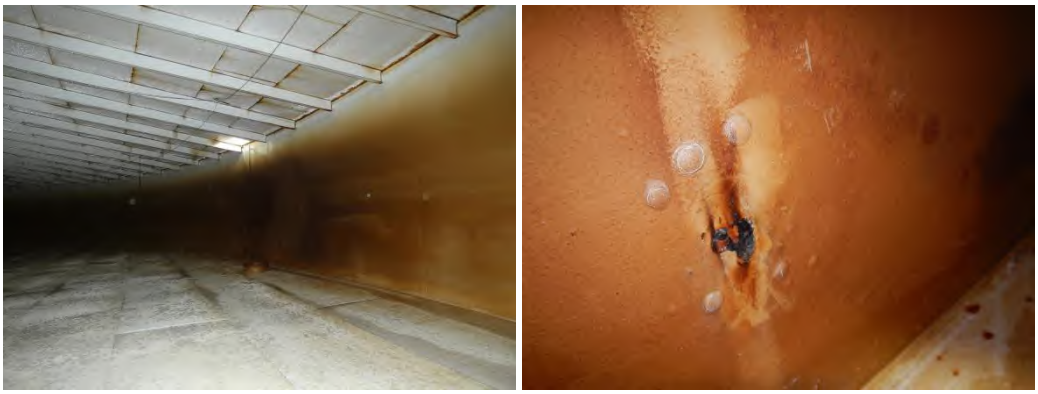


Figure 5-13: Interior walls exhibited water discoloration (Left) and minor blistering (Right).

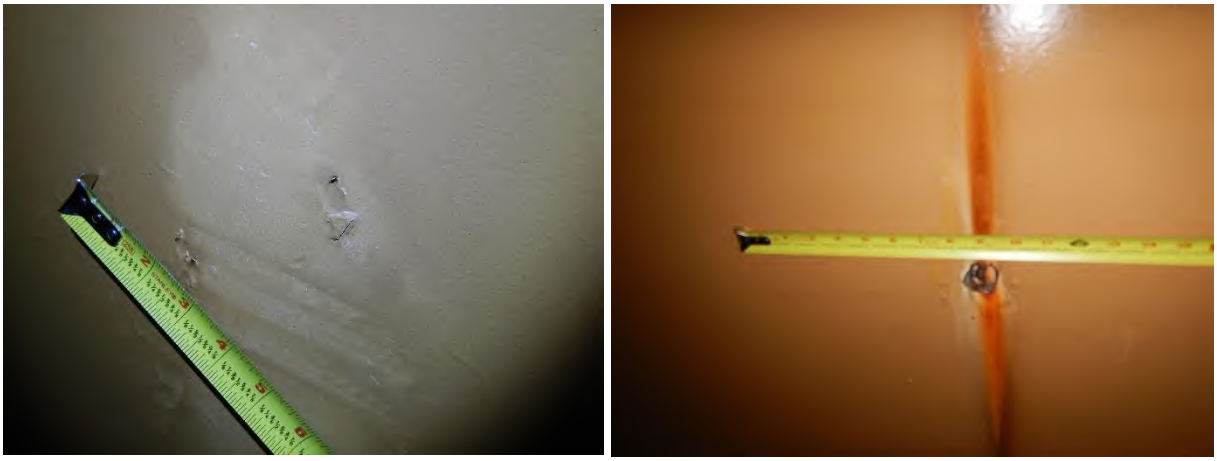


Figure 5-14: Minor isolated incidents of coating failure below the waterline

Table 5-1: Steel Plate Thicknesses

Location	Design Thickness (in)	Measured Thickness (in)
Roof	0.188	0.188
Top Course	0.375	0.397
Bottom Course	0.438	0.465
Chime plate	0.250	0.252

5.2.2.2 Floor

The coating on the floor (Figure 5-13 Left) was sound other than a few areas of bubbling (Figure 5-15). Measurements of coating DFT ranged from 5.5 to 14.5 mils on the floor. Some sediment was found near the base of the column.



Figure 5-15: Coating blisters on the floor.

5.2.2.3 Interior Roof and Columns

The interior roof exhibited light rust staining on the panels (Figure 5-16). The panels were deflecting at the edges and heavy staining correlated with areas of ponding on the exterior roof (Figure 5-17). The roof shows rust staining at all roof plate overlaps, typical for these non-seal welded areas. The structural components surrounding the access hatch and areas above the water level are experiencing general surface corrosion and crevice corrosion at steel overlap areas. Cathodic protection hangers were also rusting and in one instance, had fallen (Figure 5-18).

The columns exhibit similar rust staining as the walls (Figure 5-19). The bases of these columns have angle guides, which is atypical of water tank construction. These areas exhibited corrosion.



Figure 5-16: The roof panel light rust staining (Left and Center) and fasteners corrosion (Right).



Figure 5-17: Panels rusting, deflecting, (Left) and staining (Center). Support members also exhibited corrosion (Right)



Figure 5-18: The cathodic protection system holders are rusting (Left) and one has completely failed causing the anode to be supported only by its wires (Right).



Figure 5-19: Columns and column bases

5.2.2.4 Interior Appurtenances

The interior ladder did not have any fall protection devices. Like the walls, the ladder exhibited water staining below the waterline (Figure 5-20).



Figure 5-20: The interior ladder water staining below the waterline

5.2.3 Piping and Valving Inspection Summary

The inlet, outlet, and drain pipes are combined in a single 24-inch diameter pipe (Figure 5-21). This pipe is equipped with a silt stop, which was removed during the inspection and replaced after completion. It did not appear to sit flush with the floor. The interior of the pipe exhibited minor corrosion nodules. The drain piping was observed to have insect and bird screens (Figure 5-22). While the provided cover sheet indicates that the reservoir drains to sanitary sewer, staff reported that the reservoir drains to Whatcom Creek (Figure 5-23). The dechlorination system was not observed. This reservoir has no overflow.



Figure 5-21: The common inlet/outlet/drain with retrofitted silt stop



Figure 5-22: Drain piping (Left) and screen (Right).



Figure 5-23: Drain pipe outlet

Washdown operations can occur via a fire hydrant near the exterior ladder (Figure 5-9).

5.3 Condition Assessments

5.3.1 Cleanliness and Coatings

The exterior surface of the tank is dirty and has several areas of organic material accumulation on the roof and sidewalls. Specifically, the roof appeared to be hold significant organic debris, which is blocking a few the drains. After cleaning, the walls and roof will be in good condition. While the exterior coating is less thick than the it would be new, it is still performing. The instances of scratches and nicks are relatively minor. The coating loss on the exterior aluminum roof access hatch and ladder compartment are likely due to improper surface preparation and/or coating type. Typically, these appurtenances are left uncoated as they are non-corrosive if they are isolated from different metals. The railing and vent, which exhibited coating failure were assessed to be in fair and poor condition, respectfully.

The interior of the reservoir was clean. However, the coating on the interior roof is failing on most of the support beam edges, edges of steel plating, and areas of roof plate overlap. The coating appears to be generally intact below the waterline.

Overall, the cleanliness and coatings are assessed to be in fair condition.

5.3.2 Material Deterioration

The seal between the foundation and tank was found to be at the end of its useful life and is in poor condition.

The exterior of the shell is not corroding and is still in good condition. The railing and vent, which exhibited coating failure are experiencing corrosion and were assessed to be in fair and poor condition, respectfully. The vent's corrosion is occurring as the bare carbon steel is reacting with the bare stainless steel mesh resulting in galvanic corrosion.

On the interior, the rust colored water staining appears to be a cosmetic issue currently as steel thickness requirements are still being met. The areas of wall and floor corrosion are minor, so are overall in good condition. However, on the roof, corrosion is evident on most of the support beam edges, edges of steel plating, areas of plate overlap. These sites are prone to corrosion if a stripe coating is not applied during the coating process. As wet coatings cure, they tend to pull back from the corners and edges exposing the underlying steel. The application of a stripe coat provides and additional layer of coating thickness and protection against these losses. The roof's rust staining at all roof plate overlaps is due to the plates not being seal welded. Overall, the roof is in poor condition related to corrosion. To maintain the reservoir's structural integrity, the coating loss and corrosion should be addressed within the next five years.

5.3.3 Structural Performance

5.3.3.1 Static Analysis

Based on drawings and measurements, the roof framing, the roof plate thicknesses, rafters, and columns were all sized appropriately. However, corrosion issues can jeopardize roofs. Depending on the system hydraulics, without an internal overflow, this reservoir may be operated up to the roof level or even higher, causing roof damage. At the roof level of 17.5 feet, the shell was overstressed by only 2.5 percent. However, at the current maximum operating of 16.5 feet, the stresses were found to be within acceptable levels. The foundation is sized appropriately based on the findings of the geotechnical report. Other than the missing overflow, from a static structural perspective, the reservoir is in good condition.

5.3.3.2 Seismic Analysis

The reservoir's shell is adequate for the site's anticipated seismic loads. The slosh wave in this reservoir is estimated to be 3.6 feet high, based on the design seismic event. As a result, the operating height would need to be reduced to 14 feet to alleviate all slosh related loads on the roof components and roof rafter supports. The roof plates are not able to resist slosh wave-induced forces and would need to be welded to the rafters if impacted. Operating at a 16.5-foot

level would exceed the rafter's capacity. This reservoir was determined to be stable against overturning. At the current operating level, the reservoir is in poor seismic condition.

5.3.4 Water Quality/Sanitary

Although the common inlet/outlet/drainpipe configuration can cause problems with water quality, none have been reported. The diameter of this reservoir coupled with the combined inlet/outlet configuration are very likely causing improper mixing and stagnation within the Whatcom Falls I Reservoir. Often, diagnosing these issues requires robust sampling; no records of such sampling were supplied. To determine if adequate mixing is occurring, the City following measurements can be used:

- typical operational cycling time,
- time taken to fill and draw from minimum to maximum depths,
- time to turn over tank.

A functioning silt stop is also a current DOH best practice; this reservoir's silt stop appears to need a slight modification. Additionally, the screen on the vent and hatch were found to be out of compliance as they were not #24 mesh. The roof hatch would be classified as a "high-maintenance design" because of issues getting the gaskets to provide a tight seal against the relatively small surface area of the frame. The possibility of the roof leaking presents a minor risk to water quality as well. Due to these issues, the reservoir is in poor water quality condition.

5.3.5 Safety

Both the interior and exterior ladders are less than 24 feet high. Although no fall protection systems are required on these ladders, many shorter ladders have fall protection on them as an added safety measure. The perimeter roof railing is compliant. The roof hatch requires a roof hatch railing or temporary barrier. From a safety perspective, the reservoir is in good condition.

5.3.6 Operations and Maintenance

5.3.6.1 Site and Security

Based on the visible signs of vandalism, the fence at this site is not fully suitable to deter illicit access. However, an intrusion alarm is installed on the roof's access hatch. The soils adjacent to the reservoir were draining properly. Tall trees were found to be too close to the reservoir. Nearby trees endanger the structure, slow evaporation from the soil by the structure, and are causing organic material accumulation problems. The site/security is in fair condition.

5.3.6.2 Roof Drainage

The roof's steel plates were lapped in a fashion the allows water to pond. Also, the roof drains appear to be undersized for the amount of organic material that accumulates on the roof. While the blocked drains do not appear to have major negative impacts the structure yet, the condition appears to be affecting the shell coating. Based on our observation of ponding on the exterior roof surface and staining on the interior, a small amount of water may be seeping into the reservoir. Despite this minor evidence, the roof appears to be generally functioning as designed and in fair condition.

5.3.6.3 Appurtenances

No difficulties were found using the exterior ladder or hatches. Whatcom Falls I's vent met design requirements for roof penetration area and screened area with the existing 1/4-inch screen. However, the further constrained free area of the recommended #24 mesh would cause the vent to be undersized.

5.3.6.4 Valving and Piping

The staff did not note any operational difficulties associated with this reservoir. This reservoir drains to Whatcom Creek, so dechlorination and energy dissipation are required. Without an internal overflow, this reservoir would not meet the requirements of AWWA D100-11. In the event of an unforeseen problem, the water level within the zone may exceed the roof level and cause structural damage to the roof. Alternatively, system hydraulics can be further investigated if the City has preference on omitting the overflow.

5.3.6.5 Misc.

The currently inoperable cathodic protection system is in poor condition and needs to be serviced. While the rectifier unit is auto-potential, which accounts for fluctuations in water level, the defective AC breaker meant that the unit has not been turned on/functioning. The anode that is hanging by its wire could cause a short circuit if it touches the floor and needs attention immediately, ideally prior to or concurrent with replacing the AC breaker.

5.3.7 Obsolescence

Overall, the equipment on site appeared current and could be replaced in the event of failure.

5.3.8 Condition Scoring

Overall, the condition score of the Whatcom Falls I Reservoir was fair to good, at 3.8. It was primarily affected by the seismic score. Operated at above 14 feet, the roof would be affected by the slosh wave. Other issues include the failing coating and corrosion above the waterline in the

interior, the lack of an overflow pipe, and the cathodic protection system being in disrepair. A summary of the scoring is shown in Table 5-2 and the full Score Matrix is included in Appendix C.

Table 5-2: Condition Scoring of the Whatcom Falls I Reservoir

Categorical Scores	
Cleanliness and Coatings	3.5
Material Deterioration	4.2
Structural Performance - Static	4.0
Structural Performance - Seismic	3.5
WQ/ Sanitary	2.5
Safety	4.5
Operations & Maintenance	4.0
Obsolescence	4.7
Overall	3.8

5.4 Recommended Improvements

5.4.1 Cleanliness and Coatings

First, the exterior surfaces need to be pressure washed to remove dirt and other debris. On the exterior roof, the accumulated debris should be removed, and drains unclogged. The maintenance frequency of clearing debris from the roof is recommended to be increased until the tree spacing recommendation is met. The coating failures on the exterior walls and chime can be addressed with spot coating. The City can consider a full surface preparation and recoat of the chime as well. Exterior roof coating recommendations are dependent on the structural retrofits, outlined in Section 5.4.3.

For the aluminum exterior appurtenances, such as the ladder and roof entry hatch, the areas in contact with the roof should be checked to ensure they are not creating a metallic couple. If they are not, the coating can be removed from the surface and left as is. The steel appurtenances, such as the railing, roof vent, and drain downspouts can be addressed by removing the existing coating, preparing the surface with abrasive blasting, and recoating.

The ideal method of dealing with the intermittent corrosion below the waterline on the interior is to remove the loosely adhered coating material, exposing the underlying steel. The steel should then be abraded to provide a sufficient surface anchor profile. One to two inches of sound coating surrounding the defect should be scuffed to provide a rough surface per the coating manufacturer's recommendation. A repair coating, NSF-61 rated, should then be applied at a thickness of 8 – 10 mils in one or two coats. The discoloration on the walls can be addressed by agitation and/or detergent if the City wishes. The improvement for coating issues on the interior roof is dependent on the selected maximum operating level, discussed in Section 5.4.3.

5.4.2 Material Deterioration

Between the foundation and the tank, the failing grout should be removed back to either competent grout or the compacted oil sand base under the reservoir. Once the gap is cleared, it should be refilled with a non-shrink grout mixture, which meets the minimum thickness requirements as outlined by the manufacturer. Where grout cannot be placed, the gap should be packed with a backer material and sealed using an exterior grade elastomeric flexible caulking.

Any corrosion on the walls and floor can be addressed through spot treatment, outlined in Section 5.4.1. The improvement for corrosion issues on the interior and exterior roof is dependent on the selected maximum operating level, discussed in Section 5.4.3.

5.4.3 Structural

To address the roof issues resulting from the design seismic event, the City needs to lower the operating level to 14.0 feet or consider major retrofits. No effective intermediate storage volume exists as the roof is has a large diameter and does not have knuckle. The City should consider Options 1a and 2, with Options 1b and 1c only being considered if the City cannot employ Options 1a or 2. This work is recommended to be conducted within the next 5 years. For each of the following maximum operating levels, the following improvements are needed:

Option 1a (14.0 feet): Options 1a, 1b, and 1c would first involve an evaluation to ensure the roof is able to be retrofitted as corrosion may render this unfeasible. If repairs are feasible, Option 1a would involve removing the existing interior roof coating; seal welding the roof plates; repair of roof support joint connections, pits, and weld failures; proper surface preparation; recoating the interior roof; and spot treating the exterior roof coating.

Option 1b (14.5 feet): The code-level seismic slosh would impact only the exterior 10 feet of roof. The structure must first pass the retrofit evaluation to check the roof can be seal welded and allow the plates to be welded to the rafters. In addition to the requirements of Option 1a, the outer 10 feet of roof would need to be retrofitted by welding the roof plates to the rafters. It should be noted this will not meet current code since there will not be enough freeboard. However, the potential for damage would be reduced.

Option 1c (15.5 feet): The code-level seismic slosh would impact only the exterior 20 feet of roof. The structure must first pass the retrofit evaluation requirements of Option 1b, and the outer columns need to be found suitable for retrofitting. In addition to the requirements of Option 1a, the outer 20 feet of roof can be retrofitted by welding the roof plates to the rafters. The outer columns would also need to be retrofitted. It should be noted this will not meet current code since there will not be enough freeboard. However, the potential for damage would be reduced.

Option 2 (16.5 feet): This option would at minimum require the exterior 30 feet of the reservoir roof to be retrofitted. Our cost estimate indicates that this level of retrofitting the roof may be

uneconomical compared to installing a new roof. For planning purposes, a new shell course and new conventional roof can be considered. This reservoir is too wide to have a self-supported roof, so a conventional roof is required. This option eliminates the need to seal weld, abrasively blast, and recoat the exiting roof.

Should the reservoir continue operating without an overflow, a maximum water elevation of 17.5 feet would impact the outer 40 feet of the roof. During any retrofits, the City may consider lowering the overflow to ensure water level in the reservoir is not brought higher than the maximum allowable water level, depending on how this will impact other reservoirs in the 276 North Zone.

5.4.4 Water Quality/Sanitary

Robust Water quality monitoring is recommended in the reservoir as the common inlet/outlet/drain configuration and reservoir diameter are likely causing water stagnation. Separation of the inlet and outlet is likely, but other options can be explored during the design phase. Retrofits would likely resemble those implemented at the Marietta Reservoir where the inlet pipe extended to the other side of the reservoir and elevated. For budgetary purposes new piping is assumed.

Replacing the gasket will remedy the silt stop on the Whatcom Falls I Reservoir. Water quality risks can also be reduced by updating the screens to a #24-mesh with a 4-mesh screen backing on the roof vents, in accordance with DOH best practices. This will likely be addressed with a new vent, per Section 5.4.6.3. The gasket on the roof access hatch can be replaced with neoprene seals on both the frame and the lid or replaced with a hatch with better contact area.

5.4.5 Safety

The City can consider installing fall protection on the interior and exterior ladders, although this improvement is not mandated by L&I. As the access hatch is blocked on one side and has a railing on the other, a temporary railing would be a good option when work is conducted on the roof for this reservoir.

5.4.6 Operations and Maintenance

5.4.6.1 Site and Security

The security can be improved with fence retrofits, motion detectors, flood lights, and/or cameras. Trees that are closer to the reservoir than they are tall should be removed or transplanted. The cleared areas can be replanted with shorter growing shrubs on the perimeter to shield the reservoir from view. Because the reservoir is located in a park, removal of trees may not be feasible.

5.4.6.2 Roof Drainage

The roof drainage should continue to be monitored and maintenance frequency increased until the tree spacing requirement is met, or indefinitely if it cannot be met. The City may wish to upsize and retrofit these drains to account for the organic material load they are currently subjected to.

5.4.6.3 Appurtenances

A new vent system is recommended for the Whatcom Falls I reservoir. The penetration area needs to be approximately 3.0 square feet with a screened area of approximately 6.9 square feet to account allow for pressure relief. This could be achieved with a new centrally located, upsized vent or additional vent(s). Additional vents may also allow this wide reservoir to vent water vapor more efficiently. "Vent openings should never be… installed as an integral part of the roof hatch access structure." (DOH 2019), so the hatch vent should be removed.

5.4.6.4 Valving and Piping

The energy dissipation and dechlorination systems should be updated before the next time the reservoir is drained. Proper dechlorination at the Whatcom Falls I site could consist of a weighted system that is set in the manhole on site or a sturdy system that could be installed on the outlet pipe at Whatcom Creek. An example of a basket system is shown in Figure 4-21. The addition of an overflow is also recommended to meet AWWA requirements or system hydraulics confirmed.

5.4.6.5 Misc.

To extend the life of the coating below the waterline in the interior, the AC breaker should be repaired, a reference electrode installed, and the defective anode hanger replaced.

5.4.7 Capital Improvements Plan Table

Planning level costs for the retrofits to the Whatcom Falls I Reservoir are shown Table 5-3. This table is organized such that any roof repairs coincide with structural repairs, dependent on the updated maximum operating level. Wall and floor costs are assumed to be independent of the roof retrofits, so are included in the Cleanliness and Coating Section.

Table 5-3: Whatcom Falls I deficiencies, recommended improvements, and estimated costs

Category	Deficiency	Recommended Improvement	Estimated Cost
CLN & COAT	Organic material buildup on exterior	Pressure wash exterior	$ 2,000
	Organic material blocking roof drains	Remove organic material, clear drains, and increase maintenance frequency until tree spacing requirement is met	$ 2,000
	Intermittent exterior coating failure (walls and chime)	Spot Repair Coating	$ 7,000
	Exterior appurtenance coating failure	Remove coating on appurtenances. Prepare surface and recoat steel appurtenances	$ 10,000
	Intermittent interior wall and floor coating failure	Spot Repair Coating	$ 10,000
DETERIOR-ATION	Grout layer failure	Remove, fill gaps w/ non-shrink grout. Non-grout-able areas: fill w/ backer & caulking	$ 18,000
STRUCT & ROOF	Interior roof coating is failing and structural members are corroding. Roof impacted by seismic slosh. Intermittent exterior roof coating failure.	OPTION 1: Retain Existing Roof	
		a. Roof structural inspection	$ 3,000
		b. Abrasively blast interior roof and recoat after repairs	$ 503,000
		c. Seal weld roof plates.	$ 95,000
		d. Unforeseen roof joint connection repairs	$ 61,000
		e. Unforeseen roof pit and weld failure repairs	$ 24,000
		f. Spot repair exterior roof coating	$ 10,000
		(1a) Lower max operating level from 16.5 to 14.0 ft	
		Subtotal for Option 1a	**$ 696,000**
		(1b) Lower max operating level from 16.5 to 14.5 ft	
		g. Retrofit exterior 10 feet of roof	$ 230,000
		Subtotal for Option 1b	**$ 926,000**
		(1c) Lower max operating level from 16.5 to 15.5 ft	
		g. Retrofit exterior 20 feet of roof	$ 440,000
		h. Retrofit outer columns	$ 64,000
		Subtotal for Option 1c	**$ 1,200,000**
		OPTION 2: Maintain 16.5 ft operating level	
		a. Demo/remove old roof	$ 270,000
		b. New shell course	$ 130,000
		c. New Conventional roof	$ 1,100,000
		Subtotal for Option 2	**$ 1,500,000**
WQ	Inlet and outlet are combined and reservoir has large diameter leading to probable water stagnation	Improve inlet and outlet configuration, install hydrodynamic mixing system, associated piping improvements	$ 230,000
	Silt-stop not functioning	Retrofit silt-stop	$ 1,000
	Roof access hatch screen and vent screen non-compliant	Replace screens (addressed with new vent)	$ -
	Roof hatch is a high-maintenance design (small contact area). Hatch has screen.	Replace gasket w/ neoprene seals; removed screen portion and consider replacement	$ 1,000
SAFETY	Lacks roof hatch railing(s) or temporary barrier	Install roof hatch railing(s) or use temporary barrier	$ 1,000
O&M	Evidence of vandalism	Improve site security (w/ Whatcom Falls II)	$ 4,000
	Tree spacing recommendation not met	Tree removal and restoration	$ 33,000
	Poor roof drainage	Consider upgrades to downspouts	$ -
	Vent undersized	Replace roof vent	$ 15,000
	Energy dissipation and dechlorination non-compliant	Update energy dissipation and dechlorination system	$ 4,000
	Lacks internal overflow	Install overflow	$ 44,000
	Anode hanger defective	Replace anode hanger	$ 1,000
	Stationary reference electrode failing and rectifier's AC breaker defective	Replace reference electrode and AC breaker	$ 1,000

	Max operating Level (ft)			
	14	14.5	15.5	16.5
Subtotal	$ 1,080,000	$ 1,310,000	$ 1,584,000	$ 1,884,000
30% Contingency	$ 324,000	$ 393,000	$ 475,200	$ 565,200
8.7% Tax	$ 122,148	$ 148,161	$ 179,150	$ 213,080
Engineering, Administration, and Construction Management	$ 534,152	$ 647,906	$ 783,423	$ 931,798
Total Project Costs Estimate	$ 2,060,300	$ 2,499,067	$ 3,021,773	$ 3,594,079
Total Project Costs Estimate (rounded)	**$ 2,100,000**	**$ 2,500,000**	**$ 3,000,000**	**$ 3,600,000**

5.5 Conclusion

The most pressing issue with this reservoir it does not meet current seismic code at the current maximum operating level due to slosh impacting the roof. Retrofitting this wide reservoir would be a significant cost, so the City should evaluate if the maximum operating level can be reduced and how this will affect the 276 North Zone.

We recommend a full washout inspection of this tank next in 3 years. The roof should be inspected, and drains cleared frequently, especially in the fall, until the tree spacing recommendation is met. It is recommended the cathodic protection system be inspected by a corrosion engineer on a yearly basis. The cathodic protection system inspections entail checking the rectifier output and measuring the structure-to-electrolyte potential in the water at 2-foot increments from the roof hatch while the reservoir is in operation.

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Section 6

Dakin II Reservoir

6.1 Tank and Site Overview

The Dakin II Reservoir is a 68-foot diameter, partially buried, strand wrapped prestressed concrete reservoir (Figure 6-1). It has a listed storage capacity of 0.5 MG and was built in 1990. From floor to bottom of roof, the height is 19.5 feet. The dome roof is 4 inches thick at the center and has a thickened edge. Prestressing wire information can be found in the City-provided drawings and in the structural report in Appendix D. The overflow height is listed at 18.5 feet, which is 1-foot below the roof-to-wall interface. The operating range is 12 to 15.5 feet. This equates to an operational storage volume of 0.42 MG.



Figure 6-1: The Dakin II Reservoir, viewed looking northeast

The site where the Dakin I and II Reservoirs are located is within a forested area about 3 miles northwest of the Bellingham CBD. It is located within the 519 Dakin and Yew Zone, which is fed from the gravity zone via the Dakin and Yew Booster Pump Station. The Dakin Reservoirs also supply the 730 Alabama Hill Zone via the Balsam Lane Pump Station.

The geotechnical investigation found 15 feet of fill material around the reservoir, which consisted of medium stiff to stiff blue-brown silt with variable amounts of sand, gravel, and organic matter. This layer likely did not extend below the foundation of the reservoir. Chuckanut Sandstone was encountered at 15 feet bgs, which the reservoir is founded on. A thin layer of wood was found at

the interface between the fill and sandstone. Groundwater seepage was not observed at the final depth of boring.

With the nearest mapped faults being 5 and 10 miles away, there is not a significant risk of ground rupture at the site. Because the Dakin II Reservoir is bearing directly on bedrock, an allowable bearing pressure of 6,000 psf can be used for structural analysis. This contrasts the as-built design allowable bearing pressure of 4,000 psf. Bedrock is not at risk of liquification. This site has low risk of issues with slope instability.

6.2 Inspection Summary

A drained inspection of the Dakin II Reservoir took place on April 30, 2019.

6.2.1 Exterior Inspection Summary

6.2.1.1 Site and Security

To limit unauthorized access to the site, a chain link fence with barbed wire is about 12.5 feet from the walls (Figure 6-2 Left). The site is generally well-graded, directing runoff away from the reservoir. Tall trees were growing just outside the fence, contributing organic material accumulation to the roof (Figure 6-2 Right).



Figure 6-2: Perimeter fence and removed graffiti (Left) and leaves accumulating in the curbed roof from the nearby trees (Right)

6.2.1.2 Exterior Walls

The above-grade, visible portion of the exterior walls did not have any major issues. One 3-foot long area of efflorescence on the east side (Figure 6-3 Left). Alligator cracking was noted to encompass large areas, but the individual cracks appeared very minor (Figure 6-3 Right). On-site hammer sounding tests of the outer shotcrete layer indicate it is competent throughout the inspected areas. Graffiti and coverup areas were also noted (Figure 6-2 Left).



Figure 6-3: The exterior walls exhibit minor efflorescence and alligator cracking.

6.2.1.3 Foundation

The foundation was unable to be observed as the reservoir is partially buried.

6.2.1.4 Roof and Curb

The exterior roof of the reservoir exhibited only minor circumferential cracking in the middle of the dome (Figure 6-4). The total slope of the roof ranges from nearly flat at the center to approximately 17 degrees where the roof flattens out. The distance from the roof to ground level ranges from 14 to 21 feet.



Figure 6-4: Reservoir roof and vent

The reservoir wall extends above the roof resulting in a curb. Four roof drains are located along the perimeter but appear to be inadequate to handle the amount of debris which collects along the roof edge (Figure 6-5 Left). When debris were cleared away from drain openings the drainpipes were observed to be clogged. Access ports on the roof curb allow for the walls to be prestressed with steel threadbars (Figure 6-5 Right). The ports are generally filled with high-strength, non-shrink concrete to protect the threadbars from the elements. The seals were found to be missing and stress cracks with efflorescence were forming near some of the ports. Steel threadbars were exposed in eight of the 52 pockets.



Figure 6-5: Roof debris accumulation and blocked drains (Left). Some tensioning access ports on the curb were missing required fill and exhibited cracking with efflorescence (Right).

6.2.1.5 Exterior Appurtenances

A 14-foot exterior aluminum ladder provides access to the reservoir's roof (Figure 6-6 Left). This ladder was found to be missing an anchor point (Figure 6-6 Right).



Figure 6-6: The exterior ladder has a lockable enclosure but is missing one of the anchors.

The access hatch has a gutter inset into the curb (Figure 6-7 Left). A spider was found living inside of the roof hatch (Figure 6-7 Center). A 3-foot square penetration provides air exchange with the 2-foot diameter vent (Figure 6-4 Right). The roof vent's screen appeared to be coarser than #24 mesh (Figure 6-7 Right).



Figure 6-7: Roof access hatch (Left) with insect evidence (Center), and roof vent screen (Right)

6.2.2 Interior Inspection Summary

6.2.2.1 Interior Walls

The lower portions of interior walls were generally did not have observable issues, but mineralization was occurring along the upper portions throughout (Figure 6-8 Left). Many instances of cracking and staining were observed near the roof-to-wall interface (Figure 6-8 Right). There appeared to be organic staining as well.



Figure 6-8: Mineralization/cracking at roof-to-wall interface and overflow

6.2.2.2 Floor

The interior floor slab had no observed cracking or signs of failure. While mineralization observed, it did not appear to affect the structural integrity of the floor (Figure 6-9).



Figure 6-9: Mineralization on the floor

6.2.2.3 Interior Roof

The ceiling had a small area with rust staining (Figure 6-10 Left) and one crack with efflorescence (Figure 6-10 Right).

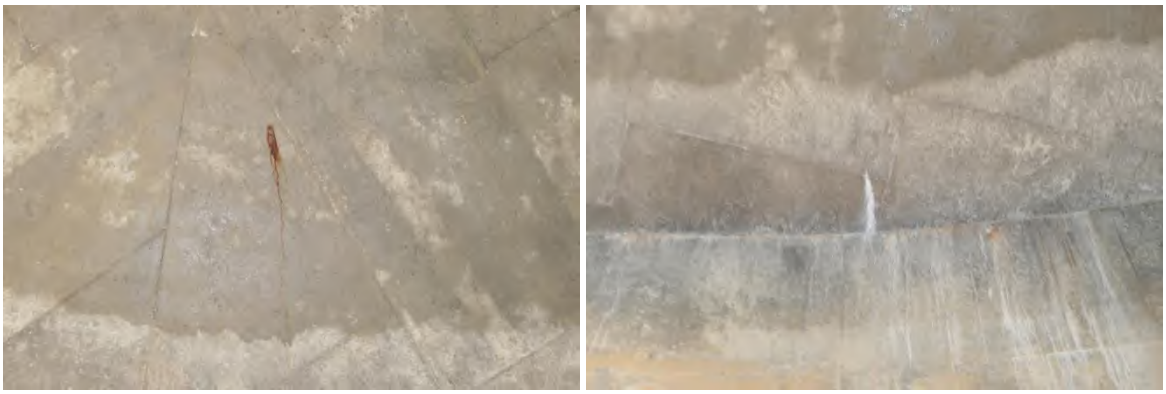


Figure 6-10: Minor roof rust staining (Left) and efflorescence (Right)

6.2.2.4 Interior Appurtenances

The interior aluminum ladder is anchored near the roof (Figure 6-7 Left) and at the base of the reservoir (Figure 6-11). Similar to the floor, there was mineral buildup (Figure 6-11) on the ladder. The ladder's galvanized cable style fall protection system was severely corroded and inoperable.



Figure 6-11: Mineralization on the aluminum ladder and corrosion on the fall protection system

6.2.3 Piping and Valving Inspection Summary

The combined inlet/outlet/drain piping (Figure 6-12 Left) had sediment accumulating at the bottom of the pipe (Figure 6-12 Center). The silt stop appeared to allow finer particles through; about half an inch of clearance was noted (Figure 6-12 Right). The overflow pipe is corroding at the floor coupling (Figure 6-12 Left), but otherwise did have signs of corrosion (Figure 6-8 Left). The overflow and drain pipes connect to the storm sewer without an air gap. The dechlorination is reported to occur in a storm drain manhole on site.



Figure 6-12: The common inlet/outlet/drain pipe with silt stop

A fire hydrant is located outside of the reservoir and is used in washdown operations. The hydrant had a black bag over it during our inspection.

6.3 Condition Assessments

6.3.1 Cleanliness and Coatings

The interior and exterior are uncoated. The exterior walls are clean. However, the roof has significant debris accumulation, clogging the drains. On the interior, there is minor aggregate accumulation and mineralization. While the interior was generally in good cleanliness condition, but the exterior was in poor condition due to the roof.

6.3.2 Material Deterioration

The exterior walls' efflorescence and alligator cracking instances are minor. Concrete deterioration is occurring on the curb (Figure 6-5 Right) and on the roof-to-wall interface (Figure 6-8). This may be a result of the roof drains not being able to handle the amount of organic material that has accumulated on the roof. Rainwater and snowmelt likely have a high residence time on the roof as the water has no way to efficiently drain. Freeze-thaw cycles of this retained water are detrimental to the roof-to-wall interface joint, causing or contributing to the observed concrete cracking and mineralization in Figure 6-8 (Right). In addition, the cracks in the curb and missing threadbar caps may be related to this issue. Overall, the curb and upper portion of the exterior walls are in poor condition.

Rainwater is naturally acidic and would become more acidic as it dissolves organic material on the roof. This low-pH solution, given time, is likely acidic enough to absorb the calcium carbonate in the concrete. The calcium carbonate would precipitate out of solution once in contact with the higher-pH water in the reservoir. The mineral depositions shown in Figure 6-9 may be the precipitate.

The corrosion and efflorescence issues on the interior roof shown in Figure 6-10, while minor, indicate that water has found its way through the roof slab in these areas. The rust staining indicates the reinforcing members are likely corroding within the roof's reinforcement.

The interior ladder's fall protection system and the base coupling of the overflow pipe are severely corroded. The ladder is made from aluminum and the fall protection system is made from galvanized steel; neither of which is ideal in an underwater environment. Further, having dissimilar metals in contact with one another induces corrosion. Ideally in underwater environmental, both would be constructed from stainless steel (or heavily/frequently coated) to limit corrosion. The overflow pipe coupling and interior ladder system are in poor corrosion-related condition.

6.3.3 Structural Performance

6.3.3.1 Static Analysis

The dome roof was found to meet requirements under AWWA D110-13. For wall reinforcement, the size and spacing of the prestressing was determined to be adequate. An overflow level of 18.5 feet would induce a soil bearing pressure of 2,500 psf. This is suitable based on the 4,000 psf and 6,000 psf allowable soil bearing pressures identified in the design documentation and geotechnical investigation report, respectively.

6.3.3.2 Seismic Analysis

At the 18.5-foot overflow level, the wall reinforcement was found to be suitable for the design seismic event. The strand wrap was found to be slightly out of code compliance at the overflow

level of 18.5 feet but was suitable at the current 15.5-foot maximum operating level. It is anticipated that a code-level seismic event would induce a 3-foot high slosh wave. While the roof would not be impacted at an operating level of 15 feet, the wave would be constrained at the 18.5-foot operating level. During such a constrained slosh event, the roof reinforcing appears to be suitable to protect the roof from damage. The reservoir hatch or other appurtenances may be damaged though, but no significant structural damage of the roof would be anticipated.

6.3.4 Water Quality/Sanitary

Although the common inlet/outlet/drainpipe configuration can cause problems with water quality issues, none have been reported. A functioning silt stop is also a current DOH best practice; this reservoir's silt stop appears to need some modification. As this reservoir drains and overflows to a storm sewer, DOH approved air gaps are required on both the overflow and the drainpipes. No air gaps are present on either pipe. The vent screen appeared to be coarser than the #24 mesh DOH recommends. Also, the access hatch is considered a high-maintenance-type design under current DOH guidelines as it can collect materials in the channels. A screen is required on the drain outlet, which was not installed. The spider living within the hatch is further evidence that the hatch needs modification. The roof-drainage issues pose a threat to water quality as well as water is apparently infiltrating into the reservoir. With these issues, the reservoir is in fair to poor condition from a water quality/sanitary perspective.

6.3.5 Safety

With the total fall distance from the exterior ladder being less than 24 feet, no exterior ladder fall protection is required. The City may wish to have a working fall protection system on this exterior ladder for safety reasons, however. The missing anchor was a noted deficiency on the exterior ladder. The roof lacks fall perimeter fall protection and a roof hatch railing or temporary barrier.

The total distance from the roof hatch to the floor of the reservoir being less than 24 feet, no fall protection is technically required on the interior ladder. However, in the interest of safety, such a system is desirable. As stated in Section 6.3.2, the ladder and fall protection system should be constructed from stainless steel. Overall, the safety is in fair condtion.

6.3.6 Operations and Maintenance

6.3.6.1 Site and Security

With the evidence of graffiti on the reservoir, the fence may not be suitable at this site. However, an intrusion alarm is installed on the roof's access hatch. The site drainage was found to be adequate. However, tall trees were found growing too close to the reservoir. Nearby trees endanger the structure, slow evaporation from the soil by the structure, are causing organic material accumulation problems, and their roots can penetrate the structure. Overall, the site/security is in fair condition.

6.3.6.2 Roof Drainage

The roof does not appear to be adequate to keep water from entering the reservoir, so the roof drainage is in poor condition.

6.3.6.3 Appurtenances

No difficulties were found using the exterior or interior ladders. The Dakin II Reservoir passed airflow capacity design requirements for the vent's roof penetration and screened area.

6.3.6.4 Valving and Piping

The staff did not note any difficulties associated with operating of the reservoir. Dechlorination likely needs improvement in this reservoir.

6.3.7 Obsolescence

Overall, the equipment on site appeared to be of newer design and would be easily replaced if needed.

6.3.8 Condition Scoring

Overall, the condition score of the Dakin II Reservoir was good, 4.5. Problems associated with this reservoir were related to the cracking on the roof-to-wall interface and curb, and apparent water infiltration. A summary of the scoring is shown in Table 6-1 and the full the full Score Matrix is included in Appendix D.

Table 6-1: Condition Scoring of the Dakin II Reservoir

Categorical Scores	
Cleanliness and Coatings	3.8
Material Deterioration	3.8
Structural Performance - Static	5.0
Structural Performance - Seismic	5.0
WQ/ Sanitary	3.5
Safety	3.8
Operations & Maintenance	4.4
Obsolescence	5.0
Overall	4.5

6.4 Recommended Improvements

6.4.1 Cleanliness and Coatings

While the exterior walls are generally clear of organic material buildup, the accumulation of organic material on the roof has likely been detrimental to the reservoir. This material should be removed, and the drains cleared as soon as possible to help prevent further damage to the structure. The maintenance frequency of clearing debris from the roof is recommended to be increased until the tree spacing recommendation is met. Roof-drainage and tree spacing improvements are discussed in Section 6.4.6. These improvements should occur prior to or concurrently with fixing the concrete, so the freeze-thaw cycles do not continue to degrade it.

6.4.2 Material Deterioration

The concrete deterioration issue should be dealt with in a timely fashion to keep this relatively new reservoir from experiencing structural issues. Degradation may be slowed if the roof is able to drain properly. The missing threadbar caps and other associated issues in the curb may be a result of the blocked drains and freeze-thaw cycle-induced strain the roof.

The cracks on the curb can be ground down to competent material. Any exposed metal can be coated and then the areas can be patched. For the missing threadbar caps, all the threadbar block-outs should be cleared of concrete. Block-outs should be safely cleaned out (threadbars are under high load) by a competent contractor familiar with prestressed concrete construction. After removal of the concrete, the top of the threadbars should be safely observed by a qualified structural engineer to determine if any additional issues are present which could adversely impact the performance of the vertical threadbar. Once inspected, any vertical threadbar issues should be corrected or repaired. After repair, all exposed surfaces (such as the concrete and the end of the threadbar) should be treated with a corrosion inhibitor/bonding agent (for example: Armetek EpoCem 100). After the corrosion inhibitor/ bonding agent has set, the block-outs should be filled with a high-strength non-shrink grout that does not contain chlorides.

Along the interior roof-to-wall interface, any cracked concrete should be removed, and the areas observed for additional corrosion. Where efflorescence and corrosion are noted, the areas should be removed back to component material. These areas should be coated with a bonding agent and patched. The exterior top and interior bottom of the roof-to-wall interface should be coated to prevent water infiltration through this joint. The areas of corrosion and efflorescence on the interior roof should be ground back, have metal treated, and patched.

The accumulated minerals on the floor may be removed during renovation activities. The corrosion on the overflow pipe coupling can be addressed by cleaning and recoating. Recommended improvements to the interior ladder are discussed in Section 6.4.5.

6.4.3 Structural

There are no structural improvements recommended on the Dakin II Reservoir.

6.4.4 Water Quality/Sanitary

Water quality should continue to be monitored as common inlet/outlet/drain configurations can cause water stagnation in the reservoir. Only a minor adjustment, such as a gasket, is needed to remedy the silt stop on the Dakin II Reservoir. Air gaps should be installed on the overflow and drain pipe for this reservoir. It may be possible to combine improvements with the improvements to Dakin I, which also requires an air gap on the drain pipe. As the combined drain/overflow pipe is underground, draining the entire reservoir via an air gap may not be possible. Should the site configuration not allow for the reservoir to be fully drained via an air gap, possible options are draining to daylight, an appropriately sized dedicated dry well with backflow prevention, or an air gap with a sump and sump pump that can pump water than cannot be drained by gravity.

The roof access hatch gutter drainage points should be screened to protect them. This will bring them into compliance with the DOH requirements for the sanitary protection or reservoirs. Finally, the vent screen should be replaced with a #24-mesh and a 4-mesh screen backing.

6.4.5 Safety

To address the safety concerns of the Dakin II Reservoir, the anchor should be replaced on the exterior ladder. Care should be taken not to impact the strand wrap of the reservoir during this process. Furthermore, the roof needs suitable fall protection, such as a railing. As the access hatch is blocked on one side and has a railing on the other, a temporary railing would be a good option when work is conducted on the roof for this reservoir.

The interior ladder's fall protection needs to be replaced. As the existing ladder is aluminum, replacement with a stainless-steel system would likely still cause corrosion. The best option would be to replace the entire ladder and fall protection with a stainless steel one. A Safety-Climb System or one of similar design is recommended. Alternatively, the ladder could be coated and re-coated routinely.

6.4.6 Operations and Maintenance

6.4.6.1 Site and Security

The City may wish to update the fence on site to further prevent vandalism. Other options include motion detectors, flood lights, and/or cameras. Trees that are closer to the reservoir than they are tall should be removed or transplanted. The cleared areas can be replanted with shorter growing shrubs on the perimeter to shield the reservoir from view.

6.4.6.2 Roof Drainage

Improvement of the roof drainage is essential, especially if the nearby trees cannot be removed to the recommended distance. The number of drainage ports can be increased from four to eight. The pipe size should be increased, and overflows installed should the pipes become blocked. An example of one such design is shown in Figure 6-13.



Figure 6-13: One retrofit option for the roof drainage to combat clogged drains

6.4.6.3 Appurtenances

There are no recommendations for the appurtenances at the Dakin II Reservoir.

6.4.6.4 Valving and Piping

Proper dechlorination of the Dakin II reservoir will need to consist of a weighted system that is set in the manhole on site. An example of a basket system is shown in Figure 4-21.

6.4.7 Capital Improvements Plan Table

Planning level costs for the retrofits to the Dakin II Reservoir are show in Table 6-2 .

Table 6-2: Dakin II deficiencies, recommended improvements, and estimated costs

Category	Deficiency	Recommended Improvement	Estimated Cost
CLN & COAT	Organic material blocking roof drains	Remove organic material, clear drains, and increase maintenance frequency until tree spacing requirement is met	$ 2,000
DETERIOR-ATION	Parapet is has cracks and is missing threadbar caps	Clear all threadbars block-outs, inspect threadbars, treat w/ corrosion inhibitor, fill w/non-shrink grout. Clean and patch parapet cracks	$ 55,000
	Cracks & efflorescence at roof-to-wall-interface. Corrosion and efflorescence on underside of roof	Remove cracked concrete, clean & coat reinforcement material, patch concrete, and coat exterior top and interior bottom of the roof-wall-interface	$ 60,000
	Corrosion on overflow pipe coupling	Clean and (re)coat	$ 1,000
WQ	Inlet and outlet are combined	Continue to monitor water quality; consider upgrades	$ -
	Silt-stop not functioning	Retrofit silt-stop	$ 1,000
	No overflow or drain air gap	Replace overflow and drain pipe	$ 132,000
	Roof hatch is a high-maintenance design (gutter type)	Add screen to access hatch gutter	$ 1,000
	Vent screen non-compliant	Replace vent screen	$ 1,000
SAFETY	Missing anchor on ext. ladder	Replace anchor	$ 1,000
	Lacks roof fall protection and roof hatch railing	Install roof fall protection and roof hatch railing	$ 43,000
	Interior ladder fall protection unusable	Replace interior aluminum ladder/ galvanized steel fall protection with stainless steel ones	$ 30,000
O&M	Evidence of vandalism	Improve site security	$ 4,000
	Tree spacing recommendation not met	Tree removal and restoration	$ 22,000
	Poor roof drainage	Add four drains, increase drain size, and add overflows	$ 32,000
	Dechlorination non-compliant	Update dechlorination system	$ 2,000
		Subtotal	$ 387,000
		30% Contingency	$ 116,100
		8.7% Tax	$ 43,770
		Engineering, Administration, and Construction Management	$ 191,404
		Total Project Costs Estimate	$ 738,274
		Total Project Costs Estimate (rounded)	**$ 740,000**

6.5 Conclusion

The most pressing issue with this reservoir is the inhibited roof drainage which has likely led to concrete issues at the roof-to-wall interface. Without correction, this issue will likely continue to degrade the reservoir. Removal of the organic material should occur immediately. Before structural retrofits and tree removal are complete, we recommend the roof and drains be inspected and cleared of organic material every 3 months and more frequently than that during the fall. After the roof drainage is improved and concrete repaired, the interior roof-to-wall interface should be inspected within 1 year to ensure the patch is functioning. The next washdown inspection should take place 5 years after the patch inspection. The reservoir should be leak tested as a first step of the next inspection.

Section 7

Kearney Reservoir

7.1 Tank and Site Overview

The Kearney Reservoir is a 130-foot diameter, partially buried, strand wrapped prestressed concrete reservoir (Figure 7-1). It has a listed storage capacity of 2.5 MG and is the newest reservoir in the City's system, built in 2006. From the floor to the bottom of roof, the height is 27 feet. The roof has an approximate 1.8-degree slope and is supported by (32) 18-inch diameter columns. Prestressing information derived from the City-provided drawings is included in the structural report in Appendix E. The minimum and maximum operating levels are 14.5 and 22 feet, respectively, which equates to an operational storage of 2.1 MG.



Figure 7-1: The Kearney Reservoir, viewed looking northwest

Kearny is situated between a new housing development and forested area in the north-central portion of the City water service area, about 3 miles north-northeast of the Bellingham CBD.

The below-grade, pre-cast piping valve vault for the reservoir is located 24 feet to the southeast. It is located within the 276 North Zone, which is fed via gravity from Whatcom Falls II. This configuration is why an overflow pipe was omitted. Per the City, the zone overflows at 276 feet City, which is 25 feet above the floor elevation of 251 feet City shown in the provided drawings.

The geotechnical investigation at the Kearney Reservoir consisted of seven test pits and two borings, performed prior to the Reservoir's construction in 2001. The borings were completed to depths of 18 to 28.3 feet. No fill was encountered, other than a very thin, 1-foot layer at one test pit in the 60 feet northeast of the reservoir. Glaciomarine drift was encountered in all explorations, ranging from 0 to 5 feet bgs. This soil consisted of gray to brown stiff clay with variable sand and

gravel/brown loose clayey sand with gravel and cobblestones. The borings indicate that Huntington Formation Bedrock (similar to the Chuckanut Formation) is found beneath the drift. The bedrock varied from siltstone, fine to coarse grained sandstone, to pebble conglomerate. During construction, the drift layer was excavated and replaced with a prism of roller compacted concrete (RCC), placed on the bedrock. Groundwater seepage was observed, ranging from 2 to 7.5 feet bgs.

With the nearest mapped faults being 5 and 10 miles away, there is not a significant risk of ground rupture at the site. Because the Kearney Reservoir is bearing directly on RCC and bedrock, an allowable bearing pressure of 8,000 psf can be used for structural analysis. Bedrock and RCC are not at risk of liquification. This site has low risk of issues with slope instability.

7.2 Inspection Summary

A drained inspection of the Kearney Reservoir took place on March 14, 2019.

7.2.1 Exterior Inspection Summary

7.2.1.1 Site and Security

To limit unauthorized access to the site, a chain link fence with barbed wire encompasses the property. A tree has fallen on the fence on the south side, damaging the fence (Figure 7-2 Left). Along the east side of the reservoir, a row of tress was planted about 18 feet away from the reservoir walls (Figure 7-2 Right). The site is set up such that water drains from the roof onto the ring road. A series of five catch basins are on the south side of the reservoir that are charged with collecting water. The access road is mostly flat, draining toward to reservoir. In many areas on the ring road, significant organic material is building up along the reservoir's perimeter (Figure 7-3).



Figure 7-2: Tree-induced fence damage by (Left) and east side trees



Figure 7-3: Organic material buildup on the ring road adjacent to the reservoir and wall staining

7.2.1.2 Exterior Walls

Between 1.5 feet and 8 feet of the 24.5-foot wall is buried. On either side of the ladder on the southeast side, areas of efflorescence were noted approximately 8 feet above grade (Figure 7-4 Left). Staining on the walls from roof drainage was found throughout the reservoir (Figure 7-4 Right). Shotcrete was crazing in some of these area (Figure 7-5 Left).



Figure 7-4: South wall efflorescence and Indications of roof drainage onto the walls.

"Sounding" of the walls around the perimeter of the reservoir was performed. Sounding is a process of tapping the reservoir's exterior surface to listen to the report of the hammer strike. A sharp "ping" sound is generally indicative of a competent shotcrete layer while a dull or hollow "thud" sound can be indicative of delamination within the shotcrete layer. While the shotcrete layer was stained in many instances, only two of the areas on the north side of the reservoir were found to be potentially delaminating. These two areas are shown on the right side of Figure 7-4 (Right) and close up is shown in Figure 7-5 (Right). This indicates that the shotcrete is no longer adequately adhered to the core wall in these areas.



Figure 7-5: Organic material on the ring road and heavy staining of exterior walls

7.2.1.3 Foundation

The foundation was unable to be observed as the reservoir is partially buried.

7.2.1.4 Exterior Roof

The exterior roof of the reservoir was mostly clean with minor organic growth only found upgradient of vents (Figure 7-6). It is sloped at approximately 1.8 degrees from the center to the perimeter. The roof is designed to shed water from the exterior walls with the slab overhanging and drip stop (Figure 7-7). The distance from the roof to ground level ranges from approximately 18 to 26 feet.



Figure 7-6: The exterior roof

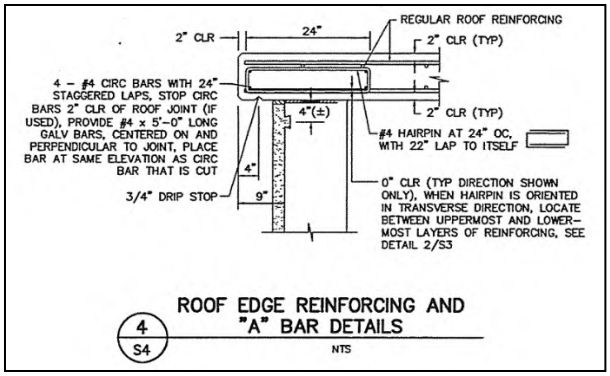


Figure 7-7: The roof overhang and drip stop design

7.2.1.5 Exterior Appurtenances

The exterior ladder (aluminum) has a lockable door were fully operational (Figure 7-4 Left). The railing stretched around the perimeter of the reservoir with a toeboard height of 6 inches and a top height of 43 inches (Figure 7-8 Left). The two 8-foot by 10-foot access hatches have a gutter inset into the curb (Figure 7-8 Left).

Two 46-inch square penetrations on the northwest and southeast quadrants with vent structures provide air exchange for the reservoir (Figure 7-8 Center). Although the mesh could not be inspected, plans and a previously-taken photo (Figure 7-8 Right) indicate that the mesh is 0.125-inch square openings with 14-gauge stainless steel wire cloth.



Figure 7-8: Roof access hatch (Left), roof vent (Center), and a supplied photo of the screen

7.2.2 Interior Inspection Summary

7.2.2.1 Interior walls

The interior walls did not exhibit cracking (Figure 7-9 Left). Formwork holes and epoxy injection ports, while overfilled in some instances (Figure 7-9 Right), which is only a cosmetic concern.



Figure 7-9: Interior walls did not have any observable issues (Left) other than. cosmetically, a few of the injection ports were overfilled (Right).

7.2.2.2 Floor

The interior floor slab had no observed issues of cracking or signs of failure. However, a significant amount of sediment covered the floor (Figure 7-10).

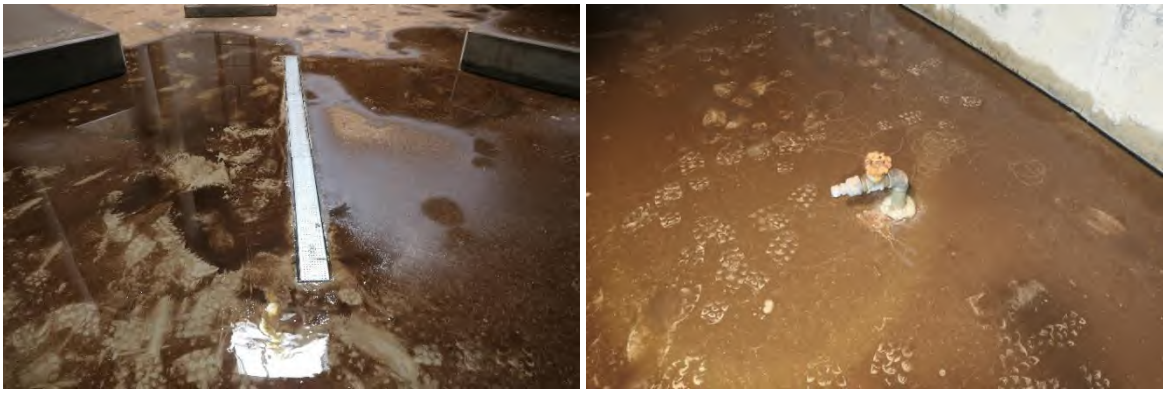


Figure 7-10: Sediment covered the floor.

7.2.2.3 Interior Roof and Columns

The ceiling was in was free of issues, other than incidental cracking around the exterior edge of the roof (Figure 7-11). Cracking was more pronounced near the column drop panels.



Figure 7-11: Minor roof cracking on the perimeter of the ceiling, localized near roof drop panels

7.2.2.4 Interior Appurtenances

The interior stainless steel ladder is anchored near the roof and at the base of the reservoir (Figure 7-9). The ladder's fall protection system was fully operational during our inspection.

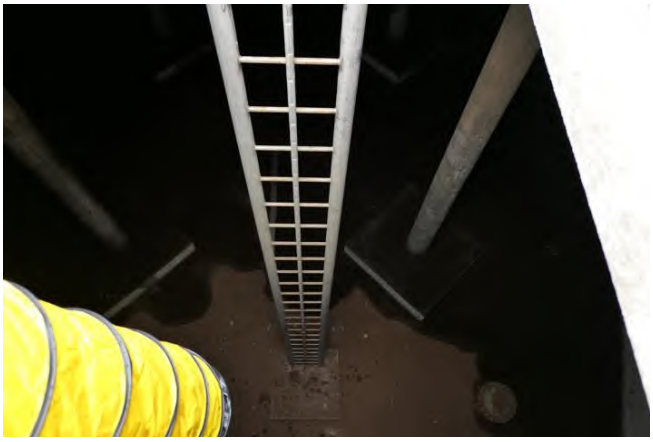


Figure 7-12: The interior ladder and fall protection were fully functional.

7.2.3 Piping and Valving Inspection Summary

The 20-inch inlet pipe had a metal flow director that exhibited corrosion (Figure 7-13 Left). The 30-inch outlet pipe is located on the opposite side of the reservoir (Figure 7-13 Right). The drains appeared to be functional (Figure 7-10 Left), but not have an observable mesh on the outlet (Figure 7-14). For dechlorination, the system appeared to treat water that overflowed, but did not treat water that drained directly to the stormwater detention basin on site. The overflow has not yet been installed (Figure 7-15 Left). The hose bibs used for washdown operations on the interior of the reservoir are corroding (Figure 7-15 Left). The control valve was operational (Figure 7-16).



Figure 7-13: The inlet (Left) and outlet (Right)



Figure 7-14: Exterior drain pipe (Left) and screen (Right).



Figure 7-15: The overflow penetration (Left) and one of two interior hose bibbs that exhibit corrosion (Right)



Figure 7-16: The control valve

7.3 Condition Assessments

7.3.1 Cleanliness and Coatings

The interior and exterior of the structure are uncoated. The exterior walls and roof have minor organic material, but the ring road has significant organic material accumulation.

The sediment accumulating on the floor indicates that the reservoir is due for a full washout inspection. There was missing or inadequate coatings on inlet flow director and hose bibs. Overall, the coatings are cleanliness are assessed to be in good condition.

7.3.2 Material Deterioration

The efflorescence on the south side of the reservoir may be the result of the differential backfill and "water-in-transit" which comes to the surface and evaporates on the south (sunward) face of the reservoir. Efflorescence is typically more of a cosmetic issue rather than a durability concern. Evaluation of the existing efflorescence did not note any additional associated issues such as delamination, cracking, or other failure of the shotcrete layer.

In contrast, the areas of staining and possible delamination noted on the northern extent of the reservoir are of higher concern. A driving force behind delamination is typically water infiltration between the core wall and shotcrete and subsequent freeze-thaw which not only causes the delamination but also makes these areas more suspectable to future water infiltration and delamination. Since the shotcrete was applied in multiple layers, three or four, some of the delamination can occur at these layers as well. Staining on these areas are indicative of roof drainage issues, which are discussed in Section 7.3.6. If these problems are not addressed, the delamination is likely to increase, and additional areas of delamination can be expected. The walls are, overall, in fair condition.

On the interior, corrosion is taking a toll on the hose bibbs and inlet flow director, which are in fair condition. These appurtenances will continue to degrade unless they are cleaned and (re)coated.

7.3.3 Structural Performance

There is no overflow installed on the structure. The City reports the reservoir overflows at 25 feet while, the design drawings indicate an anticipated overflow of 26 feet. The current maximum operating level is reported to be 22 feet.

7.3.3.1 Static Analysis

The roof slab was found to be sufficiently thick and reinforcing was found to be suitable based on current code requirements. Cracks in the roof along the perimeter are likely due to differences in stiffness between the drop panel and roof slab. These cracks appear relatively minor.

For vertical wall reinforcement, the size and spacing of the pre-stressing members were determined to be adequate. Columns were found to be suitable for anticipated design loads. An overflow level of 26 feet would induce a soil bearing pressure of 3,900 psf. This is acceptable based on the allowable soil bearing capacity of 8,000 psf noted in the geotechnical report.

7.3.3.2 Seismic Analysis

The seismic joints, strand wrap, and columns were all found to meet seismic code when operated up to the overflow level of 26 feet. The design seismic event would induce a 3-foot slosh wave at the operating level of 22 feet. This would not impact the roof, which is 5 feet above the overflow. The roof does have sufficient structural capacity to resist slosh impact at the 26-foot overflow level. The roof hatches/vents may blow out or be damaged from slosh during the design seismic event. This would likely be a localized failure or isolated damage to the hatch and isn't expected to impact the overall structural performance of the reservoir.

7.3.4 Water Quality/Sanitary

The inlet/outlet configuration appears to be suitable to facilitate adequate mixing within the reservoir. The drain pipe's air gap meets DOH requirements but may have been missing a proper screen. Based on provided drawings, the vent screens likely do not follow DOH recommendations with a #24 mesh. They are also configured in a way that makes it difficult to inspect the condition of the vent screens. Also, the access hatch is considered a high-maintenance-type design under current DOH guidelines as it can collect materials in the channels. Despite these minor issues, the reservoir is in good condition related to water quality/sanitary.

7.3.5 Safety

Fall protection on the interior and exterior ladders, and on the perimeter of the low slope roof were found to be compliant. The two access hatches did not have a railing or safety barrier, however, which are required. The reservoir is in good condition related to safety.

7.3.6 Operations and Maintenance

7.3.6.1 Site and Security

The fallen tree that has impacted the fence, which compromises the security of the site. Otherwise, the fence appeared to be suitable to prevent illicit access. Intrusion alarms are installed on the roof's access hatches. The trees along the east side are too close to the reservoir. There appeared to water held on the ring road adjacent to the reservoir, which likely is from the reservoir roof. Overall, the site/security is in fair condition.

7.3.6.2 Roof Drainage

The site and roof drainage may be a combined issue at the Kearney Reservoir. Rather than routing stormwater from the roof to the detention pond via roof drains and stormwater pipes, the structure is designed such that water drains from the roof overhang to the access road and then relies on the road's grade to convey it to storm drain catch basins on the south side of the site. For reference, a 1-inch rain event on the roof would cause to 2,300 gallons of water to be discharged onto the access road. The organic growth on the access road near the walls is indicative of excess water that is not draining from the site properly. Further, it appears that water is splashing on the ground and contributing to further staining of the reservoir (Figure 7-5).

Major drainage points from the roof can be random, dictated by minor variations in roof slope. The points of observed dark-colored staining on the sidewalls may be areas where flow is concentrated. Drainage of the roof appeared to not function properly throughout the reservoir. The drip stop shown in Figure 7-7 is possibly not sufficiently far from the walls. Water from the roof is apparently contacting the walls on this reservoir, which will continue to degrade the shotcrete if not corrected.

7.3.6.3 Appurtenances

No difficulties were found using the exterior or interior ladders. The Kearney Reservoir met design requirements for the roof vent penetration and screened areas.

7.3.6.4 Valving and Piping

The staff did not note any difficulties associated with operating of the reservoir. The current dechlorination system allows chlorinated water to enter to stormwater pond. A best practice

would be a dechlorination basket attached to the outlet of the drain pipe. Without an overflow, the reservoir would not meet the requirements of AWWA D110-13. In the event of an unforeseen problem, the water level within the zone may exceed the roof level and cause structural damage to the roof.

7.3.7 Obsolescence

Overall, the equipment on site appeared to be of newer design and would be easily replicable if needed.

7.3.8 Condition Scoring

Overall, the condition score of the Kearney Reservoir was very good, 4.6. Problems associated with this reservoir were related to the roof drainage and site drainage. A summary of the scoring is shown in Table 7-1 and the full Score Matrix is included in Appendix E.

Table 7-1: Condition Scoring of the Kearney Reservoir

Categorical Scores	
Cleanliness and Coatings	4.6
Material Deterioration	4.5
Structural Performance - Static	4.4
Structural Performance - Seismic	5.0
WQ/ Sanitary	4.4
Safety	4.5
Operations & Maintenance	4.3
Obsolescence	5.0
Overall	4.6

7.4 Recommended Improvements

7.4.1 Cleanliness and Coatings

The exterior, walls, roof, and ring road can be pressure washed to remove the efflorescence and organic material that has accumulated. The interior should also be washed out to remove the sediment accumulation on the floor.

7.4.2 Material Deterioration

While efflorescence is primarily cosmetic, it does consist of soluble salt-forming components. If these are allowed to build up for extended periods of time, these salts can result in a form of salt attack which can deteriorate and weaken the shotcrete. As efflorescence can be harder to remove over time, it is recommended that regular cleaning of the reservoir take place to removed existing efflorescence to both ensure the long-term adequacy of the shotcrete and to help remove any

issues which might obscure any underlying cracking which would otherwise be identified for repair. The efflorescence is expected to be dealt with by pressure washing. Any areas of efflorescence and crazing can continue to be monitored for growth and/or severity.

The concrete delamination on the exterior is likely a problem resulting from poor roof drainage; improvements are discussed in Section 7.4.6. While it may be possible to remove the shotcrete and assess the strand, we do not recommend this work be conducted at this time. If there are indicators of corrosion of the strand wrapping in the future, destructive testing should take place. Instead, sounding tests should be conducted at regular intervals by City staff to check if this issue is getting worse.

The corrosion on the interior pipe bend and hose bibb can be addressed by cleaning and recoating. If the hose bibbs are beyond repair, they can be abandoned and washdown water sourced from the exterior of the reservoir.

7.4.3 Structural

There are no structural improvements recommended on the Kearney Reservoir.

7.4.4 Water Quality/Sanitary

Because a compliant screen was not found on the drain pipe, an inspection should be carried out of this pipe and a DOH-compliant mesh installed on the pipe if it is found to be missing. The roof access hatch gutter drainage points should be screened to protect them. This will bring them into compliance with the DOH requirements for the sanitary protection or reservoirs. Finally, the vent screen should be replaced with a #24-mesh and 4-mesh screen backing. The City can also devise ways to make these screens observable for inspection.

7.4.5 Safety

Safety railings around the roof access hatches are recommended. Alternatively, temporary barriers can be used during inspections and maintenance.

7.4.6 Operations and Maintenance

7.4.6.1 Site and Security

The tree that has fallen should be removed and the fence repaired. The trees along the east side of the reservoir should be removed or transplanted. This area can be replanted with bushes that are not as tall, although impacts from root penetration are still possible at this distance. Site drainage improvements may be dependent on the selected improvement for roof drainage deficiencies, discussed in Section 7.4.6.2. Because the access road does not appear to be draining water away from the reservoir, the road should be regraded to increase the slope from the

reservoir. Generally, this is called out at a 2 percent minimum grade. Slopes less than this typically are difficult to install. The City may also consider improved stormwater conveyance system at this site if conditions do not improve.

7.4.6.2 Roof Drainage

Many options are possible to deal with the roof drainage issue. These improvements are essential to reduce the damage to the shotcrete and potential impacts to the strand wrapping underneath. A first step can be hosing down the roof during dry weather and observing where the water is draining. At minimum, the roof drainage should clear the walls in areas where dark discoloration is occurring but could be expanded to include the entire circumference. One such a retrofit is conceptually depicted in Figure 7-17. Care should be taken no to impact the underlying strand in the core wall or hairpins during these repairs.

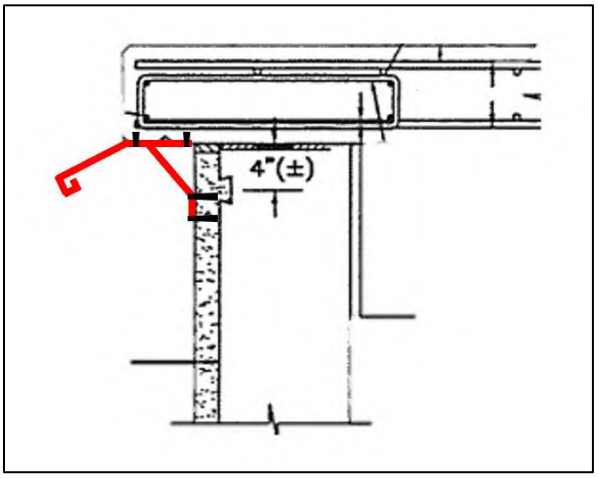


Figure 7-17: One retrofit option for the roof drainage to combat water contacting sidewalls

Alternatively, the entire roof can be improved with flow directors and a more robust drainage system with downspouts. The City can also consider piping water from new roof downspouts to catch basins. Fortunately, this reservoirs roof does not appear to be subjected to the high degree of organic material deposition as many of the City's other reservoirs. Piping this water may elevate the observed draining issues on the ring road.

7.4.6.3 Appurtenances

There are no appurtenance-related operations and maintenance improvements recommended on the Kearney Reservoir.

7.4.6.4 Valving and Piping

The dechlorination at the Kearney site could consist of a system that attaches to the drain outlet or a basket a weighted system that is set in the manhole on site. An example of a basket system is shown in Figure 4-21. A proper dechlorination system should be installed before the next time the

reservoir is drained. An overflow should also be installed to meet requirements of AWWA D110-13 or system hydraulics confirmed.

7.4.7 Capital Improvements Plan Table

Planning level costs for the retrofits to the Dakin II Reservoir are shown in Table 7-2.

Table 7-2: Kearney deficiencies, recommended improvements, and estimated costs

Category	Deficiency	Recommended Improvement	Estimated Cost
CLN & COAT	Efflorescence noted and organic material buildup on exterior and on ring road	Pressure wash exterior and ring road	$ 2,000
	Sediment accumulation on floor	Perform regular washdown inspections	$ 1,000
DETERIOR-ATION	Delaminating shotcrete on north sidewall	Monitor and track staining and delamination	$ -
	Corrosion on inlet pipe bend & hose bibbs	Clean and (re)coat	$ 1,000
WQ	Drain pipe screen non-compliant	Replace drain pipe screen	$ 1,000
	Roof hatch is a high-maintenance design (gutter type)	Add screen to access hatch gutter	$ 1,000
	Vent screen non-compliant	Replace vent screen	$ 1,000
SAFETY	Lacks roof hatch railing(s) or temporary barrier	Install roof hatch railing(s) or use temporary barrier	$ 8,000
O&M	Fence broken with tree	Remove tree and fix fence	$ 2,000
	Trees along east side too close	Tree removal and restoration	$ 4,000
	Ring road moist and has organic growth - does not appear to shed water	Upgrade site drainage. Dependent on roof drain improvements.	$ 50,000
	Roof drainage is not clearing exterior walls	Improve roof drainage	$ 20,000
	Dechlorination non-compliant	Update dechlorination system	$ 2,000
	Lacks internal overflow	Install overflow	$ 15,000
		Subtotal	$ 108,000
		30% Contingency	$ 32,400
		8.7% Tax	$ 12,215
		Engineering, Administration, and Construction Management	$ 53,415
		Total Project Costs Estimate	$ 206,030
		Total Project Costs Estimate (rounded)	**$ 210,000**

7.5 Conclusion

The most pressing issue with this relatively new reservoir is the shotcrete that is delaminating. Other areas stained with a similar pattern are likely to delaminate in the future. The City may wish to inquire with DN tanks to determine if this problem is covered by warranty. If not, the roof drainage should be improved.

The maximum water level in this reservoir could be increased from 22 feet to 26 feet and still meet structural code. If water can be hydraulically brought into the reservoir at this level, it may reduce pressure related issues in the Kearney Reservoir's service area.

Because the interior has sediment accumulation, we recommend this reservoir be prioritized in its next washout inspection. This should take place within the next 2 years. The reservoir should be

leak tested as a first step of the next inspection. We recommend City staff conduct sounding tests and map shotcrete discoloration and delamination extents every 6 months to start with. This will help determine if the delaminated areas are expanding or if additional areas of delamination are occurring. This frequency can be lessened if the roof drainage issue is resolved or if multiple inspections indicate no further deterioration or expansion of delaminating areas.

Section 8

Whatcom Falls II Reservoir

8.1 Tank and Site Overview

The Whatcom Falls II Reservoir is a 350-foot diameter, partially buried, strand wrapped prestressed reservoir (Figure 8-1). It has a listed storage capacity of 16 MG and was built in 1993. From the floor to the bottom of roof, the height is 23 feet. and is supported by (221) 24-inch diameter columns. Prestressing information derived from the City-provided drawings is included in the structural report in Appendix F. The minimum and maximum operating levels are 13 and 21 feet in the summer and 12 to 21 feet in the winter, respectively.



Figure 8-1: The Whatcom Falls II Reservoir, viewed from atop the Whatcom Falls I Reservoir, looking southeast

The site is centrally located within the distribution area, about 2 miles east of the Bellingham CBD. The site also includes the Whatcom Falls I reservoir and a pump station, which are not close enough to impact the structure during seismic event. The reservoir serves the 276 South Zone.

The geotechnical investigation at the Whatcom Falls II Reservoir consisted of six test pits, performed in 1992, prior to the Reservoir's construction. The pits were dug to depths of 1 to 15 feet. Forest duff was encountered in the first 0.5 or 1 feet of each test pit. Recent alluvium (dense silty sand), advance outwash (medium dense to very dense sand and gravel with occasional

cobbles), and glacial till (very dense silty sand with gravel) were encountered in the various test pits. Chuckanut Sandstone- Siltstone was also encountered at depths of 1-foot to 14 feet bgs. Groundwater was encountered in two test pits at 5.5 and 9.5 feet bgs. The as-built drawings indicate the alluvial soils were removed and replaced with structural fill. Thus, the reservoir is founded on dense glacial soils and structural fill.

With the nearest mapped faults being 5 and 10 miles away, there is not a significant risk of ground rupture at the site. Because the Whatcom Falls II Reservoir is bearing on dense glacial soils and structural fill, an allowable bearing pressure of 3,500 psf for wall footings and 4,000 psf for column footings can be used for structural analysis. The soils are not at risk of liquification. This site has low risk of issues with slope instability.

8.2 Inspection Summary

Floating and exterior inspections took place on June 12 and November 30, 2019, respectively. The reservoir was unable to be drained and an underwater inspection was unable to be conducted due to extenuating circumstances related to the COVID-19 outbreak.

8.2.1 Exterior Inspection Summary

8.2.1.1 Site and Security

To limit unauthorized access to the site, a chain link fence with barbed encompasses the Whatcom Falls I and II Reservoirs. The fence is 15 to 16 feet from the walls on all but the northwest quadrant where the site extends to the Whatcom Falls I Reservoir. The soils near the reservoir appeared to be wet. Tall trees were found growing just beyond the fence. (Figure 8-2).



Figure 8-2: Fence, adjacent trees, and access road (Left). Tire splashing (Right).

8.2.1.2 Exterior Walls

The exterior walls have a layer of shotcrete which protect the strand wrapping around the core wall. Many instances of graffiti-cover up were noted (Figure 8-3 Left). Staining on the walls from roof drainage was found throughout the reservoir including some areas that appeared to have concentrated flow with heavier staining (Figure 8-3 Right). There was a very minor crack with efflorescence along the southeast wall (Figure 8-4 Left) and minor cracking noted on the roof slab (Figure 8-4 Right). Sounding tests indicated the shotcrete is still adhered throughout the reservoir.



Figure 8-3: Graffiti covered and evidence of drainage from the roof contacting the sidewall



Figure 8-4: Minor cracks in the upper wall (Left) and roof slab (Right).

8.2.1.3 Foundation

The foundation was unable to be observed as the reservoir is partially buried.

8.2.1.4 Exterior Roof

The roof has a perimeter curb, ten drain locations, and retrofitted scuppers to allow the roof to shed water should the drains clog with debris. While the exterior roof (Figure 8-5) had minimal organic material building up during the summer inspection, there were minor instances of water ponding (Figure 8-6). During the fall inspection, the roof was covered with organic debris (Figure 8-7 and Figure 8-8). Many of the roof drains were clogged and water was pooling heavily. Many roof drains had the silt stops removed, although drains with and without silt stops were clogged with debris (Figure 8-9 Left). The downspout pipes appeared corroded (Figure 8-9 Right). The roof is designed to shed water from the exterior walls with scuppers in the event of drain clogs. The slab overhanging has a drip stop if the scupper clogs.

Inspecting the roof for structural issues, no major areas of visible structural failure. On the slab, only minimal, non-structural, pattern cracking observed. No additional cracking or signs of stress were noted around the solar array. The joints of the roof slabs did not exhibit structural cracking. The roof's slope was measured to be about 0 degrees near the edges and hatches. The distance from the roof to ground level is 21 feet, 4 inches.



Figure 8-5: The exterior roof



Figure 8-6: Roof in summer clear of debris with ponding and staining



Figure 8-7: Heavy organic material and ponding in the fall, roof railing



Figure 8-8: Clogged roof drains



Figure 8-9: Clogged drain with sediment (Left) and downspout pipes had corrosion (Right).

8.2.1.5 Exterior Appurtenances

The exterior stainless steel ladder has a lockable door and had sandpaper covering the rungs, except for the rungs where this sandpaper had fallen off (Figure 8-10). The roof railing stretches around the perimeter of the reservoir with a toe guard height of 4 inches and a top height of 42 inches (Figure 8-7 Right). Some of the nuts holding the railing in place were coming off or missing (Figure 8-11).



Figure 8-10: The exterior ladder has a lockable enclosure and has a safety climb rail.



Figure 8-11: The railing's bolts are at various angles and are missing nuts in a few instances.

The roof has seven 6-foot by 6-foot equipment hatches and six 3-foot by 3-foot access hatches. These hatches have a gutter inset into the curb (Figure 8-12 Left). Cracks were found in the frames of curbs of the hatches, some with significant efflorescence.

The reservoir has eight roof vents that open downward and have insect and bird screens (Figure 8-13). Water was found to be condensing and dripping allowing minor organic growth. There are

also 20 access ports on the reservoir (Figure 8-14 Right). The vents and ports had missing nuts on anchoring bolts.



Figure 8-12: The roof access hatch curbs are cracking and have gutter systems.



Figure 8-13: The roof vents and screen



Figure 8-14: Hardware missing on various roof appurtenances

8.2.2 Interior Inspection Summary

8.2.2.1 Interior walls

The interior walls did not exhibit cracking above the waterline (Figure 8-15). The interior walls were unable to observed below the waterline.



Figure 8-15: The reservoir's interior walls above the waterline

While cathodic protection systems are normally in place to protect steel tanks from corrosion, Whatcom Falls II has one installed to protect interior appurtenances. To measure output, a continuous metal circuit is generally made, which was not possible since the ladder at the #1 hatch was not in contact with the reinforcing steel. For testing purposes, the structure lead was connected to the rectifier's negative terminal, which are not as accurate as if a sensing ground were present.

8.2.2.2 Floor

The interior floor slab was unable to be fully inspected from the floating inspection but appeared to be in good condition (Figure 8-16). There did appear to be a minor amount of sediment buildup on the floor.

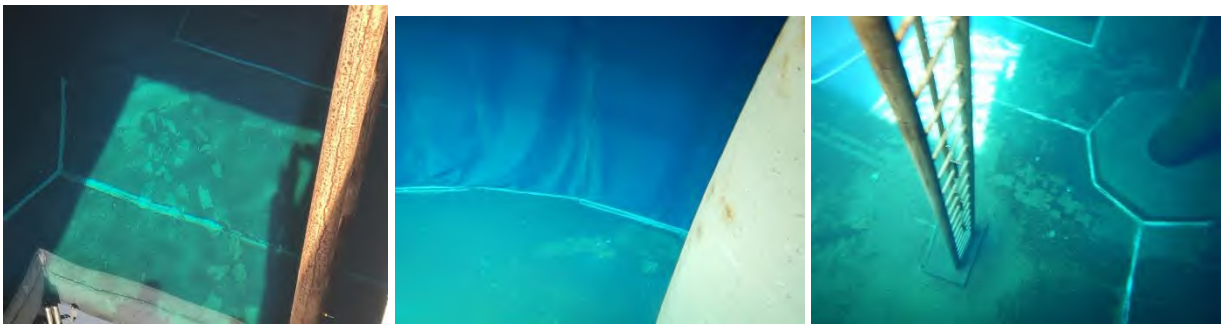


Figure 8-16: The floor appears to have minor sediment accumulation

8.2.2.3 Interior Roof and Columns

The interior roof (Figure 8-17 Left) did not exhibit structural cracking but was noted to have some minor cracking with efflorescent on the slab. Many of these areas had been sealed with epoxy injecting and coated. (Figure 8-17 Right), while others appear to be untreated (Figure 8-18). This cracking was primarily noted at the edges of some of the column drop panels.



Figure 8-17: Some cracking was noted on the perimeter of the ceiling, localized near roof drop panels.



Figure 8-18: Minor cracks were noted in the ceiling

8.2.2.4 Interior Appurtenances

The interior stainless steel ladders are anchored near the roof and at the base of the reservoir (Figure 8-19). The ladders' fall protection systems appeared to be fully operational during the inspections. Light rust staining was noted on the ladder rail and rungs. Heavy corrosion and material loss were noted on the inlet slide gate shaft. Minor rust staining was also noted on the chlorine injection system and curtain hangers (Figure 8-20 and Figure 8-21).

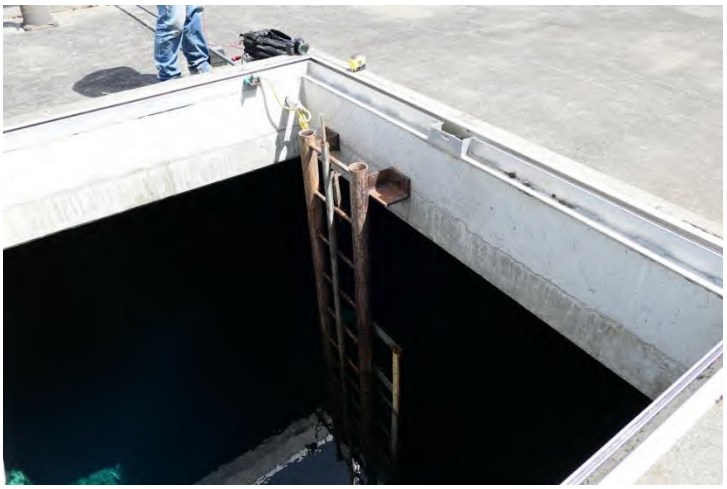


Figure 8-19: The interior ladder and fall protection minor rust discoloration

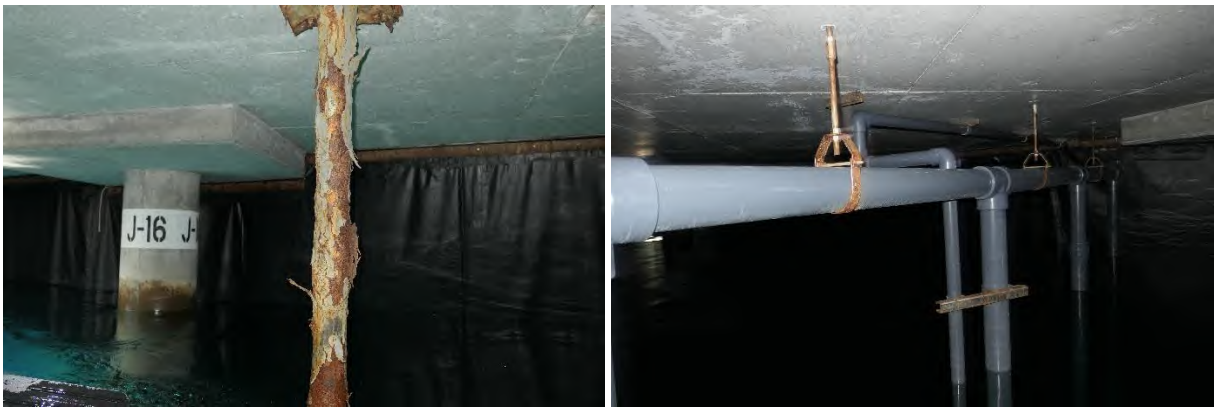


Figure 8-20: Heavy corrosion on the inlet slide gate stem (Left) and minor corrosion on the chlorine injection system hangers (Right)



Figure 8-21: The chlorine injection ceiling straps and baffle curtain mounts minor rust staining

8.2.3 Piping and Valving Inspection Summary

The 72-inch inlet pipe (Figure 8-22 Left) and the 60-inch outlet pipe (Figure 8-22 Right) did not have observable issues. The floor drains were not observed from the floating inspection. The drain piping was observed to have insect and bird screens (Figure 8-23). While the provided cover sheet indicates that the reservoir drains to sanitary sewer, staff reported that the reservoir drains to Whatcom Creek. The dechlorination system and outfall were not observed. No overflow is was noted on this reservoir.

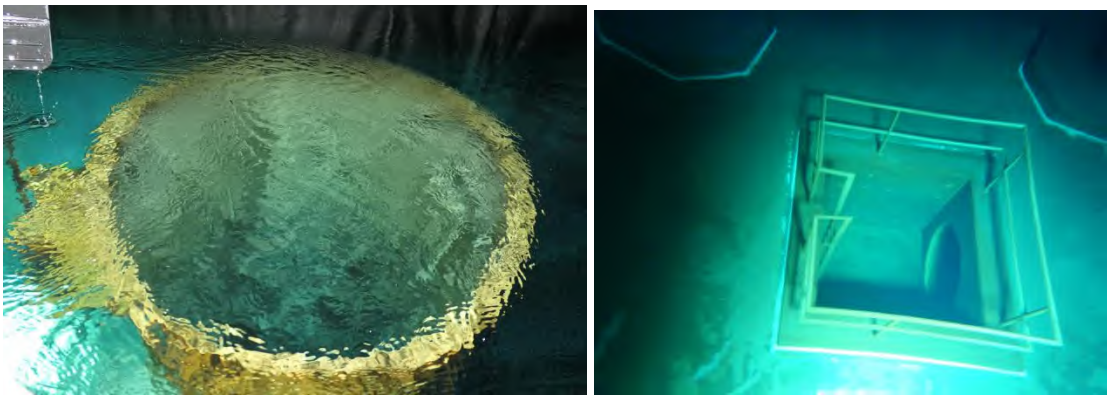


Figure 8-22: The inlet (Left and outlet (Right) pipes



Figure 8-23: Drain piping (Left) and screen (Right).



Figure 8-24: Drain pipe outlet to Whatcom Falls Creek

8.3 Condition Assessments

8.3.1 Coatings and Cleanliness

The roof was noted to have a large amount of accumulated organic debris, especially during the fall inspection. This debris originated from the adjacent vegetation and was in various stages of decomposition. This material was not present during our summer inspection. Thus, it is evident that the City clears the roof of debris as part of routine maintenance activities. The roof cleanliness was found to be in fair and poor condition during the summer and fall inspections, respectfully.

The staining on the exterior walls is discussed in Section 8.3.6. This discoloration appears to be cosmetic at this time as the shotcrete is still tightly adhered per sounding tests. This staining, if not corrected, may degrade the shotcrete, resembling what is occurring at the Kearny Reservoir (Figure 7-5 Right).

On the interior, the sediment accumulating on the floor indicates that the reservoir is overdue for a washout.

8.3.2 Material Deterioration

The cracking on the roof slab and alligator cracking in the structure appear to be minor. Some of the cracking may be due to roof drainage issues, discussed in Section 8.3.6.

According to the provided as-built drawings, the hatch curbs appear to have been constructed with two thinner sides and without the required hoop reinforcing. This is likely the reason the cracking is occurring at these areas. The missing hardware on the various external components may be occurring as the structure expands and contracts. Overall, the observed concrete of the structure is in good condition, but the concrete on the hatches is in fair condition.

On the interior, corrosion on the inlet slide gate stem was severe. Coating of this element may have been missed during construction. The rust discoloration of the other interior elements can be considered minor and are to be expected in such an environment. Overall, observed concrete deterioration and metal corrosion issues are minor on the interior, so it is in good condition.

8.3.3 Structural Performance

8.3.3.1 Static Analysis

The roof slab was found to be sufficiently thick and reinforcing was found to be suitable based on current code requirements, including the excess weight of the solar panels. Cracks in the interior roof slab near drop panels do present a structural concern currently.

For vertical wall reinforcement, the size and spacing of the pre-stressing members were determined to be adequate. Columns were found to be suitable for anticipated design loads. While the foundation design was found to be adequate for current codes, the soil's maximum bearing pressure would be exceeded at an operating level of 22 feet. This level is 1-foot higher than the current maximum operating level of 21 feet.

8.3.3.2 Seismic Analysis

The seismic joints, strand wrap, and columns were all found to meet seismic code when operated at a level of 22 feet. The design seismic event would induce a 34-inch slosh wave at the operating level of 22 feet. The roof structure was found to have requisite structural capacity to resist a slosh impact wave resulting from operating at a 22-foot operating level. While the hatches and vents would be clear of such a wave because they are in a raised curb, the chlorine injection system would be impacted by the wave. Additionally, the injection system was not observed to have diagonal bracing, protecting it from seismic event-induced lateral loading. Even if it were not affected by the wave, the piping is still susceptible to failure. The baffle system curtains tear strength would likely be greatly exceeded due to a code-level seismic event, meaning they would tear. Although this would likely not induce structural failure, the curtains could block the outlet.

8.3.4 Water Quality/Sanitary

The inlet/outlet configuration appears to be suitable to facilitate adequate mixing within the reservoir. The access hatches follow a design which is considered high maintenance under current DOH guidelines as these hatches can collect materials in the channels and are susceptible to pests without a screened outlet.

8.3.5 Safety

Because the fixed ladders are less than 24 feet tall, L&I does not mandate fall protection. However, the fall protection on these ladders were in working order. The perimeter railing on the low slope roof was also found to be compliant. The six access hatches and six equipment hatches did not have a railing or safety barrier, however, which are required. The safety systems on the reservoir are in good condition.

8.3.6 Operations and Maintenance

8.3.6.1 Site and Security

While the fence did not have any noted issues, the large amount of graffiti found on the reservoir indicates that this site's security is not functioning adequately. However, intrusion alarms are installed on the roof's access hatches. The wet access road around the reservoir indicates the soil adjacent to the reservoir may not be draining water away suitably. This may be caused or exacerbated by the roof drainage overflowing onto the area. Tall trees were found to be too close

to the reservoir. Nearby trees endanger the structure, slow evaporation from the soil by the structure, are causing organic material accumulation problems, and their roots can penetrate the structure. The site and security are in fair to poor condition.

8.3.6.2 Roof Drainage

The roof drainage is not operational with many of the drains fully blocked with debris. Only one of the ten roof drains had its cover in place while the other covers were strewn about the roof in various places. The existing drain downspout covers (Figure 8-25 Left) do not match the design (Figure 8-25 right).

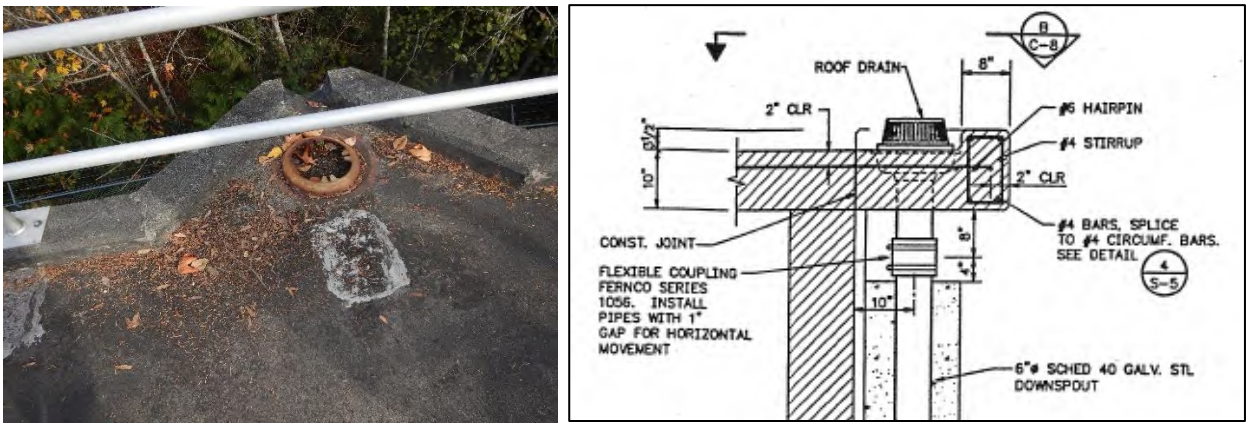


Figure 8-25: Comparison of the existing roof drain covers (Left) and the original design for the roof drains (Right)

It appears that neither these unspecified covers nor having the drains uncovered is suitable to facilitate adequate roof drainage with the organic material loads the roof is subjected to. If the covers are left in place, they appear to block water from flowing into the downspouts and instead route water to the scupper notch. This water would flow onto the adjacent access ring road. This is likely the reason these covers were removed from most of the drains. However, without any cover in place, many of the screens have become clogged with decomposing organic matter (Figure 8-8).

The ponding on the roof has caused the staining on the exterior sidewall. This is occurring either as a result of water draining through the shear cans or as water overtops the curb. Standing water migrating though the shear cans has been known to occur on reservoirs of this type of construction; the flow route for this is shown in Figure 8-26.

The other possibility for the sidewall staining is water overflowing the perimeter curb and draining onto the sidewalls. Should the scupper become so debris-laden water cannot drain, the curb would likely be overtopped. To check if water overtopping the curb would contact the sidewalls, water was poured onto the top of the curb during our inspection. This water was found to be contacting the sidewalls near where the staining has been occurring. This indicates that the drip

edge design is not suitable to keep water from contacting the sidewalls should the curb be overtopped. Water was noted to be near the top of the curb during our fall inspection.

Either mechanism for roof water contacting the sidewall presents an issue insomuch that water is retained on the roof when it should not be. The staining would likely cease when the roof drainage be improved. Should the roof retain standing water in the winter, the concrete may be stressed by freeze/thaw cycles. Cracking observed on the perimeter of the roof slab and upper portion of the walls may be due this process. Further, water held on the roof presents a concern for water quality as it may permeate through the roof.

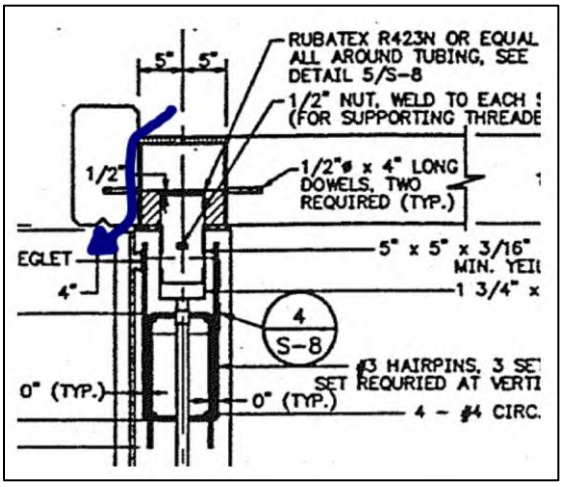


Figure 8-26: A possible route for standing roof water to contact the sidewall

With many of the drains being clogged, water is likely pouring off the scuppers (or overtopping the curb) during precipitation and snowmelt events. This may be inducing the muddy conditions encountered on the adjacent access road. For example, during a 1-inch rain event, each of the ten downspouts would be charged with handling approximately 6,000 gallons of water. A clogged drain would likely cause most of this water to be shed onto the access road.

The roof drainage problem is exacerbated by the roof being so gradually sloped that the flowing water may not force accumulated debris to the scuppers. Roofs on prestressed concrete tanks should be sloped at least 1.5 percent per AWWA D110-13. While the as-built drawing references this slope (Figure 8-27), a difference in elevation is 2.6 feet over the 175-foot radius is also indicated. This equates to a slope of only 0.85 degrees. The roof having a measured slope of 0 degrees and observed ponding at the perimeter indicates the roof slope is less than 1.5 degrees. If concrete reservoirs have a slope that is less than 1.5 percent, a "suitable coating or membrane… to prevent liquids from leaking into the tank," is required per AWWA D 110-13.

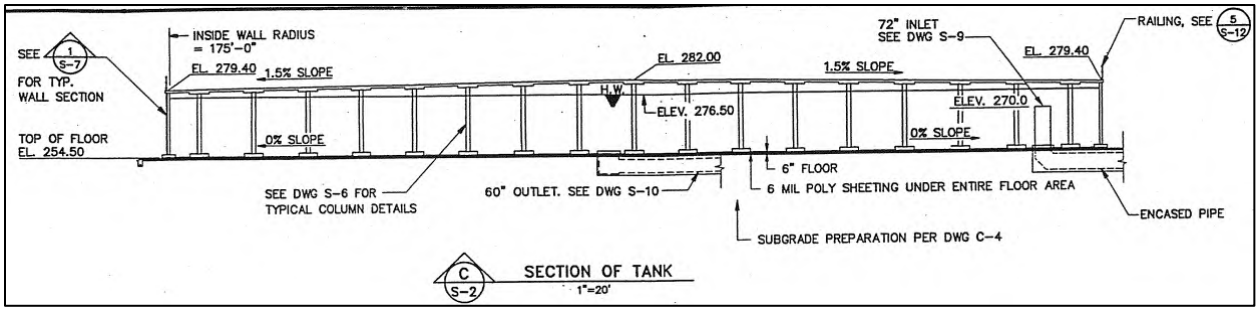


Figure 8-27: The roof's slope is 0.85 degrees, calculated with provided elevations.

Overall, the roof drainage is in poor condition with the current organic material loads.

8.3.6.3 Appurtenances

The appurtenances were, in general in good condition. No difficulties were found using the exterior or interior ladders. The Whatcom Falls II Reservoir met design requirements for the roof vent penetration and screened areas.

8.3.6.4 Piping and Valving

The operation of the piping and valving was not able to be assessed. It was not possible to drain this reservoir while meeting requirements for chlorine residual contact time. Thus, it was not possible to perform a full washdown inspection of the reservoir. This is a problem as there will be difficulties in performing future maintenance of the reservoir.

The drain piping appears to lack proper dechlorination and energy dissipation. Without an overflow, the reservoir would not meet the requirements of AWWA D110-13. In the event of an unforeseen problem, the water level within the zone may exceed the roof level and cause structural damage to the roof.

8.3.6.5 Misc.

The existing cathodic protection system transformer rectifier is a constant voltage model. Rectifier units for water tanks should be auto-potential in order to account for fluctuations in water level. Additionally, there is no continuous testing terminal to check out the cathodic protection system while it is on.

8.3.7 Obsolescence

Overall, the equipment on site appeared to be of newer design and would be easily replicable if needed.

8.3.8 Condition Scoring

Overall, the condition score of the Whatcom Falls II Reservoir was very good, 4.2. Problems associated with this reservoir were related to the roof drainage and inability to draw down the reservoir. A summary of the scoring is shown in Table 8-1 and the full Score Matrix is included in Appendix F.

Table 8-1: Condition Scoring of the Whatcom Falls II Reservoir

Categorical Scores	
Cleanliness and Coatings	3.6
Material Deterioration	4.0
Structural Performance - Static	4.3
Structural Performance - Seismic	4.3
WQ/ Sanitary	4.4
Safety	4.5
Operations & Maintenance	3.8
Obsolescence	4.3
Overall	4.2

8.4 Recommended Improvements

8.4.1 Cleanliness and Coatings

The accumulation of organic material on the roof may induce structural issues with the reservoir. Organic material should be removed, and the drains cleared as soon as possible to help prevent damage to the structure. Tree spacing and roof-drainage improvements are discussed in Section 8.4.6. Until at least one of these items is complete, the City should conduct more frequent maintenance of the roof, especially in the fall when organic material loading to the roof is heaviest.

The staining on the sidewalls should monitored for shotcrete delamination by the City. This would entail regular sounding tests and mapping of the staining to see if the area is expanding. In areas where staining is visible on the walls, the shear cans should be investigated to verify the concrete around them is still competent and they should be resealed where needed. Where the tops of shear cans can be observed in the roof, these cans should be coated to prevent any potential infiltration of water around the cans.

The interior should also be washed to remove the sediment accumulation on the floor. In lieu of a washdown, the City can consider having divers remove any accumulated sediment. A quote from LiquiVision is used for planning purposes.

8.4.2 Material Deterioration

To address the hatch curbs that are cracking, smaller cracks (<1/2-inch) can be resealed. For larger cracks, concrete can be chipped away and then the areas can be repaired with a high strength

non-shrink mortar/grout. For the missing and loose hardware on roof appurtenances, the hardware can be replaced with a Loctite to prevent them from moving.

The inlet slide gate stem appears too corroded to repair, and for planning purposes, it is recommended to be replaced. The City may also wish to investigate the gate as well which was not observable during the floating inspection.

8.4.3 Structural

To address the chlorination piping not being configured to resist lateral or slosh loads, vertical supports and horizontal bracing can be installed. Addressing the deficiencies in the baffle system needs to be fully addressed during the design phase of the project. One possible option would be to add seismic bracing to the baffling system which would likely consist of additional vertical supports that the curtain could be anchored to. Another option would be to prevent the torn curtain for the blocking the outlet of the reservoir. This could be an outlet structure or additional blocking and reinforcing of the baffling area closest to the outlet. Alternatively, contact time could occur at another site and the baffling removed completely.

8.4.4 Water Quality/Sanitary

The roof access hatch gutter drainage points should be screened to protect them. This will bring them into compliance with the DOH requirements for the sanitary protection or reservoirs.

8.4.5 Safety

Safety railings around the roof access hatches are recommended. Alternatively, temporary barriers can be used during inspections and maintenance if only a few of the hatches are opened at a time.

8.4.6 Operations and Maintenance

8.4.6.1 Site and Security

The security concerns of the site can be addressed by adding motion sensors, cameras, and/or floodlights. Trees that are closer to the reservoir than they are tall should be removed or transplanted. The cleared areas can be replanted with shorter growing shrubs on the perimeter to shield the reservoir from view.

8.4.6.2 Roof Drainage

Improvement of the roof drainage is essential to prevent damage to the core wall, shotcrete, tensioning members within the walls, and roof slab. It will also help the reservoir be resilient against environmental contamination through roof water infiltration. One way the roof drainage

can be resolved is by following the tree spacing recommendation. As the reservoir is situated in a park, we recognized removing many trees may not be feasible. As an alternative, the roof drainage should be able to handle the organic material loads the roof is subjected to. This could possibly be achieved through more regular cleaning, but retrofits are recommended. These retrofits could include one or more of following:

- Increasing the number of drainage downspouts and scuppers from ten to twenty.
- Widening of the overflow scuppers drainage point to allow material to more easily be flushed from the roof.
- Installation downspout caps, resembling those shown in the design drawings.
- Increasing the size of the downspout pipes.
- The addition of crickets to facilitate drainage to downspouts and scuppers. This is essentially a sloped surface which directs water away from the walls and to the downspouts. An example of such a system on a residential roof is shown in Figure 8-28.



Figure 8-28: Crickets facilitating roof drainage on a residential roof

To address the roof slope likely being less than 1.5 degrees, a roof lining would be the best practice. However, coating the 96,000-square foot roof would be costly. Also, the solar panels, and piping and wiring would need to be moved to allow for the coating process. Fortunately, there does not appear to be large scale infiltration into the reservoir currently. While the roof does not meet DOH recommendations, the interior of the roof and water quality should continue to be monitored. The City should plan to apply a coating to this essentially flat roof during its lifetime.

8.4.6.3 Appurtenances

There are no operational improvements recommended for the Whatcom Falls II Reservoir appurtenances.

8.4.6.4 Valving and Piping

The inability to draw down this reservoir is a major identified deficiency in the City's system. The City should consider redundancies in contact time to facilitate draw down. Drawdown of this reservoir would likely need to occur for periodic maintenance as the structure ages.

The dechlorination system on the drain pipe can be improved with a structure that attaches to the pipe or a basket that is set into the manhole, similar to that shown in Figure 4-21. A proper dechlorination system should be installed if/when the reservoir is drained. The energy dissipation can also be improved at the outlet. An overflow should also be installed to meet requirements of AWWA D110-13 or system hydraulics confirmed.

8.4.6.5 Misc.

To extend the life of the any metal below the waterline in the interior, the existing constant voltage rectifier should be replaced with an auto-potential unit. A sensing ground should also be installed on the Whatcom Falls II tank to facilitate future cathodic protection inspections.

8.4.7 Capital Improvements Plan Table

Planning level costs for the retrofits to the Dakin II Reservoir are show in Table 8-2.

Table 8-2: Whatcom Falls II deficiencies, recommended improvements, and estimated costs

Category	Deficiency	Recommended Improvement	Estimated Cost
CLN & COAT	Organic material blocking roof drains	Remove organic material, clear drains, and increase maintenance frequency until tree spacing requirement is met	$ 2,000
	Staining of exterior sidewalls	Monitor for shotcrete delamination. Investigate shear cans and reseal if necessary. Coat tops of shear cans visible from the roof slab surface.	$ 10,000
	Sediment accumulation on floor	Underwater cleaning (or washdown inspection)	$ 45,000
DETERIOR-ATION	Hatch curbs are cracked	Reseal smaller cracks (<1/2"). For larger cracks, chip away concrete and repair with high strength non-shrink mortar/grout	$ 7,000
	Missing and loose hardware on roof appurtenances	Tighten and replace hardware. Use Loctite	$ 1,000
	Inlet slide gate stem is corroded	Replace inlet slide gate stem	$ 8,000
STRUCT	Chlorination piping is not configured to resist lateral or slosh loads	Install vertical supports and horizontal bracing	$ 50,000
	Baffle system not designed to resist seismic loads	Seismic upgrades of baffle system, outlet protection, and/or contact time	$ 100,000
WQ	Roof hatch is a high-maintenance design (gutter type)	Add screen to access hatch gutter	$ 2,000
SAFETY	Lacks roof hatch railing(s) or temporary barrier	Install roof hatch railing(s) or use temporary barrier	$ 48,000
O&M	Evidence of vandalism	Improve site security (w/ Whatcom Falls I)	$ 4,000
	Tree spacing recommendation not met	Tree removal and restoration	$ 83,000
	Poor roof drainage. Ring road soils are saturated w/ moss growing.	Improve roof drainage or follow tree spacing requirement	$ 20,000
	Roof slope is less than 1.5 degrees	Monitor roofs for leaks and water quality. Plan for future membrane application	$ -
	Unable to draw down reservoir	Consider redundancies in contact time to facilitate draw down	$ -
	Energy dissipation and dechlorination non-compliant	Update energy dissipation and dechlorination system	$ 4,000
	Lacks internal overflow	Install overflow	$ 44,000
	Cathodic protection system is constant voltage model and lacks stationary reference electrode	Install automatically controlled potential rectifier and stationary reference electrode	$ 10,000
	Cathodic protection system lacks sensing ground	Install CP system sensing ground	$ 4,000
		Subtotal	$ 442,000
		30% Contingency	$ 132,600
		8.7% Tax	$ 49,990
		Engineering, Administration, and Construction Management	$ 218,607
		Total Project Costs Estimate	$ 843,197
		Total Project Costs Estimate (rounded)	**$ 840,000**

8.5 Conclusion

In conclusion, the Whatcom Falls II Reservoir's structure is in major compliance with the structural code. As this reservoir is one of the most important in the City's system, careful attention should be given to it. This reservoir should stay in service for many years to come, especially if the roof drainage issues can be addressed. The City should begin planning a way to meet contact time requirements, as at some point in the future, this reservoir will likely need to be brought offline. This is the largest system-wide deficiency we noted. If another way of providing contact time is implemented, it may address both the inability to draw down the reservoir and lack of seismic integrity of the baffling system.

Because the underwater inspection was unable to be conducted, we recommend the Whatcom Falls II reservoir is inspected again within the next two years. The reservoir should be assessed in a drained state or via an underwater inspection at that time. It is also recommended the City consider to removing any accumulated sediment or debris from the floor at this time. The next inspection should begin with a leak test of the structure if possible.

Section 9

40th Street Reservoir

9.1 Tank and Site Overview

The 40th Street Reservoir, shown in Figure 9-1, is one of five similar dome reservoirs that were built between 1958 and 1987. Drawings were prepared by John W. Cunningham & Associates for both the 40th Street and Reveille Reservoirs. With slight differences in dimensions, the five reservoirs are 0.3- or 0.5-MG reinforced concrete, self-supporting, domed roof hoppers that were originally built with common inlet/outlets/drains. The reservoirs were designed to hold water above the roof-to-wall interface. This reservoir is almost completely above-ground, and the roof of the attached valve vault is located about halfway up the reservoir's wall. It was built in 1961 and has a capacity of 0.5 MG.



Figure 9-1: The 40th Street Reservoir, viewed looking southeast

According to measurements taken in the field (Figure 9-2), the 40th Street Reservoir has an interior diameter of 60 feet. Dimensionally, the hopper base is 6 feet deep and the interior wall is 16.5 feet high. The overflow weir was measured to be 26.75 feet above the reservoir floor, which according to City-supplied documentation, corresponds to 696 feet. This height is higher than the top of the vertical wall. The ranges of operation are 20 to 23 feet. Reinforcement and concrete thicknesses of the walls and roof were shown in the provided drawings. The exterior roof and interior walls and floor of the 40th Street Reservoir were coated in 2010 using VersaFlex AquaVers primer and polyurea. The roof has a skid-resistant coating.

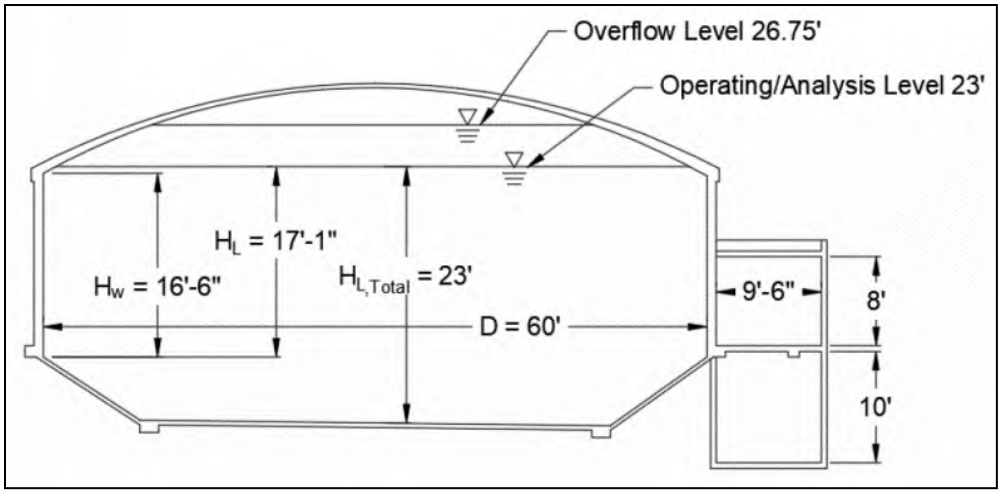


Figure 9-2: The measured interior dimensions of the 40th Street Reservoir

The 40th Street Reservoir is in the southern part of the distribution area, in a forested area about 2 miles south-southeast of the Bellingham CBD. The valve vault shares a wall with the reservoir itself and is 9.5 feet wide by 9.5 feet deep. Piping is run to the valve vault, encased in an unreinforced concrete block for protection under the footing. It serves the 699 Padden Yew Zone.

The geotechnical investigation indicated Chuckanut Sandstone from the surface to 5.5 feet bgs, where the boring could not be continued due to hard bedrock. Groundwater seepage was not observed at the final depth of boring.

With the nearest mapped faults being 5 and 10 miles away, there is not a significant risk of ground rupture at the site. Because the 40th Street Reservoir is bearing directly on bedrock, an allowable bearing pressure of 6,000 psf can be used for structural analysis. Bedrock is not at risk of liquification and the site is not expected to have issues with slope instability.

9.2 Inspection Summary

A drained inspection of the 40th Street reservoir took place on April 30, 2019.

9.2.1 Exterior Inspection Summary

9.2.1.1 Site and Security

To limit unauthorized access to the site, a chain link fence with barbed wire circles the reservoir about 12 feet beyond the walls (Figure 9-1). The site is generally well-graded, directing runoff away from the reservoir. During the site visit, it was noted that the roof of the reservoir is under the dripline of the trees on the southeast side (Figure 9-3).



Figure 9-3: The valve vault, exterior ladder, and hatch

9.2.1.2 Exterior Walls

In contrast to the City's other reservoirs of this design, this reservoir has much more of the exterior walls exposed, up to 14 feet. This is likely due to the bedrock at grade. As can be seen in Figure 9-1, there is cracking with efflorescence on the walls. Cracking was most prominent at mid-height and below the dome roof at the top of the wall. Isolated areas of topcoat failure were also noted (Figure 9-4 Right). On the bottom of the exterior, coating was missing, and moss was building up (Figure 9-5). The topcoat was found to be moderately tightly adhered, measured 5-8 mils thick, exhibited concrete loss at cracks, and was quite dirty.



Figure 9-4: The exterior walls cracking with efflorescence and coating failure of the topcoat



Figure 9-5: Missing coating and moss accumulation on bottom of tank

9.2.1.3 Foundation

The foundation was unable to be observed as it is just below the surface.

9.2.1.4 Exterior Roof

The roof of the reservoir had a textured non-slip finish, and was free of major cracking (Figure 9-6). However, leaves and organic material were found on the roof. No DFT measurements were able to be taken on the roof due to the textured coating. The roof had a grade that ranged from approximately 3 degrees near the vent to approximately 20 degrees near the reservoir roof's perimeter. The distance from the roof edge to the ground level is around 16 feet.



Figure 9-6: Organic material buildup on the roof (Left) and roof vent (Right).

9.2.1.5 Exterior Appurtenances

Two retrofitted ladders provide access to the reservoir roof (Figure 9-7 Left). The distance from the top of the roof curb of the ground level is approximately 9.5 feet. The distance from the grating near the access hatch to the roof of the valve vault is approximately 10 feet. As is typical with the

City's reservoirs of this construction, the retrofitted grating and safety railing extend only around the entry hatch and is missing a toeboard (Figure 9-7 Right). The entry hatch has a thin contact area with the lid and the gasket was not securely attached.



Figure 9-7: The exterior ladders and roof entry hatch

Because the sheet metal collar could not be removed, the 40th Street Reservoir's vent (Figure 9-6 Left) was assessed with the provided drawings and photos of the College Way Reservoir vent retrofit (Figure 9-8 Left). A 3-foot diameter penetration in the roof has a concrete vent structure above it. The concrete overhang is 4 feet, 2 inches. Approximately 2 inches of opening was exposed under the sheet metal collar. The screen was assumed to be similar to the Dakin I screen, woven with approximately 12 strands per inch. As viewed from the interior, the screen was found to be peeling off from the base of the roof with concrete spalling (Figure 9-8 Right). It is likely that the outer screen is still in place.



Figure 9-8: Provided photo of the College Way Roof Vent retrofit from January 2013 (Left) and photo taken of the vent from the interior of the 40th Street reservoir (Right).

The attached valve vault shares a wall and footing with the reservoir. The inlet, outlet, and drain pipes all run through the vault. The overflow runs through via an air gap, connecting with the drain pipe. The vault's roof has a curb that extends all the way around the perimeter of the roof (Figure 9-9).



Figure 9-9: The valve vault curb extends completely around without overflow drainage. The overflow pipe has an air gap. Organic material was building up on the vault roof.

9.2.2 Interior Inspection Summary

9.2.2.1 Interior walls

The coating on the interior walls made it difficult to determine the extent, if any, of the internal cracking of reservoir walls (Figure 9-10). A few areas of repair were visible and looked to be holding well. The measured DFT ranged from 80-130 mils; the specified DFT was 80 mils as per the supplied documents from the City.



Figure 9-10: The reservoir's vertical walls (Left) and hopper base (Right)

9.2.2.2 Floor

The floor was coated and covered by a thin layer of sediment, which made it difficult to inspect the condition (Figure 9-11). Some coating blistering of the floor was found; no blisters had burst.



Figure 9-11: The reservoir's floor was covered in sediment; visible coating bubbling but appeared to be intact.

9.2.2.3 Interior Roof

Concrete spalling was noted near the vent penetration (Figure 9-8 Right) but the roof only exhibited minor cracking and efflorescence in other areas (Figure 9-12).



Figure 9-12: Other than the concrete spalling near the vent, the reservoir roof did not exhibit major issues.

9.2.2.4 Interior Appurtenances

The interior ladder was rungs set into the wall. While the upper rungs within the access vault are still present, the rungs on the wall were removed during the coating process and have not been replaced. A removable ladder, tripod, and winch are used for inspections and maintenance.



Figure 9-13: Removable ladder and common inlet/outlet/drainpipe

9.2.3 Piping and Valving Inspection Summary

The combined inlet/outlet/drain piping exhibited corrosion nodules on the interior of the pipe (Figure 9-14 Left). The valve vault contained isolation valves and an altitude valve (Figure 9-14 Right). The overflow weir gate components (Figure 9-15 Left) exhibited corrosion. The overflow has an air gap (Figure 9-9). The drainpipe connects with the overflow and daylights to a vegetated area to the west of reservoir (Figure 9-15 Right).



Figure 9-14: The common inlet/outlet/drainpipe corrosion nodules (Left) and valving (Right).



Figure 9-15: Overflow weir (Left) and drain/overflow outlet without energy dissipation or a screen and poor dechlorination (Right).

A hose bibb for washdown operations is located within the valve vault.

9.3 Condition Assessments

9.3.1 Cleanliness and Coatings

Based on the inspection results, the exterior coating needs cleaning to extend its life 10 years (+/-) into the future. The areas of missing coating near the base also indicate a fair condition of the exterior coating system.

There is a moderate layer of sediment on the floor of reservoir. The internal coating blisters on the reservoir floor are due to groundwater effects or improper coating application. If caused by groundwater, infiltrated rainwater would likely be transmitted laterally on the relatively impermeable bedrock which the reservoir is founded on. Water beneath the reservoir would exert an upward pressure on the its base inducing bubbling in the coating. If coating application is the culprit, the maximum time between primer and polyurea may have been exceeded. At any rate, the blisters have not yet burst and do not appear to be an issue at this point. As these bubbles are not cracking and haven't burst, the coating is still functioning, and is in good condition.

9.3.2 Material Deterioration

Significant concrete deterioration was noted throughout the exterior, which needs attention. Because this cracking is structural in nature, it is discussed in 9.3.3.1. The interior coating has likely significantly decreased the rate of efflorescence accumulation around the exterior cracks as water is inhibited from passing through the concrete.

On the interior, the concrete spalling near the roof vent is likely a result of the reinforcing placed with inadequate thickness of concrete. Water can corrode the reinforcing members, causing the rust to expand and the concrete layer to cleave. Observing at the surface, the breaks are flat and

shallow which seems to support this as a possible failure method. The vent is in poor condition due to this concrete failure and screen peeling.

The combined inlet/outlet/drain piping was in poor visual condition with the corrosion nodules. Corrosion noted on the overflow weir gate components is moderate.

9.3.3 Structural Performance

9.3.3.1 Static Analysis

The dome roof was found to meet modern requirements of AWWA D110-13. However, the roof-to-wall interface is not designed to allow for roof expansion and contraction, which has resulted in cracks. Based on the provided design drawings, the wall reinforcing is adequate to handle the 23-foot maximum operating level. Cracks along the midline of the reservoir are likely caused by the walls being under reinforced. The maximum level the reservoir could be operated while still meeting static requirements is 18 feet. Another reinforcing deficiency is the inside face of the upper walls have reinforcing that is spaced 24 inches on center, which exceeds ACI 350.3's maximum allowable spacing of 12 inches on center. The foundation was found to be sized appropriately, based on the geotechnical report's soil maximum bearing capacity of 6,000 psf.

9.3.3.2 Seismic Analysis

With the walls' reinforcing already failing under static loads, they further fail design requirements for seismic forces. The operating level would need to be further reduced to 16 feet to meet design requirements. At the 23-foot operating level, the design seismic event is estimated to induce a constrained slosh wave. However, the roof reinforcing is suitable to handle the additional load. The valve vault attachment is suitable to prevent differential movement and impact during the seismic event. Based on assumed backfill conditions, the hopper base is not likely to fail and collapse onto the piping. However, the pipes do not have flexible couplings which would address potential differential settlement between the two structures during a seismic event.

9.3.4 Water Quality/Sanitary

Although the common inlet/outlet/drainpipe configuration can cause problems with water quality issues, none have been reported. A removable silt stop is required on combined drains/outlets but was not installed. Since the reservoir drains and overflows to daylight, DOH approved air gaps are not required. The missing screen on the drain/overflow outlet and damaged screen on the vent could lead to water quality issues in the reservoir. While the screen on the vent could not be carefully measured due to the sheet metal collar, it does not appear to be 24-mesh screen backed with 4-mesh screen. The roof hatch would be classified as a "high-maintenance design" because of issues getting the gasket to provide a tight seal against the relatively small surface area of the frame. The gasket not being fully adhered could potentially lead to water quality issues within the reservoir. Overall, the water quality/sanitary condition of the reservoir is fair.

9.3.5 Safety

With the distance being about 10 feet on the exterior ladders, no ladder fall protection system is required. This concrete dome reservoir has a higher distance from the roof to the ground than any of the other dome reservoirs, about 16 feet. Additionally, this roof would be considered steep, as the greatest slope is greater than 4:12. Thus, fall protection on the reservoir and valve vault roofs is required. A toeboard is also required on the existing grating and around the reservoir to protect workers below from dropped items.

With the fall protection and ladder on the interior of the reservoir being non-existent, a removable ladder, tripod, and winch were required for our inspection. While this configuration appears to meet L&I requirements, there is inherent risk of using a tripod mounted on a vault and a removable ladder. While the exterior ladder safety condition is good, the roof and interior ladder safety condition is poor.

9.3.6 Operations and Maintenance

9.3.6.1 Site and Security

The fence was found to be suitable for this reservoir, the site graded appropriately, and the soils drained adequately. An intrusion alarm is installed on the roof's access hatch. Trees were too close to the reservoir. Nearby trees endanger the structure, slow evaporation from the soil by the structure, are causing organic material accumulation problems, and their roots can penetrate the structure. Overall, the site/security is in fair condition.

9.3.6.2 Roof Drainage

The reservoir roof sheds water adequately. However, drainage of the valve vault roof appeared to not function in the event of a drain clog. If the drain were to be clogged, the roof would overflow the curb; no notches or overflow scuppers are present that would send water away from the reservoir. There are apparently no waterstops installed between the reservoir and valve vault.

9.3.6.3 Appurtenances

No difficulties were found using the exterior ladder. However, accessing the interior of the reservoir is more difficult than other style reservoirs as the tripod, winch, and removable ladder must be lifted to the roof. However, the access vault did have a ladder on the side, which made it easier to access the hatch than the other domed reservoirs. The 40th Street Reservoir met design requirements for the vent on the roof penetration, screened area, and free area on the retrofitted collar.

9.3.6.4 Valving and Piping

The staff did not note any difficulties associated with operating of the reservoir. However, the dechlorination and energy dissipation from the drain/overflow pipe did not appear to function properly.

9.3.7 Obsolescence

The equipment on site appeared to be of older design, but the components could be replaced if needed.

9.3.8 Condition Scoring

Overall, the condition score of the 40th Street Reservoir was fair, 3.6. Problems associated with this reservoir were related to the roof-to-wall interface and underenforcement of the walls. A summary of the scoring is shown in Table 9-1 and the full Score Matrix is included in Appendix G.

Table 9-1: Condition Scoring of the 40th Street Reservoir

Categorical Scores	
Cleanliness and Coatings	4.4
Material Deterioration	3.9
Structural Performance - Static	4.0
Structural Performance - Seismic	3.2
WQ/ Sanitary	3.9
Safety	3.0
Operations & Maintenance	4.1
Obsolescence	3.0
Overall	**3.6**

9.4 Recommended Improvements

9.4.1 Cleanliness and Coatings

First, the exterior should be pressure washed to remove dirt and other debris. Areas of coating failure on the reservoir exterior that are not related to thermal deformation, such as the roof and on the lower reservoir walls can be spot coated.

The interior should be washed out to remove the sediment that has accumulated on the floor. This should be done at a low pressure so as not to burst any of the blisters on the floor. The blisters should continue to be monitored and photographed during regular inspections to determine if they are getting larger, increasing in number, cracking, or bursting.

9.4.2 Material Deterioration

Discussed in Section 9.4.3 are possible solutions to deal with issues associated with the thermal expansion-related to the roof-to-wall interface and under-reinforcement.

At the roof vent penetration, the spalling concrete is recommended to be removed. Then this area can be cleaned, and the reinforcing members can be recoated. Finally, the area can be patched and concrete coated. The interior roof near the vent is expected to be difficult to access.

The corrosion on the interior of the inlet/outlet/drain pipe is recommended to be removed by mechanical agitation or by pigging. The interior of the pipe near the reservoir can be recoated or a cured in place pipe liner can be installed if corrosion jeopardizes the pipe's integrity. Weir gate component corrosion can be addressed with cleaning and recoating.

9.4.3 Structural

The recommended improvement to address the issues related to thermal deformation occurs in stages:

1. A temporary improvement should be employed soon to halt further deterioration of any reinforcing material until a permanent solution is implemented. This would entail removing damaged concrete from the cracking areas, properly cleaning cracks, and assessment by a structural engineer. Likely, the areas will need to be spot coated to prevent water damage to the reinforcing. It is imperative that any repair media be flexible so as not to accelerate structural damage as thermal movement is likely to continue to occur until the problem is addressed. Stiffening or reinforcing the cracking areas is not recommended.

2. To more permanently address the thermal deformation-related issues, several options are available. A new aluminum geodesic roof is recommended. The City can also consider a new concrete roof that is domed or flat. Another option would be lifting the entire roof and retrofitting it with a bracketing system and elastomeric bearing pad between the roof and walls. These options would likely cost much more than a new aluminum geodesic roof.

3. The cracks should be investigated by a structural engineer after the thermal deformation issue is resolved.

To address the under-reinforcement, the maximum operating level needs to be reduced to 16 feet above the floor. Retrofits may be possible on the reservoir if a higher maximum operating level is needed. This would likely first entail employing a testing firm to map the existing reinforcing and test the concrete compressive strength and reinforcing's yield strength to verify the actual values. Then the reservoir can be reevaluated, and an updated maximum level recommended. If this level is still insufficient, fiberglass reinforced polymer (FRP) fabric can be applied to areas determined

to be too weak. The City should also consider lowering the overflow to ensure it is not operated above the maximum allowable operating level in the future.

Because the valve vault shares a footing with the reservoir, there isn't space available to install flexible connections on the pipes. Instead, a new vault should be constructed with sufficient space between it and the reservoir to allow for the installation and proper operation of flexible connections.

9.4.4 Water Quality/Sanitary

Water quality should continue to be monitored as common inlet/outlet/drain configurations can cause water stagnation in the reservoir. A removable silt stop should be installed on the combined drain/outlet pipe. The overflow/drain pipe outlet can be retrofitted with a #24-mesh and 4-mesh screen backing.

The gasket on the roof access hatch can be replaced with neoprene seals on both the frame and the lid or replaced with a hatch with better contact area. The vent screen, if in fact is not compliant, it can be replaced with a #24-mesh and 4-mesh screen backing.

9.4.5 Safety

On the exterior, an encompassing L&I-compliant railing is recommended around the perimeter of the reservoir and valve vault roofs. Additionally, on the reservoir roof, a fall restraint system or positioning device system, or possibly a fall arrest system if the work is considered roofing work, is recommended. A toe board should be added to the existing grating.

On the interior, steps should be taken to ensure ingress and egress to the reservoir is as safe as possible. A new interior ladder with fall protection system is recommended. This could be similar to the ladder installed at the Kearney Reservoir, which has a removable extension (Figure 9-16).

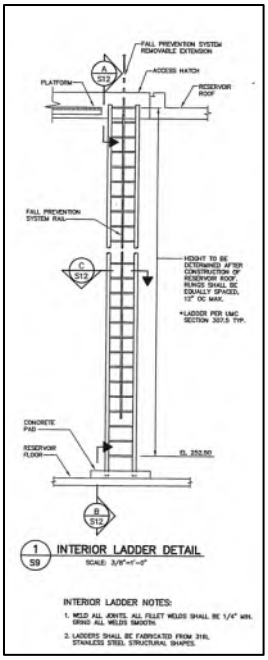


Figure 9-16: The Kearney Reservoir's ladder design, of which a similar design could be implemented the dome Reservoirs.

9.4.6 Operations and Maintenance

9.4.6.1 Site and Security

Trees that are closer to the reservoir than they are tall should be removed or transplanted. The cleared areas can be replanted with shorter growing shrubs on the perimeter to shield the reservoir from view.

9.4.6.2 Roof Drainage

On the valve vault roof curb, notches or overflow scuppers should be installed to prevent the roof from overflowing the curb if the drain backs-up.

9.4.6.3 Appurtenances

The are no recommended improvements related to the operations and maintenance for the appurtenances on the 40th Street Reservoir.

9.4.6.4 Valving and Piping

Proper dechlorination of the 40th Street Reservoir will need to consist of a weighted system that is set in the manhole on site, similar to that shown in Figure 4-21 or attached to the outlet pipe. The dechlorination system should be updated before the next time the reservoir is drained. The energy dissipation could consist of rip rap applied to the outlet.

9.4.7 Capital Improvements Plan Table

Planning level costs for the retrofits to the 40th Street Reservoir are show in Table 9-2.

Table 9-2: 40th Street deficiencies, recommended improvements, and estimated costs

Category	Deficiency	Recommended Improvement	Estimated Cost
CLN & COAT	Organic material buildup on exterior	Pressure wash exterior	$ 2,000
	Intermittent exterior coating failure	Spot Repair Coating	$ 5,000
	Sediment accumulation on floor	Perform regular washdown inspections	$ 1,000
	Blisters on interior floor coating	Monitor for blister growth and bursting. Draw down cautiously and avoid rupturing blisters.	$ -
DETERIOR-ATION	Interior concrete spalling around vent penetration	Remove spalled concrete, clean, patch and coat	$ 10,000
	Corrosion overflow weir gate components	Clean and (re)coat	$ 1,000
	Corrosion on interior of piping	Remove corrosion with agitation or pig pipe. Recoat where possible or consider cured in place pipe liner	$ 10,000
STRUCT	Roof-wall-interface does not account for thermal deformation	Resolve roof-wall-interface issues a. Clean & coat cracks related to thermal deform. b. Replace roof with new geodesic dome c. Structural inspection to determine next steps	 $ 10,000 $ 140,000 $ 2,000
	Walls under-reinforced, likely resulting in wall cracking on lower portions of walls	Remove cracked concrete, clean & coat reinforcement material, patch and coat concrete. Select Option 1 or 2.	$ 10,000
		OPTION 1: Lower max operating level from 23 to 16 ft **Subtotal for Option 1**	 **$ 10,000**
		OPTION 2: Maximum operating level above 16 ft a. Map existing reinforcing and test concrete strength b. Apply fiberglass reinforced polymer (FRP) fabric to areas under-reinforced. **Subtotal for Option 2**	 $ 5,000 $ 400,000 **$ 415,000**
	Operated at the overflow elevation, seismic slosh impacts roof and structure is under-reinforced	Consider lowering overflow	$ -
	Missing seismic valves & vault adjacent to reservoir	New seismic valve vault and associated piping	$ 200,000
WQ	Inlet and outlet are combined	Continue to monitor water quality; consider upgrades	$ -
	No silt-stop on combined drain/outlet	Install removable silt-stop	$ 1,000
	Drain pipe screen non-compliant	Replace drain pipe screen	$ 1,000
	Roof hatch is a high-maintenance design (small contact area)	Replace gasket w/ neoprene seals; consider replacement	$ 1,000
	Vent screen non-compliant	Replace vent screen	$ 1,000
SAFETY	Lacks steep roof fall protection, railings, and grating railing toeboard	Install roof fall protection, railing on heights greater than 4 feet, and toeboard on grating railing	$ 50,000
	Missing interior ladder	Interior ladder and fall protection replacement	$ 30,000
O&M	Tree spacing recommendation not met	Tree removal and restoration	$ 24,000
	Valve vault roof lacks overflow drainage	Install notches or overflow scuppers on parapet	$ 2,000
	Energy dissipation and dechlorination non-compliant	Update energy dissipation and dechlorination system	$ 4,000

	Max operating Level (ft)	
	16	>16
Subtotal	$ 505,000	$ 910,000
30% Contingency	$ 151,500	$ 273,000
8.7% Tax	$ 57,116	$ 102,921
Engineering, Administration, and Construction Management	$ 249,765	$ 450,072
Total Project Costs Estimate	$ 963,381	$ 1,735,993
Total Project Costs Estimate (rounded)	**$ 960,000**	**$ 1,700,000**

9.5 Conclusion

The 40th Street Reservoir, built in 1958, has major structural issues. The City should determine if the 16-foot maximum operating level is feasible. This 7-foot reduction in maximum operating level is the highest recommended drop of any of the reservoirs. Coupled with the lack of ability of the roof-wall-interface to deal with roof thermal movement and the missing flexible pipe couplings, the under-reinforcement issue will likely tip this reservoir in the side of replacement over rehabilitation. The City should weigh the cost/benefit of reservoir rehabilitation vs. replacement.

Because the interior has sediment accumulation, this reservoir should be prioritized in its next washout inspection. This should take place within the next 2 years. The reservoir should be leak tested as a first step of the next inspection. The internal blistering, while not a concern at this time, should be inspected at 3- to 5- year intervals to determine if the problem is progressing.

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Section 10

College Way Reservoir

10.1 Tank and Site Overview

The College Way Reservoir, shown in Figure 10-1, is one of five similar dome reservoirs that were built between 1958 and 1987. While as-built drawings for it are unavailable, drawings of the 40th Street and Reveille Reservoirs, which were built in the same period, designed by the same consulting engineering group, and are of similar construction are available. With slight differences in dimensions, the five reservoirs are 0.3- or 0.5-MG reinforced concrete, self-supporting, domed roof hoppers that were originally built with common inlet/outlets/drains. The reservoirs were designed to hold water above the roof-to-wall interface. This reservoir is partially buried, and the attached valve vault is located below roof. It was built in 1968 and has a capacity of 0.5 MG.



Figure 10-1: The College Way Reservoir, viewed looking east

According to measurements taken in the field (Figure 10-2), the College Way Reservoir has an interior diameter of 64 feet. The hopper base is 5.5 feet deep and the interior wall is 13.5 feet high. The overflow weir was measured to be 23.5 feet above the reservoir floor, which according to City-supplied documentation, corresponds to 541 feet City. This height is higher than the top of the vertical wall. The operating range is 14 to 19 feet. Wall and roof reinforcement were assumed to be similar to the 40th Street and Reveille Reservoirs. The interior walls and floor of the College Way Reservoir were coated in 2013 using a VersaFlex AquaVers primer and polyurea.

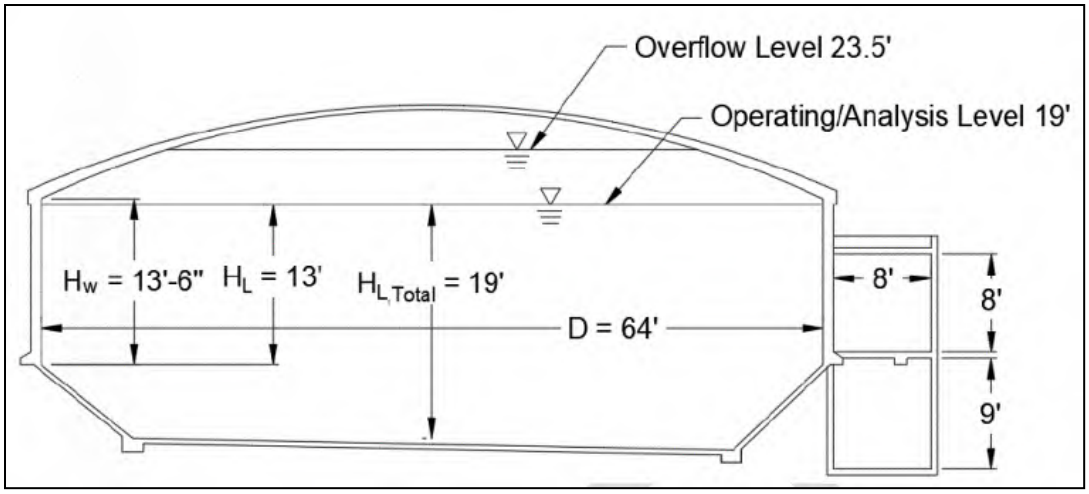


Figure 10-2: The measured interior dimensions of the College Way Reservoir

The site where the College Way Reservoir is situated in a suburban residential neighborhood, adjacent to Western Washington University. It is about one mile south-southwest of the Bellingham CBD. It is located within the 457 South Zone and provides service to the 541 College Way Zone via the College Way Booster Pump Station. The valve vault shares a wall with the reservoir itself and is 8 feet wide by 8 feet deep. The College Way Pump Station was built near the reservoir in 2006. A new hydraulic mixing pipe and outlet to the pump station were constructed at this time.

The geotechnical investigation indicated Chuckanut Sandstone from the surface to the extent of the boring to refusal, 5.5 feet. Weathered Chuckanut Sandstone was found in the top 3 feet of the boring, which consisted of very dense fine to coarse sand. Groundwater seepage was not observed at the final depth of boring.

With the nearest mapped faults being 5 and 10 miles away, there is not a significant risk of ground rupture at the site. Because the College Way Reservoir is bearing directly on bedrock, an allowable bearing pressure of 6,000 psf can be used for structural analysis. Bedrock is not at risk of liquification and the site is not expected to have issues with slope instability.

10.2 Inspection Summary

A drained inspection of the College Way Reservoir took place on March 14, 2019.

10.2.1 Exterior Inspection Summary

10.2.1.1 Site and Security

To limit unauthorized access to the site, a chain link fence with barbed wire encompasses the property (Figure 10-1). The site is generally well-graded, directing runoff away from the reservoir.

During the site visit, it was noted that the roof of the reservoir is under the dripline of the trees and other vegetation (Figure 10-3).



Figure 10-3: Trees overhang the reservoir roof and coating failure

10.2.1.2 Exterior Walls

Of the visible portion of the exterior walls above grade, cracking with efflorescence was noted throughout (Figure 10-4). This cracking was found just below the roof overhang and spread diagonally to the attached vault. Multiple locations were noted where the exterior sidewall was missing the topcoat and there were locations where bare concrete was exposed (Figure 10-5). The DFT of the sidewalls ranged from 8-14 mils.



Figure 10-4: Areas of cracking with efflorescence and coating failure on the exterior walls



Figure 10-5: Topcoat loss (Left) and area of missing coating near the base of the reservoir (Right)

10.2.1.3 Foundation

The foundation was unable to be observed as the reservoir is partially buried.

10.2.1.4 Exterior Roof

Approximately 15 percent of the exterior textured roof topcoat is gone, localized in the east quadrant where vegetative debris is allowed to accumulate (Figure 10-6 Left). The undercoating appears to be fairly tightly adhered to the concrete surface. The most significant item noted in the roof was a circumferential crack that ran around the entire circumference of the roof approximately half-way between the center and edge (Figure 10-6 Right). No DFT measurements were able to be taken on the roof due to the textured non-slip coating. The roof had a grade that ranged from 3.4 degrees near the vent to 19.9 degrees near the reservoir roof's perimeter. The distance from the roof to ground level ranges from 4 feet to 10 feet.



Figure 10-6: Debris buildup and coating failure and a minor circumferential crack

10.2.1.5 Exterior Appurtenances

To access the reservoir and vault roof, a single retrofitted ladder is used (Figure 10-7). The total distance from the top of the stairs to the grating is approximately 10 feet. The stair adds an additional 6 feet to the ground level surface. As is typical with the City's reservoirs of this

construction, the retrofitted grating and safety railing extend only around the entry hatch and is missing a toeboard. The entry hatch has a thin contact area with the lid and the gasket was not securely attached.



Figure 10-7: Retrofitted ladder and roof entry hatch

Because the sheet metal collar could not be removed, the College Way Reservoir's vent (Figure 10-8 Left) was assessed via the provided drawings of similar reservoir and photos of its vent retrofit (Figure 10-8 Right). A 3-foot diameter penetration in the roof has a concrete vent structure above it. The concrete overhang is 4 feet, 2 inches. Approximately 2 inches of opening was exposed under the sheet metal collar. The screen was assumed to be similar to the Dakin I screen, woven with approximately 12 strands per inch.



Figure 10-8: The roof vent (Left) and a provided photo of the College Way Roof Vent retrofit from January 2013 (Right)

The attached valve vault shares a wall and footing with the reservoir. The inlet and drain pipes run through the vault. The overflow runs through via an air gap, connecting with the drain pipe. The vault roof has curb that extends all the way around (Figure 10-7 Left). No waterstop has been installed on the join between the valve vault and the reservoir and water was found to be pooling up within the lower level of the valve vault (Figure 10-9).

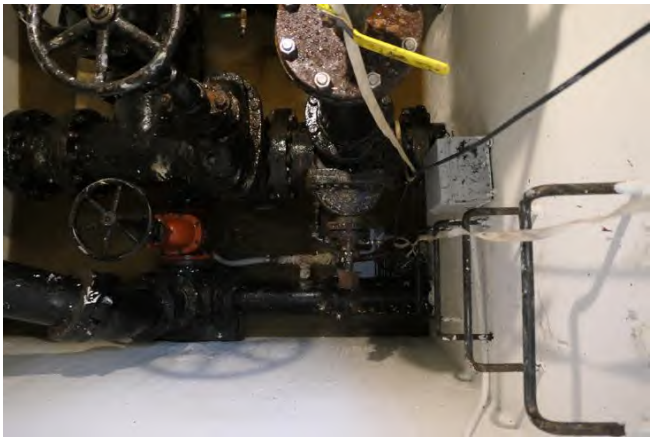


Figure 10-9: Water accumulating in the bottom of the valve vault

10.2.2 Interior Inspection Summary

10.2.2.1 Interior walls

The coating on the interior walls made it difficult to determine the extent, if any, of the internal cracking of reservoir walls. The coating was intact (Figure 10-10). The measured DFT ranged from 80-110 mils; the specified DFT was 80 mils as per the supplied documents from the City.



Figure 10-10: Interior walls and removable ladder (Left). A retrofitted outlet and hydraulic mixing system are installed on the reservoir (Right).

10.2.2.2 Floor

The floor was coated and covered by a thin layer of residue and leftover water (Figure 10-11). From what could be seen, the coating was intact and there was no cracking.



Figure 10-11: The reservoir floor's thin layer of residue

10.2.2.3 Interior Roof

The interior roof did not exhibit cracking (Figure 10-12).



Figure 10-12: The reservoir interior roof was free of observable issues.

10.2.2.4 Interior Appurtenances

The interior ladder was rungs set into the wall. While the upper rungs within the access vault are still present, the rungs on the wall were removed during the coating process and have not been replaced. A removable ladder, tripod, and winch are used for inspections and maintenance. A pipe for the level sensor was near the ladder but did not inhibit entry.

10.2.3 Piping and Valving Inspection Summary

The combined inlet/drain piping exhibited only minor corrosion on the interior of the pipe (Figure 10-13 Left). The attached valve vault contained isolation valves and an altitude valve. Based on the updated College Way Pump Station, the reservoir outlets to the pump station. Minor turbuculation

was noted on the outlet pipe. The drainpipe connects with the overflow and extends to the storm sewer without an air gap (Figure 10-9). Standing water was noted at the bottom of the valve vault.



Figure 10-13: The common inlet/drain (Left) and the outlet (Right) exhibit minor tuberculation.

The overflow weir gate components, the exterior overflow pipe, and interior hydraulic mixing pipe exhibited corrosion. (Figure 10-14) The overflow pipe has an approximate 12-inch air gap. It connects with the drain line in the vault, before going to the storm sewer.



Figure 10-14: Overflow weir gate (Left), exterior overflow pipe (Center), and interior hydraulic mixing pipe (Right) corrosion. Organic material was building up on the vault roof (Center).

No washdown piping was observed during our inspection.

10.3 Condition Assessments

10.3.1 Cleanliness and Coatings

The exterior topcoat on the sidewalls and roof is no longer functional in many places. The organic material accumulation, topcoat deterioration, and exposed concrete indicate the walls are roof are in poor condition. However, the coating on the valve vault was in good condition. If cleaned and spot repaired, the life of the exterior coating can be extended another 10 (+/-) years. There was significant organic debris accumulating within the valve vault, however.

The interior floor has minor sediment on the floor, but the interior coating is in good condition.

10.3.2 Material Deterioration

Significant concrete deterioration was noted throughout the exterior walls, which needs attention. Because this cracking is structural in nature, it is discussed in Section 10.3.3.1. The interior coating has likely significantly decreased the rate of efflorescence accumulation around the exterior cracks as water is inhibited from passing through the concrete.

Corrosion on the ductile iron hydraulic mixing pipe was significant, caused by a metallic couple with the rebar within the walls. The spool piece is coated, which has saved it from heavy tuberculation while the flanged end is uncoated and is exhibiting heavy tuberculation. A similar phenomenon is causing the minor tuberculation in the pump station outlet pipe. Corrosion on the exterior overflow pipe and overflow weir components is likely due to the pipe not being properly coated recently.

10.3.3 Structural Performance

10.3.3.1 Static Analysis

The dome roof was found to meet modern requirements of AWWA D110-13. However, the roof-to-wall interface is not designed to allow for roof expansion and contraction, which has resulted in cracks. The structure is braced at the valve vault, which is why the cracking extends diagonally near to it from the roof. Assuming the walls are reinforced similar to the 40th Street and Reveille Reservoirs' plans, the wall reinforcing appears to be acceptable for static loads. However, the upper sections of the interior wall have reinforcing at 24 inches on center, which exceeds ACI 350.3's maximum allowable spacing of 12 inches on center. The foundation was found to be sized appropriately, based on the geotechnical report's soil bearing capacity of 6,000 psf.

10.3.3.2 Seismic Analysis

At the 17-foot operating level, the walls' reinforcement was found to be suitable for the design seismic event. This was not the case if operated at the overflow level. Similarly, the design seismic

event is estimated to cause a constrained slosh wave, causing damage to the roof if operated at the overflow level. However, at the 19-foot operating level, the roof is adequately reinforced. Incidental damage may still occur to hatches and appurtenances. The valve vault attachment is suitable to prevent differential movement and impact during the seismic event. Also, based on assumed backfill conditions, the hopper base is not likely to fail and collapse onto the piping. However, the pipes do not have flexible couplings which would address potential differential settlement between the two structures during a seismic event.

10.3.4 Water Quality/Sanitary

The retrofitted inlet/outlet pipe configuration with hydraulic mixing system is likely suitable to promote high water quality within the reservoir. As this reservoir drains to a storm drain, a DOH approved air gap is required on both the overflow and the drainpipe. No air gap is installed on the drain pipe. The air gap between the overflow and receiving pipe was found to be too narrow. While the screen on the vent could not be carefully measured due to the sheet metal collar, it does not appear to be 24-mesh screen backed with 4-mesh screen. The roof hatch would be classified as a "high-maintenance design" because of issues getting the gasket to provide a tight seal against the relatively small surface area of the frame. The gasket not being fully adhered could potentially lead to water quality issues within the reservoir. Overall, the water quality/sanitary condition is good.

10.3.5 Safety

With the distance being about 10 feet on the exterior ladder, a ladder fall protection system is not required. This reservoir roof has some areas where a fall would be greater than 4 feet. A fall would be greater than 4 feet from the valve vault as well. Thus, an L&I-compliant railing is required on these areas. The reservoir roof is considered steep as the greatest slope is greater than 4:12. Thus, additional fall prevention is required.

With the fall protection and ladder on the interior of the reservoir being non-existent, a removable ladder, tripod, and winch were required for our inspection. While this configuration appears to meet L&I requirements, there is inherent risk of using a tripod mounted on a vault and a removable ladder. While the exterior ladder safety condition is good, the roof and interior ladder safety condition is fair to poor.

10.3.6 Operations and Maintenance

10.3.6.1 Site and Security

The fence and drainage were found to be suitable for this reservoir. An intrusion alarm is installed on the roof's access hatch. However, trees were too close to the reservoir. Nearby trees endanger the structure, slow evaporation from the soil by the structure, are causing organic material accumulation problems, and their roots can penetrate the structure. Overall, the site/security is in fair condition.

10.3.6.2 Roof Drainage

The reservoir roof sheds water adequately. However, drainage of the valve vault roof appeared to not function in the event of a drain clog. If the drain were to be clogged, the roof would overflow the curb; no notches or overflow scuppers are present that would send water away from the reservoir. There are apparently no waterstops installed between the reservoir and valve vault. The water in the bottom of the valve vault may be a result of this or a leaking pipe.

10.3.6.3 Appurtenances

No difficulties were found using the exterior ladder to access the roof. However, accessing the interior of the reservoir is more difficult than other style reservoirs as the tripod, winch, and removable ladder must be lifted to the roof. College Way does not have a ladder on the exterior of the roof access hatch vault, so climbing into the hatch can also be challenging.

Due to the pump station upgrade, the College Way Reservoir has a larger outlet pipe than the other similar reservoirs. Even with the pipe being higher in the reservoir, water would drain at a higher flow rate than a failure of the existing drain pipe. Using screen and vent information from the Reveille as-built drawings indicates the penetration, screened, and retrofitted collar free area are sufficient for the max operating height. The vent is sized for operations up to 22.5 feet, 1-foot below the overflow level.

10.3.6.4 Valving and Piping

The staff did not note any difficulties associated with operating of the reservoir. No dechlorination system was observed onsite for drained water.

10.3.6.5 Misc.

Although the hydraulic mixing system could not be observed in operation, it appeared to be suitable for promoting good water quality within the reservoir.

10.3.7 Obsolescence

With the new equipment installed in the College Way Pump Station, the obsolescence favorable.

10.3.8 Condition Scoring

Overall, the condition score of the College Way Reservoir was fair, 3.9. Problems associated with this reservoir were related to the structural problems with the roof-wall-interface. A summary of the scoring is shown in Table 10-1 and the full Score Matrix is included in Appendix H.

Table 10-1: Condition Scoring of the College Way Reservoir

Categorical Scores	
Cleanliness and Coatings	3.8
Material Deterioration	3.7
Structural Performance - Static	4.1
Structural Performance - Seismic	3.7
WQ/ Sanitary	4.5
Safety	3.3
Operations & Maintenance	4.1
Obsolescence	5.0
Overall	**3.9**

10.4 Recommended Improvements

10.4.1 Cleanliness and Coatings

First, the exterior should be pressure washed to remove dirt and other debris. Areas of coating failure on the reservoir that are not related to thermal deformation, such as the roof can be spot coated.

The interior should also be washed out to remove the sediment that has accumulated on the floor.

10.4.2 Material Deterioration

Discussed in Section 10.4.3 are possible solutions to deal with the thermal expansion-related issues of the roof-to-wall interface.

The corrosion on the exterior overflow, outlet pipe, mixing pipe, and overflow weir gate components can be addressed with cleaning and recoating.

10.4.3 Structural

To confirm the assumptions made in the analysis, as-built drawings may be obtained, or a testing firm could be employed to map the existing reinforcing.

The recommended improvement to address the issues related to thermal deformation occurs in stages:

1. A temporary improvement should be employed soon to halt further deterioration of any reinforcing material until a permanent solution is implemented. This would entail removing damaged concrete from the cracking areas, properly cleaning cracks, and assessment by a structural engineer. Likely, the areas will need to be spot coated to prevent water damage to the reinforcing. It is imperative that any repair media be flexible so as not to accelerate

structural damage as thermal movement is likely to continue to occur until the problem is addressed. Stiffening or reinforcing the cracking areas is not recommended.

2. To more permanently address the thermal deformation-related issues, several options are available. A new aluminum geodesic roof is recommended. The City can also consider a new concrete roof that is domed or flat. Another option would be lifting the entire roof and retrofitting it with a bracketing system and elastomeric bearing pad between the roof and walls. These options would likely cost much more than a new aluminum geodesic roof.

3. The cracks should be investigated by a structural engineer after the thermal deformation issue is resolved.

The best approach to deal with the wall reinforcement being spaced 24 inches on center rather than 12 inches on center is to monitor the structure. The City should also consider lowering the overflow to ensure it is not operated above the maximum allowable operating level in the future.

Because the valve vault shares a footing with the reservoir, there isn't space available to install flexible connections on the pipes. Instead, a new vault should be constructed with sufficient space between it and the reservoir to allow for the installation and proper operation of flexible connections.

10.4.4 Water Quality/Sanitary

A removable silt stop should be installed on the combined drain/outlet pipe. A DOH-approved air gap should also be installed on the drain pipe. With the drain pipe being 9 feet underground, this would likely be logistically challenging at the College Way site. Possible options are draining to daylight, an appropriately sized dedicated dry well with backflow prevention, or an air gap with a sump and sump pump that can pump water than cannot be drained by gravity.

The overflow air gap can be widened on the reservoir. A trash rack is recommended on the receiving pipe. With the wall of the reservoir close to the overflow, the gap needs to be three times the pipe diameter.

The gasket on the roof access hatch can be replaced with neoprene seals on both the frame and the lid or replaced with a hatch with better contact area. The vent screen, if in fact is not compliant, it can be replaced with a #24-mesh and 4-mesh screen backing.

10.4.5 Safety

On the exterior, an L&I-compliant railing is recommended around valve vault roof. The railing will also need to extend around the perimeter of the reservoir at all areas where the fall distance is greater than 4 feet. Additionally, on the reservoir roof, a fall restraint system or positioning device

system, or possibly a fall arrest system if the work is considered roofing work, is recommended. A toe board should be added to the existing grating.

On the interior, steps should be taken to ensure ingress and egress to the reservoir is as safe as possible. A new interior ladder with fall protection system is recommended. This could be similar to the ladder installed at the Kearney Reservoir, which has a removable extension and is shown in Figure 9-16. A new exterior ladder should be installed on the exterior of the access vault that is similar to the ladder installed on the 40th Street Reservoir, shown in Figure 9-7 Right.

10.4.6 Operations and Maintenance

10.4.6.1 Site and Security

Trees that are closer to the reservoir than they are tall should be removed or transplanted. The cleared areas can be replanted with shorter growing shrubs on the perimeter to shield the reservoir from view.

10.4.6.2 Roof Drainage

To address the standing water in the bottom of the valve vault, the water should be pumped out. The joints between the valve vault and reservoir should be sealed to prevent leakage and pipes checked for leakage. If water returns, the source of the leak should be identified and sealed. A working sump pump can also be installed in the vault. On the valve vault roof curb, notches or overflow scuppers should be installed to prevent the roof from overflowing the curb if the drain backs-up.

10.4.6.3 Appurtenances

The vent is undersized for the overflow elevation but is sized appropriately for the maximum reported operating level of 19 feet and up to 22.5 feet. Thus, the recommended improvement is to continue operating within the reported range. Other than inspecting the vent to verify the assumptions made in the analysis, there are no recommended improvements for the appurtenances, related to operations and maintenance at the College Way Reservoir.

10.4.6.4 Valving and Piping

Proper dechlorination of the College Way Reservoir will need to consist of a weighted system that is set in the manhole. An example of a basket system is shown in Figure 4-21.

10.4.7 Capital Improvements Plan Table

Planning level costs for the retrofits to the College Way Reservoir are shown in Table 10-2.

Table 10-2: College Way deficiencies, recommended improvements, and estimated costs

Category	Deficiency	Recommended Improvement	Estimated Cost
CLN & COAT	Organic material buildup on exterior	Pressure wash exterior	$ 2,000
	Intermittent exterior coating failure	Spot Repair Coating	$ 6,000
DETERIOR-ATION	Corrosion on outlet pipe, exterior overflow, mixing pipe, & overflow weir gate components	Clean and (re)coat	$ 3,000
STRUCT	Roof-wall-interface does not account for thermal deformation	Resolve roof-wall-interface issues a. Clean & coat cracks related to thermal deform. b. Replace roof with new geodesic dome c. Structural inspection to determine next steps	 $ 11,000 $ 150,000 $ 2,000
	Maximum reinforcement spacing exceeded	Continue to monitor for structural issues	$ -
	Operated at the overflow elevation, seismic slosh impacts roof and structure is under-reinforced	Consider lowering overflow	$ -
	Missing seismic valves & vault adjacent to reservoir	New seismic valve vault and associated piping	$ 200,000
WQ	No silt-stop on combined drain/outlet	Install removable silt-stop	$ 1,000
	No drain air gap	Upgrade drain pipe w/ air gap	$ 88,000
	Overflow air gap too narrow	Retrofit overflow pipe air gap	$ 5,000
	Roof hatch is a high-maintenance design (small contact area)	Replace gasket w/ neoprene seals; consider replacement	$ 1,000
	Vent screen non-compliant	Replace vent screen	$ 1,000
SAFETY	Lacks steep roof fall protection, railings, and grating railing toeboard	Install roof fall protection, railing on heights greater than 4 feet, and toeboard on grating railing	$ 50,000
	Ingress and egress difficult and missing interior ladder	Install exterior access vault ladder and install interior ladder with fall protection	$ 32,000
O&M	Tree spacing recommendation not met	Tree removal and restoration	$ 28,000
	Valve vault roof lacks overflow drainage	Install notches or overflow scuppers on parapet	$ 2,000
	Water in bottom of valve vault	Seal vault-to-reservoir interfaces and check for leaking pipes. Install sump pump if water is still present	$ 5,000
	Dechlorination non-compliant	Update dechlorination system	$ 2,000
		Subtotal	$ 589,000
		30% Contingency	$ 176,700
		8.7% Tax	$ 66,616
		Engineering, Administration, and Construction Management	$ 291,311
		Total Project Costs Estimate	$ 1,123,626
		Total Project Costs Estimate (rounded)	**$ 1,100,000**

10.5 Conclusion

The two biggest items to be dealt with on the College Way Reservoir are the thermal deformation issues and the lack of flexible couplings on the pipes passing through the valve vault. The new seismic valve vault will likely reduce or eliminate costs associated with valve vault drainage, water in the bottom of the vault, and narrow overflow air gap. A new roof would likely reduce or eliminate costs associated the roof hatch and roof fall protection.

The next washdown inspection should take place within the next 3 to 5 years. The reservoir should be leak tested as a first step of the next inspection.

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Section 11

Consolidation Reservoir

11.1 Tank and Site Overview

The Consolidation Reservoir, shown in Figure 11-1, is one of five similar dome reservoirs that were built between 1958 and 1987. While as-built drawings for it are unavailable, drawings of the 40th Street and Reveille Reservoirs, which were built in the same period, designed by the same consulting engineering group, and are of similar construction are available. With slight differences in dimensions, the five reservoirs are 0.3 or 0.5 MG reinforced concrete, self-supporting, domed roof hoppers that were originally built with common inlet/outlet/drain pipes. The reservoirs were designed to hold water above the roof-to-wall interface. This reservoir is mostly buried, and the attached valve vault is located at the roof level. It was built in 1959 and has a capacity of 0.5 MG.



Figure 11-1: The Consolidation Reservoir, viewed looking northwest

According to measurements taken in the field (Figure 11-2), the Consolidation Reservoir has an interior diameter of 64 feet. The hopper base measured 7 feet deep and the interior wall measured 11.25 feet high. The overflow weir was measured to be 23 feet above the reservoir floor, which according to City-supplied documentation, corresponds to 519 feet above mean sea level (AMSL). This height is higher than the top of the vertical wall. The operating range is 15.5 to 19.5 feet. Wall and roof reinforcement were assumed to be similar to the 40th Street and Reveille Reservoirs. The interior of this reservoir has not been coated.

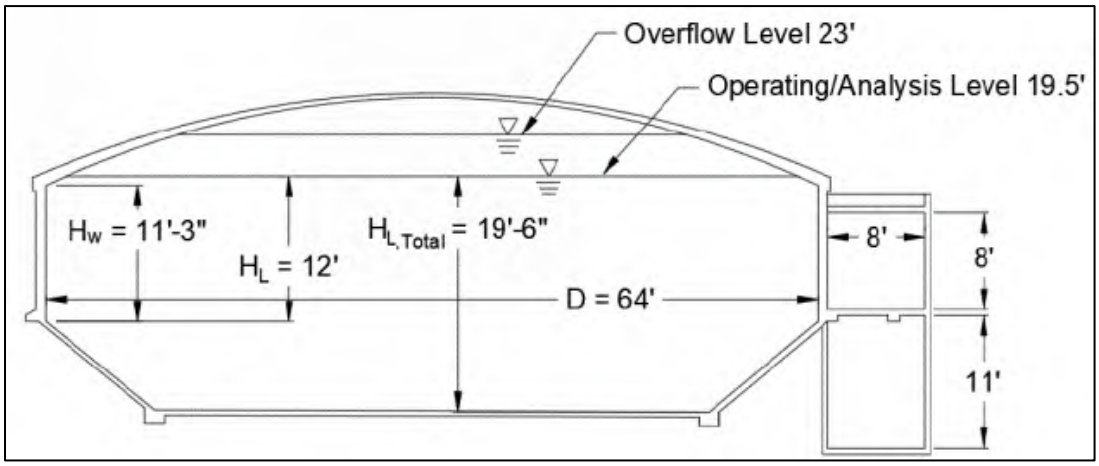


Figure 11-2: The measured interior dimensions of the Consolidation Reservoir

The Consolidation Reservoir is located on the outskirts of town, about 2 miles southeast of the Bellingham CBD. The valve vault shares a wall with the reservoir itself and is 8 feet wide by 8 feet deep. It serves the 519 Dakin and Yew Zone, which is fed from the gravity zone via the Dakin and Yew Booster Pump Station.

The geotechnical investigation indicated 0.5 feet of topsoil with 4.5 feet of fill material around the reservoir. The fill consisted of stiff brown sandy silt with gravel. Glaciomarine drift, which consists of stiff brown silt with sand and occasional gravel grading to dense silty sand, was encountered between 5 and 12.5 feet. Chuckanut Sandstone was encountered from 12.5 feet bgs to boring refusal, 15.5 feet bgs. Based on the height of the reservoir, the soil layers likely did not extend below the foundation of the reservoir. Groundwater seepage was not observed at the final depth of boring.

With the nearest mapped faults being 5 and 10 miles away, there is not a significant risk of ground rupture at the site. Because the Consolidation Reservoir is bearing directly on bedrock, an allowable bearing pressure of 6,000 psf can be used for structural analysis. Bedrock is not at risk of liquification and the site is not expected to have issues with slope instability.

11.2 Inspection Summary

A drained inspection of the Consolidation Reservoir took place on November 7, 2019.

11.2.1 Exterior Inspection Summary

11.2.1.1 Site and Security

Unlike many other reservoirs, Consolidation's site does not have a perimeter fence (Figure 11-1). The site is generally well-graded, directing runoff away from the reservoir. During the site visit, it

was noted that the roof of the reservoir and valve box are under the dripline of the trees (Figure 11-3). The consolidated layer of leaves around the perimeter of the reservoir is evidence of leaf accumulation on the roof that fall or are washed off during rain.



Figure 11-3: Fence around site perimeter (Left) and trees overhanging reservoir roof (Right)

11.2.1.2 Exterior Walls

Of the visible portion of the exterior walls above grade, cracking with efflorescence was noted throughout, especially below the roof-to-wall interface (Figure 11-4). Many of these areas were found to be wet to touch (Figure 11-5 Left). Insects were found at some of the locations as well (Figure 11-5 Right). The exterior coating was found to be peeling, blistering, and exhibiting efflorescence. Approximately 50 percent of the topcoat is missing, and 20 percent is blistering on the sidewall surfaces. The valve vault was missing 5 percent of the topcoat (Figure 11-1).



Figure 11-4: The exterior walls exhibit cracking with efflorescence.



Figure 11-5: The exterior walls are blistering and effloresing (Left) and have insects.

11.2.1.3 Foundation

The foundation was unable to be observed as the reservoir is buried.

11.2.1.4 Exterior Roof

The exterior roof of the reservoir exhibited circumferential and radial cracking with efflorescence, which can be seen in Figure 11-3 and Figure 11-6.The radial cracking extends up the roof side to intersect a series circumferential cracks that run around the entire reservoir roof. The circumferential cracks are located approximately 6-feet up the side of the roof. Coating was also missing in some areas (Figure 11-6 Right). The roof had a grade that ranged from 3 degrees near the vent to 20 degrees near the reservoir roof's perimeter. The distance from the roof to ground level is around 2 feet.



Figure 11-6: The roof circumferential and radial cracking and coating loss

11.2.1.5 Exterior Appurtenances

To access the roof, a single retrofitted ladder is used (Figure 11-1) The total distance from the 1-foot high concrete pad to the grating is approximately 7.3 feet. As is typical with the City's reservoirs of this construction, the retrofitted grating and safety railing extend only around the entry hatch and is missing a toeboard (Figure 11-1). The entry hatch has a thin contact area with the lid and the gasket was not securely attached (Figure 11-7 Left). Corrosion was found on the nuts (Figure 11-7 Right).



Figure 11-7: The roof entry hatch gasket is not securely attached and corrosion is affecting nuts.

The Consolidation Reservoir's vent has a sheet metal collar that was not removed during our inspection (Figure 11-8). The gap between the collar and roof was large enough to photograph the screen (Figure 11-8 Left), which appeared to be woven with approximately 4 strands per inch. It was also assessed via the provided drawings of similar reservoir and photos of the College Way Reservoir vent retrofit (Figure 11-8 Right). A 3-foot diameter penetration in the roof has a concrete vent structure above it. The concrete overhang is 4 feet, 2 inches. Approximately 1.25 inches of opening was exposed under the sheet metal collar.



Figure 11-8: The roof vent screen (Left) and a provided photo of the College Way Roof Vent retrofit from January 2013 (Right)

The attached valve vault shares a wall and footing with the reservoir. The inlet, outlet, and drain pipes all run through the vault and the Consolidation Booster Pump Station is housed in the upper section. The overflow runs through via an air gap, connecting with the drain pipe. The vault roof has curb that extends all the way around (Figure 11-9 Left). There was evidence of organic material buildup and the drain was clogged (Figure 11-9 Right). Within the upper section, the pipes penetrating the roof were efflorescing (Figure 11-10). A minor diagonal crack was noted near the window.



Figure 11-9: The attached valve vault has a curb that collects debris. The drain is blocked.



Figure 11-10: Efflorescence on the overflow and vault roof drain pipe (Left) and pump station with washdown piping (Right)

11.2.2 Interior Inspection Summary

11.2.2.1 Interior walls

The walls, being uncoated, were noted to have a similar cracking pattern as the exterior walls (Figure 11-11).



Figure 11-11: The uncoated interior walls exhibited minor cracking.

11.2.2.2 Floor

The floor had no observed issues (Figure 11-12).



Figure 11-12: The reservoir's floor

11.2.2.3 Interior Roof

The ceiling exhibited a similar cracking as the exterior roof. However, no major issues with interior efflorescence or other modes of failure were noted in the roof (Figure 11-13).



Figure 11-13: The reservoir roof minor cracking without efflorescence.

11.2.2.4 Interior Appurtenances

The interior ladder is rungs set into the wall with rungs spaced 15 inches apart. The ladder was very corroded and exhibited loss (Figure 11-14 Left); it was deemed unsafe for use. A removable ladder, tripod, and winch are used for inspections and maintenance. A large corroded pipe was located adjacent to the removable ladder which made ingress and egress difficult (Figure 11-14 Right).

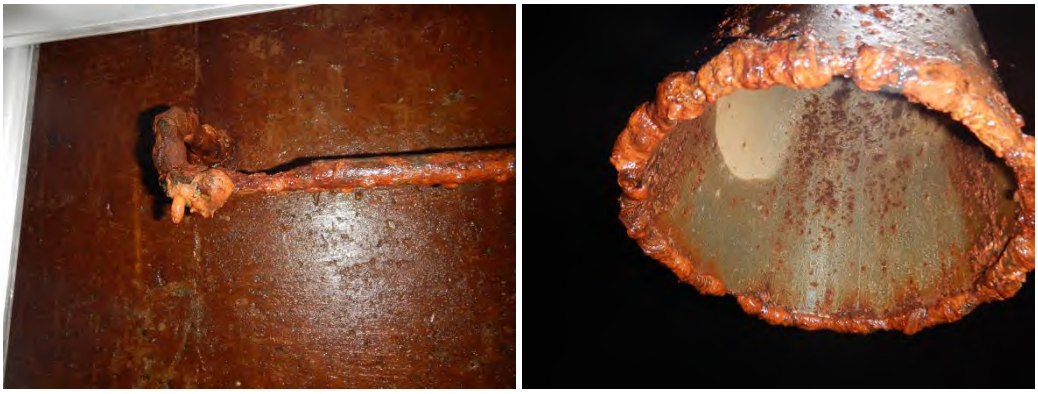


Figure 11-14: The corroded interior ladder (Left) and remnant pipe (Right)

11.2.3 Piping and Valving Inspection Summary

The combined inlet/outlet/drain pipe had standing water within it (Figure 11-15 Left). This was likely because the pipe leading to the pump station in the upper vault was leaking. Around the pipe frame, corrosion was noted. Corrosion nodules were noted on the interior of the pipe (Figure 11-15 Right). The overflow weir, shown in Figure 11-16 (Left), is in good condition, but rust was noted on the overflow weir gate components. The air gap on the overflow pipe is approximately 11 inches (Figure 11-9).

The valve vault contained an altitude valve and isolation valves (Figure 11-9 Right). The drain pipe connects with the overflow and extends to a swale via a culvert that sits flush with the ground (Figure 11-17 Left). Dechlorination was with a dechlorination bag that was found to be out of the main flow path during our inspection (Figure 11-17 Right). As water was still flowing from the pipe, it was moved more in line with the center of flow. The swale leads to a pond on a neighboring property (Figure 11-18).



Figure 11-15: The common inlet/outlet/drainpipe frame corrosion and standing water (Left), interior pipe corrosion nodules and water flowing from pump station pipe (Right).



Figure 11-16: Weir gate (Left) and vault piping, altitude valve, and isolation valves (Right).



Figure 11-17: Drain/overflow outlet (Left) and its dechlorination bag (Right).



Figure 11-18: The overflow/drain destination is a pond on an adjacent property

Washdown piping is located within the valve vault.

11.3 Condition Assessments

11.3.1 Cleanliness and Coatings

The exterior is very dirty, and the coating is no longer functional on the roof and walls of the reservoir structure. The debris accumulation, coating condition, exposed concrete, efflorescence, and insects affected the overall condition of the exterior cleanliness and coating, which is poor.

While the interior is uncoated, the staff had just finished a washdown of the reservoir. The efflorescence on overflow and roof drain pipes within valve vault is more of a cosmetic concern but is indicative of poor drainage of the valve vault.

11.3.2 Material Deterioration

The concrete is heavily deteriorating and efflorescing on the exterior; the concrete is in poor condition. Significant concrete deterioration was noted throughout the exterior, which needs attention. The cracks were noted to be wet, which is likely due to the water migrating through the cracks. Because this cracking is structural in nature, it is discussed in Section 11.3.3.1.

The cracks noted on the interior of the structure are related to those noted on the exterior, so is assessed to be in poor condition. Corrosion on the inlet/outlet/drain pipe, ancillary pipe, weir gate components, pipe frame, and vault lid was significant, and were in poor condition.

11.3.3 Structural Performance

11.3.3.1 Static Analysis

The dome roof was found to meet modern requirements of AWWA D110-13. However, the roof-to-wall interface is not designed to allow for roof expansion and contraction, which has resulted in cracks. The cracking in the roof is likely a result of this issue and the walls be further constrained by being almost completely buried.

Assuming the walls are reinforced similar to the 40th Street and Reveille Reservoirs' plans, the wall reinforcing appears to be acceptable for static loads. The horizontal reinforcing was found to be sufficient for the current operating level, but not if operated any higher. However, the upper sections of the interior wall have reinforcing at 24 inches on center, which exceeds ACI 350.3's maximum allowable spacing of 12 inches on center. The foundation was found to be sized appropriately, based on the geotechnical report's soil bearing capacity of 6,000 psf.

11.3.3.2 Seismic Analysis

At the 19.5-foot operating level, the walls' reinforcement was found to be suitable for the design seismic event. This was not the case if operated at the overflow level. Only the horizontal hoop

reinforcing was exceeded by 2 percent, which would likely not warrant lower operation. The design seismic event would cause a constrained slosh wave, causing damage to the roof if operated at the overflow level. However, at the 19.5-foot operating level, the roof is adequately reinforced. Incidental damage may still occur to hatches and appurtenances. The valve vault attachment is suitable to prevent differential movement and impact during the seismic event. Also, based on assumed backfill conditions, the hopper base is not likely to fail and collapse onto the piping. However, the pipes do not have flexible couplings which would address potential differential settlement between the two structures during a seismic event.

11.3.4 Water Quality/Sanitary

Although the common inlet/outlet/drainpipe configuration can cause problems with water quality issues, none have been reported. A removable silt stop is required on combined drains/outlets but was not installed. Since the reservoir drains to daylight, a DOH approved air gap is not required. The missing screen on the drain/overflow outlet could lead to water quality issues in the reservoir. It did not appear that the screen on the vent is a 24-mesh screen backed with 4-mesh screen. The roof hatch would be classified as a "high-maintenance design" because of issues getting the gasket to provide a tight seal against the relatively small surface area of the frame. The gasket not being fully adhered could potentially lead to water quality issues within the reservoir. The cracks in the concrete could also be a way for water quality issues to develop. Overall, the water quality/sanitary condition is fair.

11.3.5 Safety

With the total fall distance from the exterior ladder to ground level being about 7.3 feet, no ladder fall protection is required. This roof is considered steep, as the greatest slope is greater than 4:12 (18.4) degrees. Even with this slope, the total fall distance from the roof's edge to the ground is less than 4 feet, so L&I does not mandate roof fall protection. The fall from the valve vault roof would be more than 4 feet, so a worker would need fall protection. A toeboard is also required on the existing grating.

With the fall protection and ladder on the interior of the reservoir being non-existent, a removable ladder, tripod, and winch were required for our inspection. While this configuration appears to meet OSHA requirements, there is possible risk of failure in this setup. Overall, the safety condition of the reservoir is fair.

11.3.6 Operations and Maintenance

11.3.6.1 Site and Security

The lack of a perimeter fence was a noted deficiency with the reservoir. However, an intrusion alarm is installed on the roof's access hatch. Soil drainage was found to be suitable for this reservoir. Trees were too close to the reservoir. Nearby trees endanger the structure, slow

evaporation from the soil by the structure, are causing organic material accumulation problems, and their roots can penetrate the structure. Overall, the site/security condition is fair to poor.

11.3.6.2 Roof Drainage

The reservoir roof sheds water adequately. However, drainage of the valve vault roof appeared to not function in the event of a drain clog. If the drain were to be clogged, the roof would overflow the curb; no notches or overflow scuppers are present that would send water away from the reservoir. There are apparently no waterstops installed between the reservoir and valve vault.

11.3.6.3 Appurtenances

No difficulties were found using the exterior ladder to access the roof. However, accessing the interior of the reservoir is more difficult than other style reservoirs as the tripod, winch, and removable ladder must be lifted to the roof. Consolidation does not have a ladder on the exterior of the roof access hatch vault, so climbing into the hatch can also be challenging. The Consolidation Reservoir met design requirements for the vent on the roof penetration, screened area, and free area on the retrofitted collar.

11.3.6.4 Valving and Piping

The staff noted that draining reservoir of this reservoir is difficult and time consuming as the neighboring property can be flooded during the process. The pipe was leaking a lot of water during our inspection indicating poor condition of the isolation valving. The dechlorination was not adequately treating all flow from the drain pipe. Overall, the condition of the valving and piping operation was poor.

11.3.7 Obsolescence

Overall, the equipment on site appeared to be of older design, and difficulty would be expected replacing components.

11.3.8 Condition Scoring

Overall, the condition score of the Consolidation Reservoir was fair, 3.3. Problems associated with this reservoir were related to the structural problems with the roof-wall-interface. A summary of the scoring is shown in Table 11-1 and the full Score Matrix can be found in Appendix I.

Table 11-1: Condition Scoring of the Consolidation Reservoir

Categorical Scores	
Cleanliness and Coatings	2.9
Material Deterioration	2.6
Structural Performance - Static	4.1
Structural Performance - Seismic	3.0
WQ/ Sanitary	3.6
Safety	4.0
Operations & Maintenance	3.6
Obsolescence	1.0
Overall	**3.3**

11.4 Recommended Improvements

11.4.1 Cleanliness and Coatings

First, the exterior should be pressure washed to remove dirt and other debris. The valve vault drain should also be cleared. All the exposed exterior areas that are experiencing coating failure are due to thermal effects, discussed in Section 11.4.3.

For the efflorescence on the overflow and valve vault roof drain, cleaning and recoating is recommended. The valve vault roof is also recommended to be resealed and drain unclogged.

11.4.2 Material Deterioration

One approach to deal with the apparent leaking concrete is to line the interior, like what has been done in the other dome reservoirs. Discussed in Section 11.4.3 are possible solutions to deal with the thermal expansion-related issues of the roof-to-wall interface.

The corrosion on the access hatch vault lid nuts, overflow weir gate components, ancillary pipe, and pipe frame can be addressed with cleaning and recoating The corrosion on the interior of the inlet/outlet/drain pipe is recommended to be removed by mechanical agitation or by pigging. The interior of the pipe near the reservoir can be recoated or a cured in place pipe liner can be installed if corrosion jeopardizes the pipe's integrity.

11.4.3 Structural

To confirm the assumptions made in the analysis, as-built drawings may be obtained, or a testing firm could be employed to map the existing reinforcing.

The recommended improvement to address the issues related to thermal deformation occurs in stages:

1. A temporary improvement should be employed soon to halt further deterioration of any reinforcing material until a permanent solution is implemented. This would entail removing damaged concrete from the cracking areas, properly cleaning cracks, and assessment by a structural engineer. Likely, the areas will need to be spot coated to prevent water damage to the reinforcing. It is imperative that any repair media be flexible so as not to accelerate structural damage as thermal movement is likely to continue to occur until the problem is addressed. Stiffening or reinforcing the cracking areas is not recommended.

2. To more permanently address the thermal deformation-related issues, several options are available. A new aluminum geodesic roof is recommended. The City can also consider a new concrete roof that is domed or flat. Another option would be lifting the entire roof and retrofitting it with a bracketing system and elastomeric bearing pad between the roof and walls. These options would likely cost much more than a new aluminum geodesic roof.

3. The cracks should be investigated by a structural engineer after the thermal deformation issue is resolved.

Since the cracks in the roof are probably due to the thermal issue, a similar procedure should be followed as part 1, ensuring the structure is not restrained by non-flexible repairs.

The best approach to deal with the wall reinforcement being spaced 24 inches on center rather than 12 inches on center is to monitor the structure. The City should also consider lowering the overflow to ensure it is not operated above the maximum allowable operating level in the future.

Because the valve vault shares a footing with the reservoir, there isn't space available to install flexible connections on the pipes. Instead, a new vault should be constructed with sufficient space between it and the reservoir to allow for the installation and proper operation of flexible connections.

11.4.4 Water Quality/Sanitary

Water quality should continue to be monitored as common inlet/outlet/drain configurations can cause water stagnation in the reservoir. A removable silt stop should be installed on the combined drain/outlet pipe. The overflow/drain pipe outlet can be retrofitted with a #24-mesh and 4-mesh screen backing.

The gasket on the roof access hatch can be replaced with neoprene seals on both the frame and the lid or replaced with a hatch with better contact area. The vent screen, if in fact is not compliant, it can be replaced with a #24-mesh and 4-mesh screen backing.

11.4.5 Safety

On the exterior, an L&I-compliant railing can be installed around the valve vault roof. A toeboard can also be installed on the grating.

On the interior, steps should be taken to ensure ingress and egress to the reservoir is as safe as possible. A new interior ladder with fall protection system is recommended. This could be similar to the ladder installed at the Kearney Reservoir, which has a removable extension and is shown in Figure 9-16. A new exterior ladder should be installed on the exterior of the access vault that is similar to the ladder installed on the 40th Street Reservoir, shown in Figure 9-7 right.

11.4.6 Operations and Maintenance

11.4.6.1 Site and Security

A fence should be installed around the reservoir for security reasons. Trees that are closer to the reservoir than they are tall should be removed or transplanted. The cleared areas can be replanted with shorter growing shrubs on the perimeter to shield the reservoir from view.

11.4.6.2 Roof Drainage

On the valve vault roof curb, notches or overflow scuppers should be installed to prevent the roof from overflowing the curb if the drain backs-up.

11.4.6.3 Appurtenances

The are no recommended improvements related to the operations and maintenance for the appurtenances for the Consolidation Reservoir.

11.4.6.4 Valving and Piping

Proper dechlorination of the Consolidation Reservoir will need to consist of a weighted system that is set in the manhole or affixed to the culvert at the outlet. An example of a basket system is shown in Figure 4-21. The City was informed of the leaking valve, but this should be repaired or replaced to facilitate draining of the reservoir and minimize contamination issues.

11.4.7 Capital Improvements Plan Table

Planning level costs for the retrofits to the Consolidation Reservoir are shown in Table 11-2

Table 11-2: Consolidation deficiencies, recommended improvements, and estimated costs

Category	Deficiency	Recommended Improvement	Estimated Cost
CLN & COAT	Organic material buildup on exterior	Pressure wash exterior. Clear valve vault drain.	$ 1,000
	Valve vault roof drain is blocked.	Clear clogged drain.	$ 1,000
	Efflorescence on overflow and roof drain pipes within valve vault	Clean and recoat. Seal valve vault roof.	$ 3,000
DETERIOR-ATION	Cracks in concrete and leaks	Coat interior	$ 143,000
	Corrosion on access hatch vault lid nuts, overflow weir gate components, ancillary pipe, and pipe frame	Clean and (re)coat. Remove ancillary pipe if not needed.	$ 2,000
	Corrosion on interior of piping	Remove corrosion with agitation or pig pipe. Recoat where possible or consider cured in place pipe liner	$ 10,000
STRUCT	Roof-wall-interface does not account for thermal deformation	Resolve roof-wall-interface issues a. Clean & coat cracks related to thermal deform. b. Replace roof with new geodesic dome c. Structural inspection to determine next steps	$ 17,000 $ 120,000 $ 2,000
	Maximum reinforcement spacing exceeded	Continue to monitor for structural issues	$ -
	Operated at the overflow elevation, seismic slosh impacts roof and structure is under-reinforced	Consider lowering overflow	$ -
	Missing seismic valves & vault adjacent to reservoir	New seismic valve vault and associated piping	$ 200,000
WQ	Inlet and outlet are combined	Continue to monitor water quality; consider upgrades	$ -
	No silt-stop on combined drain/outlet	Install removable silt-stop	$ 1,000
	Drain pipe screen non-compliant	Replace drain pipe screen	$ 1,000
	Roof hatch is a high-maintenance design (small contact area)	Replace gasket w/ neoprene seals; consider replacement	$ 1,000
	Vent screen non-compliant	Replace vent screen	$ 1,000
SAFETY	Lacks valve vault roof fall protection and grating railing toeboard	Install toeboard on grating railing and railing around valve vault roof	$ 4,000
	Ingress and egress difficult; interior ladder corroded and non-compliant	Install exterior vault access ladder and replace interior ladder with one with fall protection	$ 33,000
O&M	Fence does not encompass reservoir	Install/replace fence	$ 18,000
	Tree spacing recommendation not met	Tree removal and restoration	$ 11,000
	Valve vault roof lacks overflow drainage	Install notches or overflow scuppers on parapet	$ 2,000
	Isolation valve for pump station not functioning	Replace isolation valve	$ 10,000
	Energy dissipation and dechlorination non-compliant	Update energy dissipation and dechlorination system	$ 4,000
		Subtotal	$ 585,000
		30% Contingency	$ 175,500
		8.7% Tax	$ 66,164
		Engineering, Administration, and Construction Management	$ 289,332
		Total Project Costs Estimate	$ 1,115,996
		Total Project Costs Estimate (rounded)	**$ 1,100,000**

11.5 Conclusion

The two biggest items to be dealt with on the Consolidation Reservoir are the thermal deformation issues and the lack of flexible couplings on the pipes passing through the valve vault. If the City wishes to update to a modern seismic valve vault soon, it may not be necessary address issues with the existing vault.

The next washdown inspection should take place within the next 3 to 5 years. The reservoir should be leak tested as a first step of the next inspection.

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Section 12

Dakin I Reservoir

12.1 Tank and Site Overview

The Dakin I Reservoir, shown in Figure 12-1, is one of five similar dome reservoirs that were built between 1958 and 1987. While as-built drawings for it are unavailable, drawings of the 40th Street and Reveille Reservoirs, which were built in the same period, designed by the same consulting engineering group, and are of similar construction are available. With slight differences in dimensions, the five reservoirs are 0.3 or 0.5 MG reinforced concrete, self-supporting, domed roof hoppers that were originally built with common inlet/outlets/drainpipes. The reservoirs were designed to hold water above the roof-to-wall interface. This reservoir is partially buried, and the attached valve vault is located at the roof level. It was built in 1987 and has a capacity of 0.5 MG.



Figure 12-1: The Dakin I Reservoir, viewed looking northeast

According to measurements taken in the field (Figure 12-2), the Dakin I Reservoir has an interior diameter of 66 feet, 8 inches. The hopper base measured 7.3 feet deep and the interior wall measured 10.3 feet high. The overflow weir was measured to be 21.9 feet above the reservoir floor, which according to City-supplied documentation, corresponds to 519 feet City. This height is higher than the top of the vertical wall. The operating range is 13.5 to 17 feet. Wall and roof reinforcement were assumed to be similar to the 40th Street and Reveille Reservoirs. The interior walls and floor of the Dakin I Reservoir were coated in 2009 using VersaFlex AquaVers primer and polyurea.

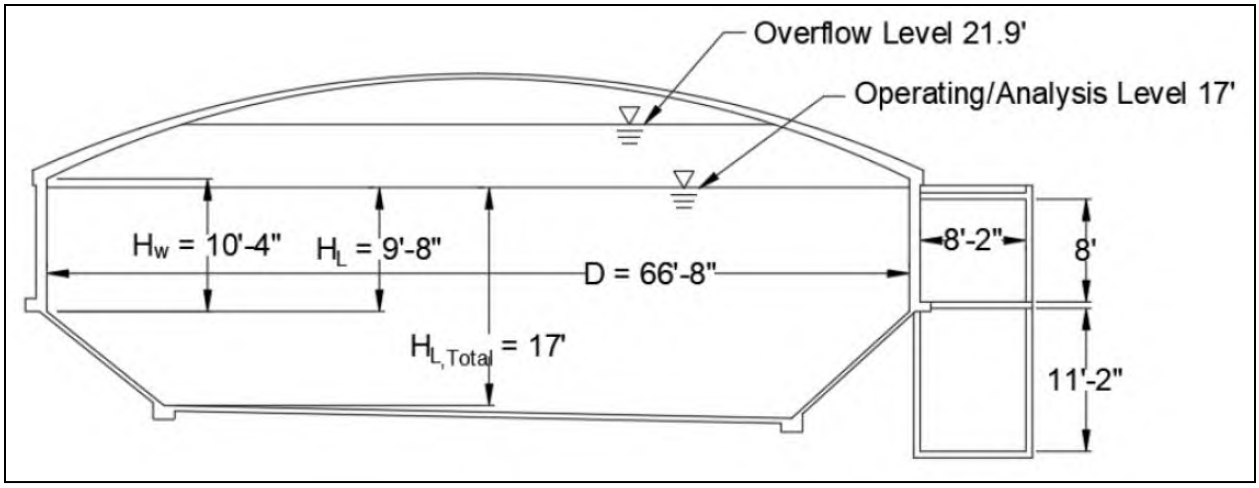


Figure 12-2: The measured interior dimensions of the Dakin I Reservoir

The site where the Dakin I and II Reservoirs are located is within a forested area about 3 miles northwest of the Bellingham CBD. The valve vault shares a wall with the reservoir itself and is 8 feet wide by 9 feet deep. It serves the 519 Dakin and Yew Zone, which is fed from the gravity zone via the Dakin and Yew Booster Pump Station. The Dakin Reservoirs also supply the 730 Alabama Hill Zone via the Balsam Lane Pump Station.

The geotechnical investigation indicated 4 feet of fill material around the reservoir, which consisted of medium stiff to stiff blue-brown silt with variable amounts of sand, gravel, and organic matter. This layer likely did not extend below the foundation of the reservoir. Chuckanut Sandstone was encountered at 4 feet bgs. Groundwater seepage was not observed at the final depth of boring.

With the nearest mapped faults being 5 and 10 miles away, there is not a significant risk of ground rupture at the site. Because the Dakin I Reservoir is bearing directly on bedrock, an allowable bearing pressure of 6,000 psf can be used for structural analysis. Bedrock is not at risk of liquification and the site is not expected to have issues with slope instability.

12.2 Inspection Summary

A drained inspection of the Dakin I Reservoir took place on April 8, 2019.

12.2.1 Exterior Inspection Summary

12.2.1.1 Site and Security

To limit unauthorized access to the site, a chain link fence with barbed wire encompasses the property (Figure 12-3 Left). The site is generally well-graded, directing runoff away from the reservoir. During the site visit, it was noted that the roof of the reservoir and valve box are under the dripline of the trees (Figure 12-3 Right).



Figure 12-3: Fence around site perimeter (Left) and trees overhanging reservoir roof (Right)

12.2.1.2 Exterior Walls

Of the visible portion of the exterior walls above grade, cracking with efflorescence was noted throughout, especially below the roof-to-wall interface (Figure 12-4). The exterior coating was found to be peeling, blistering, and exhibiting efflorescence (Figure 12-5 Left). Areas of missing coating were also found near ground level (Figure 12-5 Right) The DFT of the sidewalls ranged from 24-33 mils. Approximately 5-10 percent of the topcoat is missing, and 1-3 percent is blistering on the sidewall surfaces, mostly at the ground interface.



Figure 12-4: The exterior walls cracking with efflorescence



Figure 12-5: Exterior wall blistering and efflorescing (Left) and missing coating near ground level (Right)

12.2.1.3 Foundation

The foundation was unable to be observed as the reservoir is buried.

12.2.1.4 Exterior Roof

The exterior roof of the reservoir exhibited minor circumferential and radial cracking (Figure 12-6) and organic matter/debris accumulation. No DFT measurements were able to be taken on the roof due to the textured non-slip coating. The roof had a grade that ranged from 3.3 degrees near the vent to 19.4 degrees near the reservoir roof's perimeter. The distance from the roof to ground level ranges from 4 to 5 feet.



Figure 12-6: Roof minor circumferential and radial cracking and roof vent

12.2.1.5 Exterior Appurtenances

The original ladder that is set into the walls (Figure 12-1) is used to access the valve vault roof and even the roof in general. A retrofitted ladder with grading similar to the other reservoirs also provides access to the roof. As is typical with the City's reservoirs of this construction, the

retrofitted grating and safety railing extend only around the entry hatch and is missing a toeboard (Figure 12-7 Left). The entry hatch has a thin contact area with the lid and the gasket was not securely attached (Figure 12-7 Right).



Figure 12-7: The roof entry hatch (Left and Right) and overflow weir (Right)

Dakin I Reservoir's vent has a sheet metal collar that was not removed during our inspection (Figure 12-6). The gap was large enough the photograph the screen (Figure 12-8 Left) which appeared to be woven with approximately 12 strands per inch. It was also assessed via the provided drawings of similar reservoir and photos of the College Way Reservoir vent retrofit (Figure 12-8 Right). A 3-foot diameter penetration in the roof has a concrete vent structure above it. The concrete overhang is 4 feet, 2 inches. Approximately 2 inches of opening was exposed under the sheet metal collar.



Figure 12-8: The roof vent screen (Left) and a provided photo of the College Way Roof Vent retrofit from January 2013 (Right)

The attached valve vault shares a wall and footing with the reservoir. The inlet, outlet, and drain pipes all run through the vault. The overflow runs through via an air gap, connecting with the drain pipe. The vault roof has curb that extends all the way around (Figure 12-7 Left). The coating on the attached valve vault and entry vault was failing (Figure 12-1 and Figure 12-3 Left).

12.2.2 Interior Inspection Summary

12.2.2.1 Interior walls

The coating on the interior walls made it difficult to determine the extent, if any, of the internal cracking of reservoir walls. Small blistering on the hopper base and coating sags in the upper walls were noted in the interior coating (Figure 12-9). The blue prime coat is still intact beneath blisters, but water was present under the blisters. The measured DFT ranged from 80-100 mils; the specified DFT was 80 mils as per the supplied documents from the City.



Figure 12-9: The reservoir's walls (Left) minor bubbling on the hopper base(Right)

12.2.2.2 Floor

The floor was also coated and covered by a thin layer of sediment, which made it difficult to inspect the condition (Figure 12-10). From what could be seen, the floor's coating was intact. No blistering was observed.



Figure 12-10: The reservoir's floor covered in sediment

12.2.2.3 Interior Roof

The ceiling exhibited a similar minor crack as the exterior roof and is uncoated.



Figure 12-11: The reservoir roof exhibited circumferential cracking

12.2.2.4 Interior Appurtenances

The interior ladder was rungs set into the wall. While the upper rungs within the access vault are still present, the rungs on the wall were removed during the coating process and have not been replaced (Figure 12-12 Left). A removable ladder, tripod, and winch are used for inspections and maintenance. A large corroded pipe was located adjacent to the removable ladder which made ingress and egress difficult (Figure 12-12 Right).

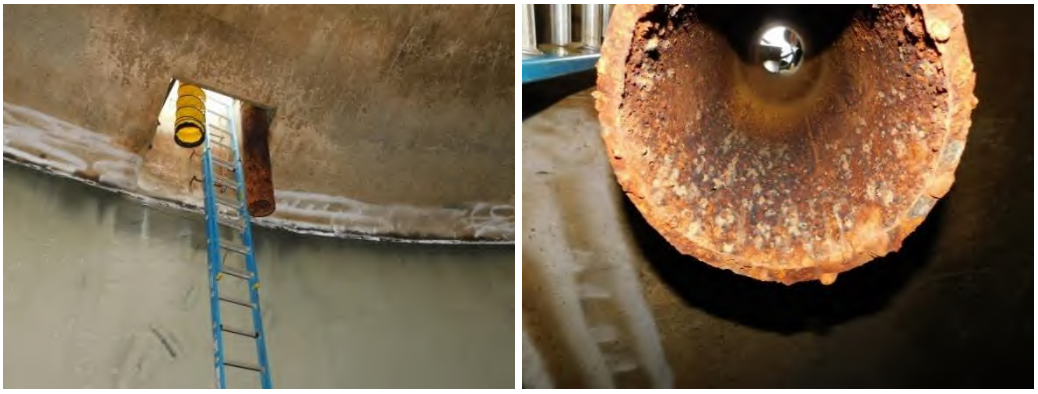


Figure 12-12: Removable interior ladder (Left) and a large uncoated corroded pipe

12.2.3 Piping and Valving Inspection Summary

The combined inlet/outlet/drain piping exhibited minor discoloration on the interior of the pipe (Figure 12-13). The valve vault contained an altitude valve and isolation valves (Figure 12-14 Left). The drain pipe connects with the overflow and extends to the storm sewer without an air gap (Figure 12-14 Right).



Figure 12-13: The common inlet/outlet/drainpipe with a sample line running though



Figure 12-14: Piping, an altitude valve, and isolation valves within the vault (Left). The drainpipe connects to the storm sewer without air gap (Right).

The overflow weir, shown in Figure 12-7 (Right) had rust on the gate components (Figure 12-15 Left). The total air gap distance is approximately 6 inches (Figure 12-15 Right). It connects with the drain line in the vault, draining to the storm sewer.



Figure 12-15: Corrosion on the overflow gate (Left) and exterior overflow piping with very narrow air gap (Right)

A fire hydrant is located outside of the reservoir and is used in washdown operations.

12.3 Condition Assessments

12.3.1 Cleanliness and Coatings

The exterior roof walls and roof have organic material buildup and efflorescence. The exterior topcoat is no longer functional in many places on the reservoir structure, valve vault, and access vault. If spot treated, the exterior coating will be viable for up to 10 years (+/-) to come. The debris accumulation, topcoat condition, and exposed concrete caused the exterior walls and roof to be in fair to poor condition.

On the interior, the amount of accumulated sediment indicates that this reservoir is due for a washout inspection. The bubbling and sags on the interior coating should continue to be monitored, but do not appear to be affecting the integrity of the coating at this time. As the prime coat is intact under the blisters on the hopper base, they are likely not due to groundwater effects. Instead, these blisters are more likely due to air entrapment during the polyurea's application.

12.3.2 Material Deterioration

Significant concrete deterioration was noted throughout the exterior, which needs attention. Because this cracking is structural in nature, it is discussed in Section 12.3.3.1. The interior coating has likely significantly decreased the rate of efflorescence accumulation around the exterior cracks as water is inhibited from passing through the concrete.

The combined inlet/outlet/drain piping was in good visual condition, but the corrosion on the ancillary pipe and weir gate components were significant, causing it to be in poor condition.

12.3.3 Structural Performance

12.3.3.1 Static Analysis

The dome roof was found to meet modern requirements of AWWA D110-13. However, the roof-to-wall interface is not designed to allow for roof expansion and contraction, which has resulted in cracks. Assuming the walls are reinforced similar to the 40th Street and Reveille Reservoirs' plans, the wall reinforcing appears to be acceptable for static loads. However, the upper sections of the interior wall have reinforcing at 24 inches on center, which exceeds ACI 350.3's maximum allowable spacing of 12 inches on center. The foundation was found to be sized appropriately, based on the geotechnical report's soil bearing capacity of 6,000 psf.

12.3.3.2 Seismic Analysis

At the 17-foot operating level, the walls' reinforcement was found to be suitable for the design seismic event. This was not the case if operated at the overflow level. Similarly, the design seismic event would cause a constrained slosh wave, causing damage to the roof if operated at the

overflow level. However, at the 17-foot operating level, the roof is adequately reinforced. Incidental damage may still occur to hatches and appurtenances. The valve vault attachment is suitable to prevent differential movement and impact during the seismic event. Also, based on assumed backfill conditions, the hopper base is not likely to fail and collapse onto the piping. However, the pipes do not have flexible couplings which would address potential differential settlement between the two structures during a seismic event.

12.3.4 Water Quality/Sanitary

Although the common inlet/outlet/drainpipe configuration can cause problems with water quality issues, none have been reported. A removable silt stop is required on combined drains/outlets but was not installed. As this reservoir drains to a storm drain, a DOH approved air gap is required on both the overflow and the drain pipe. No air gap is installed on the drain pipe. The air gap between the overflow and receiving pipe was found to be too narrow. While the screen on the vent could not be carefully measured due to the sheet metal collar, it does not appear to be 24-mesh screen backed with 4-mesh screen The roof hatch would be classified as a "high-maintenance design" because of issues getting the gasket to provide a tight seal against the relatively small surface area of the frame. The gasket not being fully adhered could potentially lead to water quality issues within the reservoir. Overall, the water quality/sanitary condition is fair to good.

12.3.5 Safety

With the exterior ladders being short, no ladder fall protection is required. This reservoir roof has some areas where a fall would be greater than 4 feet. A fall would be greater than 4 feet from the valve vault as well. Thus, an L&I-compliant railing is required on these areas. The reservoir roof is considered steep as the greatest slope is greater than 4:12. Thus, additional fall prevention is required.

With the fall protection and ladder on the interior of the reservoir being non-existent, a removable ladder, tripod, and winch were required for our inspection. While this configuration appears to meet OSHA requirements, there is possible risk of failure in this setup. While the exterior ladder safety condition is good, the valve vault roof condition is fair, and the interior ladder safety condition is fair to poor.

12.3.6 Operations and Maintenance

12.3.6.1 Site and Security

The fence and drainage were found to be suitable for this reservoir. An intrusion alarm is installed on the roof's access hatch. However, trees were too close to the reservoir. Nearby trees endanger the structure, slow evaporation from the soil by the structure, are causing organic material accumulation problems, and their roots can penetrate the structure. Overall, the site/security is fair condition.

12.3.6.2 Roof Drainage

The reservoir roof sheds water adequately. However, drainage of the valve vault roof appeared to not function in the event of a drain clog. If the drain were to be clogged, the roof would overflow the curb; no notches or overflow scuppers are present that would send water away from the reservoir. There are apparently no waterstops installed between the reservoir and valve vault.

12.3.6.3 Appurtenances

No difficulties were found using the exterior ladder to access the roof. However, accessing the interior of the reservoir is more difficult than other style reservoirs as the tripod, winch, and removable ladder must be lifted to the roof. Dakin I does not have a ladder on the exterior of the roof access hatch vault, so climbing into the hatch can also be challenging. The Dakin I Reservoir met design requirements for the vent on the roof penetration, screened area, and free area on the retrofitted collar.

12.3.6.4 Valving and Piping

The staff did not note any difficulties associated with operating of the reservoir. No dechlorination system was observed onsite.

12.3.7 Obsolescence

Overall, the equipment on site appeared to be of older design, and difficulty would be expected replacing components.

12.3.8 Condition Scoring

Overall, the condition score of the Dakin I Reservoir was fair, 3.7. Problems associated with this reservoir were related to the structural problems with the roof-wall-interface. A summary of the scoring is shown in Table 12-1 and the full Score Matrix can be found in Appendix J.

12.4 Recommended Improvements

12.4.1 Cleanliness and Coatings

First, the exterior should be pressure washed to remove dirt and other debris. Areas of coating failure on the exterior that are not thermal related such as the valve vault and access vault can be spot coated.

The interior should be washed out to remove the sediment that has accumulated on the floor. This should be done at a low pressure so as not to burst any of the blisters on the hopper base.

The blisters should continue to be monitored and photographed during regular inspections to determine if they are getting larger, increasing in number, cracking, or bursting. The prime coat should also be monitored.

Table 12-1: Condition Scoring of the Dakin I Reservoir

Categorical Scores	
Cleanliness and Coatings	4.1
Material Deterioration	4.2
Structural Performance - Static	4.1
Structural Performance - Seismic	3.3
WQ/ Sanitary	4.1
Safety	4.0
Operations & Maintenance	4.2
Obsolescence	1.0
Overall	**3.7**

12.4.2 Material Deterioration

Discussed in Section 12.4.3 are possible solutions to deal with the thermal expansion-related issues of the roof-to-wall interface.

The corrosion on the weir gate components, should the City wish to continue operating them, can be addressed with cleaning and recoating. The corroded pipe within the access vault is recommended to be removed per section 12.4.6.3. If it cannot be removed, it should be cleaned and coated.

12.4.3 Structural

To confirm the assumptions made in the analysis, as-built drawings may be obtained, or a testing firm could be employed to map the existing reinforcing.

The recommended improvement to address the issues related to thermal deformation occurs in stages:

1. A temporary improvement should be employed soon to halt further deterioration of any reinforcing material until a permanent solution is implemented. This would entail removing damaged concrete from the cracking areas, properly cleaning cracks, and assessment by a structural engineer. Likely, the areas will need to be spot coated to prevent water damage to the reinforcing. It is imperative that any repair media be flexible so as not to accelerate structural damage as thermal movement is likely to continue to occur until the problem is addressed. Stiffening or reinforcing the cracking areas is not recommended.

2. To more permanently address the thermal deformation-related issues, several options are available. A new aluminum geodesic roof is recommended. The City can also consider a new concrete roof that is domed or flat. Another option would be lifting the entire roof and retrofitting it with a bracketing system and elastomeric bearing pad between the roof and walls. These options would likely cost much more than a new aluminum geodesic roof.

3. The cracks should be investigated by a structural engineer after the thermal deformation issue is resolved.

The best approach to deal with the wall reinforcement being spaced 24 inches on center rather than 12 inches on center is to monitor the structure. The City should also consider lowering the overflow to ensure it is not operated above the maximum allowable operating level in the future.

Because the valve vault shares a footing with the reservoir, there isn't space available to install flexible connections on the pipes. Instead, a new vault should be constructed with sufficient space between it and the reservoir to allow for the installation and proper operation of flexible connections.

12.4.4 Water Quality/Sanitary

Water quality should continue to be monitored as common inlet/outlet/drain configurations can cause water stagnation in the reservoir. A removable silt stop should be installed on the combined drain/outlet pipe. A DOH-approved air gap should also be installed on the drain pipe. With the drain pipe being 11 feet underground, this would likely be logistically challenging at the Dakin I site. Possible options are draining to daylight, an appropriately sized dedicated dry well with backflow prevention, or an air gap with a sump and sump pump that can pump water than cannot be drained by gravity.

While the overflow air gap is too narrow, extending it is not possible with the current configuration; the roof of the valve vault is too close to the overflow outlet. To meet current DOH recommendations, the overflow would likely need replacement. The new overflow could outlet to the site or pass around the valve vault with an approved air gap before re-entering the vault or storm sewer.

The gasket on the roof access hatch can be replaced with neoprene seals on both the frame and the lid or replaced with a hatch with better contact area. The vent screen, if in fact is not compliant, it can be replaced with a #24-mesh with a 4-mesh screen backing.

12.4.5 Safety

On the exterior, an L&I-compliant railing is recommended around valve vault roof. The railing will also need to extend around the perimeter of the reservoir at all areas where the fall distance is greater than 4 feet. Additionally, on the reservoir roof, a fall restraint system or positioning device

system, or possibly a fall arrest system if the work is considered roofing work, is recommended. A toe board should be added to the existing grating.

On the interior, steps should be taken to ensure ingress and egress to the reservoir is as safe as possible. A new interior ladder with fall protection system is recommended. This could be similar to the ladder installed at the Kearney Reservoir, which has a removable extension and is shown in Figure 9-16. A new exterior ladder should be installed on the exterior of the access vault that is similar to the ladder installed on the 40th Street Reservoir, shown in Figure 9-7 Right.

12.4.6 Operations and Maintenance

12.4.6.1 Site and Security

Trees that are closer to the reservoir than they are tall should be removed or transplanted. The cleared areas can be replanted with shorter growing shrubs on the perimeter to shield the reservoir from view.

12.4.6.2 Roof Drainage

On the valve vault roof curb, notches or overflow scuppers should be installed to prevent the roof from overflowing the curb if the drain backs-up.

12.4.6.3 Appurtenances

To facilitate access to the interior of the reservoir, the corroded ancillary pipe should be removed.

12.4.6.4 Valving and Piping

Proper dechlorination of the Dakin I Reservoir will need to consist of a weighted system that is set in the manhole or affixed to the culvert at the outlet. An example of a basket system is shown in Figure 4-21.

12.4.7 Capital Improvements Plan Table

Planning level costs for the retrofits to the Dakin I Reservoir are shown in Table 12-2

Table 12-2: deficiencies, recommended improvements, and estimated costs

Category	Deficiency	Recommended Improvement	Estimated Cost
CLN & COAT	Organic material buildup on exterior	Pressure wash exterior	$ 1,000
	Coating failure on reservoir (not thermal related - small areas) - vaults and roof	Spot Repair Coating	$ 7,000
	Sediment accumulation on floor	Perform regular washdown inspections	$ 1,000
	Blisters on hopper base coating	Monitor for blister growth	$ -
DETERIOR-ATION	Corrosion on overflow weir gate components	Clean and recoat overflow weir gate components	$ 1,000
STRUCT	Roof-wall-interface does not account for thermal deformation	Resolve roof-wall-interface issues a. Clean & coat cracks related to thermal deform. $ 11,000 b. Replace roof with new geodesic dome $ 150,000 c. Structural inspection to determine next steps $ 2,000	
	Maximum reinforcement spacing exceeded	Continue to monitor for structural issues	$ -
	Operated at the overflow elevation, seismic slosh impacts roof and structure is under-reinforced	Consider lowering overflow	$ -
	Missing seismic valves & vault adjacent to reservoir	New seismic valve vault and associated piping	$ 200,000
WQ	Inlet and outlet are combined	Continue to monitor water quality; consider upgrades	$ -
	No silt-stop on combined drain/outlet	Install removable silt-stop	$ 1,000
	No drain air gap	Upgrade drain pipe w/ air gap	$ 88,000
	Overflow air gap too narrow	Replace overflow	$ 25,000
	Roof hatch is a high-maintenance design (small contact area)	Replace gasket w/ neoprene seals; consider replacement	$ 1,000
	Vent screen non-compliant	Replace vent screen	$ 1,000
SAFETY	Lacks steep roof fall protection, railings, and grating railing toeboard	Install roof fall protection, railing on heights greater than 4 feet, and toeboard on grating railing	$ 30,000
	Ingress and egress difficult and missing interior ladder	Install exterior access vault ladder and install interior ladder with fall protection	$ 32,000
O&M	Tree spacing recommendation not met	Tree removal and restoration	$ 8,000
	Valve vault roof lacks overflow drainage	Install notches or overflow scuppers on parapet	$ 2,000
	Corroded pipe near entry hatch inhibits ingress	Remove pipe. Clean and coat if cannot be removed	$ 1,000
	Dechlorination non-compliant	Update dechlorination system	$ 2,000
		Subtotal	$ 564,000
		30% Contingency	$ 169,200
		8.7% Tax	$ 63,788
		Engineering, Administration, and Construction Management	$ 278,946
		Total Project Costs Estimate	$ 1,075,934
		Total Project Costs Estimate (rounded)	**$ 1,100,000**

12.5 Conclusion

The two biggest items to be dealt with are the thermal deformation issues and the lack of flexible couplings on the pipes passing through the valve vault. The Dakin I reservoir, built in 1987, is considerably newer than the other dome reservoirs which were built between 1958 and 1968. Because the reservoir is still relatively new, the City may be favor rehabilitation of this reservoir in comparison to the other older reinforced dome reservoirs.

Because the interior has sediment accumulation, this reservoir is recommended to be prioritized in its next washout inspection. This should take place within the next 2 years. The reservoir should be leak tested as a first step of the next inspection. The internal blistering, while not a concern at this time, should be inspected at 3- to 5-year intervals to determine if the problem is progressing.

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Section 13

Reveille Reservoir

13.1 Tank and Site Overview

The Reveille Reservoir, shown in Figure 13-1, is one of five reservoirs that were built between 1958 and 1987. Drawings were prepared by John W. Cunningham & Associates for both the 40th Street and Reveille Reservoirs. With slight differences in dimensions, the five reservoirs are approximately 0.5 MG reinforced concrete, self-supporting, domed roof hoppers that were originally built with common inlet/outlets/drainpipes. The reservoirs were designed to hold water above the roof-to-wall interface. This reservoir is partially buried, and the attached valve vault is located below roof. This reservoir is the oldest, built in 1958 and has a capacity of only 0.3 MG.



Figure 13-1: The Reveille Reservoir, viewed looking southwest

According to measurements taken in the field (Figure 13-2), The Reveille Reservoir has an interior diameter of 52 feet. The hopper base is 6 feet deep and the interior wall is 13 feet high. The overflow weir was measured to be 23.25 feet above the reservoir floor, which according to City supplied document, corresponds to 696 feet City. This height is higher than the top of the vertical wall. Operational heights range from 15 to 19 feet. Reinforcement and concrete thicknesses of the walls and roof were shown in the provided drawings. The interior is uncoated.

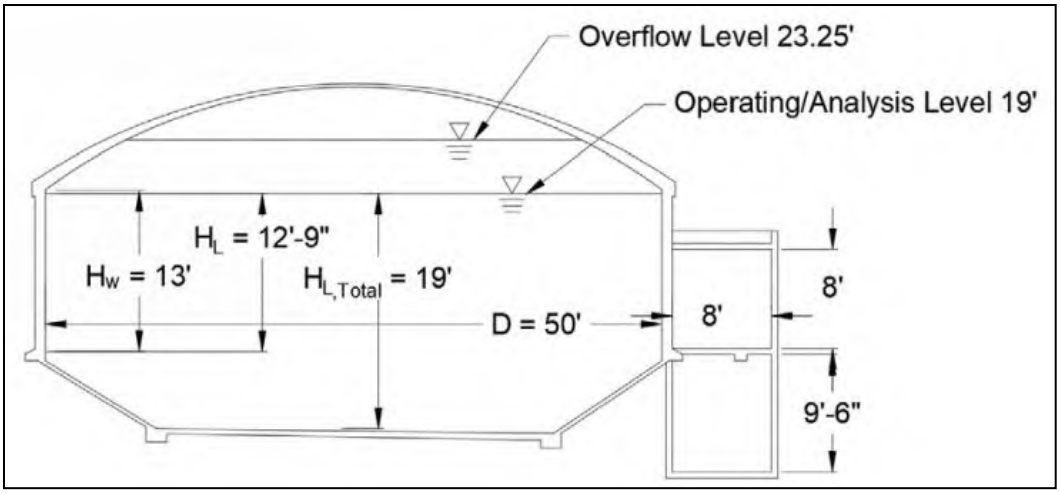


Figure 13-2: The measured interior dimensions of the Reveille Reservoir

Reveille is located in a suburban neighborhood in the southern portion of the service district, about 2 miles southeast of the Bellingham CBD. It serves the 696 Padden Yew Zone. The valve vault shares a wall with the reservoir itself and is 8 feet wide by 8 feet deep. Piping is run to the valve vault, encased in an unreinforced concrete block for protection under the footing. The upper section of vault contains the Reveille Pump Station.

The geotechnical investigation indicated fill consisting of red-brown silt with sand, gravel, and occasional organic matter from the surface to 4.5 feet bgs. Glaciomarine drift, which was comprised of very stiff brown silt with sand and gravel was found between 4.5 to 7 feet bgs. Chuckanut Sandstone was encountered from the 7 to 8 feet bgs, the extent of the boring to refusal. Groundwater seepage was not observed at the final depth of boring.

With the nearest mapped faults being 5 and 10 miles away, there is not a significant risk of ground rupture at the site. Because the Reveille Reservoir is bearing directly on bedrock, an allowable bearing pressure of 6,000 psf can be used for structural analysis. Bedrock is not at risk of liquification and the site is not expected to have issues with slope instability.

13.2 Inspection Summary

A drained inspection of the Reveille Reservoir took place on May 21, 2019.

13.2.1 Exterior Inspection Summary

13.2.1.1 Site and Security

Unlike many other reservoirs, Reveille's site does not have a perimeter fence (Figure 13-1). The site is apparently frequented by local skiers and snowboarders, who use the sloped roof and berm to gain speed for a jump. The site is generally well-graded, directing runoff away from the

reservoir. During the site visit, it was noted that the roof of the reservoir is under the dripline of the trees and other vegetation (Figure 13-3).



Figure 13-3: Trees overhang the reservoir roof and a diagonal crack spreads to the valve vault.

13.2.1.2 Exterior Walls

A berm encompasses most of reservoir's walls. Cracking with efflorescence was noted below the roof overhang and spread diagonally to the valve vault (Figure 13-3 and Figure 13-4).



Figure 13-4 A crack with efflorescence located below the roof overhang

13.2.1.3 Foundation

The foundation was unable to be observed as the reservoir is partially buried.

13.2.1.4 Exterior Roof

The exterior roof of the reservoir had coating intact and appeared largely competent with only minor cracking (Figure 13-5). These cracks included a full-circumference circumferential crack approximately 7 feet up the dome and radial cracks at 4 to 5 feet on center. The roof had a grade

that ranged from 6.8 degrees near the vent to 26.6 degrees near the roof's perimeter. The distance from the roof to ground level is about 3 feet but is greater near the valve vault.



Figure 13-5: Minor circumferential and radial cracking of the roof

13.2.1.5 Exterior Appurtenances

To access the roof, a single retrofitted ladder is used (Figure 13-6 Left). The total distance from the 1-foot high concrete pad to the grating is approximately 10.5 feet. The lowest rung is 18.5 inches from above the concrete pad. As is typical with the City's reservoirs of this construction, the retrofitted grating and safety railing extend only around the entry hatch and is missing a toeboard (Figure 13-6 Right). The entry hatch has a thin contact area with the lid and the gasket was not securely attached. Corrosion was noted on the nuts and washers holding the hatch base to the concrete.



Figure 13-6: The retrofitted exterior ladder (Left) and entry hatch (Right)

Because the sheet metal collar could not be removed, the Reveille Reservoir's vent (Figure 13-7 Left) was assessed via the provided drawings of similar reservoirs and photos of the College Way Reservoir vent retrofit (Figure 13-7 Right). A 3-foot diameter penetration in the roof has a concrete vent structure above it. The concrete overhang is 4 feet, 2 inches. Approximately 2 inches of opening was exposed under the sheet metal collar. The screen was assumed to be similar to the Dakin I, woven with approximately 12 strands per inch.



Figure 13-7: Roof vent (Left) and a provided photo of the College Way Roof Vent retrofit from January 2013 (Right)

The attached valve vault shares a wall and footing with the reservoir. The inlet, outlet, and drainpipes all run through the vault. It appears the inlet/outlet/drainpipe penetration through the slab floor was poorly executed, but likely will not affect the structural capacity of the floor (Figure 13-8 Left). Both the upper and lower vault roofs had signs of water infiltration along the wall edges (Figure 13-8 Right). Infiltration in the lower vault was more severe and may be originating from a circumferential crack on the hopper base. The overflow runs through via an air gap, connecting with the drainpipe. The vault's roof had curb that extend all the way around roof (Figure 13-6 Left).



Figure 13-8: The floor penetration into the reservoir is poorly executed (Left). Infiltration was noted in the lower vault (Right).

13.2.2 Interior Inspection Summary

13.2.2.1 Interior walls

The walls, being uncoated, were noted to have a similar cracking pattern as the exterior (Figure 13-9). Observations of the cracking near the ladder showed the crack to be between 1/8-inch and 1/4-inch in width. Circumferential cracks in the hopper base were 1/16-inch in width.



Figure 13-9: The reservoir's walls



Figure 13-10: Cracks in the walls (Left) and hopper base (Right)

13.2.2.2 Floor

The uncoated floor was covered by a thin layer of sediment, which slightly obscured the floor (Figure 13-11). Cracks were present in the floor.

13.2.2.3 Interior Roof

The ceiling exhibited minor cracking with efflorescence. No instances of concrete spalling or exposed rebar were observed (Figure 13-12).



Figure 13-11: Floor's thin layer of residue (Left) and cracks (Right).



Figure 13-12: The reservoir roof minor radial and circumferential cracking

13.2.2.4 Interior Appurtenances

The interior ladder is rungs set into the wall with rungs spaced 15 inches apart. The ladder was very corroded and exhibited loss (Figure 13-13); it was deemed unsafe for use. A removable ladder, tripod, and winch are used for inspections and maintenance.



Figure 13-13: The interior ladder corroding with material loss

13.2.3 Piping and Valving Inspection Summary

The combined inlet/outlet/drain piping exhibited minor corrosion on the interior of the pipe (Figure 13-14). However, the mouth of the pipe had a rough-concrete interface. The frame around the pipe was also heavily corroded. Significant accumulation of sediment was noted near the pipe. The drainpipe connects with the overflow and extends to the storm sewer without an airgap.



Figure 13-14: The common inlet/outlet frame exhibits corrosion (Left) and significant sediment has accumulated in and around the pipe (Right).

The overflow weir, shown in Figure 13-6 (Right) was crack-free, but rust was noted on the overflow weir gate components. The distance between the supply pipe and overflow rim of the drain pipe is approximately 1 foot (Figure 13-15 Left). The overflow connects with the drain line in the vault, draining to the storm sewer. The attached valve vault contained update isolation valves (Figure 13-15 Right).

A hose bibb is in the valve vault, used in washdown operations.



Figure 13-15: The overflow air gap and organic material accumulation on the vault roof (Left). Piping and valving within the vault (Right).

13.3 Condition Assessments

13.3.1 Cleanliness and Coatings

The exterior roof walls and roof have organic material buildup and efflorescence. The exterior topcoat is no longer functional in many places on the reservoir structure, valve vault, and access vault. If spot treated, the exterior coating will be viable for up to 10 years (+/-) to come. The debris accumulation, topcoat condition, and exposed concrete caused the exterior walls and roof to be in fair to poor condition.

The rust-colored sediment accumulation around the inlet/outlet/drain pipe indicates the reservoir is due for a washout inspection. The staining on the lower section of the valve vault may be caused by water leaking from the reservoir.

13.3.2 Material Deterioration

Significant concrete deterioration was noted at the roof-to-wall interface, which needs attention. Because this cracking is structural in nature, it is discussed in Section 6.3.3.1. The interior walls and floor are also in poor condition. Similar in pattern to the exterior, the interior walls, as well as the hopper base and floor are cracking. These cracks may be allowing water to infiltrate into or exfiltrate out of the reservoir.

Corrosion on the interior ladder, hatch anchoring, pipe frame, and overflow weir is significant and needs attention.

13.3.3 Structural Performance

13.3.3.1 Static Analysis

The dome roof was found to meet modern requirements of AWWA D110-13. However, the roof-to-wall interface is not designed to allow for roof expansion and contraction, which has resulted in cracks. Based on the supplied plans, the wall reinforcing appears to be acceptable for static loads. However, the upper sections of the interior wall have reinforcing at 18 inches on center, which exceeds ACI 350.3's maximum allowable spacing of 12 inches on center. The foundation was found to be sized appropriately, based on the geotechnical report's soil bearing capacity of 6,000 psf.

13.3.3.2 Seismic Analysis

At the 17-foot operating level, the walls' reinforcement was found to be suitable for seismic event. This was not the case if operated at the overflow level. Similarly, the design seismic event would cause a constrained slosh wave, causing damage to the roof if operated at the overflow level. However, at the 19-foot operating level, the roof is adequately reinforced. Incidental damage may

still occur to hatches and appurtenances. The valve vault attachment is suitable to prevent "differential movement and impact during the seismic event. Also, based on assumed backfill conditions, the hopper base is not likely to fail and collapse onto the piping. However, the pipes do not have flexible couplings which would address potential differential settlement between the two structures during a seismic event.

13.3.4 Water Quality/Sanitary

Although the common inlet/outlet/drainpipe configuration can cause problems with water quality issues, none have been reported. A removable silt stop is required on combined drains/outlets but was not installed. As this reservoir drains to a storm drain, a DOH approved air gap is required on both the overflow and the drainpipe. No air gap is installed on the drainpipe. The air gap between the overflow and receiving pipe was found to be too narrow. While the screen on the vent could not be carefully measured due to the sheet metal collar, it does not appear to be 24-mesh screen backed with 4-mesh screen. The roof hatch would be classified as a "high-maintenance design" because of issues getting the gasket to provide a tight seal against the relatively small surface area of the frame. The gasket not being fully adhered could potentially lead to water quality issues within the reservoir. Overall, the reservoir is in fair water quality/sanitary condition.

13.3.5 Safety

With the total fall distance from the exterior ladder to ground level being 10.5 feet, no ladder fall protection is required. However, the exterior ladder's first rung is 18.5 inches off the ground, so it is not in current L&I compliance; the maximum rung spacing is 12 inches. This reservoir roof has some areas where a fall would be greater than 4 feet. A fall would be greater than 4 feet from the valve vault as well. Thus, an L&I-compliant railing is required on these areas. The reservoir roof is considered steep as the greatest slope is greater than 4:12. Thus, additional fall prevention is required.

The interior ladder is too corroded to use and the rung spacing is 16 inches, more than the maximum OSHA-allowed 14 inches. It was deemed unsafe and there is no fall protection in the interior. We used a mechanical winch to lower ourselves into the reservoir for the inspection. While this configuration appears to meet OSHA requirements, there is inherent risk of using a tripod mounted on a vault and a removable ladder. Overall, the safety condition is fair.

13.3.6 Operations and Maintenance

13.3.6.1 Site and Security

The lack of a perimeter fence was a noted deficiency with the reservoir. An intrusion alarm is installed on the roof's access hatch. Drainage was found to be suitable for this reservoir. Trees were too close to the reservoir. Nearby trees endanger the structure, slow evaporation from the

soil by the structure, are causing organic material accumulation problems, and their roots can penetrate the structure. Overall, the site/security is in fair to poor condition.

13.3.6.2 Roof Drainage

The reservoir roof sheds water adequately. Drainage of the valve vault roof appeared to not function in the event of a drain clog. If the drain were to be clogged, the roof would overflow the curb; no notches or overflow scuppers are present that would send water away from the reservoir. There are apparently no waterstops installed between the reservoir and valve vault. The water visible at the roof-wall interface also shows that rainwater or reservoir water may be infiltrating into the reservoir.

13.3.6.3 Appurtenances

The first rung of the exterior ladder was difficult to climb. Also, accessing the interior of the reservoir is more difficult than other style reservoirs as the tripod, winch, and removable ladder must be lifted to the roof. Reveille does not have a ladder on the exterior of the roof access hatch vault, so climbing into the hatch can also be challenging. The Reveille Reservoir met design requirements for the vent on the roof penetration, screened area, and free area on the retrofitted collar.

13.3.6.4 Valving and Piping

The staff did not note any difficulties associated with operating of the reservoir. However, no dechlorination system was observed onsite for drained water.

13.3.7 Obsolescence

Overall, the equipment on site appeared to be of newer design, so a favorable obsolescence score was given.

13.3.8 Condition Scoring

Overall, the condition score of the Reveille Reservoir was fair, 3.7. Problems associated with this reservoir were related to the structural problems with the roof-to-wall interface. A summary of the scoring is shown in Table 13-1 and the full Score Matrix is included in Appendix K.

Table 13-1: Condition Scoring of the Reveille Reservoir

Categorical Scores	
Cleanliness and Coatings	4.4
Material Deterioration	3.9
Structural Performance - Static	4.1
Structural Performance - Seismic	3.3
WQ/ Sanitary	3.8
Safety	2.3
Operations & Maintenance	3.8
Obsolescence	5.0
Overall	**3.7**

13.4 Recommended Improvements

13.4.1 Cleanliness and Coatings

First, the exterior should be pressure washed to remove dirt and other debris. The interior should also be washed out to remove the sediment that has accumulated on the floor, especially near the inlet/outlet/drain pipe.

13.4.2 Material Deterioration

To halt water from migrating through the cracks, the interior is recommended to be coated with a product similar to that used on the other reinforced concrete dome reservoirs (Versaflex AquaVers primer and polyurea). Discussed in Section 13.4.3 are possible solutions to deal with the thermal expansion-related issues of the roof-to-wall interface.

The corrosion on the access hatch vault lid nuts, overflow weir gate components, and inlet/outlet/drain pipe frame can be addressed with cleaning and recoating. The existing corroded interior ladder should be removed and replaced, per Section 13.4.5.

13.4.3 Structural

The recommended improvement to address the issues related to thermal deformation occurs in stages:

1. A temporary improvement should be employed soon to halt further deterioration of any reinforcing material until a permanent solution is implemented. This would entail removing damaged concrete from the cracking areas, properly cleaning cracks, and assessment by a structural engineer. Likely, the areas will need to be spot coated to prevent water damage to the reinforcing. It is imperative that any repair media be flexible so as not to accelerate structural damage as thermal movement is likely to continue to occur until the problem is addressed. Stiffening or reinforcing the cracking areas is not recommended.

2. To more permanently address the thermal deformation-related issues, several options are available. A new aluminum geodesic roof is recommended. The City can also consider a new concrete roof that is domed or flat. Another option would be lifting the entire roof and retrofitting it with a bracketing system and elastomeric bearing pad between the roof and walls. These options would likely cost much more than a new aluminum geodesic roof.

3. The cracks should be investigated by a structural engineer after the thermal deformation issue is resolved.

The best approach to deal with the wall reinforcement being spaced 18 inches on center rather than 12 inches on center is to monitor the structure. The City should also consider lowering the overflow to ensure it is not operated above the maximum allowable operating level in the future.

Because the valve vault shares a footing with the reservoir, there isn't space available to install flexible connections on the pipes. Instead, a new vault should be constructed with sufficient space between it and the reservoir to allow for the installation and proper operation of flexible connections.

13.4.4 Water Quality/Sanitary

Water quality should continue to be monitored as common inlet/outlet/drain configurations can cause water stagnation in the reservoir. A removable silt stop should be installed on the combined drain/outlet pipe. A DOH-approved air gap should also be installed on the drain pipe. With the drain pipe being 10 feet underground, this would likely be logistically challenging at the Reveille site. Possible options are draining to daylight, an appropriately sized dedicated dry well with backflow prevention, or an air gap with a sump and sump pump that can pump water than cannot be drained by gravity.

The overflow air gap can be widened on the reservoir. A trash rack is recommended on the receiving pipe. With the wall of the reservoir close to the overflow, the gap needs to be three times the pipe diameter.

The gasket on the roof access hatch can be replaced with neoprene seals on both the frame and the lid or replaced with a hatch with better contact area. The vent screen, if in fact is not compliant, it can be replaced with a #24-mesh with a 4-mesh screen backing.

13.4.5 Safety

The exterior ladder can have an additional rung installed on the lowest level. An L&I-compliant railing is recommended around valve vault roof. The railing will also need to extend around the perimeter of the reservoir at all areas where the fall distance is greater than 4 feet. Additionally, on the reservoir roof, a fall restraint system or positioning device system, or possibly a fall arrest

system if the work is considered roofing work, is recommended. A toe board should be added to the existing grating.

On the interior, steps should be taken to ensure ingress and egress to the reservoir is as safe as possible. A new interior ladder with fall protection system is recommended. This could be similar to the ladder installed at the Kearney Reservoir, which has a removable extension and is shown in Figure 9-16. A new exterior ladder should be installed on the exterior of the access vault that is similar to the ladder installed on the 40th Street Reservoir, shown in Figure 9-7 Right.

13.4.6 Operations and Maintenance

13.4.6.1 Site and Security

A fence with barbed wire should be installed around the reservoir. Trees that are closer to the reservoir than they are tall should be removed or transplanted. The cleared areas can be replanted with shorter growing shrubs on the perimeter to shield the reservoir from view.

13.4.6.2 Roof Drainage

On the valve vault roof curb, notches or overflow scuppers should be installed to prevent the roof from overflowing the curb if the drain backs-up. These improvements would be incorporated into the design of any new valve vault. To address the staining and apparent infiltration in the lower portion of the valve vault, the joints between the valve vault and reservoir should be sealed to prevent leakage. Coating of the interior of the reservoir may halt this infiltration into the vault as well. The staining can then be cleaned, and further action taken if the water reappears.

13.4.6.3 Appurtenances

The are no recommended improvements related to the operations and maintenance for the appurtenances for the Reveille Reservoir.

13.4.6.4 Valving and Piping

Proper dechlorination of the Reveille Reservoir will need to consist of a weighted system that is set in the manhole or affixed to the culvert at the outlet. An example of a basket system is shown in Figure 4-21.

13.4.7 Capital Improvements Plan Table

Planning level costs for the retrofits to the Reveille Reservoir are shown in Table 13-2.

Table 13-2 Reveille deficiencies, recommended improvements, and estimated costs

Category	Deficiency	Recommended Improvement	Estimated Cost
CLN & COAT	Organic material buildup on exterior	Pressure wash exterior	$ 1,000
	Sediment accumulation on floor	Perform regular washdown inspections	$ 1,000
DETERIOR-ATION	Cracks in concrete and leaks	Coat interior	$ 99,000
	Corrosion on access hatch vault lid nuts, overflow weir gate components, and pipe frame	Clean and (re)coat	$ 5,000
STRUCT	Roof-wall-interface does not account for thermal deformation	Resolve roof-wall-interface issues a. Clean & coat cracks related to thermal deform. b. Replace roof with new geodesic dome c. Structural inspection to determine next steps	 $ 8,000 $ 110,000 $ 2,000
	Maximum reinforcement spacing exceeded	Continue to monitor for structural issues	$ -
	Operated at the overflow elevation, seismic slosh impacts roof and structure is under-reinforced	Consider lowering overflow	$ -
	Missing seismic valves & vault adjacent to reservoir	New seismic valve vault and associated piping	$ 200,000
WQ	Inlet and outlet are combined	Continue to monitor water quality; consider upgrades	$ -
	No silt-stop on combined drain/outlet	Install removable silt-stop	$ 1,000
	No drain air gap	Upgrade drain pipe w/ air gap	$ 88,000
	Overflow air gap too narrow	Replace overflow	$ 44,000
	Roof hatch is a high-maintenance design (small contact area)	Replace gasket w/ neoprene seals; consider replacement	$ 1,000
	Vent screen non-compliant	Replace vent screen	$ 1,000
SAFETY	Missing ladder rung on ext. ladder	Install ladder rung	$ 1,000
	Lacks steep roof fall protection, railings, and grating railing toeboard	Install roof fall protection, railing on heights greater than 4 feet, and toeboard on grating railing	$ 30,000
	Ingress and egress difficult; interior ladder corroded and non-compliant	Install exterior vault access ladder and replace interior ladder with one with fall protection	$ 33,000
O&M	Fence does not encompass reservoir	Install/replace fence	$ 18,000
	Tree spacing recommendation not met	Tree removal and restoration	$ 11,000
	Valve vault roof lacks overflow drainage	Install notches or overflow scuppers on parapet	$ 2,000
	Lower level valve vault leaks	Clean and seal	$ 1,000
	Dechlorination non-compliant	Update dechlorination system	$ 2,000
		Subtotal	$ 659,000
		30% Contingency	$ 197,700
		8.7% Tax	$ 74,533
		Engineering, Administration, and Construction Management	$ 325,932
		Total Project Costs Estimate	$ 1,257,164
		Total Project Costs Estimate (rounded)	**$ 1,300,000**

13.5 Conclusion

The two biggest items to be dealt with on the Reveille Reservoir are the thermal deformation issues and the lack of flexible couplings on the pipes passing through the valve vault. If the City wishes to update to a modern seismic valve vault and coat the interior soon, it may not be necessary to deal with the staining in the valve vault. The interior should be coated in a similar fashion to the other dome reservoirs to prevent leaking or groundwater infiltration into the reservoir.

With the heavy accumulation of debris near the inlet/out/drain pipe, this reservoir is recommended to be prioritized in its next washout inspection. This should take place within the next 2 years. The reservoir should be leak tested as a first step of the next inspection.

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Section 14

Sehome Reservoir

14.1 Tank and Site Overview

The Sehome Reservoir is a partially buried, concrete reservoir that was built around the 1920s (Figure 14-1). It has a listed storage capacity of 0.7 MG, resembling in shape a football with the ends excised. As shown in Figure 14-2, the interior is approximately 100 feet long (running northeast to southwest). The reservoir is 73 feet wide at the center and narrows to 66 feet at each end. The end walls (measured at the center of the reservoir's basin) have a maximum height of 13.5 feet on the northeast end and 16.0 feet on the southwest end. The roof, which was added in the 1950s, has a slight slope to the center then to southwest and is supported by 15 1-foot square columns. While no reinforcement or concrete drawings are available for the reservoir, additional information is available in the structural report in Appendix L.



Figure 14-1: The Sehome Reservoir, viewed looking northeast

Two structures are located on the site. A below-grade piping vault that houses the 12-inch main for the reservoir and 10-inch main for Jersey Street is located just southwest of the reservoir. Twenty feet further to the southwest is the concrete box enclosure that houses the overflow pipe outlet.

Located in the Sehome Hill Arboretum off Bill McDonald Parkway, it is around 1-mile south of the Bellingham CBD. Although the reservoir has been empty for the last 5 years, the minimum and

maximum operating levels would be 10 and 13 feet, respectively. It is located within the 457 South Zone, which is fed via the Otis Street Pump Station.

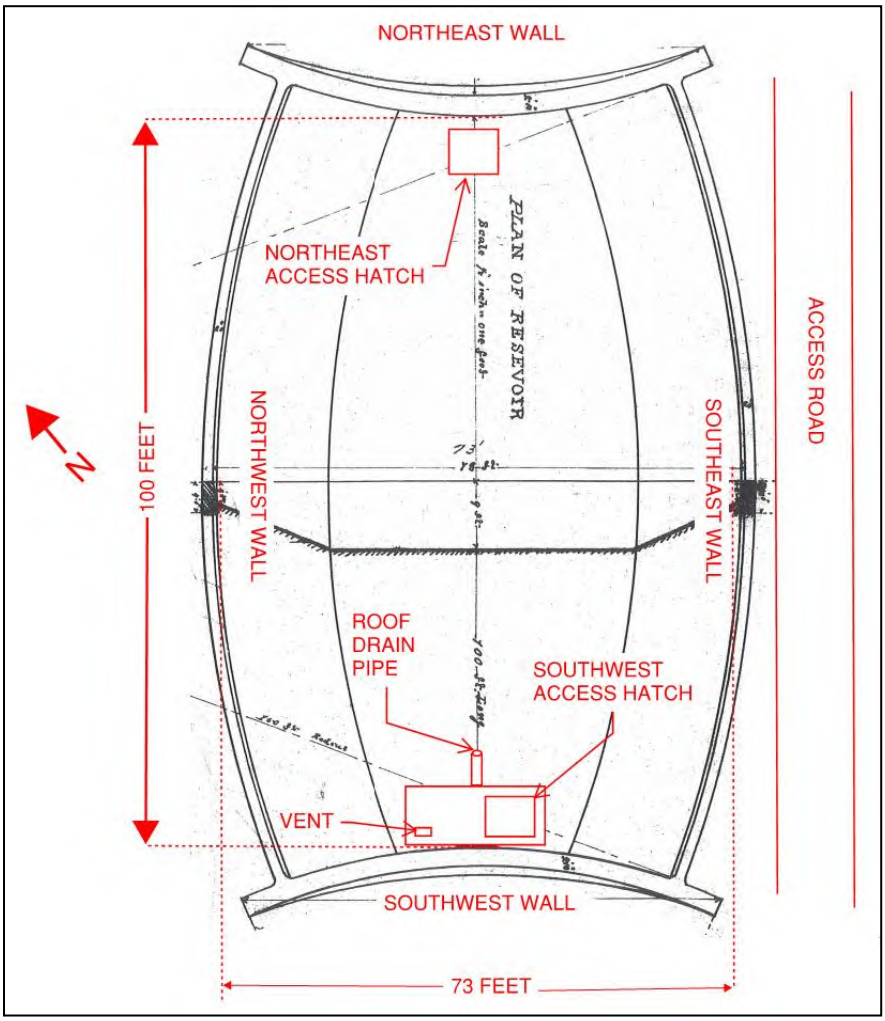


Figure 14-2: Interior dimensions, exterior appurtenances, and site overview of the Sehome Reservoir

A boring drilled east of the reservoir in the geotechnical investigation indicated 1-foot of forest duff and fill to 6 feet bgs. Relict topsoil/weathered horizon was found from 6 to 9 feet bgs, consisting of medium stiff brown silt with sand and organic matter. Glaciomarine drift, which was stiff, brown, sandy silt was found between 9 and 15 feet bgs. Chuckanut sandstone was encountered 15 feet bgs to the boring refusal, 17.5 feet bgs. Groundwater seepage was not observed at the final depth of boring.

With the nearest mapped faults being 5 and 10 miles away, there is not a significant risk of ground rupture at the site. With the reservoir bearing directly on bedrock and glaciomarine drift, an allowable bearing pressure of 3,000 psf can be used. The soils are not at risk of liquification and the site is expected to have low risk of slope instability.

14.2 Inspection Summary

A drained inspection of the Sehome Reservoir took place on January 24, 2019.

14.2.1 Exterior Inspection Summary

14.2.1.1 Site and Security

The reservoir has a barbed wire fence on the northeast, northwest, and southwest walls (Figure 14-1 and Figure 14-3 Left). The fence is missing from the access road on the southeast side of the reservoir (Figure 14-3 Right). It appears the adjacent slope and access road are graded in such a way drainage is routed to the reservoir roof. During the site visit, trees were found overhanging the reservoir.



Figure 14-3: Painted northeast wall, fence, two U-shaped roof vents in the corners (Left). Adjacent slope and access road drains to heavily organic material-laden roof.

14.2.1.2 Exterior Walls

Despite the reservoir's age, the visible portion of the walls were without signs of major cracking and few instances of bugholes or voids in the concrete. The northeast and southwest walls have been painted in murals and were generally free of debris (Figure 14-1 and Figure 14-3 Left). The northwest wall was covered in a thick layer of moss which hampered a complete visual assessment (Figure 14-4). The walls extend higher than the roof, resulting in a curb that ranges from 13 to 19 inches above the roof surface. On the southeast side, the curb is not present where the access road has been graded to the reservoir roof.



Figure 14-4: Moss growth on the northwest wall

14.2.1.3 Foundation

The foundation was unable to be observed as the reservoir is partially buried.

14.2.1.4 Exterior Roof

The roof is accessible from the access road. A significant amount of organic debris accumulation was noted throughout (Figure 14-3 Right) but was noted to be especially heavy along the southeast side near the access road. Clearing debris, it appears the roof may have been coated in the past but has since degraded (Figure 14-5 Left). No cracks were noted in the roof, but much of the roof could not be inspected due to debris. It is slightly sloped, draining to a 6-inch pipe on the centrally located southwest access vault (Figure 14-5 Right). The roof drainpipe extends through the interior of the reservoir and outlets on the near the southeast wall (Figure 14-6). The distance from the roof to ground level ranges from 0 to approximately 7 feet.



Figure 14-5: Exterior roof (Left) and roof drain, southwestern access hatch and one of five U-shaped vents (Right)



Figure 14-6: Roof drain passing through the interior of the reservoir (Left) and outlets to the right of the side access hatch (Right). Jersey Street Water Main penetrates the reservoir near unused exterior ladder (Right)

14.2.1.5 Exterior Appurtenances

A 4-foot by 3-foot side entry hatch on the southwestern wall provides access to the level sensor and overflow weir (Figure 14-6 Right). An exterior ladder was installed to the right of the hatch. This ladder is not currently in use, as the fence is installed at the top of the wall and the roof can be accessed from the adjacent road.

There are two roof hatches installed on the reservoir. The 30-inch square northeast hatch is set on a vault (Figure 14-7) while the 30-inch by 24-inch southwest access hatch shares the vault with a vent and the roof drainpipe (Figure 14-5 Right). While both roof hatch lids appeared to be capable of keeping water out, the applied silicon gasket system was not functional. Some concrete deterioration was noted at the bottom of the structures.



Figure 14-7: The northeast roof access hatch

In each of the four corners is a 3-inch U-shaped roof vent pipe (Figure 14-3 Left and Figure 14-8 Left) that provide air exchange. One additional vent is located on the southwest roof vault (Figure

14-5 Right), for a total of five vents. The south corner vent has 0.125-inch drilled hole screen (Figure 14-8 Center) while the other four vents have 0.125-inch mesh screens (Figure 14-8 Right). The distances from the screens to the surfaces below are approximately 12 inches for all vents.

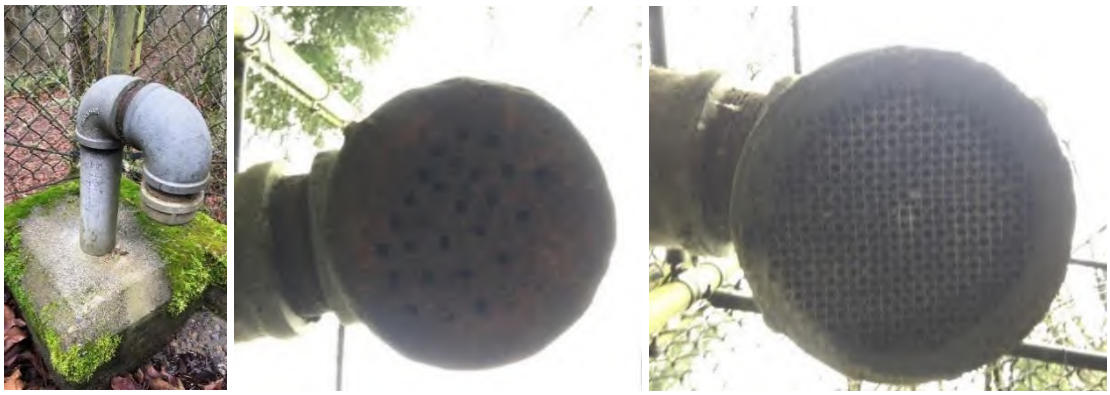


Figure 14-8: Sehome vents are 3-inch U-shaped pipes (Left). The south corner vent has 0.125-inch drilled holes (Center) while the others have 0.125-inch screens (Right).

14.2.2 Interior Inspection Summary

14.2.2.1 Interior walls

The northeast and southwest interior end walls appeared to consist of a lower portion that extends to just above the slope floor on the northwest and southeast sides (Figure 14-9). A 1-inch thick layer of black-tar mastic can be found at the top of this section. Above the sloped walls and mastic are the original 3-foot high walls that encompassed the open-air reservoir. The 1950s renovation added 5 to 6 feet of wall height to these walls along with the roof.



Figure 14-9: The reservoir's walls did not exhibit major issues (Left). The layer between the old and new walls appeared competent (Right).

Overall, the walls appeared to be largely free of bugholes or cracks other than in two areas. One of those areas is an area of heavy efflorescence on the northwest side wall (Figure 14-10 Left). The

other was the northeast wall below the newer wall addition where a few concrete sections were observed to be failing, exposing the underlying aggregate (Figure 14-10 Right).



Figure 14-10: An area of heavy efflorescence on the northwest side wall (Left) and an area of exposed aggregate on the northeast wall (Right)

14.2.2.2 Floor

The slab floor did not exhibit cracking. An efflorescent sheen was, however, observed on floor. Untreated lumber was mounted to the floor and was found to be rotting with organic growth (Figure 14-11).

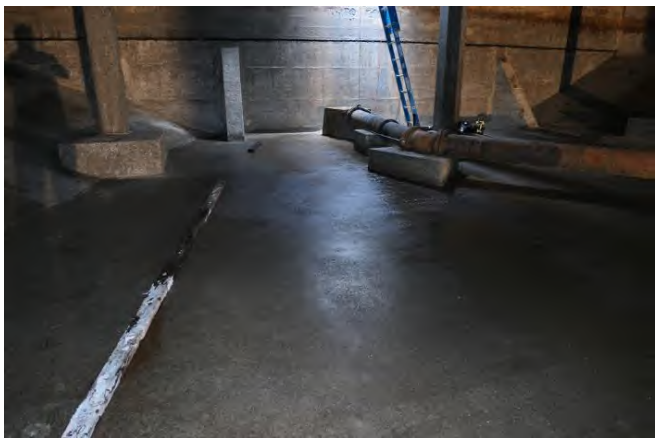


Figure 14-11: A sheen and decaying wood on the reservoir floor

14.2.2.3 Interior Roof and Columns

The interior surface of the roof slab was noted to have a variety of minor efflorescing cracks (Figure 14-12 Left). A red hue was noted in some of these areas. The beams appeared to be crack-free, other than the beams running northeast-to-southwest near the center (Figure 14-12 Right). These beams had some notable crack-associated efflorescing observed at their mid-section. The cracking did not appear to be due to structural failure or creep.



Figure 14-12: Cracking was noted on the ceiling panels (Left) and some of the beams (Right)

14.2.2.4 Interior Appurtenances

No interior ladder is installed on the reservoir. The roof penetration for the centrally located roof vent on the southwest hatch was exhibited spalling (Figure 14-13 Left). Heavy corrosion was also noted on the Jersey Street Water Main, especially on the southwest side (Figure 14-13 Right).



Figure 14-13: Concrete failure on one of the roof vent penetrations (Left) and corrosion on the Jersey Street Water Main (Right).

14.2.3 Piping and Valving Inspection Summary

The 12-inch common inlet/outlet and drain piping are all located adjacent to one another on the southwest side (Figure 14-14 Left). All of these pipes appeared to be heavily corroded (Figure 14-14 Center). The drain piping outlet that connects to the storm sewer at Oak Street and High Street was not accessible (Figure 14-14 Right). It did not appear a dechlorination system was in place.



Figure 14-14: The left picture shows the three pipes on the southwest side of the reservoir. From left to right, these pipes are the 12-inch common inlet/outlet, a 6-inch unknown pipe, and the 8-inch drain. The center picture shows a closeup of the combined inlet/outlet pipe, which has corrosion and debris accumulation. The right picture is the drain outlet, which we were unable to access during our inspection due to it being locked.

The overflow weir (Figure 14-15 Left) and overflow outlet (Figure 14-15 Right) were functional. However, the PVC cap on the outlet had 0.125-inch (+/-) holes drilled.



Figure 14-15: The overflow weir and outlet

Within the valve vault, the altitude valve and gate valves appeared to be of older design and were experiencing light corrosion (Figure 14-16).

Washdown piping was not observed during our inspection.



Figure 14-16: The valves and piping within the valve vault are of older design.

14.3 Condition Assessments

14.3.1 Cleanliness and Coatings

The exterior roof, having an exceptional amount of debris, was found to be in poor cleanliness condition. The moss growth on the northwest wall may be deleterious to concrete as the moss produces acidic conditions and the roots can cause or exacerbate cracking in the walls. However, the observable portion of the exterior northeast and southwest walls' decorative coating looks to be holding.

On the interior, the fungus growth and sheen on the interior indicated poor cleanliness condition. The interior pipes were also noted to have corrosion-related material buildup.

14.3.2 Material Deterioration

Overall, the observed concrete deterioration on the exterior is minimal. Minor observed corrosion was noted on the exterior reservoir vents.

Inside the reservoir, the cracking with efflorescence in the interior roof is indicative of water migrating through cracks. Because the red tinge is present on some of these cracks, corrosion could be occurring within the reinforcement. The efflorescence on the northwest wall interior (Figure 14-10 Left) may be due to differential settlement. The cause may be due to during the 1950s roof retrofit, a sandstone outcropping was covered in concrete making this area stiffer compared to the remainder of the foundation. The area of concrete failure on the northeast wall (Figure 14-10 Right) is localized and does not appear to be part of a larger failure pattern. Spalling of concrete near the SW vent may be due to poor reinforcement.

The coating on the observable portion of interior pipes has degraded, leading to corrosion. The Jersey Street Water Main appears to be at end of life due to heavy corrosion.

14.3.3 Structural Performance

14.3.3.1 Static Analysis

Based on field measurements, other than the center, which is supported by a beam, the roof meets requirements for thickness. It is unknown how, or if, the roof is reinforced. Figure 14-17 shows the large amount of debris that was removed from the roof in 2017. Because the roof has not collapsed during previous soil/debris loads, the roof reinforcement likely exceeds static code requirements for spacing. Per code, the roof could likely withstand a load induced by roof drain backup to curb height since the load would be similar to that induced from historic soil/debris accumulation. However, a combination of debris accumulation and water weight from a plugged drain could exceed previous loads, inducing failure. It is unclear if the roof reinforcement is designed to support the weight of a vehicle.



Figure 14-17: A photo taken in 2017 of City staff removing accumulated organic material, soil, and vegetation from the roof

Based on the supplied drawings, it appears the original walls of the Sehome Reservoir are not reinforced, but rather poured thick enough to withstand expected hydrostatic forces. The walls were found to be suitable to withstand the current 13-foot maximum operating level-induced force. The upper section of the roof, mostly located above the waterline, is likely reinforced and does not experience high hydrostatic loads. Based on historical performance, the wall configuration appears to have been sufficient to withstand additional forces on the base of the structure and wall ends.

The columns appear to be suitable to resist design loads applied to them from the roof based on assumed reinforcing density and historical performance. The reservoir does not appear to have a footing, but rather wall thickness varying from 43 to 54 inches wide. Operating at the 13-foot level, the reservoir would induce a bearing pressure less than the maximum allowable pressure of 3,000 psf recommended in the geotechnical report.

14.3.3.2 Seismic Analysis

Current concrete design requires reinforcing to be used to prevent concrete from failure during seismic event. Because the Sehome Reservoir apparently does not have, or has minimal, reinforcing in the lower sections of the walls, the seismic wall reinforcing is deficient. The roof-to-wall interface lacks the ability to deal with thermal expansion or seismic events, but unlike the domed reservoirs, this has not caused significant cracking problems. Based on field estimates, there is likely insufficient thickness at the roof-wall-interface at the end walls to be able to withstand the seismic event. A code-level seismic event at the 13-foot operating level would induce a 2.6-foot slosh wave. At this level, there is currently 3 feet of freeboard, so the roof would not be impacted.

14.3.4 Water Quality/Sanitary

The combined inlet/outlet configuration, coupled with the reservoir's shape (longer than wide), likely means that water is not mixing properly, and stagnation is occurring. The vent and overflow screens do not follow DOH recommendations with a #24 mesh. The undersides of the vents were not high enough to meet DOH recommendations. Also, the access hatch lack of a proper gasket is a noted DOH deficiency. The lack of an air gap on the drainpipe is also an issue. Furthermore, the roof drainpipe passes through the interior of the reservoir. These designs are very risky because if this pipe were to leak, water contamination is expected. The Sehome Reservoir is in poor water quality/sanitary condition.

14.3.5 Safety

The fence encompassing the reservoir is suitable to prevent falls from the roof. No fall protection is needed on the exterior ladder since it is currently not in use and is less than 24 feet. With the total drop on the interior being 16 feet with a removable ladder, fall protection is not required by OSHA. However, fall protection and a permanent ladder would improve safety at this reservoir. The safety condition is good.

14.3.6 Operations and Maintenance

14.3.6.1 Site and Security

The lack of a fence on the southeast wall allows for unpermitted access to the reservoir. There did not appear to be intrusion alarms on the hatches. Trees and vegetation were found to be too close to the reservoir. Nearby trees endanger the structure, slow evaporation from the soil by the structure, are causing organic material accumulation problems, and their roots can penetrate the structure. Drainage from the adjacent slope and access road is directed to the reservoir roof. The lion's share of copious amounts of organic material accumulation on the roof is likely a result of this material being carried with overland flow to the roof. The site/security is in poor condition.

14.3.6.2 Roof Drainage

Water was apparently making its way through the roof cracks. Drainage of the roof appeared to not function as would be required. The pipe is too small and can become easily clogged by the amount of organic material that is on the roof. The roof drainage is in poor condition.

14.3.6.3 Appurtenances

Accessing the interior of the reservoir was manageable, but not ideal with the removable ladder. The Sehome Reservoir did not meet design requirements for the vent on the roof penetration and screened area.

14.3.6.4 Valving and Piping

The staff did not note any difficulties associated with operating of the reservoir. With the drainpipe manhole being locked, we were unable to assess dechlorination procedures.

14.3.7 Obsolescence

Overall, the equipment on site appeared to be of older design and difficulties in obtaining parts would be expected.

14.3.8 Condition Scoring

Overall, the condition score of the Sehome Reservoir was poor, 2.6. Problems associated with this reservoir were related to the lack of reinforcement on the lower sections, site grading, and litany of DOH deficiencies. A summary of the scoring is shown in Table 14-1 and the full Score Matrix can be found in Appendix L.

Table 14-1: Condition Scoring of the Sehome Reservoir

Categorical Scores	
Cleanliness and Coatings	2.9
Material Deterioration	3.4
Structural Performance - Static	3.3
Structural Performance - Seismic	1.7
WQ/ Sanitary	1.6
Safety	4.5
Operations & Maintenance	2.9
Obsolescence	1.0
Overall	**2.6**

14.4 Recommended Improvements

If the Sehome reservoir is to be salvaged, several major improvements will need to occur. First a testing firm should be employed to map any existing reinforcing in the structure and estimate the concrete's strength. Major structural retrofits would likely be very expensive on this nonstandard, geriatric structure. Should the structure be able to be structurally retrofitted, other improvements will be required. These improvements include regrading the adjacent road; other concrete repairs, removing corrosion from the pipes, improving roof drainage; and installing new vents, a water mixing system, access hatches, interior ladders, and a drain air gap. This work should also include tree removal and restoration around the reservoir. Because the reservoir is located in an arboretum, removal of trees may not be feasible.

While the Sehome Reservoir is historic and unique, it does not appear fiscally advantageous to rehabilitate the structure. Thus, it is recommended to be replaced. Please note that replacing the structure at this site and elevation is not recommended due to the adjacent slopes and abundance of nearby (possibly protected) trees.

While remaining, the City should assume this reservoir will fail during a seismic event, so it should be used only for non-critical storage. The roof should not be driven on, as no information is available about the roof's reinforcing.

It appears the Jersey Street Water Main will need to be replaced.

Planning level costs for a new reservoir are shown in Table 14-2.

Table 14-2: Sehome deficiencies, recommended improvements, and estimated costs

Category	Deficiency	Recommended Improvement	Estimated Cost
CLN & COAT	Organic material buildup on exterior		
	Fungus and sheen on interior floor		
	Material buildup in pipes		
DETERIOR-ATION	Roof and wall cracking		
	Concrete spalling near roof vent penetration		
	Corrosion on interior of piping		
	Jersey Street Water Main corroding		
STRUCT	Walls unlikely reinforced		
WQ	Lacks water mixing system		
	Overflow pipe screen non-compliant		
	No drain air gap		
	Roof drain pipe passes through reservoir		
	Access hatches and gaskets non-compliant		
	Vent Screens non-compliant		
SAFETY	Missing interior ladder		
O&M	Fence does not encompass reservoir		
	Lacks hatch intrusion alarms		
	Tree spacing recommendation not met		
	Site is graded so flow is routed to reservoir		
	Poor roof drainage; roof drain blocked	Demolish Ex Reservoir	$ 65,000
	Vents undersized and of non-compliant design	Replace Jersey St Water Main	$ 12,000
	Dechlorination non-compliant	New 0.7 MG prestressed reservoir	$ 1,700,000
		Subtotal	$ 1,777,000
		30% Contingency	$ 533,100
		8.7% Tax	$ 200,979
		Engineering, Administration, and Construction Management	$ 878,878
		Total Project Costs Estimate	$ 3,389,956
		Total Project Costs Estimate (rounded)	**$ 3,400,000**

14.5 Conclusion

Although the Sehome Reservoir may have historic value, it likely represents more of a liability to the City at this time. The City should consult a historic register to ensure the structure is not protected before moving forward with plans to demolish it. It is possible the structure or its material may be able to be reused or repurposed. Should the reservoir remain and be unused, it should be inspected again at 3- to 5-year intervals. The reservoir should be leak tested if it returns to service.

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Section 15

Parkhurst Standpipe

15.1 Tank and Site Overview

A standpipe is a water holding structure that is taller than it is wide. With a height of 35 feet and a diameter of 30 feet, the Parkhurst structure (Figure 15-1) would be considered a standpipe. It was built in 1997 and it has a listed storage capacity of 0.185 MG. There are seven concrete courses, each of which is 5 feet tall. The lowest course had approximately 1-foot buried, and 4 feet exposed. Additional information is included in the structural report in Appendix M.



Figure 15-1: The Parkhurst Standpipe, viewed looking northeast

It is located in the southeastern extent of the service area, about 2.5 miles from the Bellingham CBD. The minimum and maximum operating levels are 16 and 24 feet, respectively, which equates to an operational storage of 0.183 MG. A 6.5-foot by 4-foot valve vault containing associated piping is located 25 feet to the southwest of standpipe.

The Parkhurst Standpipe is the only water holding structure within the highest zone of the distribution system, the 873 Governor Road Zone. The zone is fed via the Governor Road Pump Station. The overflow is located at 34.5 feet, or 872.5 feet City.

The geotechnical investigation indicated Chuckanut Sandstone from the surface to the terminal of the boring at 5.5 feet bgs. From the surface to 4 feet, the sandstone was weathered, consisting of very dense silty fine to coarse sand with gravel. Groundwater seepage was not observed at the final depth of boring.

With the nearest mapped faults being 5 and 10 miles away, there is not a significant risk of ground rupture at the site. Since the standpipe is founded on bedrock, the maximum allowable bearing pressure is 6,000 psf; bedrock is not at risk of liquification. This site has a low risk of issues with slope instability.

15.2 Inspection Summary

A drained inspection of the Parkhurst Standpipe took place on May 21, 2019.

15.2.1 Exterior Inspection Summary

15.2.1.1 Site and Security

To limit unauthorized access to the site, a chain link fence with barbed wire encompasses the property (Figure 15-1). The site is generally well-graded, directing runoff away from the standpipe. Trees were growing just outside of the fence which was 16 to 17 feet away from the standpipe walls. Some of the trees near the fence were taller than the standpipe. This is the only site that had a camera, which was located just below the exterior ladder.

15.2.1.2 Exterior Walls

While the upper five courses have not been coated, the lower two courses have been previously coated. The upper exterior walls appeared darkly discolored where roof drainage contacts the walls (Figure 15-2 Left).

The lower three courses have efflorescence emanating from between the adjacent concrete course joints (Figure 15-2 and Figure 15-3). There is also pinpoint efflorescence originating from the middle of the course (Figure 15-2 Right). Additional efflorescing horizontal and vertical cracking was also observed in these courses (Figure 15-3 and Figure 15-4 Left). This cracking is minor, less than 1/16-inch wide. Bugholes, which are small defects in the surface layer of the concrete, were also noted throughout the first two courses (Figure 15-4).

It appears that areas of efflorescence in the first two courses had at one point been mechanically ground off, possibly before being sealed, to prevent further efflorescence. The problems have since reemerged.



Figure 15-2: Dark staining in the upper courses (Left) and efflorescence at the concrete course joints and pinpoint efflorescence in the middle of the course (Right).



Figure 15-3: Lower two courses exterior wall cracking efflorescence.



Figure 15-4: Vertical cracking, efflorescence, and bug holes (a name for small defects in concrete)

15.2.1.3 Foundation

The foundation was unable to be observed as the standpipe is partially buried.

15.2.1.4 Exterior Roof

The exterior roof of the standpipe was free of issues (Figure 15-5). It is sloped at approximately 08:12 (3.8 degrees) from the center. The distance from the roof to ground level is approximately 35 feet.



Figure 15-5: The exterior roof and access hatch

15.2.1.5 Exterior Appurtenances

The exterior galvanized steel caged ladder has a lockable door (Figure 15-1 and Figure 15-6 Left). A railing was installed around the 30-inch by 48-inch entry hatch, but not around the perimeter of the standpipe (Figure 15-5 Left and Figure 15-6 Right). The gasket is rubber adhered to the lid. The vent roof penetration and the hood are 8 and 12 inches in diameter, respectfully (Figure 15-7 Left). The mesh has 1/8-inch square openings with 14-gauge stainless steel wire cloth (Figure 15-7 Right). Some corrosion was noted on the hatch lid and anchor points of the railing and vent.



Figure 15-6: The exterior ladder (Left) and roof access hatch (Right)



Figure 15-7: The roof vent (Left) and screen (Right)

15.2.2 Interior Inspection Summary

15.2.2.1 Interior walls

The interior walls had a seal applied to the course joints (Figure 15-8 Left). Bugholes were also present (Figure 15-8 Right), but less notable than the exterior. Some efflorescence was noted within the remnant form panel edges (Figure 15-9).



Figure 15-8: Interior walls sealed at the joints (Left) and smaller bugholes (Right)



Figure 15-9: Course joint seal that is blistering (Left) and minor efflorescence in remnant form panel edges and overflow (Right)

15.2.2.2 Floor

The interior floor slab had no observed issues of cracking or signs of failure. The floor was generally clear of sediment (Figure 15-10 Left).

15.2.2.3 Interior Roof

The interior roof had no observed issues (Figure 15-10 Right).



Figure 15-10: Clean floor and outlet and anti-vortex, ladder, and base of inlet pipe (Left). Roof had no observable issues (Right)

15.2.2.4 Interior Appurtenances

The interior ladder is galvanized steel, anchored to the walls (Figure 15-6 Right and Figure 15-11 Left); both the ladder itself and its anchors were heavily corroded (Figure 15-11). The galvanized steel cable fall protection system was heavily corroded and unusable. A remnant lug was also exhibiting corrosion (Figure 15-12).



Figure 15-11: The interior ladder and fall protection corrosion



Figure 15-12: The Remnant lug's heavy corrosion

15.2.3 Piping and Valving Inspection Summary

As shown in Figure 15-13 (Left and Center), the 6-inch inlet pipe coupling and wall brace are corroding. The PVC is attached and runs 32 feet above the standpipe floor with a 90 degree bend (Figure 15-13 Right). The 10-inch outlet pipe and anti-vortex device are exhibiting corrosion as well (Figure 15-14 Left). A 4-inch drain is centrally located on the floor (Figure 15-14 Right).



Figure 15-13: The inlet pipe coupling (Left) and brace (Center) corrosion. The inlet has a 90-degree bend near the roof (Right).



Figure 15-14: The outlet and anti-vortex device corrosion (Left). The drain is centrally located (Right).

The 6-inch overflow pipe extends below the ground level (Figure 15-15). The overflow and drain daylight to the northeast side of standpipe to quarry spalls. The overflow outlet is above, shown in Figure 15-16 (Left) in the upper center of the photo. The drain pipe is located below the overflow outlet, behind and to the left the dechlorination bag in the photo. Water flows downhill from this area, shown in Figure 15-16 (Right). A closeup of the overflow (Left) and drain (Right) pipes are shown in Figure 15-17. The screens have coarser meshes than #24 mesh.

The valve vault (Figure 15-18) contains a check valve and isolation valves on the inlet and outlet. A hose is located in the vault that can be used in washdown operations.



Figure 15-15: The overflow pipe



Figure 15-16: The daylit drain and overflow pipes and dechlorination system (Left) and area where flow is directed (Right)



Figure 15-17: The outlets of the overflow (Left) and drain pipe (Right)



Figure 15-18: The valve vault and washdown hose

15.3 Condition Assessments

15.3.1 Cleanliness and Coatings

Based on the efflorescence on the exterior walls, the coating that has been applied to the exterior lower two courses is not functioning properly. Discoloration from roof drainage onto walls is common with this type of temporary of structure but does not appear to be negatively affecting it. The interior is generally clean and is uncoated. Overall, the observed cleanliness and coatings issues appear minor, so the standpipe is good condition related to this assessment category.

15.3.2 Material Deterioration

The observed exterior cracking with efflorescence, efflorescing concrete course joints, and bugholes are discussed in Section 15.3.3 as they may be related to structural issues.

The roof's appurtenances including the roof hatch, railing, and vent, and their anchors are constructed from galvanized steel. In modern reservoirs, these are generally made from aluminum, which is more corrosion resistant on the exterior of this type of structure. The anchors exhibiting rust indicates that these items need attention and are in poor condition.

The interior appurtenances, such as the ladder, fall protection system, pipe clamps, and anti-vortex device are also made from galvanized steel. Galvanized steel is generally not specified for underwater environments on the interior of reservoirs unless they are heavily coated. These appurtenances are generally constructed from stainless steel. Of the corrosion noted on the interior, the ladder, its anchor points, and fall protection system are the most concerning. Should the ladder fail while in use, significant personnel injury may occur. The major corrosion on the remnant lug needs to be addressed.

15.3.3 Structural Performance

15.3.3.1 Static Analysis

The conical roof met requirements for thickness and reinforcing, having sufficient capacity for self-weight, roof live, and snow loads. While the roof-wall-interface does not allow for differential thermal deformation between the roof and wall, it appears that this has not (yet) induced cracking. This may be because the high amount of reinforcing at the roof-to-wall interface.

The vertical wall reinforcing, and all other wall reinforcing appear to be sufficient for current code strength requirements for operation up to the overflow level. In the upper sections of the wall, the spacing of interior and exterior reinforcing is 18 inches on center, which exceeds the current maximum allowable spacing of 12 inches on center. This is likely not the reason for observed issues in the lower courses of the structure.

The cracking in the lower three courses may be due to the concrete being overstressed; checking the wall for the tension induced by the circular reinforcing, the concrete was found to be slightly over capacity. The possibility remains that the cracking and efflorescence has been induced by poor detailing and construction practices which also contributed to bug holes in the concrete. The provided as-builts do not indicate that waterstops between courses or other detailing designed to limit leakage from the reservoir have been installed. Instead the joints have attempted to be sealed, which is not suitable per the bubbling and efflorescence at joints.

The reservoir's foundation is sized appropriately, based on the geotechnical findings, provided as-build drawings, and overflow operating level.

15.3.3.2 Seismic Analysis

The seismic wall reinforcing was found to meet requirements based on the design seismic event. However, during the design event and operated at the overflow level, the standpipe would exceed overturning requirements. The highest level the reservoir could be operated at while meeting requirements for overturning is 31.5 feet. Even at the overflow level, the standpipe was found to meet requirements for seismic lateral loads.

The design seismic event would induce a 2.9-foot slosh wave at the overflow level. Because the overflow is only 6 inches below the roof, a constrained slosh wave would occur; the roof would be damaged. However, at the reported maximum operating height, there is sufficient room to accommodate the slosh wave from the design event.

Operating at the overflow level, the design event would induce a soil bearing pressure less than the maximum allowable bearing pressure of 6,000 psf based on the geotechnical report.

15.3.4 Water Quality/Sanitary

The inlet/outlet configuration appears to be suitable to facilitate adequate mixing within the standpipe. The vent screen appears to follow DOH recommendations with a #24 mesh. However, the overflow and drain pipes do not have this type of mesh installed.

15.3.5 Safety

On the exterior, the fall protection system on the ladder is a cage system, which alone as fall protection will not meet code in 2036. On the roof, the railing extends around the access hatch but not around the reservoir entirely.

As discussed in Section 15.3.2, the corrosion on the galvanized steel interior ladder, fall protection, and anchors is significant. The corrosion on the anchors and ladder presents a safety concern. Since the interior ladder is greater than 24 feet, it requires working fall protection. Overall, the safety condition of the reservoir is poor.

15.3.6 Operations and Maintenance

15.3.6.1 Site and Security

The fence and drainage were found to be suitable for the standpipe. An intrusion alarm is installed on the roof's access hatch. However, tall trees were found to be too close to the standpipe. Nearby trees endanger the structure, slow evaporation from the soil by the structure, can cause organic material accumulation problems, and their roots can penetrate the structure. Overall, the site/security is in fair condition.

15.3.6.2 Roof Drainage

Although there is not a gutter system or other way to convey water from the structure, there does not appear to be significant damage to the sidewalls yet. Overall, the roof drainage is in good to fair condition.

15.3.6.3 Appurtenances

No difficulties were found using the exterior or interior ladder. The Parkhurst Standpipe did not meet design requirements for neither the vent's roof penetration area nor the screened area.

15.3.6.4 Valving and Piping

The staff did not note any difficulties associated with operating of the reservoir. Assessing the dechlorination system, the bag likely would be pushed out of the way from the force of the water being drained from standpipe. Draining the reservoir appears to cause erosion at the outlet without an adequate energy dissipation system.

15.3.7 Obsolescence

Overall, the equipment on site appeared to be of newer design and would be easily replicable if needed.

15.3.8 Condition Scoring

Overall, the condition score of the Parkhurst Standpipe was good, 4.0. Problems associated with this standpipe were related to the poor condition of the concrete in the lower courses, corrosion on interior appurtenances, and lack of a compliant dechlorination system. A summary of the scoring is shown in Table 15-1 and the full Score Matrix is included in Appendix M.

Table 15-1: Condition Scoring of the Parkhurst Standpipe

Categorical Scores	
Cleanliness and Coatings	4.4
Material Deterioration	3.8
Structural Performance - Static	4.8
Structural Performance - Seismic	4.0
WQ/ Sanitary	4.4
Safety	2.0
Operations & Maintenance	4.0
Obsolescence	5.0
Overall	**4.0**

15.4 Recommended Improvements

15.4.1 Cleanliness and Coatings

The exterior should be pressure washed to remove efflorescence and any accumulated organic material. To halt water from migrating through the concrete and associated efflorescence, the interior is recommended to be coated with a product similar to that used on the reinforced concrete dome reservoirs (Versaflex AquaVers primer and polyurea). The City can consider grinding down the exterior efflorescing areas and patching if desired.

15.4.2 Material Deterioration

Issues with exterior concrete deterioration should be rectified through recoating the interior, outlined in Section 15.4.1.

The corrosion on the exterior roof hatch could be addressed with cleaning and touched-up with a new paint-on galvanized coating. The anchors of the railing and vent should be cleaned and then assessed if they are still structurally competent. These anchors can be replaced with non-corrodible anchors as well. Instead of continuously cleaning and recoating, the City may wish to replace these appurtenances with ones that are constructed from aluminum.

The corrosion on the piping requires cleaning and coating to ensure the pipes keep functioning as designed. If corrosion grows unabated on the outlet pipe, it may eventually block flow. The remnant lug, if not serving a purpose, is recommended to be removed. Otherwise, it should be cleaned back to competent material so that no corrosion remains and coated. While the pipe braces and anti-vortex device could be cleaned and recoated, a better solution would be to replace them with ones constructed from stainless steel.

Recommendations for improvements to address corrosion on the interior ladder, ladder anchors, and fall protection are presented in Section 15.4.5.

15.4.3 Structural

While the roof-wall-interface does not account for thermal movement, no issues are yet observable. This is recommended to be monitored. Similarly, the best approach to deal with the wall reinforcement being spaced 18 inches on center rather than 12 inches on center is to monitor the structure. The City should also consider lowering the overflow to ensure it is not operated above the maximum 31.5 feet, reducing overturning and slosh risk to an appropriate level.

15.4.4 Water Quality/Sanitary

The overflow and drain pipe screens are recommended to be replaced with a #24-mesh with a 4-mesh screen backing.

15.4.5 Safety

The exterior fall protection should be upgraded before the 2036 deadline. The City may consider upgrading the exterior ladder concurrently with other retrofits. For the roof, a fully encompassing railing is recommended.

Given the corrosion on the interior ladder, its anchors, and its fall protection, it is recommended to be replaced. It should be replaced with an L&I-compliant stainless steel ladder and fall protection, similar to that found on the Kearney Reservoir, shown in Figure 9-16.

15.4.6 Operations and Maintenance

15.4.6.1 Site and Security

Trees that are closer to the reservoir than they are tall should be removed or transplanted. The cleared areas can be replanted with shorter growing shrubs on the perimeter to shield the reservoir from view.

15.4.6.2 Roof Drainage

The roof drainage is recommended to be monitored. Should the City conduct other retrofits on the structure, better roof drainage can be considered.

15.4.6.3 Appurtenances

The vent size is recommended to be increased, allowing for adequate airflow during filling and draining events. Designing the vent around the overflow level is recommended. The overflow level requires a minimum penetration area of approximately 1.2 square feet with a safety factor

account for flow through a vent structure. This could be achieved by expanding the existing vent or the addition of a new vent.

15.4.6.4 Valving and Piping

The energy dissipation and dechlorination systems should be updated before the next time the reservoir is drained. Proper dechlorination at the Parkhurst site could consist of a weighted system that is set in the manhole on site or a sturdy system that could be installed on the outlet pipe at the back of the site. An example of a basket system is shown in Figure 4-21.

15.4.7 Capital Improvements Plan Table

Planning level costs for the retrofits to the Parkhurst Standpipe are shown in Table 15-2.

Table 15-2: Parkhurst deficiencies, recommended improvements, and estimated costs

Category	Deficiency	Recommended Improvement	Estimated Cost
CLN & COAT	Organic material and efflorescence on exterior	a. Pressure wash exterior b. Coat interior	$ 2,000 $ 61,000
DETERIOR-ATION	Corrosion on exterior hatch/hardware	Clean and (re)coat. Consider replacing exterior appurtenances with aluminum ones	$ 3,000
	Corrosion on and interior appurtenances, anti-vortex device, and remnant lug	Clean and (re)coat. Consider removing remnant lug. Consider replacing with stainless steel	$ 3,000
STRUCT	Roof-to-wall-interface does not account for thermal deformation	Continue to monitor for structural issues	$ -
	Maximum reinforcement spacing exceeded	Continue to monitor for structural issues	$ -
	Operated at the overflow elevation, seismic slosh impacts roof and structure overturns	Consider lowering overflow to 31.5 feet	$ -
WQ	Drain pipe screen non-compliant	Replace drain pipe screen	$ 1,000
	Overflow pipe screen non-compliant	Replace overflow pipe screen	$ 1,000
SAFETY	Exterior ladder fall protection is cage	Replace exterior ladder fall protection by 2036	$ 6,000
	Lacks roof fall protection	Install roof fall protection	$ 42,000
	Interior ladder fall protection unusable	Interior ladder and fall protection replacement	$ 30,000
O&M	Tree spacing recommendation not met	Tree removal and restoration	$ 5,000
	Vent undersized	Replace roof vent	$ 15,000
	Energy dissipation and dechlorination non-compliant	Update energy dissipation and dechlorination system	$ 4,000
		Subtotal	$ 173,000
		30% Contingency	$ 51,900
		8.7% Tax	$ 19,566
		Engineering, Administration, and Construction Management	$ 85,563
		Total Project Costs Estimate	$ 330,030
		Total Project Costs Estimate (rounded)	**$ 330,000**

15.5 Conclusion

While the Parkhurst Standpipe was designed to be a temporary structure, it is still structurally competent and only needs minor maintenance to keep it functioning. The next washdown inspection should take place within the next 3 years. The reservoir should be leak tested as a first step of the next inspection. This inspection could take place during or after the interior coating and ladder replacement.

Section 16

Conclusion

16.1 Major Notes

The City has many small reservoirs that are in tight sites. The average age of the structures is around 50 years; AWWA (2013) estimates the average lifespan of steel and prestressed reservoirs to be around 50 years. However, Murraysmith has observed well-maintained structures to last significantly longer than this lifespan estimate.

A few improvements should be prioritized. These items include the following:

- Clearing the organic debris from the roofs and roof drains as soon as possible, and on a more frequent basis for reservoirs experiencing problems
- Pressure washing the exteriors of the reservoirs.
- Repairing the AC breaker for the Whatcom Falls I cathodic protection system
- Safety related issues - We recommend that when on the ladders and roofs of reservoirs, dedicated and trained staff be present to monitor roof safety until safety improvements can be implemented.
- Deciding on improvements for the 40th Street Reservoir
- Tree removal and restoration planning
- Repairing the leaking pipe/valve at the Consolidation Reservoir

Before being drained again, all the reservoirs should have dechlorination improvements. The City should also make sure washdown piping is available in reservoirs where we did not observe any during our inspections.

Padden, Whatcom Falls I, and 40th Street Reservoirs have recommendations on lowering the maximum operating level or be faced with expensive structural retrofits. Marietta does as well, although it is not in use. The City should consider how lowering the operating ranges of the reservoirs may affect other reservoirs in their zone. A summary of potential updates in each zone is provided in Table 16-1. If the maximum operating ranges cannot be reduced in these zones, reservoir replacement may begin to look more favorable.

Table 16-1: Differences in Maximum Operating Levels for the Reservoirs

Zone Name	Reservoir Name	Maximum Operating Elevation (ft)		Difference (ft)	Max Operating Level Drop in Zone (ft)
		Current	Adjusted w/o structural repairs		
276 North	Kearney	22	22	0	5.5
	Marietta	50	44.5	5.5	
	Whatcom Falls I	16.5	14	2.5	
	Whatcom Falls II	21	21	0	
457 South	College Way	19	19	0	4.75
	Padden	24.5	19.75	4.75	
	Sehome	13	13	0	
519 Dakin & Yew	Consolidation	19.5	19.5	0	0
	Dakin I	17	17	0	
	Dakin II	15.5	15.5	0	
696 Padden Yew	40th Street	23	16	7	7
	Reveille	19	19	0	
873 Governor Rd	Parkhurst	24	24	0	0

For planning purposes, should the City desire new tanks, provided in Table 16-2 are planning level cost estimates for new reservoirs.

Table 16-2: Planning level cost estimates for new reservoirs

Capacity (MG)	Base Cost[1] ($ Million)	Total Cost[2] ($ Million)
0.5	1.5	2.9
0.75	1.7	3.2
1	1.8	3.4
1.5	2.1	4.0
2	2.4	4.6
3.5	3.2	6.1
4	3.5	6.7
5	4	7.6
7.5	5.4	10
10	6.8	13
15	9.6	18
20	12	24

[1] Includes structure cost. Does not include other costs such as site/land preparation, drawings, access roads, electrical, instrumentation and control, testing/ startup, site finishing, and yard piping.
[2] Includes 30% contingency, 8.7% tax, and 35% Engineering

16.2 Site Considerations

As the City continues in the planning process for water storage, the sites should be considered. A suitable site for a reservoir does not have trees closer to the reservoir than the trees are tall. For partially buried reservoirs, the minimum spacings is 50 feet. Sufficiently spaced trees or shrubs can be planted on the perimeter of the site to shield the structure from view. Part of routine maintenance is clearing any encroaching vegetation. Following this guideline will help extend the life of structures.

It is also important to plan for replacement of these structures. One solution is select a suitable site that is large enough to build another reservoir when the existing structure is nearing the end of its useful life. This will facilitate easy yard piping improvements and demolition can take place after the new structure is online. An example of a site that has space for a new reservoir and adequate vegetation spacing is shown in Figure 16-1.



Figure 16-1: An example of a reservoir site is provided. It is clear of trees and has space to build an adjacent replacement reservoir when the existing structure has reached the end of its life.

To deter vandalism, like what was implemented on the Sehome Reservoir, the City may wish to decoratively paint structures. An example of such a practice is shown in Figure 16-2.

While only the Parkhurst site had a camera, the City should also consider increasing security on its reservoir sites. Additional requirements are likely to be mandated from the Department of Homeland Security in addition to DOH and EPA.



Figure 16-2: Decorative painting on the exterior of reservoirs can deter vandalism

16.3 Future Inspections

AWWA M42 states "Tanks should be washed out and inspected at least once every 3 years, and where water supplies have sediment problems, annual washouts are recommended." Prestressed reservoirs should be inspected on 5- to 10- year intervals per AWWA D110-13. Based on this round of inspections, the City is comfortable draining almost all its reservoirs and can plan future inspections. With 13 reservoirs in its inventory, we recommend the City to conduct inspections on around four reservoirs each year.

16.4 Closing Remarks

Overall, the recommended improvements are the items we noted from our as-built or plan reviews, inspections, and additional analyses. These improvements would be already be included if the structure was built today. There is a great deal more understanding about the structures, appurtenances, and piping/valving than when the structures were designed and built. The governing codes have also changed since these times. Many cities and water suppliers in the region have similar issues to the reservoirs in the City's inventory. The City has done an excellent job at proactively addressing issues and getting high quality water to its customers. This report serves as a roadmap to address the reservoirs and aid the City's decision makers in preparing for next steps.

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WAC 296-876-500 Fixed ladder design and construction installed on or after December 1, 2006

WAC 296-876-600 Fixed ladder design and construction installed before December 1, 2006.

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Nora

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From: Max Mozer <mmozer@carollo.com>
Sent: Monday, March 3, 2025 3:22 PM
To: Nora LeVasseur <NLeVasseur@carollo.com>
Subject: FW: (EW-0240) Bellingham WSP: Condition Reservoir Projects

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From: Aurelie Nabonnand <ANabonnand@carollo.com>
Sent: Friday, August 30, 2024 4:36 PM
To: Max Mozer <mmozer@carollo.com>
Subject: FW: (EW-0240) Bellingham WSP: Condition Reservoir Projects

Projects to be included in the CIP

From: Leininger, Nickolas R. <nrleininger@cob.org>
Sent: Friday, August 30, 2024 4:03 PM
To: Bergner, Jim P. <jbergner@cob.org>; Bradshaw, Steven R. <srbradshaw@cob.org>; Day, Stephen M. <smday@cob.org>; Aurelie Nabonnand <ANabonnand@carollo.com>
Subject: RE: (EW-0240) Bellingham WSP: Condition Reservoir Projects

CAUTION: This email originated from outside Carollo Engineers. Do not open attachments or click links unless you recognize the sender.

Hey Aurelie,

I believe we should include the items addressed in the report, minus the Marietta portion. It would take considerably more work to even get back online, with no current plans to do so now or the foreseeable future.

Name	2020 Cost	Project Elements	COB Feedback
~~Marietta Reservoir~~	~~$ 409,000~~	~~• Exterior recoating~~ ~~• Fall protection~~ ~~• Overflow non-compliant~~	
Padden Reservoir	$ 816,300	• Exterior recoating • Interior recoating • Structural members are corroding • Fall protection	

Whatcom Falls I Reservoir	$ 4,921,000	• Interior recoating • Structural members are corroding • Lacks internal overflow	
Dakin II Reservoir	$ 738,000	• Parapet cracks • No overflow • Fall protection • Porr site drainage	
Kearney Reservoir	$ 206,000	• Poor site drainage	
Whatcom Falls II Reservoir	$ 844,000	• Sediment accumulation on the floor • Piping configuration • Seismic risk • Tree Spacing • Site drainage • No internal overflow • Fall protection	
40th Street Reservoir	$ 2,427,000	• Walls under-reinforced resulting in wall cracking • Seismic risk • Fall protection	
College Way Reservoir	$ 1,123,183	• Roof wall interface issues • Seismic risk • Poor site drainage • Fall protection	
Consolidation Reservoir	$ 1,118,000	• Interior recoating • Roof wall interface issues • Seismic risk • Fall protection	
Dakin I Reservoir	$ 1,075,000	• Roof wall interface issues • Seismic risk • Poor site drainage • Fall protection	
Reveille Reservoir	$ 1,258,000	• Interior recoating • Roof wall interface issues • Seismic risk • Poor site drainage • Fall protection	
Sehome Reservoir	$ 3,400,000	• Replace Reservoir	
Parkhurst Standpipe	$ 222,000	• Interior recoating • Fall protection	

From: Bergner, Jim P. <jbergner@cob.org>
Sent: Wednesday, August 21, 2024 10:03 AM
To: Bradshaw, Steven R. <srbradshaw@cob.org>; Leininger, Nickolas R. <nrleininger@cob.org>; Day, Stephen M. <smday@cob.org>
Subject: Fw: (EW-0240) Bellingham WSP: Condition Reservoir Projects

Hi Guys,

Below is a list of projects that were pulled from the Reservoir Assessment Report. Carollo is asking if any should be include in the CIP with the new plan.

Thank you,

_____

Jim Bergner

Utility Operations Engineer

Bellingham Public Works – Engineering

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My incoming and outgoing email messages are subject to public disclosure requirements per RCW 42.56

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Subject: (EW-0240) Bellingham WSP: Condition Reservoir Projects

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Jim-

APPENDIX K DEMOGRAPHIC AND DEMAND FORECAST



Whatcom County Comprehensive Plan

Population and Employment:

Growth Projections and Preliminary Allocations

Technical Report

Prepared by: Leland Consulting Group

May 7, 2024

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Introduction

The Whatcom County Department of Planning and Development Services, in coordination with the cities in Whatcom County, is engaged in a multi-year project to update the Whatcom County Comprehensive Plan and conduct an urban growth area (UGA) review by 2025, as required by the Washington State Growth Management Act (GMA). An initial step in this process is to develop a reasonable set of projections of future growth in population and economic activity and allocations of where this growth will occur. These projections and allocations of growth are foundational inputs that will inform many aspects of the comprehensive planning process over the next few years.

Projections and allocations of population and employment will be developed using a two-step process. The first step is to develop technical projections and allocations based on existing forecasts, historical trends, and additional data analysis. The second step is to make adjustments to the technical allocations based on local plans, special circumstances, and other policy considerations. This technical memo addresses the first step in the process – to establish 20-year technical projections of population and employment and then distribute this growth to UGAs and areas outside UGAs.

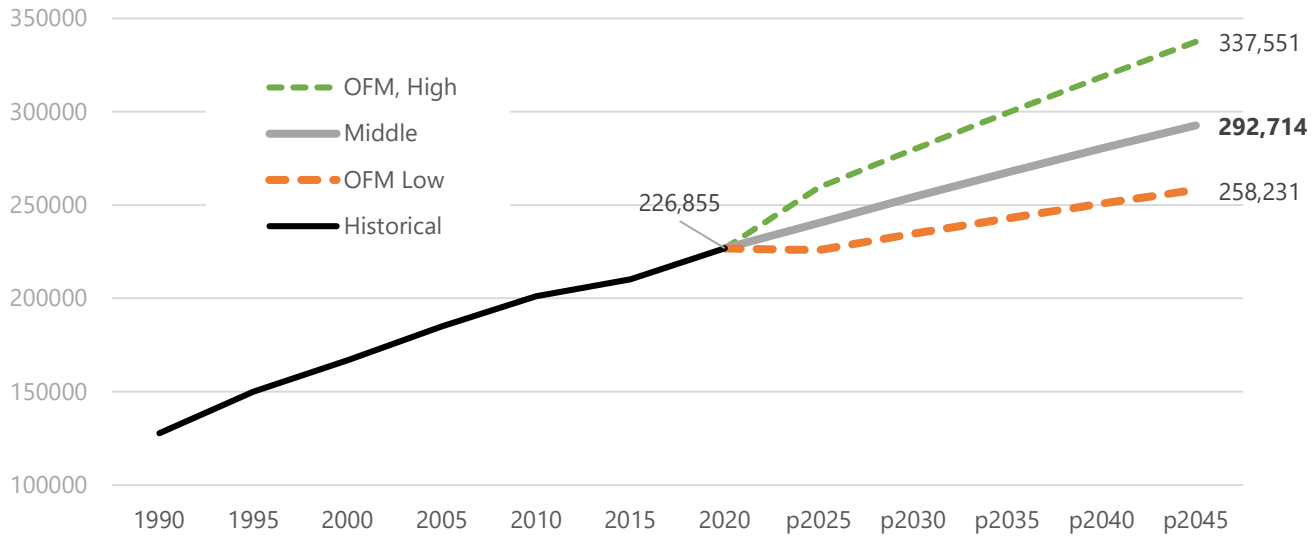
Using these technical projections as a starting point, city and County representatives will then collaborate to make policy-based adjustments to the technical projections and allocations of growth. It is anticipated that final projections and allocations of growth will be adopted by the Whatcom County Council and city councils in 2025. The specific elements documented in this technical memo include the following:

- Countywide projections of population and employment.
- Allocations of population and employment to UGAs and lands outside of UGAs.
- Trend analysis of Whatcom County age cohorts

Countywide Population

The Washington Office of Financial Management (OFM) updates County and state long-range population forecasts every five years to support Growth Management Act planning. The most recent forecasts out to 2050 were issued in 2022 and are shown in Figure 1. OFM considers the middle projection the most likely because it is based on assumptions that have been validated with past and current information. The high and low projections represent the range of uncertainty that should be considered when using these projections for planning purposes.

Figure 1: Whatcom County Population, 1990-2045



Source: Office of Financial Management (OFM) historical data and projections from 2022

The middle projection issued in 2022 reflects slightly decreased growth expectations relative to OFM's 2012 forecasts, with 2020 to 2040 forecasted growth now estimated to be approximately 1.6% lower than in that previous forecast. The 2012-issued low forecast for 2040, on the other hand, was *increased* by 9% in the 2022 series forecast. That 2012 low forecast had been conservative in part because the nation and region had yet to show convincing signs of recovery from the Great Recession, so it was unclear when a recovery would occur and how fully growth would resume once it did.

The high projection scenario had been fairly aggressive in the 2012 forecasts – partly in recognition of the impressive rates of growth that had immediately preceded the recession. By the time of the 2022 series forecast, it was clear that those high scenario growth rates were unlikely to resume and the 2040 high scenario projection was accordingly reduced by 9% to be more realistic – shifting from a 2040 population of 350,000 in the 2012 high forecast to approximately 319,000 in the 2022 updated model.

OFM Historical and Projected Population Growth

Population growth is driven by three components of change: births, deaths, and migration. The difference of births minus deaths is considered the natural component of change (or natural increase), and net migration (the difference in in-migration and out-migration) is considered the migration component of change. Exhibit 2 shows that in both Whatcom County and Washington State, the net migration component has been and is expected to be larger than the natural component of population increase.

Whatcom County has historically had a larger percentage of its population growth come from net migration than the State. That gap was largest in the early 2000s, when 80% of Whatcom County's growth was due to migration, versus just 52% of statewide growth. The gap narrowed during the Great

Recession. From 2010 to 2015, the County attributed just 57% of its growth to migration, almost as low as the 52% recorded statewide.

Figure 2: Components of Population Change, 1990-2045

		Whatcom County				Washington State			
		Net Migration	Natural Increase	Total Population Growth	Percent Migration	Net Migration	Natural Increase	Total Population Growth	Percent Migration
Estimates	1990-95	17,819	4,343	22,162	80%	327,599	202,307	529,906	62%
	1995-00	12,858	4,026	16,884	76%	316,328	181,246	497,574	64%
	2000-05	14,475	3,665	18,140	80%	227,948	176,706	404,654	56%
	2005-10	11,975	4,199	16,174	74%	222,185	203,558	425,743	52%
	2010-15	5,117	3,859	8,976	57%	198,862	183,587	382,449	52%
	2015-20	14,445	2,286	16,731	86%	444,774	154,547	599,321	74%
OFM Forecast (Mid)	2020-25	11,768	1,706	13,474	87%	300,650	93,424	394,074	76%
	2025-30	11,042	2,795	13,837	80%	277,685	124,695	402,380	69%
	2030-35	12,415	889	13,304	93%	293,530	88,218	381,748	77%
	2035-40	13,408	-595	12,813	105%	303,364	60,597	363,961	83%
	2040-45	13,558	-1,119	12,439	109%	306,500	43,624	350,124	88%
10-yr Trend	*2010-20*	*9,781*	*3,073*	*12,854*	*76%*	*321,818*	*169,067*	*490,885*	*66%*
20-yr Trend	*2000-20*	*11,503*	*3,502*	*15,005*	*77%*	*273,442*	*179,600*	*453,042*	*60%*
30-yr Trend	*1990-20*	*12,782*	*3,730*	*16,511*	*77%*	*289,616*	*183,659*	*473,275*	*61%*

Source: OFM - Forecasting & Research, December 2022
Note: The percentage of total growth from migration exceeds 100% from 2035 to 2045 because natural increase is negative

The OFM forecasts assume a gradually decreasing natural component of population growth largely due to growth in elderly population, a trend explored further in the Age Cohort Analysis section of this report. The migration component of population change tends to be more volatile than the natural increase component. Major economic, social, or policy changes can generate spurts or slowdowns in migration that are difficult to predict. The Office of Financial Management cites uncertainty about the pace of economic recovery and possible changes in U.S. immigration policy as factors that could affect migration trends in the future.

The 2022 OFM forecasts do not attempt to predict the timing or magnitude of major long-term migration shifts but OFM demographers do track migration closely for future forecast updates. From 2015 to 2020, as the Pacific Northwest was booming and attracting migrants from across the U.S. and abroad, migration had rebounded to account for 86% of Whatcom growth and 74% of statewide growth.

Informed in part by this components-of-change analysis, OFM produces the three future growth scenarios (low, middle, high) depicted in Figure 1 and summarized below along with average annual growth totals and average annual percentage rates of growth.

Historical and Projected Population Growth Rates

Figure 3: Historical and Projected Population Growth Rates, 1990-2045

		Whatcom County			Washington State	
		Population	Avg. Annual Growth	Avg. Annual Rate	Population	Avg. Annual Rate
Historical	1995	149,950			5,397,039	
	2000	166,834	3,377	2.2%	5,894,613	1.8%
	2005	184,974	3,628	2.1%	6,299,267	1.3%
	2010	201,148	3,235	1.7%	6,725,010	1.3%
	2015	210,124	1,795	0.9%	7,107,459	1.1%
	2020	226,855	3,346	1.5%	7,706,780	1.6%
OFM Forecast (Low)						
	2025	225,902	-191	-0.1%	7,530,451	-0.5%
	2030	234,679	1,755	0.8%	7,765,833	0.6%
	2035	242,954	1,655	0.7%	7,982,666	0.6%
	2040	250,769	1,563	0.6%	8,183,532	0.5%
	2045	258,231	1,492	0.6%	8,371,969	0.5%
OFM Forecast (Middle)						
	2025	240,321	2,693	1.2%	8,100,854	1.0%
	2030	254,158	2,767	1.1%	8,503,234	1.0%
	2035	267,462	2,661	1.0%	8,884,982	0.9%
	2040	280,275	2,563	0.9%	9,248,943	0.8%
	2045	292,714	2,488	0.9%	9,599,067	0.7%
OFM Forecast (High)						
	2025	259,547	6,538	2.7%	8,748,039	2.6%
	2030	279,846	4,060	1.5%	9,406,820	1.5%
	2035	299,569	3,945	1.4%	10,043,320	1.3%
	2040	318,762	3,839	1.2%	10,660,617	1.2%
	2045	337,551	3,758	1.2%	11,262,964	1.1%

Source: OFM - Forecasting & Research, December 2022

- From 1995 to 2010, the Whatcom County population grew at a faster rate than the state of Washington as a whole. After 2010, however, statewide population growth has been slightly higher on an average annual percentage basis. From 2015 to 2020, the state grew at 1.6% per year, versus 1.5% for Whatcom County.
- Looking forward, the OFM population projections – in each of the low, middle, and high scenarios – assume that Whatcom County will return to a slightly faster annual growth rate versus the statewide average, with that gap between state and County held steady at one to two tenths of a percent.
- By 2045, the horizon year for the Comprehensive Plan update, Whatcom County's population is anticipated to reach 292,714 in the middle scenario. The low and high scenarios for 2045 range from 258,231 to 337,551, respectively.

- After 2025, growth statewide and in Whatcom County is projected to gradually decline in both percentage rate and in absolute annual additions. This slow deceleration is largely due to declining birth rates and rising death rates. Differences in assumed annual net in-migration account for most of the difference between low, mid, and high scenarios.
- Although almost 10% more ambitious than the 2012 set of OFM low projections, the latest low scenario forecast for Whatcom County remains quite conservative. The fastest future growth period (2025-2030) is projected to grow at a rate of 0.77%, lower than any 5-year period in Whatcom's modern history. The lowest prior recorded average growth rate over five years was from 2010 to 2015, following the Great Recession, when growth managed just 0.88% annually. In fact, even the middle forecast series averages just 1.0% annually overall through 2045, well below the 1.7% pace for the comparable historical timeframe.

Comprehensive Plan Population Growth Alternatives

OFM demographers are generally thorough and consistent in their forecasting of population at the state and county levels, relying on widely accepted age cohort, fertility, and death rate data as inputs to a components-of-change model that then factors in migration tendencies based largely on broad economic and employment flows. The OFM middle projection is considered the most likely future and can safely be treated as a baseline assumption for the trajectory of Countywide growth for the present Comprehensive Plan update work underway in the County.

The OFM low and high projections generally represent well-reasoned attempts to capture the range of possible growth scenarios that may result in slower or faster population increase than baseline projections. Following the precedent used in the 2016 Whatcom County forecast work, we have determined that the OFM high-low range may represent outcomes that are both unlikely and too divergent for practical planning purposes. We have accordingly made minor adjustments to effectively tighten the forecast range. Figure 4 shows these alternative projections and how they compare to the OFM projections developed in 2022.

The alternatives were developed using the following rationale:

- **Middle projection**. No adjustments were made to the OFM middle projection, which is considered the most likely future. The OFM middle projection forecasts a slower annual growth rate between 2023-2045 (1.0%) than was experienced over the past 25 years (1.7% annually between 1995-2020). That slowdown is a reflection of steadily dropping fertility rates, rising death rates, and uncertain net migration.
- **Low projection**. The OFM low projection assumes growth rates much lower than historical averages. Over the past 30 years, there has not been a five-year period with an average annual growth rate as low as the 0.4% annual rate OFM is projecting between 2023 and 2045. In the early-mid 1980s, five-year annual average growth rates slipped to 1.2%, and most recently the annual average growth rate between 2010 and 2015 was 0.8% during that post-recession period.

The proposed alternative low projection results in a 2045 population of about 274,000. It is based on an assumption that migration will be 30% less than under the middle projection, and the natural component is the same as the middle projection. The unadjusted OFM low scenario resulted in total absolute growth that was 61% lower than the middle scenario. In contrast, after adjustment, the low scenario yields total horizon period growth that is just 33% lower than the OFM middle.

- **High projection**. The OFM high projection assumes an annual growth rate (1.7%) that is somewhat higher than the 2010-2020 growth rate (1.2%) the County has experienced most recently, and yields a 2045 population of about 338,000. The alternative high projection results in a 2045 population of about 322,000. It is based on an assumption that the annual migration component will be approximately 50% higher than under the middle projection, and the natural increase component is the same as in the middle projection. After adjustment, the reduced high scenario results in absolute growth that is 51% above the middle scenario total growth, compared to the unadjusted OFM high growth total that was 79% higher than the middle scenario.

  The smaller magnitude of adjustment used for the high projection versus the low reflects an intentional decision, based on the idea of preserving more of a conservative approach to infrastructure planning – helping to avoid a scenario where infrastructure expansion fails to keep pace with higher-than-expected growth (or even constrains growth despite strong demand).

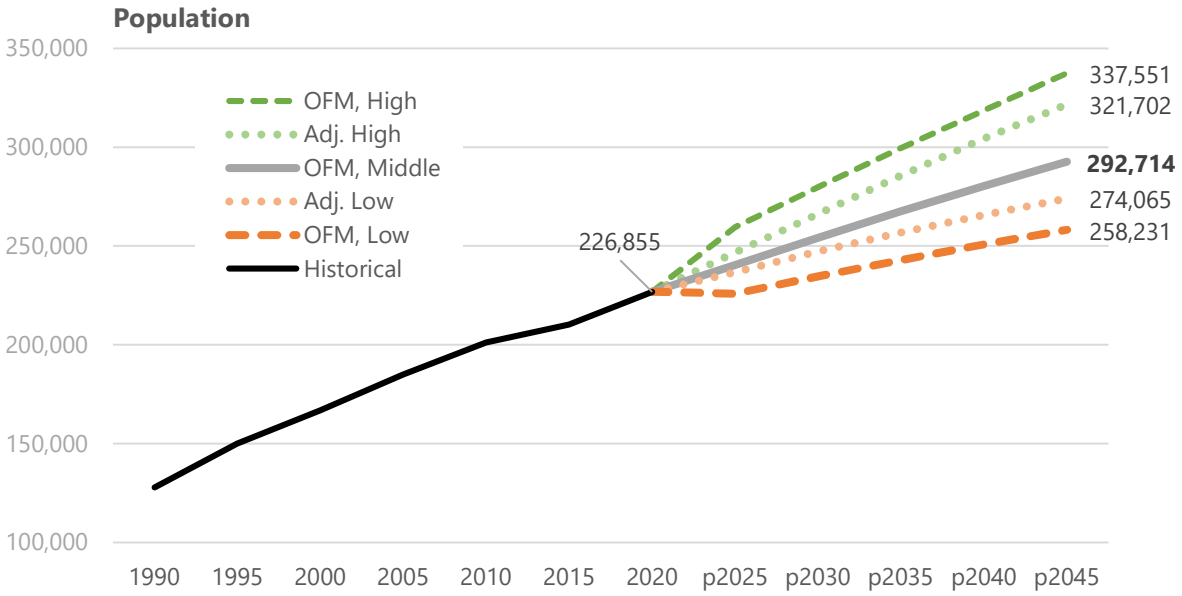
The table below shows growth figures, both adjusted and unadjusted, for the specific starting and horizon years used in the plan update (2023 to 2045). The chart following the table uses even 5-year breaks to illustrate the differences in trajectory for the adjusted low and high scenarios relative to the original OFM projections.

Figure 4: Population Forecast Ranges, OFM vs. Adjusted, 2023-2045

		Projected					
	2023 Population	**2045, OFM**	**2045, Adjusted**	**Total Growth (Adjusted)**	**CAGR (Adjusted)**	*Total Growth (OFM)*	*OFM CAGR*
low	235,800	258,231	274,065	38,265	0.69%	22,431	0.41%
middle	235,800	292,714	292,714	56,914	0.99%	56,914	0.99%
high	235,800	337,551	321,702	85,902	1.42%	101,751	1.64%

Source: OFM - Forecasting & Research, December 2022; and Leland Consulting Group
CAGR is the Compound Annual Growth Rate

Figure 5: Revised Population Forecast Ranges, Whatcom County



Source: OFM - Forecasting & Research, December 2022; and Leland Consulting Group
Note: P means projection. For example "p2045" is the projected population in the year 2045.

Allocation of Population to UGAs

After establishing a range of Countywide growth projections, the next step is to allocate future growth to UGAs. The process to develop technical allocations involves analysis of historical trends in population growth by UGA and assigning future growth based on these trends. The technical allocations will be used as a starting point for collaboration between the County and cities to make adjustments based on local plans, special circumstances, and other policy considerations.

Historical Population Estimates by UGA

Historical estimates of population by urban growth areas are shown in the table below. The estimates are based on current 2023 UGA boundaries. Non-UGA areas within the County are combined and treated as a separate "all other" geography so that totals sum to the Countywide figure. Figure 7 shows population for each UGA in 2013 and 2023, along with absolute growth between those two years. The final column shows each UGA's share of standing Countywide population in 2023, followed by the UGA share of Countywide growth over that ten year period. The share of County population can be interpreted as essentially a given UGA's share of growth across the history of the County.

Bellingham, the primary city and UGA in Whatcom County, has a recent share of growth (42%) that is only slightly lower than its share of standing Countywide population (45%). Other UGAs such as Blaine, Ferndale, and Lynden have a 10-year growth share that is considerably higher than their share of standing population, reflecting more recent growth pressures. Fully 30% of the County's population can

be found in rural areas outside the ten official UGA geographies, although those areas account for just 19% of recent growth. That decreasing dependence on non-UGA areas for housing the County's growing population is consistent with the State of Washington's big-picture growth management policy and the concept of an urban growth boundary in general.

Figure 6: Historical Population Growth and Growth Share by UGA, 2013-2023

UGA	Pop. 2013	Pop. 2023	Growth 2013 to 2023	Average Annual % Growth	Share of County Population 2023	Share of 10-yr. County Growth
Bellingham	92,915	105,529	12,614	*1.3%*	**44.8%**	***42.4%***
Birch Bay	7,698	8,908	1,210	*1.5%*	**3.8%**	***4.1%***
Blaine	5,277	6,728	1,451	*2.5%*	**2.9%**	***4.9%***
Cherry Point	35	61	26	*5.7%*	**0.0%**	***0.1%***
Columbia Valley	3,060	3,577	517	*1.6%*	**1.5%**	***1.7%***
Everson	2,683	3,171	488	*1.7%*	**1.3%**	***1.6%***
Ferndale	12,962	16,762	3,800	*2.6%*	**7.1%**	***12.8%***
Lynden	13,208	16,696	3,487	*2.4%*	**7.1%**	***11.7%***
Nooksack	1,389	1,573	184	*1.3%*	**0.7%**	***0.6%***
Sumas	1,445	1,810	365	*2.3%*	**0.8%**	***1.2%***
Areas outside UGAs	65,349	70,985	5,637	*0.8%*	**30.1%**	***18.9%***
Total	**207,937**	**235,800**	**29,779**	**1.3%**	**100.0%**	**100.0%**

Source: OFM – Small Area Estimate Program (SAEP), December 2023; and Leland Consulting Group

Unless individual jurisdictions foresee significant changes to their local growth policies or confidently anticipate major shifts in the locational preferences of the homebuilding market, the more recent 10-year share-of-growth figure is assumed here to be the most appropriate numerical factor to use for apportioning out the forecasted County-level growth across Whatcom's smaller planning geographies.

Technical Allocations of Countywide Growth to UGAs

The following table show how that allocation plays out across UGAs under the low, middle, and high forecast scenarios for the County. As per the discussion in the previous section, the adjusted Countywide growth projected for 2023 to 2045 is 38,265 for the low, 56,914 for middle, and 82,902 for the high scenarios. These totals are multiplied by the recent share-of-growth percentages for each UGA, as shown below.

Figure 7: Technical Allocations of Adjusted Countywide Population Growth to UGAs, 2023 to 2045

		Allocated Growth by Scenario (2023 to 2045)			Average Annual % Growth (2023 to 2045)		
UGA	*Allocation Share*	**Low**	**Middle**	**High**	**Low**	**Middle**	**High**
Bellingham*	***42.5%***	16,242	24,158	36,462	0.7%	0.9%	1.4%
Birch Bay	***4.1%***	1,555	2,313	3,490	0.7%	1.1%	1.5%
Blaine	***4.9%***	1,865	2,774	4,186	1.1%	1.6%	2.2%
Cherry Point*	**-**	-	-	-	2.0%	2.7%	3.7%
Columbia Valley	***1.7%***	665	988	1,492	0.8%	1.1%	1.6%
Everson	***1.6%***	627	933	1,408	0.8%	1.2%	1.7%
Ferndale	***12.8%***	4,883	7,262	10,961	1.2%	1.6%	2.3%
Lynden	***11.7%***	4,481	6,665	10,060	1.1%	1.5%	2.2%
Nooksack	***0.6%***	237	352	531	0.6%	0.9%	1.3%
Sumas	***1.2%***	468	697	1,052	1.1%	1.5%	2.1%
Areas outside UGAs	***18.9%***	7,243	10,773	16,260	0.4%	0.6%	0.9%
Total Population Growth	**100%**	**38,265**	**56,914**	**85,902**	**0.7%**	**1.0%**	**1.4%**

Source: Leland Consulting Group, based on OFM – Small Area Estimate Program (SAEP), December 2023 .

Note: Although the Cherry Point UGA did account for a very small percentage (0.1%) of County growth over the past decade, it is assumed for this analysis to have no future residential capacity. Accordingly, Cherry Point's calculated shares of population growth (33, 50, and 75 for low, middle, and high) were instead assigned to Bellingham.

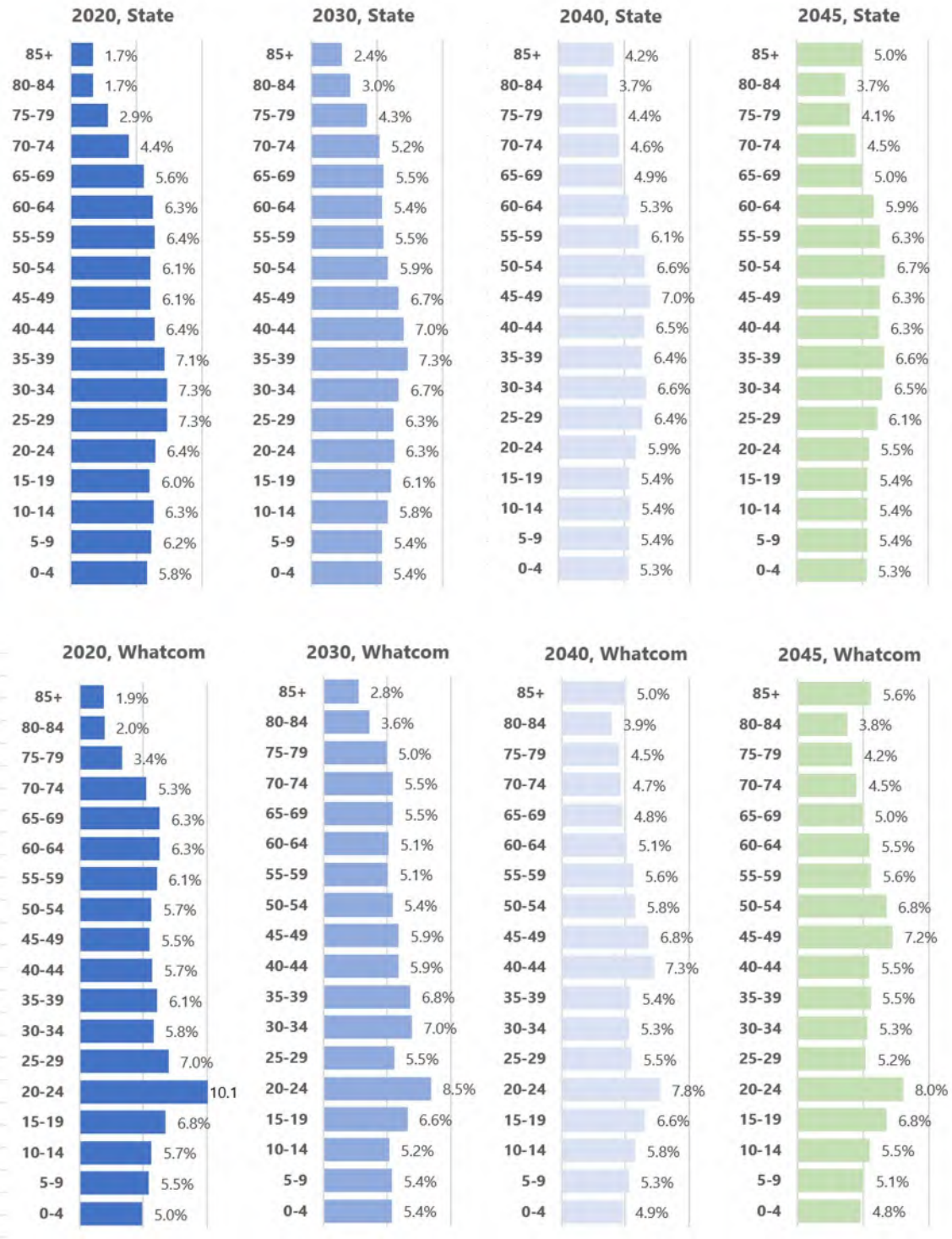
- Allocated in this manner, Bellingham would add between roughly 16,000 and 36,000 new residents by 2045.
- Although its share of growth has declined over time, the Other/Rural category of non-UGA areas receives the next-highest allocation, with anticipated population growth ranging between approximately 7,000 and 16,000 by the planning horizon.
- Ferndale and Lynden are set to grow at a similar pace, adding between 4,000 and 11,000 residents each, followed by Blaine and Birch Bay, with expected middle scenario growth in the mid-2,000s.

These population allocations are considered "technical" as they are strictly modeled on recent past growth performance, rather than reflecting any specific differences in goals or policies across the jurisdictions. As such, they represent a starting point subject to refinement through discussion and negotiation among the County and cities as a next step in the process.

Age Cohort Analysis

Age cohorts in Whatcom County and Washington State were analyzed to provide context for some of the broader population changes being projected by the Office of Financial Management. Figures 9 and 10 shows the age distributions by five-year increments in Washington State and Whatcom County for 2020 and as projected by the OFM for 2030 and 2040.

Figure 8: Age Distribution, Statewide and Whatcom County, 2020 and Projections to 2045



Source: OFM; Leland Consulting Group

To aid in tracking population shifts across age cohorts, another illustration of those same distributions is shown below in tabular form, with conditional formatting of cells to highlight population skews by

shades of green. This method helps to understand how the aging of the two major U.S. population "bulges" effects the population as they track with each passing decade.

The largest shares of total population statewide can be found among Millennials. In Whatcom County, a distinct third concentration can be seen for college age young adults.

In fact, in 2020, the age 20 to 24 bracket in Whatcom County briefly accounted for a double-digit share of Countywide population, as the prime college age overlapped with the "natural" Millennial bulge found in the non-college population.

Figure 9: Statewide and Whatcom County Population Shares by Age, 2020 to 2040

State of Washington

	2020	2030	2040	2045
0-4	5.8%	5.4%	5.3%	5.3%
5-9	6.2%	5.4%	5.4%	5.4%
10-14	6.3%	5.8%	5.4%	5.4%
15-19	6.0%	6.1%	5.4%	5.4%
20-24	6.4%	6.3%	5.9%	5.5%
25-29	7.3%	6.3%	6.4%	6.1%
30-34	7.3%	6.7%	6.6%	6.5%
35-39	7.1%	7.3%	6.4%	6.6%
40-44	6.4%	7.0%	6.5%	6.3%
45-49	6.1%	6.7%	7.0%	6.3%
50-54	6.1%	5.9%	6.6%	6.7%
55-59	6.4%	5.5%	6.1%	6.3%
60-64	6.3%	5.4%	5.3%	5.9%
65-69	5.6%	5.5%	4.9%	5.0%
70-74	4.4%	5.2%	4.6%	4.5%
75-79	2.9%	4.3%	4.4%	4.1%
80-84	1.7%	3.0%	3.7%	3.7%
85+	1.7%	2.4%	4.2%	5.0%

Millennials

Baby Boomers

Whatcom County

	2020	2030	2040	2045
0-4	5.0%	5.4%	4.9%	4.8%
5-9	5.5%	5.4%	5.3%	5.1%
10-14	5.7%	5.2%	5.8%	5.5%
15-19	6.8%	6.6%	6.6%	6.8%
20-24	10.1%	8.5%	7.8%	8.0%
25-29	7.0%	5.5%	5.5%	5.2%
30-34	5.8%	7.0%	5.3%	5.3%
35-39	6.1%	6.8%	5.4%	5.5%
40-44	5.7%	5.9%	7.3%	5.5%
45-49	5.5%	5.9%	6.8%	7.2%
50-54	5.7%	5.4%	5.8%	6.8%
55-59	6.1%	5.1%	5.6%	5.6%
60-64	6.3%	5.1%	5.1%	5.5%
65-69	6.3%	5.5%	4.8%	5.0%
70-74	5.3%	5.5%	4.7%	4.5%
75-79	3.4%	5.0%	4.5%	4.2%
80-84	2.0%	3.6%	3.9%	3.8%
85+	1.9%	2.8%	5.0%	5.6%

Students

Millennials

Baby Boomers

Source: OFM; Leland Consulting Group

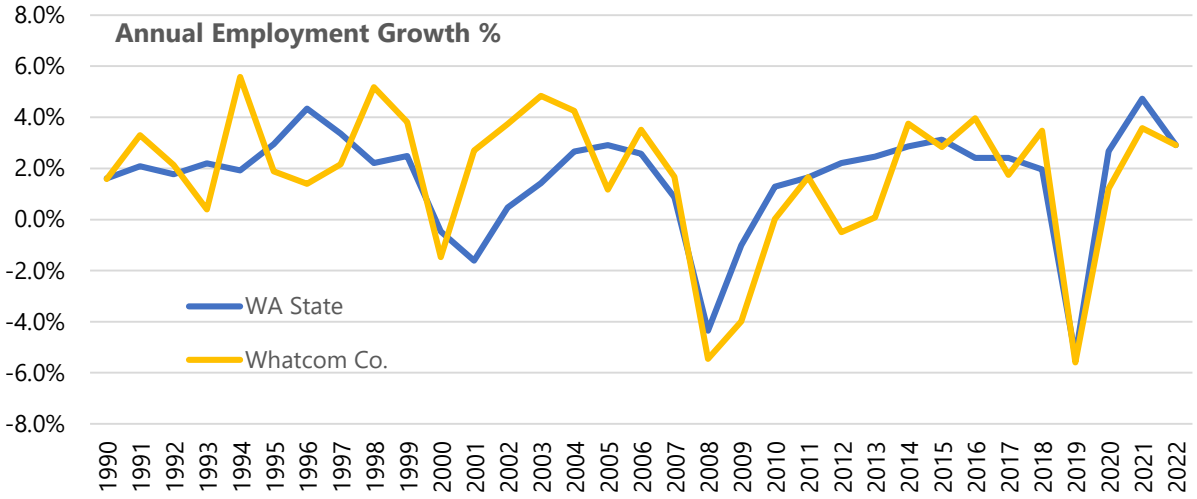
Although the Millennial and Baby Boomer generational cohorts were similar in size at their peak, the population shares for Boomers have begun to increasingly tail off as members of that group begin to reach average life expectancies. That said, a sizeable portion of Whatcom County's population is reaching empty-nest and/or retirement age, where housing needs for some can begin to favor lower-maintenance options in walkable neighborhoods, such as urban missing middle housing. Others will be attracted to the continuum of senior housing options, ranging from age-restricted active senior apartments to assisted living and nursing care facilities.

In 2022, Whatcom County's population aged 15 to 34 was just over 67,000, while the combined population aged 60 and up was approximately 61,000. By 2030, those two age ranges will have evened out at just over 70,000 each.

Countywide Employment Trends

Historically, annual employment growth in Whatcom County has closely tracked along with the state of Washington as a whole. In the past ten years, the County has grown at 1.5% annually, compared to 1.9% statewide, with the difference mainly owing to increased volatility at the local level. Over a twenty year span, the average growth rates roughly converge, with the County growing at 1.3% versus the state at 1.4% per year.

Figure 10: County vs. State Historical Employment Growth Rates by Year, 1990 to 2022

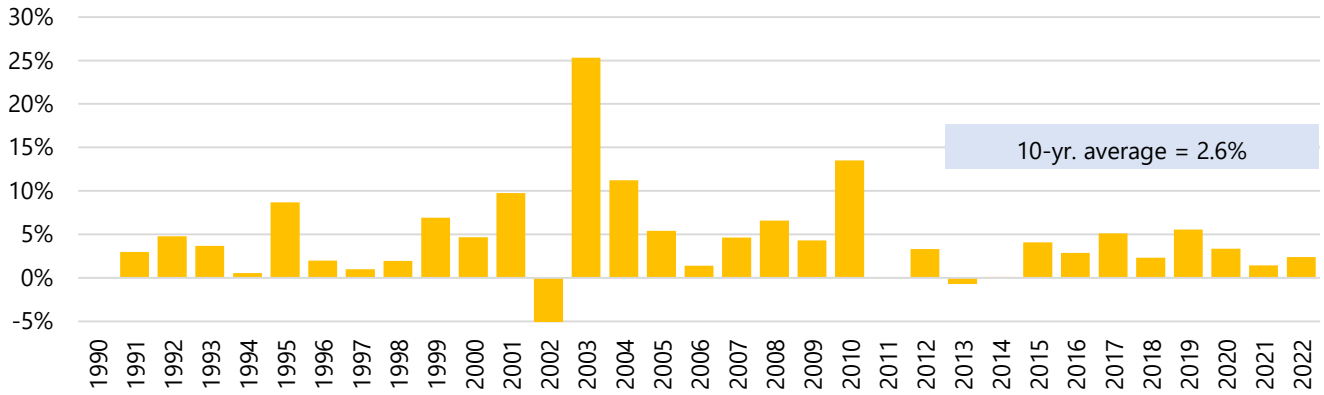


Source: U.S. Bureau of Labor Statistics

The next graph tracks the County's share of statewide employment growth over the same time period. Though there have been spikes, such as in 2003 and 2010, when the County briefly captured an outsize share of growth, more recent years have settled into a more predictable pattern, with Whatcom County accounting for 2.6% of annual statewide job growth over the past 10 years.

Since 2000, Whatcom's share of total statewide jobs (all standing employment, rather than just growth) has remained within a relatively narrow range, from just above 3.0% on the low end, to just over 3.4% on the high end. Currently, the County accounts for 3.1% of total statewide employment.

Figure 10: Whatcom County Share of State Employment Growth, 1990 to 2022

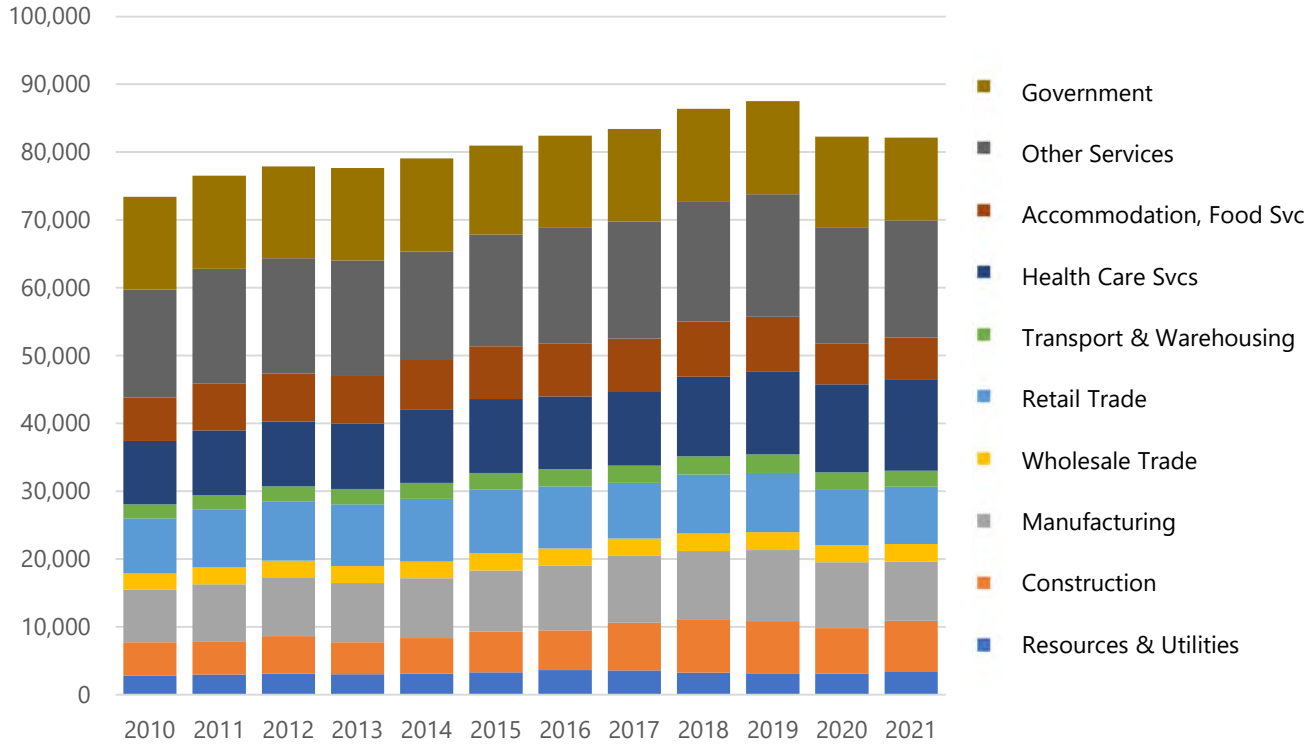


Source: U.S. Bureau of Labor Statistics

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Employment by Industry

Figure 11: Whatcom County Employment by Industry Sector, 2010 to 2021



Source: U.S. Census Longitudinal Employer-Household Dynamics (LEHD) On the Map; and Leland Consulting Group
Note: LEHD industry sector grouping differ slightly from State of Washington ESD categories and have been adjusted to match.

The figure below summarizes overall Countywide job growth (or loss) by those same groupings, to highlight areas of substantial change. The largest single growth sector was Health Care Services, which

added over 4,100 jobs in the County in just over a decade. At the same time, the Government sector lost nearly 1,500 jobs. Much of the employment decline occurred during 2020 and 2021, suggesting that temporary factors related to COVID-19 may account for some of that job loss.

The past decade saw a boom in Construction in the County, with that sector adding almost 2,700 jobs from 2010 to 2021. That growth was largely due to a very strong multifamily housing market, along with substantial transportation and infrastructure construction projects. The construction sector is historically one of the most volatile and responsive to business cycles. The current boom only recently reached annual job levels seen during the late 2000s, during the last major upcycle.

Despite the trends in automation reducing the labor requirements in Manufacturing, that sector has remained a somewhat surprising category for recent employment strength and expansion. The 8,700 manufacturing jobs in 2021 is up nearly 1,000 jobs from the 2010 employment level (even after falling from a peak of 10,400 jobs in 2019). In fact this relatively healthy trend in manufacturing is based on data that does not yet include some recent facility additions in the alternative energy subsector in the Bellingham market.

Figure 12: Whatcom County Historical Employment Growth by Sector, 2010 to 2021

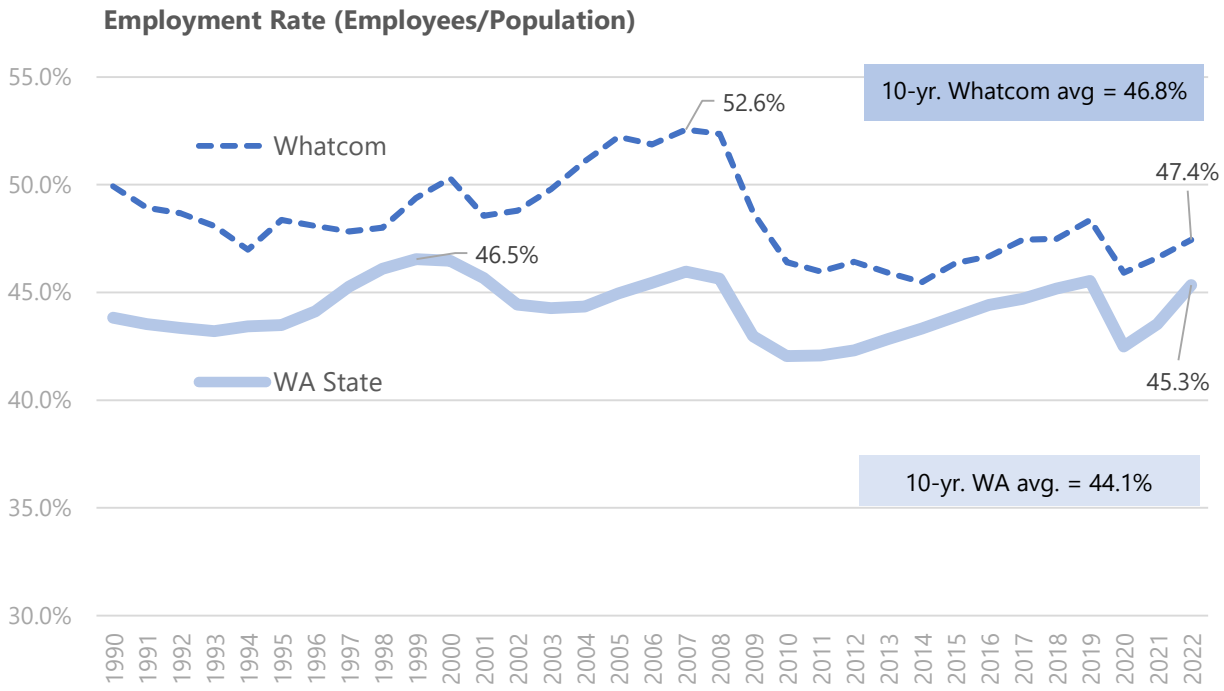
Industry	2010	2021	Growth	Percent Change 2010-21
Resources & Utilities	2,829	3,343	514	18.2%
Construction	4,885	7,556	2,671	54.7%
Manufacturing	7,738	8,699	961	12.4%
Wholesale Trade	2,425	2,629	204	8.4%
Retail Trade	8,099	8,450	351	4.3%
Transport & Warehousing	2,073	2,344	271	13.1%
Health Care Svcs	9,347	13,494	4,147	44.4%
Accommodation & Food Svc	6,413	6,148	-265	-4.1%
Other Services	15,893	17,247	1,354	8.5%
Government	13,718	12,247	-1,471	-10.7%
Total	**73,420**	**82,157**	**8,737**	**11.9%**

Source: U.S. Census LEHD On the Map; and Leland Consulting Group

Projecting Countywide Employment Growth

Neither the Washington Employment Security Department (ESD) nor OFM generate long-range employment projections for Whatcom County specifically. Given this limitation, it is useful to examine the historical relationship between employment and population, which are typically correlated. The next exhibit shows recent trends in that ratio (referred to as the employment rate) for Whatcom County and Washington State.

Figure 13: Employment Rate (Employees/Population), Whatcom County vs. State of Washington, 1990 to 2022



Source: U.S. Bureau of Labor Statistics, OFM; and Leland Consulting Group

As an example, in 2022, Whatcom County had a population of approximately 231,000 and total employment of approximately 109,000. The employment rate for that year was is 47.4% (109,000 divided by 231,000).

Over time, this ratio has historically remained relatively stable, falling largely within a fairly narrow, plus or minus 1%, band around an average of 46.77 over the past ten years in Whatcom County. This predictable relationship between population and employment allows for reasonably reliable estimates of future employment based on our forecasts for County population.

Figure 14: Projecting Future Employment Based on Employment Rate, 2023 to 2045

	Whatcom (low)	Whatcom (middle)	Whatcom (high)
2023 population	235,800	235,800	235,800
2045 population (proj.)	**274,065**	**292,714**	**321,702**
Assumed employment rate	*46.77%*	*46.77%*	*46.77%*
2023 employment, est.	112,633	112,633	112,633
2045 employment, proj.	128,185	136,912	150,466
Employment growth, 2023 to 2045	**15,553**	**24,279**	**37,834**
(including resource/ag industries)			

Source: U.S. Bureau of Labor Statistics, OFM, Leland Consulting Group

Notes:

- *2023 Whatcom County total employment was not available at the time of this analysis. We estimate 2023 based on the 2022 total plus an additional year of growth (at the statewide job growth rate).*

Technical Allocation of Employment Growth to UGAs

Now that a low, middle, and high range of total employment growth has been established for Whatcom County, based on the historic ratio of employment to population (the employment rate), the next step is to allocate that Countywide growth across the County's ten UGAs. That allocation applies the most current available (2021) distribution of jobs across industry types within those UGAs (and in the rural remainder of the County not included in any UGA).

To determine the proportion of Countywide employment accounted for by each UGA, we first obtained the most current geographic boundaries of each UGA in a GIS shapefile format. Those shapefiles could then be uploaded, one UGA at a time, to define selection areas within the U.S. Census' LEHD-On the Map website to get estimated job counts across major industry sectors. Those LEHD results are returned using the 20 two-digit North American Industry Classification System (NAICS) code industry sector categories.

In order be useful for planning purposes, the 20 NAICS industry sectors are combined into broad industry categories, using the categorization scheme below (as was used in the 2016 allocation methodology

Figure 15: Translation of NAICS Industry Codes into Broad Industry Type Categories

NAICS	Industry Sector	Broad Industry Type (for allocations)
11	Agriculture, Forestry, Fishing & Hunting	**Resources**
21	Mining, Quarrying, & Oil & Gas Extraction	
22	Utilities	**Industrial**
23	Construction	
31-33	Manufacturing	
42	Wholesale Trade	
44-45	Transportation & Warehousing	
48-49	Retail Trade	**Retail**
51	Information	**Comm'l**
52	Finance & Insurance	
53	Real Estate & Rental & Leasing	
54	Professional, Scientific, & Technical Services	
55	Management of Companies & Enterprises	
56	Administration & Support, Waste Mgmt	
61	Educational Services	
62	Health Care & Social Assistance	
71	Arts, Entertainment, & Recreation	
71	Accommodation & Food Services	
81	Other Services (excl. Public Admin)	
92	Public Administration	

Source: Leland Consulting Group, using WCOG industry category definitions

The table below shows the share of existing jobs by those broad industry groupings for 2021, as found using the UGA boundary GIS layers uploaded individually to LEHD/On the Map for analysis. Running the same analysis for the County as a whole allowed for determination of the Other/Rural group lying outside any UGA boundary.

Figure 16: Share of Current (2021) Employment by UGA and Broad Industry Type

	UGA Job Shares by Broad Industry Type				
UGA	**Resources**	**Industrial**	**Retail**	**Comm'l**	**Total**
Bellingham	14.9%	44.5%	73.7%	71.4%	**62.5%**
Birch Bay	0.0%	0.3%	0.4%	0.6%	**0.5%**
Blaine	0.4%	5.2%	1.9%	2.2%	**2.9%**
Cherry Point	0.0%	7.1%	0.0%	0.3%	**2.0%**
Columbia Valley	0.0%	0.1%	0.1%	0.0%	**0.1%**
Everson	1.1%	1.4%	1.0%	0.6%	**0.8%**
Ferndale	2.0%	15.2%	8.0%	6.6%	**8.8%**
Lynden	2.1%	9.6%	7.3%	6.8%	**7.4%**
Nooksack	0.0%	0.5%	0.3%	0.3%	**0.3%**
Sumas	0.2%	1.5%	0.3%	0.3%	**0.6%**
Other/Rural	79.3%	14.6%	6.9%	10.8%	**14.0%**
Whatcom Total	**100%**	**100%**	**100%**	**100%**	**100%**
% of Total Whatcom Jobs by Industry Category	*3.8%*	*26.1%*	*10.3%*	*59.8%*	*100.0%*

Those total job shares by broad category (3.8% Resources, 26.1% industrial, 10.3% retail, 59.8%, commercial) were applied to the low, middle, and high employment projections to arrive at Countywide employment totals by industry group. These totals were used for allocation to the UGAs.

Figure 17: Countywide Growth Totals by Broad Industry Group Across Low, Middle, and High Scenarios

	Scenario	Total Employment Growth to Allocate	Resources	Industrial	Retail	Comm'l
% of Total Whatcom Jobs by Industry Category			3.8%	26.1%	10.3%	59.8%
Total Proj. Growth 2023-2045	Low	**15,553**	594	4,057	1,600	9,302
	Middle	**24,279**	928	6,333	2,497	14,521
	High	**37,834**	1,446	9,869	3,891	22,627

For example, we estimate that **15,553** total jobs will be added in Whatcom County from 2023 to 2045 under the low growth scenario.

Applying the retail share of jobs **(10.3%)**, we get **1,600** low scenario retail jobs for allocation across the County.

Referring back to Figure 18, we then apportion those 1,446 jobs to the various UGAs based on their historical share of retail jobs. The Bellingham UGA gets 73.7% of all County retail jobs, so in the low scenario, is allocated **1,180** retail jobs (73.7% x 1,600 = 1,180) in the low scenario.

The final three tables below use this described method to allocate employment growth from the Countywide level to each of the constituent UGAs under each of the three growth scenarios.

Figure 18: 2023-2045 UGA Employment Growth Allocations by Industry, by Scenario

Low Scenario	UGA	Resources	Industrial	Retail	Comm'l	Total
	Bellingham	88	1,807	1,180	6,644	**9,719**
	Birch Bay	0	14	6	59	**80**
	Blaine	2	210	30	207	**449**
	Cherry Point	0	289	0	27	**316**
	Columbia Valley	0	4	2	3	**9**
	Everson	6	56	16	52	**130**
	Ferndale	12	615	129	616	**1,372**
	Lynden	13	388	117	635	**1,152**
	Nooksack	0	19	4	28	**51**
	Sumas	1	62	5	27	**96**
	Area outside UGAs	472	594	110	1,004	**2,180**
	Whatcom Total	**594**	**4,057**	**1,600**	**9,302**	**15,553**

Middle Scenario	UGA	Resources	Industrial	Retail	Comm'l	Total
	Bellingham	138	2,820	1,841	10,373	**15,172**
	Birch Bay	0	22	10	92	**124**
	Blaine	4	327	48	322	**701**
	Cherry Point	0	450	0	43	**493**
	Columbia Valley	0	6	3	4	**13**
	Everson	10	88	24	81	**203**
	Ferndale	19	961	201	961	**2,141**
	Lynden	20	606	183	991	**1,799**
	Nooksack	0	29	7	44	**79**
	Sumas	2	98	8	43	**150**
	Area outside UGAs	736	927	172	1,567	**3,403**
	Whatcom Total	**928**	**6,333**	**2,497**	**14,521**	**24,279**

High Scenario	UGA	Resources	Industrial	Retail	Comm'l	Total
	Bellingham	215	4,395	2,869	16,163	**23,642**
	Birch Bay	0	35	16	144	**194**
	Blaine	6	510	74	502	**1,092**
	Cherry Point	0	702	0	67	**769**
	Columbia Valley	0	9	5	7	**21**
	Everson	16	137	38	127	**317**
	Ferndale	29	1,497	313	1,498	**3,337**
	Lynden	31	944	285	1,544	**2,803**
	Nooksack	0	45	11	68	**124**
	Sumas	3	152	12	66	**233**
	Areas outside UGAs	1,147	1,445	268	2,442	**5,302**
	Whatcom Total	**1,446**	**9,869**	**3,891**	**22,627**	**37,834**

Appendix: Population & Employment Allocations, Select Years

Countywide Population & Employment Projections (select years)

Population		2023	2025	2031	2035	2045	2023 to 2045 Growth
	low	**235,800**	236,799	249,210	256,903	**274,065**	38,265
	middle	**235,800**	240,329	256,773	267,470	**292,714**	56,914
	high	**235,800**	246,801	269,952	285,671	**321,702**	85,902

Population Growth		2023	2025	2031	2035	2045	2023 to 2045 Growth
	low		500	1,887	1,945	1,695	38,265
	middle		2,275	2,607	2,715	2,531	56,914
	high		5,563	3,793	4,014	3,513	85,902

Total Employment		2023	2025	2031	2035	2045	2023 to 2045 Growth
	low	**112,633**	110,755	116,560	120,158	**128,185**	15,553
	middle	**112,633**	112,407	120,098	125,101	**136,912**	24,279
	high	**112,633**	115,434	126,262	133,614	**150,466**	37,834

Resources Employment		2023	2025	2031	2035	2045	*2023 to 2045 Growth*
	low	**4,305**	4,233	4,455	4,592	**4,899**	*594*
	middle	**4,305**	4,296	4,590	4,781	**5,233**	*928*
	high	**4,305**	4,412	4,826	5,107	**5,751**	*1,446*

Industrial Employment		2023	2025	2031	2035	2045	*2023 to 2045 Growth*
	low	**29,381**	28,891	30,405	31,344	**33,438**	*4,057*
	middle	**29,381**	29,322	31,328	32,633	**35,714**	*6,333*
	high	**29,381**	30,111	32,936	34,854	**39,250**	*9,869*

Retail Employment		2023	2025	2031	2035	2045	*2023 to 2045 Growth*
	low	**11,584**	11,391	11,988	12,359	**13,184**	*1,600*
	middle	**11,584**	11,561	12,352	12,867	**14,082**	*2,497*
	high	**11,584**	11,873	12,986	13,742	**15,476**	*3,891*

Commercial Employment		2023	2025	2031	2035	2045	*2023 to 2045 Growth*
	low	**67,363**	66,240	69,712	71,864	**76,664**	*9,302*
	middle	**67,363**	67,228	71,827	74,820	**81,883**	*14,521*
	high	**67,363**	69,038	75,514	79,911	**89,990**	*22,627*

UGA Population & Employment Projections (select years)

Population - Middle	2023	2025	2031	2035	2045	*2023 to 2045 Growth*
Bellingham	**105,529**	107,447	114,413	118,944	129,641	24,112
Birch Bay	**8,908**	9,092	9,760	10,194	11,220	2,313
Blaine	**6,728**	6,949	7,751	8,272	9,502	2,774
Cherry Point	**61**	65	80	89	111	50
Columbia Valley	**3,577**	3,656	3,942	4,127	4,566	989
Everson	**3,171**	3,245	3,514	3,690	4,104	933
Ferndale	**16,762**	17,340	19,438	20,803	24,025	7,263
Lynden	**16,696**	17,226	19,152	20,404	23,361	6,666
Nooksack	**1,573**	1,601	1,703	1,769	1,925	352
Sumas	**1,810**	1,865	2,067	2,198	2,507	697
Other/Rural	**70,985**	71,842	74,955	76,980	81,751	10,766*
County Total	**235,800**	**240,329**	**256,773**	**267,470**	**292,714**	**56,914**

Total Employment - Middle	2023	2025	2031	2035	2045	*2023 to 2045 Growth*
Bellingham	**70,384**	70,243	75,049	78,176	85,556	*15,172*
Birch Bay	**577**	576	615	641	702	*124*
Blaine	**3,251**	3,244	3,466	3,610	3,951	*701*
Cherry Point	**2,288**	2,284	2,440	2,541	2,781	*493*
Columbia Valley	**62**	62	66	69	75	*13*
Everson	**943**	941	1,006	1,048	1,147	*203*
Ferndale	**9,934**	9,914	10,592	11,034	12,075	*2,141*
Lynden	**8,345**	8,328	8,898	9,269	10,144	*1,799*
Nooksack	**369**	368	393	410	448	*79*
Sumas	**695**	694	741	772	845	*150*
Other/Rural	**15,785**	15,753	16,831	17,532	19,188	*3,403*
County Total	**112,633**	**112,407**	**120,098**	**125,101**	**136,912**	***24,279***

Resource Jobs - Middle	2023	2025	2031	2035	2045	*2023 to 2045 Growth*
Bellingham	**640**	639	683	711	778	138
Birch Bay	**0**	0	0	0	0	0
Blaine	**16**	16	18	18	20	4
Cherry Point	**0**	0	0	0	0	0
Columbia Valley	**0**	0	0	0	0	0
Everson	**47**	47	50	52	57	10
Ferndale	**86**	86	92	96	105	19
Lynden	**92**	92	98	102	112	20
Nooksack	**0**	0	0	0	0	0
Sumas	**8**	8	9	9	10	2
Other/Rural	**3,415**	3,408	3,641	3,793	4,151	736
County Total	**4,305**	**4,296**	**4,590**	**4,781**	**5,233**	**928**

** 2045 Rural/Other population (Middle) was manually reduced by 8 people to correct for a discrepancy across OFM source tables*

UGA Population & Employment Projections (select years), cont.

Industrial Jobs - Middle	2023	2025	2031	2035	2045	*2023 to 2045 Growth*
Bellingham	**13,083**	13,057	13,950	14,531	15,903	2,820
Birch Bay	**103**	103	110	114	125	22
Blaine	**1,518**	1,515	1,618	1,686	1,845	327
Cherry Point	**2,089**	2,085	2,228	2,321	2,540	450
Columbia Valley	**26**	26	28	29	32	6
Everson	**407**	406	434	452	495	88
Ferndale	**4,457**	4,448	4,752	4,950	5,418	961
Lynden	**2,809**	2,803	2,995	3,120	3,415	606
Nooksack	**134**	134	143	149	163	29
Sumas	**452**	452	482	502	550	98
Other/Rural	**4,302**	4,293	4,587	4,778	5,229	927
County Total	**29,381**	**29,322**	**31,328**	**32,633**	**35,714**	**6,333**

Retail Jobs - Middle	2023	2025	2031	2035	2045	*2023 to 2045 Growth*
Bellingham	**8,542**	8,525	9,109	9,488	**10,384**	*1,841*
Birch Bay	**47**	47	50	52	**57**	*10*
Blaine	**221**	220	235	245	**268**	*48*
Cherry Point	**0**	0	0	0	**0**	*0*
Columbia Valley	**15**	15	16	17	**18**	*3*
Everson	**112**	112	120	125	**137**	*24*
Ferndale	**931**	929	993	1,034	**1,132**	*201*
Lynden	**849**	847	905	943	**1,032**	*183*
Nooksack	**32**	31	34	35	**38**	*7*
Sumas	**37**	37	39	41	**45**	*8*
Other/Rural	**799**	798	852	888	**972**	*172*
County Total	**11,584**	**11,561**	**12,352**	**12,867**	**14,082**	**2,497**

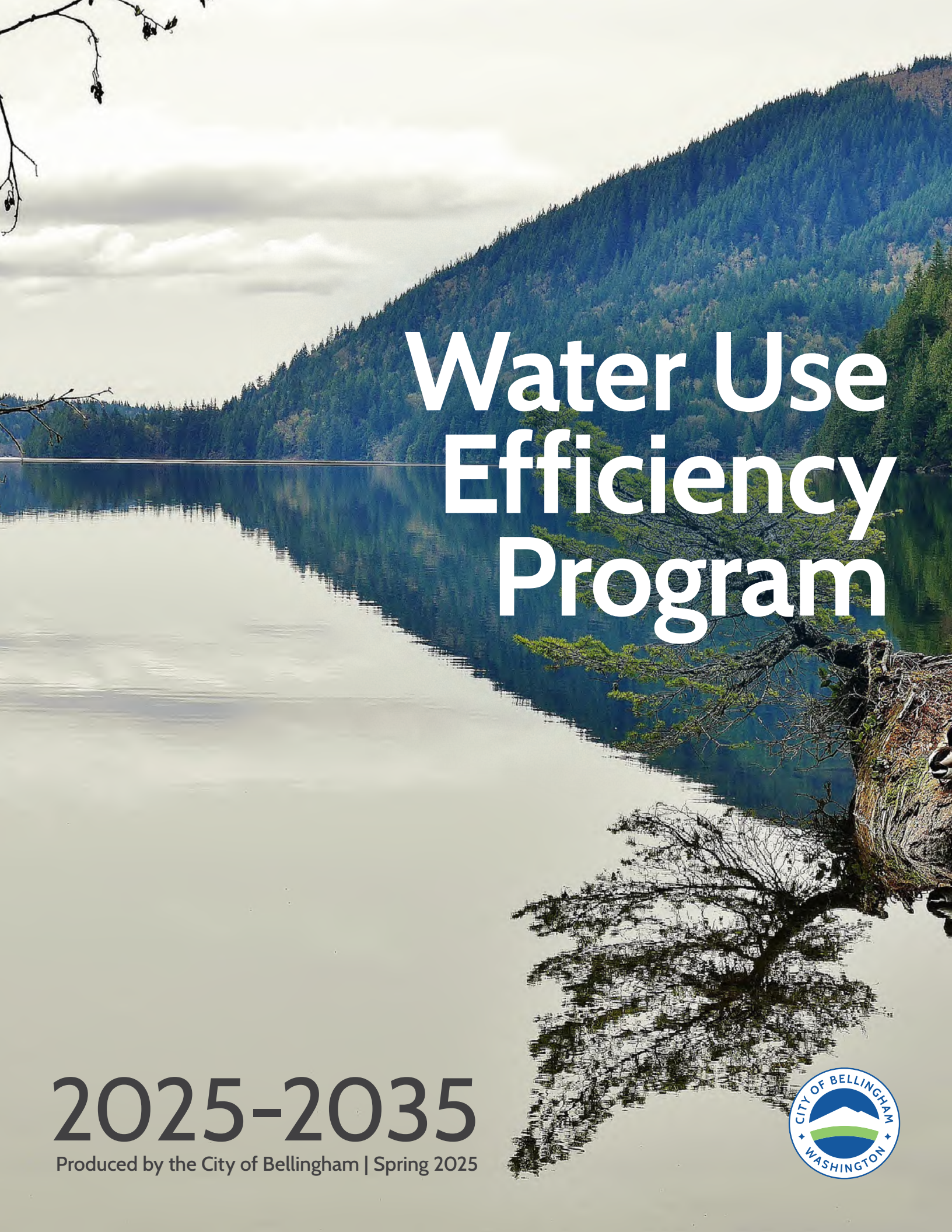
Comm'l Jobs - Middle	2023	2025	2031	2035	2045	*2023 to 2045 Growth*
Bellingham	**48,119**	48,022	51,308	53,445	**58,491**	*10,373*
Birch Bay	**428**	427	456	475	**520**	*92*
Blaine	**1,496**	1,493	1,595	1,661	**1,818**	*322*
Cherry Point	**199**	198	212	221	**242**	*43*
Columbia Valley	**21**	21	22	23	**25**	*4*
Everson	**377**	376	402	419	**458**	*81*
Ferndale	**4,460**	4,451	4,755	4,953	**5,421**	*961*
Lynden	**4,595**	4,586	4,900	5,104	**5,586**	*991*
Nooksack	**203**	202	216	225	**247**	*44*
Sumas	**197**	197	211	219	**240**	*43*
Other/Rural	**7,269**	7,254	7,751	8,073	**8,836**	*1,567*
County Total	**67,363**	67,228	71,827	74,820	**81,883**	***14,521***

Errata:

In the April, 2024 version of this report, page 24 included two tables of employment allocations to UGAs with incorrect data (*Total Employment – Middle* and *Resources Employment Middle*). Those tables have been replaced in this May 7, 2024 version.

APPENDIX L

BELLINGHAM 2025-2035 WUE PROGRAM



Water Use Efficiency Program

2025-2035

Produced by the City of Bellingham | Spring 2025

Water Use Efficiency Program 2025-2035

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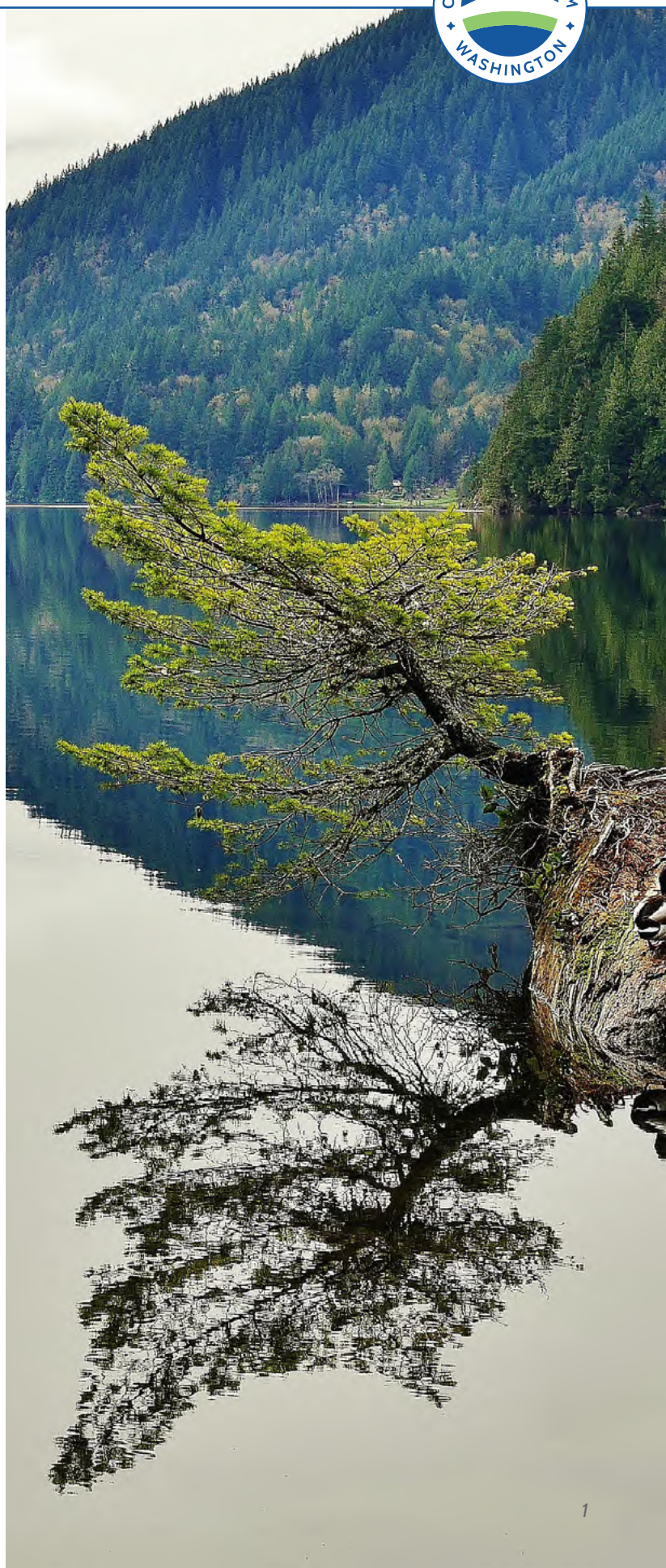
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Appendix 12



Background

Municipal Law Requirements

In 2003 the Washington State Legislature passed Engrossed Substitute House Bill 1338, known as the Municipal Water Law (MWL) to address increasing demand on our state's water resources. The Department of Health (DOH) was directed to oversee and enforce a Water Use Efficiency Program (WUE) to help support the collective goal of ensuring a safe and reliable drinking water supply.

The WUE program seeks to support this goal in the following ways:

- Contribute to long-term water supply reliability and public health protection
- Promote good stewardship of the state's water resources
- Ensure efficient operation and management of water systems

Enacted on January 22, 2007, water suppliers must fulfill certain responsibilities. Applicable requirements specific to the City of Bellingham are listed in Table 1.

Table 1: City of Bellingham WUE program requirements

Requirements	Timeline
Water Use Efficiency Program • Goal Setting and Performance Measures	Every 10 years
Performance Reporting	Annually
Distribution Leakage Standard	2020

Water Use Efficiency Program

As part of the Planning Requirements of the WUE, municipal water suppliers are required to collect data, forecast demand, evaluate WUE measures, calculate distribution leakage and implement a WUE program to meet their goals. As of January 1, 2007, water suppliers have been obligated to collect production and consumption data on a regular basis to include in planning documents and annual performance reporting. As part of this data collection, demand forecasting is also an essential component for determining future use and potential savings through a water use efficiency program. A description of the water supplier's water source and supply characteristics must also be provided.



Goal Setting and Performance Measures

The WUE program requires municipal water suppliers to establish a water use efficiency goal and measures for a six-year period through a public process. Goals must be measurable, address water supply and demand forecasting, and include an implementation schedule.

Performance Reporting

A progress report on annual water system production total, update on adopted WUE goals and measure performance, and distribution system leakage information, when applicable, are required in the report by July 1 of each year. Performance reports are to be made available to the public via the website or as part of the annual Consumer Confidence Report.



Distribution Leakage Standard

Municipal water suppliers are required to meet a 10 percent or less distribution system leakage rate to comply with the state standard. Leakage must be presented both as a percentage and as leakage volume and based on a rolling three-year average.

In 2020, the water meter on the demand side of the City's system was verified to report inaccurate flows during times of low demand. The current system condition is a 60" main that is reduced down to a 48" pipe where an electromagnetic insertion style flow meter is located. This flow meter is considered one of the most accurate for this size of pipe. Further reductions of pipe size would affect the ability to maintain storage levels at times of high demand. The typical recommended flow range for this meter is 2-20 ft/s. We conducted multiple flow checks on this meter and find flow velocities range from 0.4 to 2.0 ft/s. Of these flow checks, 22 percent were below 1.0 ft/s (8.2 mgd) and 100 percent of the test flows were below 2.0 ft/s (16.3 mgd). We also did flow checks where we maintained flows below 1.0 ft/s and could not obtain repeatable data to allow for percentage corrections.

System layout limits the ability of simple or low-cost system modification.

Due to the low flow velocities experienced within our system, which often fall outside the recommended flow range for our existing flow meter, we are unable to accurately calculate our annual system leakage. While we are confident in our proactive maintenance practices, swift response to main breaks, and the effectiveness of our leak detection program in minimizing water loss, to fulfill State requirements for the 2025-2035 program period, we will collaborate with the Department of Health to establish either:

- An alternative leakage calculation methodology as outlined in WAC 246-290-820(1)(b)(ii) and 246-290-820(3).
- A water loss control action plan as specified in WAC 246-290-820(1)(b)(iv) and 246-290-820(4).

This approach will ensure compliance with state regulations while acknowledging the limitations of our current metering infrastructure.

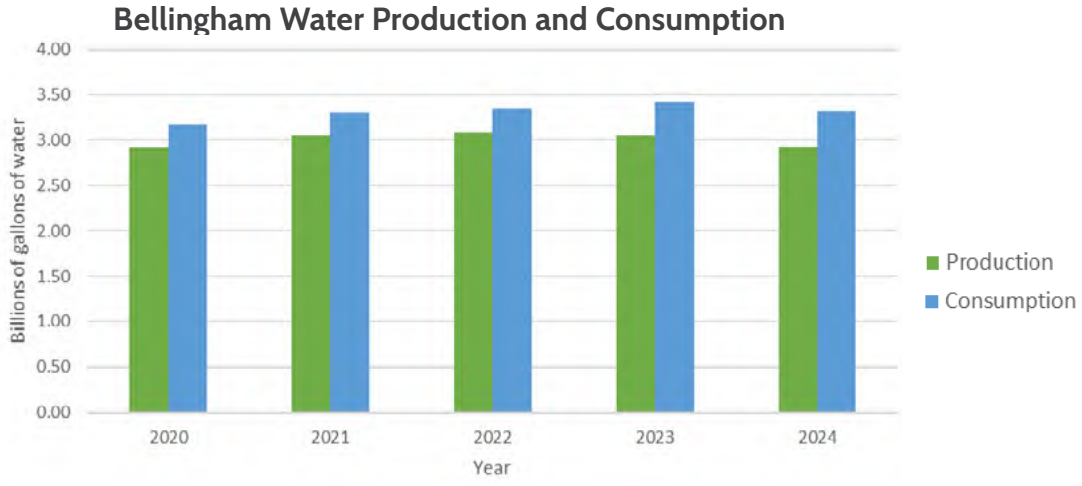


Figure 1 illustrates the inaccurate flows that are currently measured at the Water Treatment Plant due to pipe size.

City of Bellingham Water Supply Characteristics

Source

The City of Bellingham's (hereafter "the City") water supply originates as rain and snow in the Lake Whatcom and the Middle Fork Nooksack River watersheds. Water from the Middle Fork can be diverted via a dam through an underground tunnel in Bowman Mountain. From there, the water travels to Mirror Lake, where fine sediment settles out, and then on to Anderson Creek and its final destination of Lake Whatcom. Lake Whatcom is the principal supply reservoir for the system. Water withdrawn from Lake Whatcom is screened then treated at the water treatment plant (WTP), located near Whatcom Falls Park.

Production and Delivery System

The WTP produces drinking water continuously, and with the help of many water storage reservoirs stationed throughout the city, delivers water to its customers. The reservoirs store twice the daily average demand for the city and are used to supply the peak water demands throughout the day. The storage reservoir levels are constantly monitored by WTP Operators and refilled when the water demands are lower. Typically, on a warm summer day the water demand goes up in the afternoon and drops off around midnight. The production rates at the plant average between 8 million gallons per day during the winter months and up to 14 million gallons per day in the summer.

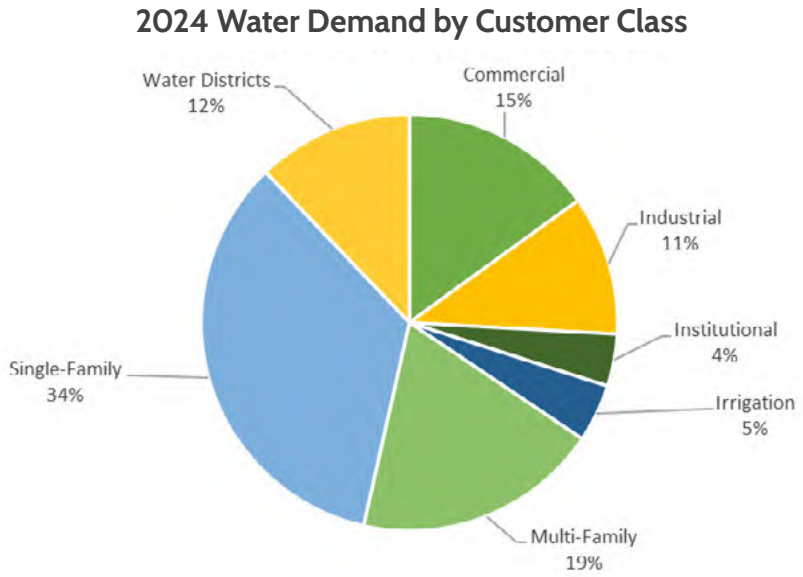


Figure 2 summarizes water consumption in 2024 by customer type. After single-family residential, multi-family residential and commercial are the second and third largest water consumers by customer type.

2020-2024 Water Use Efficiency Program Summary

Program Goal: Maintain average Peak Day Demand (PDD) between June 1 and August 31 of each year to below 14 million gallons per day (mgd) during the 2020-2024 period.

Table 2: Peak Day Demand (mgd)

Months	2020	2021	2022	2023	2024
June – August	12.53	13.93	12.95	12.84	12.51

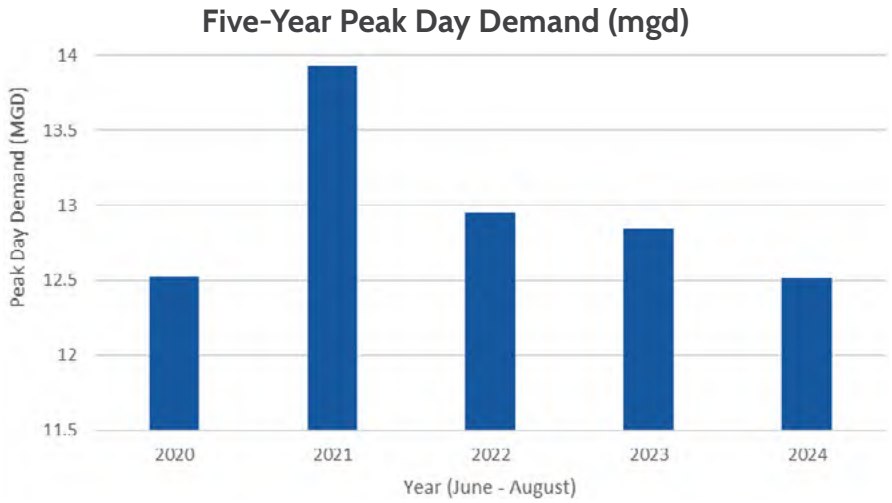


Figure 3: Five-year Peak Day Demand between 2020-2024

The Peak Day Demand represents the highest daily total of water that was sent into the water distribution system. Previous reports in 2020 and 2021 reported the highest instantaneous peak flow measurement, rather than the daily total. The numbers above more accurately reflect our peak water production and distribution, which is remaining relatively steady during the warmer summer months, and below our goal of 14 mgd. The region experienced an extreme heat dome in July 2021, likely contributing to higher usage during this time.

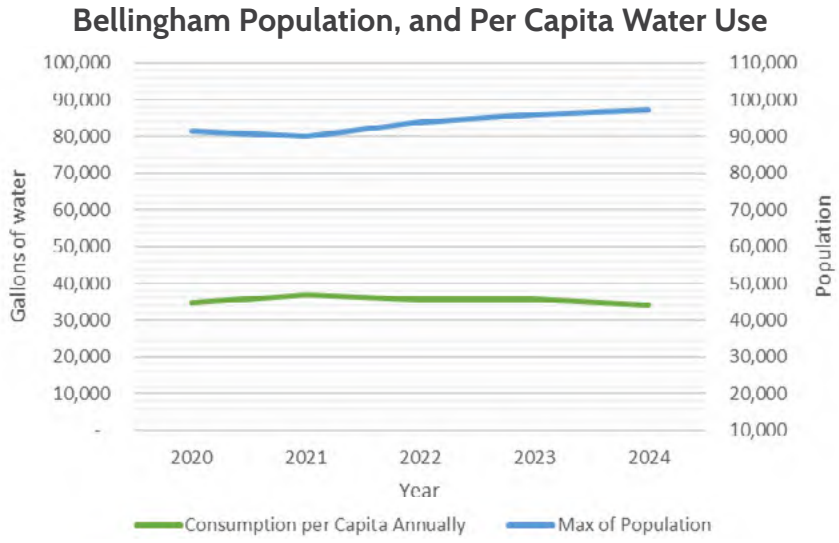


Figure 4 shows annual per capita water use as it relates to our population

Completed Measures

Table 3: Measures and savings (in gallons) between 2020-2024

Measure	Estimated total annual water savings (2020–2024)
Single family rebates	631,008
Multi-family direct install program	98,670
Commercial rebates and direct install program	1,431,163
Total estimated water savings	**2,062,171**

Report on Nine Adopted Measures - 2020-2024



1. Continue single-family residential rebate program

Goal: save 750,000 gallons per year

We continued our partnership with the Opportunity Council's Community Energy Challenge (CEC) to conduct water use efficiency and energy conservation outreach. CEC staff conduct assessments of single-family residences and provide information on indoor and outdoor water-saving fixtures, program information, and rebate process.

Table 4: Single-family residential rebate program savings

SFR Rebates	2020	2021	2022	2023	2024	Total 2020–2024
Assessments conducted	38	80	89	118	79	404
Number of rebates provided	58	33	30	27	27	175
Money provided for rebates	$7,149	$3,525	$2,598	$2,447	$1,400	$17,119
Estimated gallons saved	196,192	99,692	115,340	113,517	106,267	**631,008**



2. Continue multi-family residential rebate program

Goal: save 750,000 gallons per year

Through our continued partnership with the Opportunity Council's Community Energy Challenge (CEC), building owners are provided with water efficiency related services that include an assessment of water fixtures, water conservation program information dissemination, and assistance with water rebate submissions.

Much of this work was put on pause during the Coronavirus Pandemic, due to challenges and restrictions on in-person assessments of homes.

Between 2020-2024, CEC staff conducted eight assessments in multi-family residences, totaling 343 units. Building owners are provided with showerheads and aerators on-site and given information on how to pursue rebates for larger fixtures, such as toilets and clothes washers. An estimated 98,670 gallons of water was saved in 2024 due to the direct install of low-flow showerheads and aerators in multi-family residences.

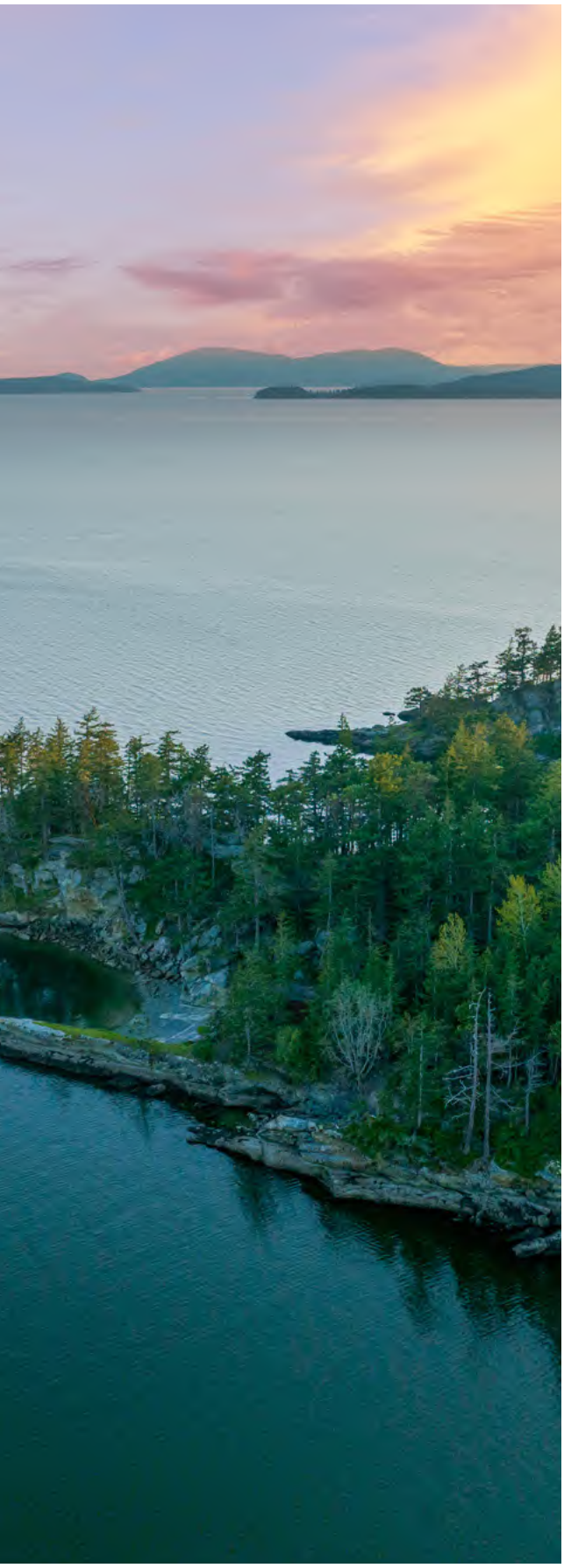
3. Continue commercial and institutional rebate program

Goal: save 2,000,000 gallons per year

Through our continued partnership with Sustainable Connections, water-saving information and devices are provided to commercial customers, including fixture assessments, water efficiency retrofits, and water use efficiency rebate and program information dissemination.

Table 5: Commercial and institutional rebate program savings

Commercial/Institutional	2020	2021	2022	2023	2024	Total 2020–2024
Assessments conducted	26	11	30	76	10	153
Completed projects	16	10	19	52	3	100
Units/devices upgraded	80	73	161	119	27	460
Estimated gallons saved	340,485	198,120	382,200	404,898	104,460	**1,431,163**



4. Initiate industrial rebate program

Goal: save 1,000,000 gallons per year

We explored a potential cooling tower rebate program but based on the low number of customers, and the technical expertise and administrative overhead that such a program would require, we did not pursue an industrial rebate program during this reporting period. Technology, development, and advancements in this field may make this a worthwhile program to pursue in the future.

5. High water use notification program

With the installation of smart meters, the City's water department is able to use the data points provided to detect higher-than-normal water consumption, which usually indicates a leak. The water division runs regular reports to check for high consumption and potential leakage. Using month-to-month comparative data, customers with unusually high-water usage are notified either by letter or phone call, depending on the severity of the use. Customers are provided with information on identifying leaks, making repairs, and implementing water saving methods.

6. Create a plan to work with highest summer water users to reduce consumption

Irrigation systems have ample opportunities to waste water therefore ample opportunities to implement water conservation practices.

We published an Irrigation System Best Management Practices guide that outlines 13 best management practices to help improve the functionality of an irrigation system and conserve water at the same time.

7. Evaluate the option of switching to monthly billing

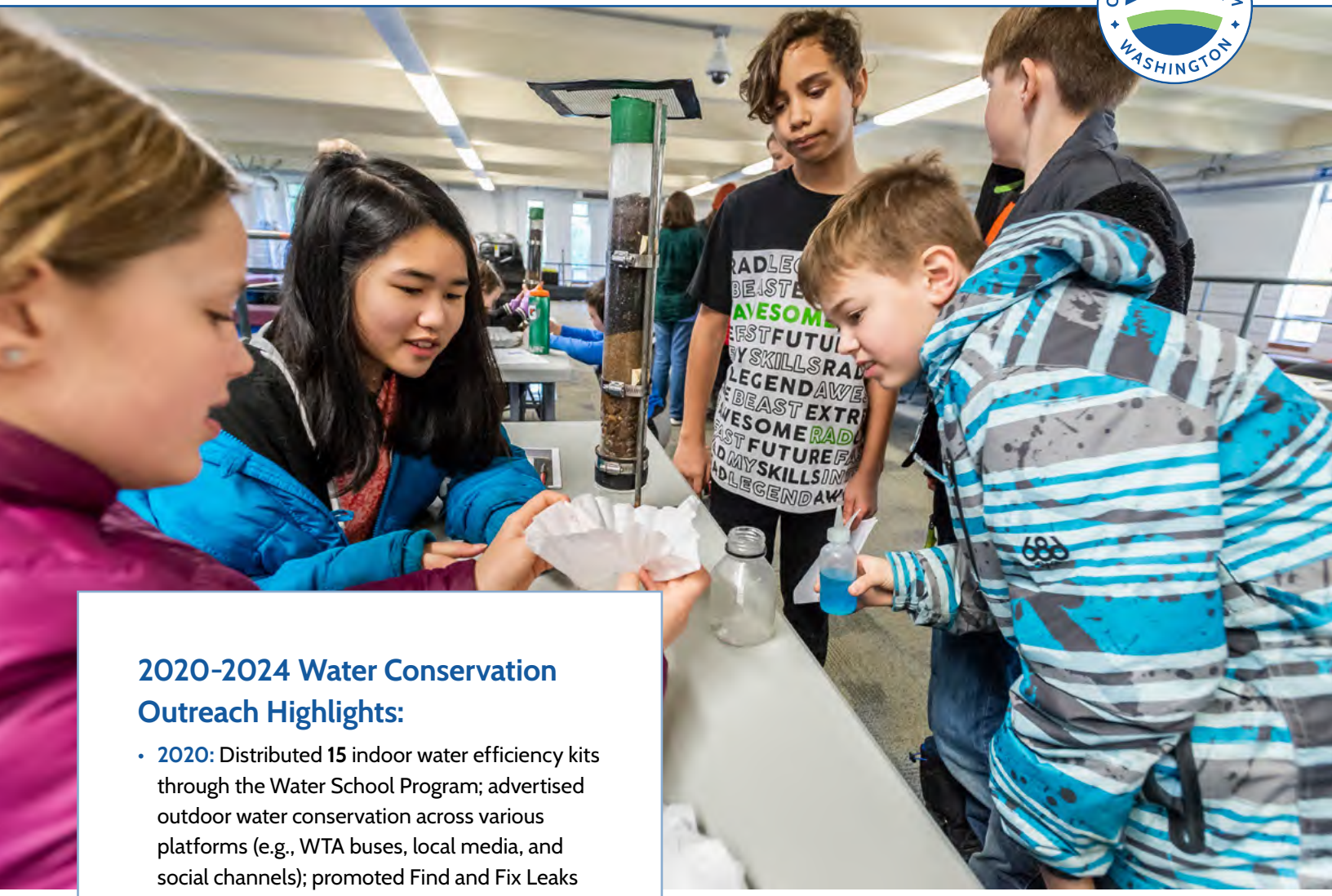
This work is completed. The transition to monthly billing began at the end of 2021 with all accounts fully transitioned to monthly billing in early 2022.

8. Adjust water billing rates to promote conservation

This work is ongoing and will incorporate data from the forthcoming Water System Plan.

9. Continue community education and engagement programs

We continued our robust community education efforts to promote water conservation and increase awareness and understanding. These consistent, multi-year efforts have actively engaged the community and distributed essential tools to promote sustainable water use.



2020-2024 Water Conservation Outreach Highlights:

- **2020:** Distributed **15** indoor water efficiency kits through the Water School Program; advertised outdoor water conservation across various platforms (e.g., WTA buses, local media, and social channels); promoted Find and Fix Leaks campaign and Water Week; distributed **20** outdoor conservation kits to pledge participants.
- **2021:** Received **62** outdoor water conservation pledges; provided **130** water-saving devices (e.g., moisture meters, hose timers, and repair kits); continued advertising Water Week and outdoor conservation.
- **2022:** Outdoor conservation outreach resulted in **60** pledges and **76** distributed water-saving devices.
- **2023:** Continued outdoor water conservation advertising.
- **2024:** Hosted outdoor conservation tables at the Bellingham Farmers Market, securing **112** pledges and distributing **221** water-saving devices; promoted summer voluntary watering and Manage Weeds Naturally programs.

Water School is the City of Bellingham's outreach program to fifth grade students. During Water School, students study the relationship between human activity and the City's water system with two classroom visits and a field trip to the Water Treatment Plant that incorporates a student-designed filtration project. Educators lead students through a variety of hands-on learning experiences focusing on three large, water-related issues: watersheds, the progression of water in the City water system, and stormwater pollution. From 2019 until 2024, 4,360 students and 666 adult chaperones and teachers have participated in Water School.

Voluntary Summer Watering Schedule: Every summer, we encourage reduced lawn watering or stopping entirely during warmer months, aligned with street addresses.

2025-2035 Work Plan

2025-2035 Goal: Keep consumption below 154 gallons per day per single-family residential account.

This goal most closely reflects the City's predicted future consumption, based on demand projections, projected growth rates, and historical consumption.

Single-Family Consumption Rates 2018–2022	2018	2019	2020	2021	2022
Number of single-family residential connections	21,648	21,964	21,983	22,102	22,269
Total consumption in gallons	1,226,427,532	1,185,598,700	1,232,414,524	1,241,992,664	1,234,466,288
Average annual consumption per service in gallons	56,653	53,979	56,062	56,194	55,434
Average consumption per month in gallons	4,721	4,498	4,672	4,683	4,620
Average consumption in gallons per day	155	148	154	154	152

1. Continue single-family residential rebate program

The single-family residential rebate program will continue. Water assessments will continue to be provided by a reputable local contractor to verify eligibility for rebates.

Estimated savings: 750,000 gallons per year

Estimated budget: $30,000

Implementation Schedule: On-going

2. Continue multi-family residential rebate program

The multi-family residential rebate program will continue. Water assessments will continue to be provided by a reputable local contractor to verify eligibility for rebates and complete direct installs of faucet aerators, showerheads, and spray nozzles.

Estimate savings: 750,000 gallons per year

Estimated budget: $30,000

Implementation Schedule: On-going

3. Continue commercial and institutional rebate and direct install program

The commercial and institutional rebate program will continue. Water assessments will continue to be provided by a reputable local contractor to verify eligibility for rebates and complete direct installs of faucet aerators, showerheads, and spray nozzles.

Estimated savings: 2,000,000 gallons per year

Estimated budget: $30,000

Implementation Schedule: On-going

4. Continue high-water use notification program

During the 2025-2035 program period, the Water Distribution Division will explore ways to estimate the amount of water savings incurred annually through the high-water use notification program.

Estimated savings: unknown

Estimated budget: unknown

Implementation schedule: Tracking and reporting process in place by 2027

5. Evaluate water billing rates to promote conservation

Customers are currently charged a flat rate for service, plus a volume fee for each unit of water used. A new Water System Plan will be adopted in 2025 and this rate structure will be evaluated and adjustments will be made in order to promote water conservation.

6. Continue direct-install toilet and fixtures program for low-income households

A direct-install program was initiated in 2024, providing assessment and installation of water-saving fixtures to income-qualifying households. This work will continue to be provided by a reputable local contractor.

Estimated savings: 100,000 gallons per year

Estimated budget: $45,000

Implementation schedule: On-going

7. Continue community education and engagement programs

To continue the focus on indoor and outdoor water conservation, current education and outreach programs will continue, including water-saving device giveaways.

- Continue to work with local schools to provide water conservation education.
- Outdoor water conservation education, including tabling at community events.
- Water-saving device giveaways to City water customers are a popular way to engage our community members and educate them about water-saving measures they can take at home. We will continue to give away low-cost devices to City water customers, including hose timers, repair kits, moisture meters, rain gauges, hose nozzles, faucet aerators, and low-flow showerheads.
- Use the City's new utility billing software to help educate customers about water conservation.
- Additional customer education opportunities, including advertising (bus ads, bill inserts, print media, Pickford Film Center ads, etc).

8. Explore updates to the City's development code for irrigation systems and required fixture counts

There may be an opportunity to update the City's development code requirements to reduce the size of the water service required and update our irrigation standards with water conservation in mind. These options will be explored over the next five years.

9. Evaluate and reduce water consumption in the City's Operating and Maintenance procedures

The Water Distribution Division of Public Works continues to efficiently and effectively maintain the flow of water to our customers. Practices such as the annual flushing program will continue to improve over time and can lead to reduced water consumption. For example, in 2024, 10,966,400 gallons of water were used in the annual flushing program. Staff will work to reduce this amount through improved processes and staff training.



Appendix 1. Public Engagement Process and Comments

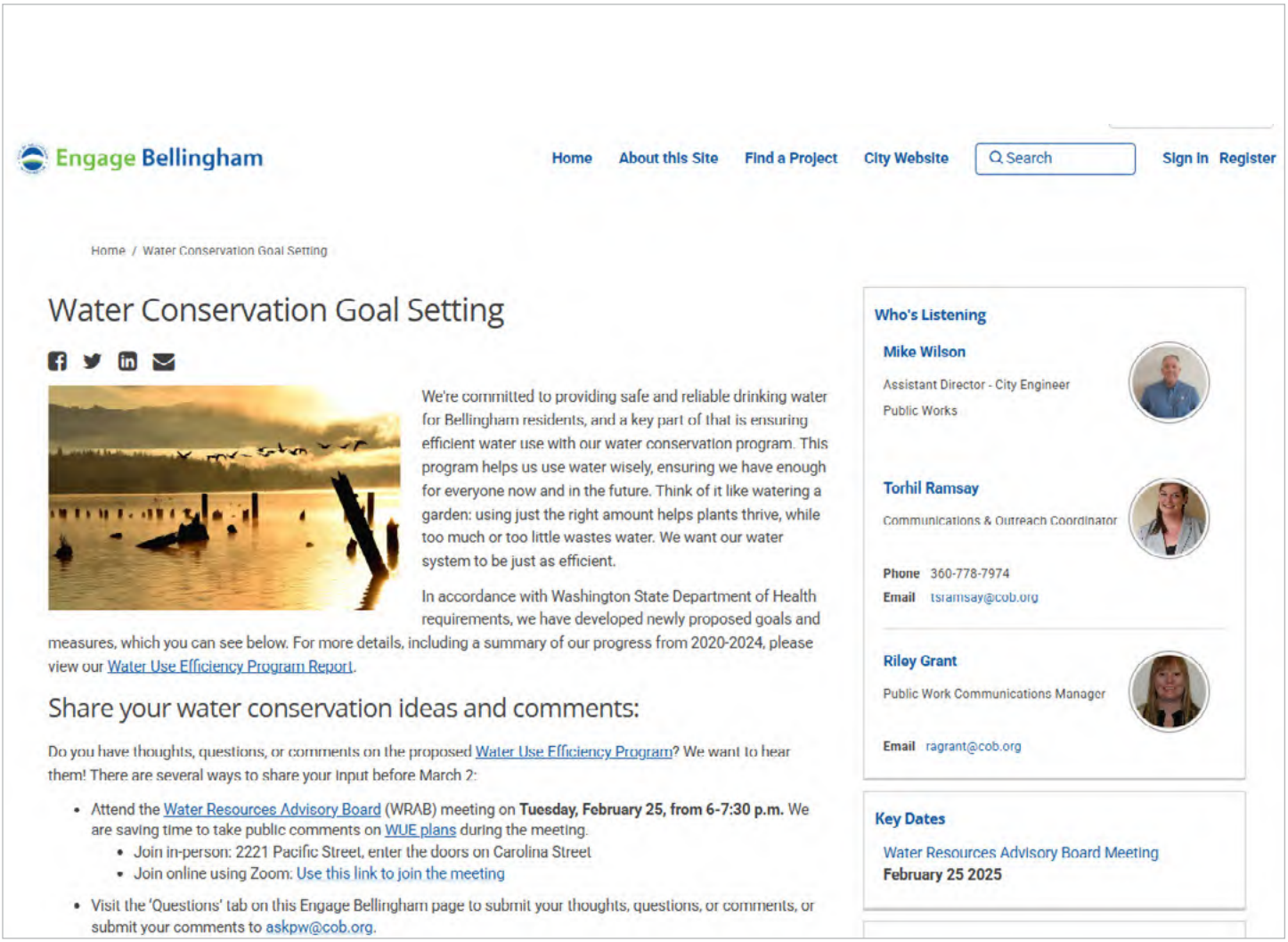
The 2025-2035 Water Use Efficiency Program report was published and shared with our community on February 21, 2025, along with an invitation to review and comment on the proposed goal and measures on the City's Engage Bellingham page and attend the upcoming Water Resources Advisory Board (WRAB) meeting. This information was also posted on the City's social media pages and shared in our weekly Friday news release. Public comment was received through March 2, 2025.

On February 25, 2025, the City presented the 2025-2035 Water Use Efficiency Program report to the Water Resources Advisory Board (WRAB) and held a public forum for the new water use efficiency goal and measures. The meeting was held both in person and via zoom to allow for multiple avenues for the community to provide feedback and comment on the City's proposed goal and measures.

No public comment was received at the WRAB meeting. On the next page is a summary of other comments received through the City's Engage Bellingham website.

Members of the WRAB reviewed the plan, offered feedback and requested some clarification on the report, but made no substantive changes to the goal or measures. The WRAB unanimously approved a resolution (WRAB Res. 2025-01) recommending adoption of the 2025-2035 Water Use Efficiency Program.

Engage Bellingham website



Responses to public comments:

Public Comment	Staff Response	Action
Comment in reference to Proposed Goal. I like this idea of a quantitative goal and suggest that this goal be reduced year by year to encourage greater water-use efficiency. What is average household consumption currently? More or less than 154 gpd?	The goal of keeping consumption below 154 gallons per day per single-family residential account is based on careful projections of our future water demand, considering growth, use patterns, and aligns with our Water System Plan. Consumption has dropped in recent years, with consumption in 2022 averaging 152 gallons per day per single family residential account. We believe this goal sets a responsible and achievable goal, balancing conservation and meeting the needs of our growing community.	Information provided.
Comment in reference to Proposed Measure 4. I am frugal with water but my usage jumped up to 20 CCF per month due to an underground water leak. No one notified me but I noticed it on the bill. I called the city water department for advice and they offered nothing at all. It took months before I learned that there are specialized leak detection services. Specialized equipment is needed to find deep underground leaks. It's much cheaper than digging up the whole line or replacing it. The only semi-local provider being American Leak Detect, based in Seattle, who found the leak for me. The city should help people connect with this service.	Our water distribution division regularly reviews water usage and reaches out to customers when unusual usage or spikes occur. We are limited in recommendations we can make regarding a residence's private water service, but we will continue to review and refine our processes, outreach, and materials that we are able to provide.	We will continue to refine and improve our notification and tracking processes through this program period.
Comment in reference to Proposed Measure 4. This is a great idea - focus on those few customers who use the most water. I'm eager to hear how well this program works. Also, I'm curious whether high users have leaks or other problems with their plumbing or use a lot of water. If the latter, is it because they have lots of people in their household?	Our water distribution division will work on implementing better tracking and reporting processes over the course of this plan period. This will enable us to determine how and where leaks may be occurring, when might be causing them, and how to proactively fix leaks, and/or provide further education on how to conserve water.	We will continue to refine and improve our notification and tracking processes through this program period.
Comment in reference to Proposed Measure 5. Because economics matter so much to most of us, I urge the City to carefully study and consider an inclining-block rate structure, in which the more you use the more you pay per ccf. And rates should be much higher during the summer months than the rest of the year to reflect the scarcity of water in the summer. Any "excess" revenue so generated could be used for a variety of water projects, including additional land purchases in the Lake Whatcom watershed.	Water rates and structures will be carefully reviewed with the upcoming Water System Plan update. There is a dedicated fund that is restricted to acquiring property in the watershed.	Information provided.
Comment in reference to Proposed Measure 8. It is surely much more cost effective to require efficiency measures in new construction than in retrofits. So this is an excellent idea.	This comment is made in response to exploring updates to the City's development code for irrigation systems and required fixture counts. There may be an opportunity to reduce development costs while also encouraging conservation. This will be evaluated within the plan period.	Information provided.
Comment in reference to water conservation in general. I take a bath every day and could use the water to water plants if I could divert the water. We could save water in barrels when it rains and use it later. Replace lawns with vegetable gardens, use drip irrigation The Japanese reuse water from washing their hands to flush the toilet.	These are all great ideas to help conserve water! Every effort counts. We offer a number of tips and resources to help identify different ways to save water on our website at cob.org/conservation, including a native plant guide, irrigation best management practices, rainwater harvesting and more. We appreciate you sharing your ideas and doing your part to conserve resources. Information provided.	Information provided.

City social media post, 2/24/2025



City news release, 2/21/2025

Feedback invited for water conservation program

Help us shape our water use efficiency goals! We invite the community to review and comment on our proposed water use efficiency goal and measures to promote water conservation. All public water systems in Washington State are required to use a public process to adopt their water use efficiency goals. The proposed goal and measures are posted on Engage Bellingham and there is an opportunity to provide public comment during the upcoming Water Resources Advisory Board meeting on February 25, 6 p.m. at the Pacific Street Operations Center, 2221 Pacific Street. This is your chance to provide feedback on conservation efforts and future initiatives. Join the discussion and help ensure a smart and sustainable water future for our community. Comments and questions will be collected through Sunday, March 2.

APPENDIX M

RECORD OF PUBLIC ENGAGEMENT AND COMMENT

Responses to public comments:

Public Comment	Staff Response	Action
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City social media post, 2/24/2025



City news release, 2/21/2025

Feedback invited for water conservation program

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APPENDIX N

GRAVITY FLOW METER ASSESSEMENT

Jacobs

Memorandum

1100 112th Avenue NE, Suite 500
Bellevue, Washington 98004-5118
United StatesT +1.425.453.5000

www.jacobs.com

Subject	City of Bellingham Gravity Flow Meter Assessment
Attention	Steve Bradshaw
From	Joshua Kennedy, Phil Martinez
Date	October 2, 2020

The City of Bellingham (City) has a finished water reservoir, Whatcom Falls Reservoir II (also known as the CT Reservoir), that supplies the entire water system with potable water from the water treatment plant (WTP). A flow meter is located in the CT Reservoir outlet pipe that measures the flow to the distribution system and is known as the 'Gravity Flow Meter'. We understand that in recent years, flows measured by this flow meter are lower on average than the flows being measured at the service meters within the distribution system. In other words, the distribution system is currently seeing more flow being used by customers than is being put into the system overall.

It is possible that the Gravity Flow Meter is not measuring correctly, or it is possible that the service meters in the distribution system are the culprit. The City asked Jacobs to provide recommendations to determine the cause of this discrepancy.

Background

The CT Reservoir has a 60-inch steel outlet pipeline with a reduction to 48-inch steel pipe where the insertion-style flow meter is located. The flow meter is an FPI-Mag by McCrometer and uses electromagnetic induction to detect velocity through the meter.

The meter was installed in 2016 by Bainbridge Associates, the McCrometer sales representative located in Camas, WA. We recently had a conversation with them, and Bainbridge and associates noted that during previous work on this insertion mag meter, they found air in the pipeline which may have caused inaccurate flow meter readings. From our perspective, this seems unlikely due to the location of the meter and the fact that it is conveying water that is coming from a large reservoir. That stated, air pockets are known to cause inaccurate readings with mag meters so this warrants further investigation.

Data Analysis

The Gravity Flow Meter data is logged by SCADA continuously and stored in Wonderware Historian software. Readings from this flow meter were provided to Jacobs by the City for June 29 to September 28, 2020 to determine what the issues might be. The data showed flows between 3.4 and 16.2 mgd which correspond to velocities of 0.4 to 2.0 ft/s. A percentile graph showing the percentage of values exceeding a specific flow/velocity is shown in Figure 1. As evident from the figure, 22% of the readings were below

1 ft/s and 100% of the readings were below 2 ft/s. The typical recommended range is from 2 to 20 ft/s, though accurate readings below 2 ft/s are possible.

It is evident from the data that the Gravity Flow Meter is measuring flows at the low end of its recommended range. Consequently, poor accuracy and under-counting appear to be potential culprits to be assessed as a first order of business. Additional data should be gathered to confirm that lower-than-desirable velocity is the cause of the meter inaccuracies and under-counting.

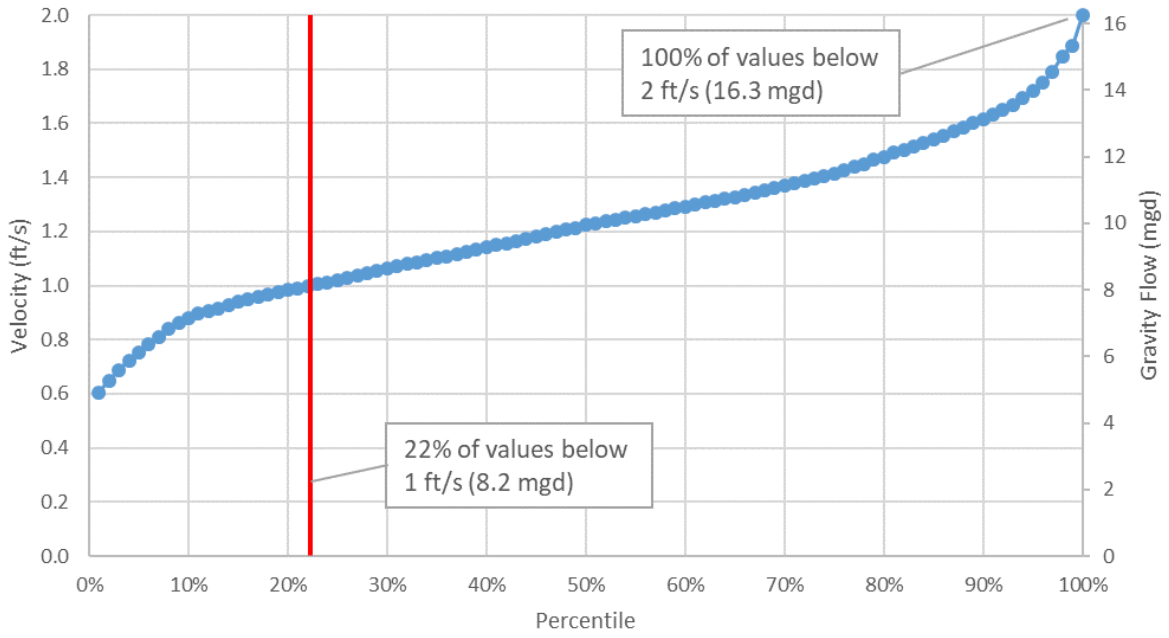


Figure 1. CT ReservoirOutlet Gravity Flow and Velocity

The average diurnal flow pattern for this 3-month data set are shown in Figure 2. The highest (peak) flows occur between 6 AM to 9 PM and the lowest (off-peak) flows occur between 9 PM and 6 AM.

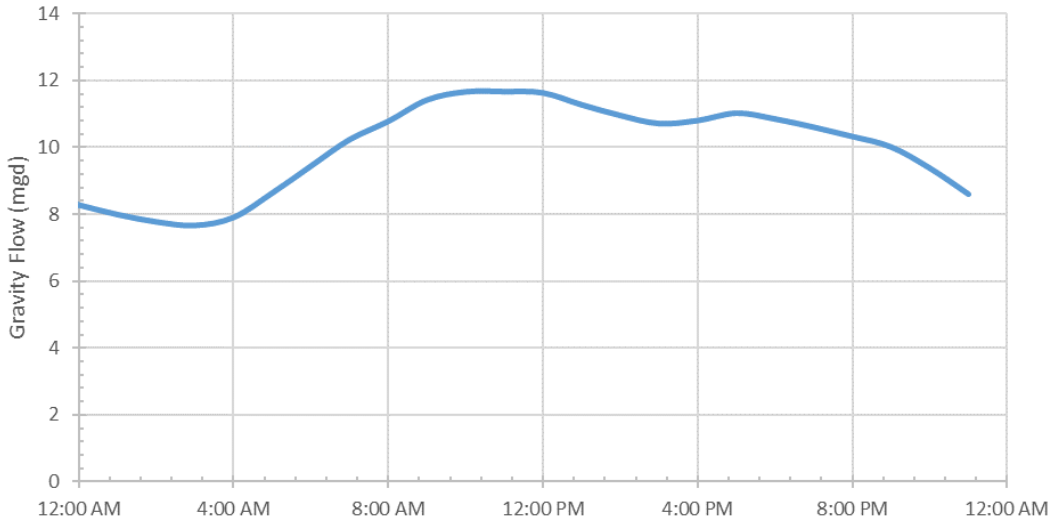


Figure 2. Gravity Flow Meter Diurnal Flow Patterns

Recommendations

The following tasks are recommended to identify what the issue is:

1. Remove the insertion mag meter, perform a visual inspection, and clean the outside of the meter and electrode elements.

2. Inspect the installed location to determine if there is air in the pipeline. As stated above, Bainbridge Associates noted that they had seen air accumulate at this location in the past prior to installation of this meter. While this seems unlikely, as stated above, some effort should be undertaken to assess the presence of trapped air..

3. Perform a volumetric test of the flow meter to determine the accuracy of the meter.

It is recommended that the cleaning and check for air be performed prior to the volumetric test. The volumetric test will provide verified flow values which can be compared to the flow meter readings to give a real sense of the accuracy. It is recommended that a volumetric test be performed during peak hours (6 am to 8 pm) and off-peak hours (8 pm to 6 am). If possible, the test should have a duration of 24 hours to span the diurnal flow cycle.

A volumetric test should be performed as followed:

- Fill the CT Reservoir.

- Shutdown the WTP.

- Isolate the CT Reservoir by closing the CT Reservoir influent valve located just downstream of the CT Influent Flow Meter.

- Monitor the drop in the CT Reservoir level over a period of time to determine the flowrate out of the CT Reservoir volumetrically. Note that each foot of CT Reservoir level corresponds to 800,000 gallons of storage.

- Compare the volumetrically-derived flowrate to actual flow meter readings over the same time period and assess the meter accuracy. Do this twice over the night-time lower-flow period (12midnight to 5am) and twice over the daytime higher-flow period (9am to 2pm) for roughly 5 hours each. Alternatively, this could be done over a 24 hour period as long as reservoir level data and totalizer data is collected consistently over the time period. In either case, a testing protocol should be developed that works for WTP staff.

After comparing the volumetric test results with the actual meter data, assess the path forward and the potential options.

APPENDIX O

WATER RIGHTS CERTIFICATES

State of Washington
Department of Ecology

Water Right Claims Registration

Water Right Claim

Name EDWIN W JOHNSON

Address 4292 KINGMT. RD.

BELLINGHAM Zip Code 98225 Phone No. 734-3222

1) Source from which the right to take and make use of water is claimed: ☐ Surface Water ☒ Ground Water

If surface water, please indicate source; give name if known:

_____

(River, stream, lake, pond, spring, etc.)

2) Purpose(s) for which water is used:

☒ Domestic ☐ Stockwatering ☐ Irrigation (lawn and garden) ☐ Other Use (specify) _____

3) Legal description of lands on which water is used: S 10 AC S.E N.W. SEC 8 T-38 R 3 E ALSO THAT PART of LOT A BLK 61 A BAKERVIEW ADD LYING E of S.D. T R N BEING PROLONGATION of N LINE SAID N½ S½ S½ S.E N.W. EXTENDED W. ACROSS SAID LOT A AND S LINE BEING 166.7 FT N. PAR of S LINE of SAID BLK 61 A

If located within the limits of a recorded platted property:

Lot _____ Block _____ of _____
(Give name of plat or addition)

In addition, please indicate Sec. 8 T. 38 N. R. 3 (E) W. W.M.

County in which lands are located WHATCOM

DO NOT USE THIS SPACE

The filing of a statement of claim does not constitute an adjudication of any claim to the right to use of waters as between the water use claimant and the state or as between one or more use claimants and another or others. This acknowledgment constitutes receipt for the filing fee.

Date Registered

This has been assigned Water Right Claim Registry No.

MAR 10 75 13 3062

Director, Department of Ecology

I hereby swear that the above information is true and accurate to the best of my knowledge and belief.

X Edwin W Johnson

Date 6/25/1974

If claim filed by designated representative print or type full name and mailing address of agent below.

_____

_____

☐ Additional information relating to water quality and/or well construction is available.

A FEE OF $200 MUST ACCOMPANY THIS WATER-RIGHT CLAIM

ORIGINAL DOE

Return all three copies with carbons intact, along with your fee to:
Department of Ecology, Water Right Claims Registration, Olympia, Washington 98504

RECEIVED
OCT 15 1997
Public Works-Operations

1508515

CERTIFICATE OF CHANGE
TO CHANGE THE PURPOSE OF USE OF SURFACE WATERS

THIS IS TO CERTIFY THAT the City of Bellingham has complied with the requirements of the Revised Code of Washington, 90.03.280 and 90.03.380, and is hereby granted a change of purpose of use of surface waters as previously granted in Surface Water Right Certificate S1-00547C, recorded in Whatcom County.

That the previous purpose of use was recorded as: municipal supply, industrial and domestic supply - continuously.

1508515

That the purpose of use is changed and will be recorded as: Municipal supply, industrial and domestic supply -continuously. Power generation - only when water is being transported in the pipeline for the purposes of municipal supply, industrial and domestic supply.

That the instantaneous quantity, source and place of use will remain unchanged and are: 125 cfs, Middle Fork Nooksack River and area served by City of Bellingham.

Given under my hand and seal of this office, Department of Ecology, Northwest Region, this 4th day of June, 1985.

Department of Ecology
Andrea Beatty Riniker

by Joan K. Thomas
Joan K. Thomas
Northwest Regional Manager

RECORDED:

Certificate of Change
Vol. 1, page 55

O.K.

RECORDED
STATE OF WASHINGTON
JUN 6 2 40 PM '85
REQUEST OF
WHATCOM COUNTY

215 471

1171752

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

CERTIFICATE OF WATER RIGHT

☒ *Surface Water* (issued in accordance with the provisions of Chapter 117, Laws of Washington for 1917, and amendments thereto, and the rules and regulations of the Department of Ecology)

☐ *Ground Water* (issued in accordance with the provisions of Chapter 263, Laws of Washington for 1945, and amendments thereto, and the rules and regulations of the Department of Ecology)

CERTIFICATE NUMBER	PERMIT NUMBER	APPLICATION NUMBER	PRIORITY DATE
S1-00547C	9855	13150	October 6, 1954

01025

NAME: CITY OF BELLINGHAM

ADDRESS (STREET): 210 Lottie Street | (CITY): Bellingham | (STATE): Washington | (ZIP CODE): 98225

This is to certify that the herein named applicant has made proof to the satisfaction of the Department of Ecology of a right to the use of the public waters of the State of Washington as herein defined, and under and specifically subject to the provisions contained in the Permit issued by the Department of Ecology, and that said right to the use of said waters has been perfected in accordance with the laws of the State of Washington, and is hereby confirmed by the Department of Ecology and entered of record as shown.

PUBLIC WATER TO BE APPROPRIATED

SOURCE: Middle Fork Nooksack River

TRIBUTARY OF (IF SURFACE WATERS): Nooksack River

MAXIMUM CUBIC FEET PER SECOND	MAXIMUM GALLONS PER MINUTE	MAXIMUM ACRE-FEET PER YEAR
125.0		

QUANTITY, TYPE OF USE, PERIOD OF USE: Municipal supply, industrial and domestic supply - continuously

LOCATION OF DIVERSION/WITHDRAWAL

APPROXIMATE LOCATION OF DIVERSION/WITHDRAWAL: South 48° West at distance of 1800 feet from Northeast corner of Sec. 19

LOCATED WITHIN (SMALLEST LEGAL SUBDIVISION)	SECTION	TOWNSHIP N.	RANGE, E. OR W. W.M.	W.R.I.A.	COUNTY
NE¼	19	38	6 E.	1	Whatcom

RECORDED PLATTED PROPERTY

LOT	BLOCK	OF (GIVE NAME OF PLAT OR ADDITION)

LEGAL DESCRIPTION OF PROPERTY WATER TO BE USED ON

Area served by City of Bellingham.

VOL 233 PAGE 216

CERTIFICATE

PROVISIONS

1171752

Nothing in this permit shall be construed as excusing the permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations including those administered by local agencies under the Shoreline Management Act of 1971.

It is further provided that the diversion shall cease when the flow of the Middle Fork of the Nooksack River falls to between 10 and 15 c.f.s. (The exact figure to be determined by study.) in the immediate vicinity of the diversion and the diversion intake shall be screened in a manner which is mutually acceptable to the Departments of Fisheries and Game and the City of Bellingham.

The right to the use of the water aforesaid hereby confirmed is restricted to the lands or place of use herein described, except as provided in RCW 90.03.380, 90.03.390, and 90.44.020.

This certificate of water right is specifically subject to relinquishment for nonuse of water as provided in RCW 90.14.180.

Given under my hand and the seal of this office at Olympia, Washington, this 15th *day of* September *19*74.

JOHN A. BIGGS, *Director*
Department of Ecology

by K. JERRY BOLLEN, Assistant Director

ENGINEERING DATA
OK DKK

FOR COUNTY USE ONLY

1974 SEP 19 AM 11:09

RECORDED

1171752

VOL 233 PAGE 217

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STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
WATER RIGHT CLAIMS REGISTRATION

WATER RIGHT CLAIM

RECEIVED
DEPARTMENT OF ECOLOGY
JUN 12 1974
CASH OTHER NONE

1. NAME City of Bellingham
ADDRESS 210 Lottie Street
Bellingham, Wash. ZIP CODE 98225 PHONE NO. 676-6961

2. SOURCE FROM WHICH THE RIGHT TO TAKE AND MAKE USE OF WATER IS CLAIMED: Surface (SURFACE OR GROUND WATER)
Lake Whatcom W.R.I.A. 01 (LEAVE BLANK)

A. IF GROUND WATER, THE SOURCE IS

B. IF SURFACE WATER, THE SOURCE IS Lake Whatcom

3. THE QUANTITIES OF WATER AND TIMES OF USE CLAIMED:

A. QUANTITY OF WATER CLAIMED: 82 MGD (CUBIC FEET PER SECOND OR GALLONS PER MINUTE) PRESENTLY USED 25 MGD Dom. 57 MGD Ind.

B. ANNUAL QUANTITY CLAIMED 92,000 acre feet (ACRE FEET PER YEAR) PRESENTLY USED 70,730 acre feet

C. IF FOR IRRIGATION, ACRES CLAIMED --- PRESENTLY IRRIGATED --

D. TIME(S) DURING EACH YEAR WHEN WATER IS USED: Continuously

4. DATE OF FIRST PUTTING WATER TO USE: MONTH April + YEAR 1883 - Whatcom 1894 - New Wha

5. LOCATION OF THE POINT(S) OF DIVERSION/WITHDRAWAL 990 FEET North AND 570 FEET East FROM THE Southwest CORNER OF SECTION 26

BEING WITHIN W 1/2 of SE 1/4 of SW 1/4 OF SECTION 26 T. 38 N., R. 3E (E.orW.) W.M.

IF THIS IS WITHIN THE LIMITS OF A RECORDED PLATTED PROPERTY, LOT BLOCK OF
(GIVE NAME OF PLAT OR ADDITION)

6. LEGAL DESCRIPTION OF LANDS ON WHICH THE WATER IS USED: Corporate City of Bellingham and contiguous areas

COUNTY Whatcom

7. PURPOSE(S) FOR WHICH WATER IS USED: Domestic and Industrial

8. THE LEGAL DOCTRINE(S) UPON WHICH THE RIGHT OF CLAIM IS BASED: Appropriation

DO NOT USE THIS SPACE
THE FILING OF A STATEMENT OF CLAIM DOES NOT CONSTITUTE AN ADJUDICATION OF ANY CLAIM TO THE RIGHT TO USE OF WATERS AS BETWEEN THE WATER USE CLAIMANT AND THE STATE OR AS BETWEEN ONE OR MORE WATER USE CLAIMANTS AND ANOTHER OR OTHERS. THIS ACKNOWLEDGEMENT CONSTITUTES RECEIPT FOR THE FILING FEE.
DATE RETURNED THIS HAS BEEN ASSIGNED WATER RIGHT CLAIM REGISTRY NO.
1375-46016
DIRECTOR - DEPARTMENT OF ECOLOGY

I HEREBY SWEAR THAT THE ABOVE INFORMATION IS TRUE AND ACCURATE TO THE BEST OF MY KNOWLEDGE AND BELIEF
X Theron L. Martin
DATE June 10, 1974
IF CLAIM FILED BY DESIGNATED REPRESENTATIVE, PRINT OR TYPE FULL NAME AND MAILING ADDRESS OF AGENT BELOW.
Theron L. Martin
210 Lottie Street
Bellingham, Wash. 98225
☐ ADDITIONAL INFORMATION RELATING TO WATER QUALITY AND/OR WELL CONSTRUCTION IS AVAILABLE.

A FEE OF $2.00 MUST ACCOMPANY THIS WATER RIGHT CLAIM

RETURN ALL THREE COPIES WITH CARBONS INTACT, ALONG WITH YOUR FEE TO:
DEPARTMENT OF ECOLOGY
WATER RIGHT CLAIMS REGISTRATION
OLYMPIA, WASHINGTON 98504

ORIGINAL DNR

Printed by ViewDirector ActiveX 2.0 Demo using ViewDirector Version 4.110b.

S. P. No. 349—1939—3M. 12806.

CERTIFICATE RECORD No. 5, PAGE No. 2020

STATE OF WASHINGTON, COUNTY OF Whatcom

MICROFILMED

CERTIFICATE OF WATER RIGHT

(For rights perfected under original, enlargement or secondary permits.)
(In accordance with the provisions of Chapter 117, Laws of Washington for 1917, and the regulations of the State Supervisor of Hydraulics thereunder.)

This is to certify, that City of Bellingham

of Bellingham, *State of* Washington, *has made proof to the satisfaction of the State Supervisor of Hydraulics of Washington, of a right to the use of the waters of* Lake Whatcom, *a tributary of* ,

for the purposes of Storage of water for domestic, industrial and power use

under Reservoir *Permit No.* 121 *issued by the State Supervisor of Hydraulics, and that said right to the use of said waters has been perfected in accordance with the laws of Washington, and is hereby confirmed by the State Supervisor of Hydraulics of Washington and entered of record in Volume* 5, *at Page* 2020, *on the* 24th *day of* May, 19 41, *that the right hereby confirmed dates from* March 9, 1937; *that the amount of water to which such right is entitled and hereby confirmed, for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed* 20,000 acre-feet

A description of the lands under such right to which the water hereby confirmed is appurtenant, and the place where such water is put to beneficial use, is as follows:

PLACE OF USE			LEGAL SUBDIVISION	FOR IRRIGATION	
Section	Township	Range		No. Acres Described in Permit	No. Acres Actually Irrigated

LOCATION OF POWER PLANT			LEGAL SUBDIVISION	FOR POWER	
Section	Township	Range		H. P. Described in Permit	H. P. Actually Developed

Location of Impounding Dam:

Section	Township	Range	LEGAL SUBDIVISION	FOR OTHER USES
28	38 N.	3 E.W.M.	E½ of NE¼	Storage of water for Domestic, industrial and power purposes.

The right to the use of the water aforesaid hereby confirmed is restricted to the lands or place of use herein described, except as provided in Section 39, Chapter 117, Session Laws 1917.

WITNESS the seal and signature of the State Supervisor of Hydraulics affixed this 24th day of May, 19 41.

Chas. J. Carhart
State Supervisor of Hydraulics.

ENGINEERING DIV.
O.K. 70

#70

APPENDIX P

HYDRAULIC MODEL DEVELOPMENT AND CALIBRATION TECHNICAL MEMORANDUM

Water System Plan



TECHNICAL MEMORANDUM 1

Hydraulic Model Development and Calibration

DRAFT / January 2025

Water System Plan

TECHNICAL MEMORANDUM 1

Hydraulic Model Development and Calibration

DRAFT / January 2025

This document is released for the purpose of information exchange review and planning only under the authority of Edward A. Wicklein, January 27, 2025, State of Washington PE No. 43049.

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Abbreviations

ADD	average day demand
AMI	Advanced Meter Infrastructure
AWWA	American Water Works Association
City	City of Bellingham
EPS	Extended Period Simulation
GIS	geographic information system
gpm	gallons per minute
HGL	hydraulic grade line
ID	identification
MDD	maximum day demand
Plan	Water System Plan
PRV	pressure reducing valve
PS	pump station
psi	pound per square inch
SCADA	supervisory control and data acquisition
TM	technical memorandum

TM 1 HYDRAULIC MODEL DEVELOPMENT AND CALIBRATION

1.1 Introduction

As part of the City of Bellingham's (City) Water System Plan (Plan), a new hydraulic computer model was developed of its water distribution system to represent current conditions. The City's model was created from scratch using the latest system information provided by the City. The new hydraulic model was developed in the Autodesk InfoWater Pro platform.

This technical memorandum (TM) documents the development of the all-pipes hydraulic model. This includes documenting the creation of the system geometric network based on the latest geographic information system (GIS) data, calculation and allocation of the existing demands using Advanced Meter Infrastructure (AMI) water metering and billing data. Diurnal patterns were developed to account for daily fluctuations in water demand. This TM also documents the calibration for flows and pressures of the hydraulic model, which included Extended Period Simulation (EPS) calibration from system operating data and steady state calibration from fire flow testing. The calibrated model will serve as a tool for system planning and operational analyses.

1.2 Hydraulic Model Development

This section summarizes the step-by-step process used to create the City's new hydraulic model in Autodesk's InfoWater Pro.

- The first step consisted of an initial review of the City's GIS database to identify any connectivity issues that needed to be addressed and what additional information would be needed (Section 1.2.2).
- After the initial GIS review was completed with the City, and the connectivity issues were addressed, the updated GIS data was imported into the hydraulic model (Section 1.2.3).
- Next, the physical and operational characteristics for each model element type, including pipes, pumps, tanks, and valves, were reviewed and updated as needed. The 2013 Water System Operations Manual served as the basis for pump operations in the model. (Section 1.2.3).
- Finally, model demands were calculated using AMI and totalized consumption data, which were then spatially allocated to model junctions (Section 1.3).

1.2.1 Hydraulic Modeling Software

Autodesk's InfoWater Pro was the software used to develop the City's hydraulic model. InfoWater Pro was originally developed by Innovyze. Recently, Innovyze was acquired by AutoDesk, and its services were updated. Innovyze offers InfoWater Pro as its main water system modeling package, which was developed by MWSoft (later becoming Innovyze) through a progression of software packages, H_2ONET, H2OMAP Water, and InfoWater.

InfoWater Pro is used within ESRI's ArcGIS Pro platform. The software combines a dynamic point-and-click interface for network construction and database management with the EPANET engine. With EPANET, users can perform EPS' of the hydraulics within pressurized pipe networks, which consist of pipes, nodes, pumps, valves, storage tanks, and reservoirs. It can be used to track the flow of water in each pipe, the pressure at each node, and the height of the water in each tank.

1.2.2 Pipe Connectivity Review

One of the initial steps in building the hydraulic model involved a detailed review of the City's water system GIS database to improve GIS accuracy to ensure a 1:1 relationship between the GIS and the model pipe setup. The GIS review included the following pipe network connectivity checks:

- Duplicate pipes.
- Duplicate pipe identifications (ID).
- Disconnected pipes from the network:
  - Pipe split candidates.
  - Reconnected pipes.

The connectivity issues discovered were addressed by the City prior to the final import into the model.

1.2.3 GIS to Hydraulic Model Mapping

After the initial review of the connectivity issues, the City provided an updated pipe GIS shapefile. This shapefile, along with other GIS information, was used to develop the hydraulic model. The model includes all finished water pipes, pumping and storage facilities, and pressure reducing valves (PRV). Table 1.1 presents a summary count of the different types of model elements that were imported into the model. Relevant feature classes identified in the GIS were imported into the hydraulic model. A reservoir was manually added at Whatcom Falls II, where the treatment plant enters the distribution system by gravity. The reservoir model element represents an unlimited source of water and is typically used to represent water supplies. A pattern was applied to the reservoir representing the treatment plant to represent field measured hydraulic grade line (HGL) conditions during the calibration periods.

Table 1.1 Model Import Summary

Modeled Element	Number
Pipes	7,788
Junctions	6,727
Pumps	49
Tanks	9(1)
PRVs	12

Notes:
(1) While there are 10 total tanks in the system, Dakin 1 and 2 were combined into one tank in the model.

During the model import, the fields in a GIS feature class need to be mapped to the fields for an element in the model. In addition to the default fields for each element in the model, a set of user-defined fields was created to be able to import City specific information into the model. For all elements, the ID number was used to maintain a 1:1 relationship between the GIS and the hydraulic model. For future updates, data between the two databases can be exchanged using this unique identifier.

The following are the required parameters for hydraulic calculations for each element type:

- **Pipes:** start node, stop node, length, diameter, and c-factor. Initially, a c-factor of 130 was assigned to all pipes in the model and adjusted as needed during calibration.
- **Tanks:** area, area type (constant or variable), ground and base elevations, water levels, and volume. All tanks in the City have a constant area and were modeled as cylindrical tanks. The Dakin I and II tanks were modeled as one combined tank to avoid model instabilities with flow transferring back and forth between the tanks. Elevations and water levels were provided by the City in GIS, technical drawings, and excel documents.
- **Pumps:** pump centerline elevation, pump curve, pump direction, pump on and off settings, and percent speed setting. Pump curves were developed based on manufacturer's pump curves, when available, or from the previous hydraulic model. Elevations, water levels, and control settings were provided by the City in GIS, technical drawings, and Excel documents.
- **PRVs:** pressure setting, elevation, and valve direction. Pressure settings were obtained from the City. Elevations and water levels were provided by the City in GIS, technical drawings, and Excel documents.
- **Junctions:** elevation and demand. Elevations were assigned using the topographic contours provided by the City, assuming ground level elevations for modeling. Demand allocation at the model junctions is presented in Section 1.3.
- **Reservoir:** head. The WTP reservoir level was calculated based on historical levels at Whatcom Falls II.

1.3 Demand Allocation and Diurnal Pattern Development

Demands in an EPS hydraulic model are comprised of three elements: a base demand, a demand pattern, and a multiplier. The demand at a junction is calculated for any given timestep (i) using the following formula:

$$\text{Demand}_i = \text{Base Demand} \times \text{Demand Pattern}_i \times \text{Unaccounted for Water Multiplier}$$

Where:

- i = time

The base demand represents the annual average customer usage allocated to a junction (typically based on billing consumption data from AMI). The demand pattern is a diurnal curve that describes fluctuations of water usage throughout the day and should average to 1 over a 24-hour period. The unaccounted for water multiplier is used to adjust the demand from billing to production levels and accounts for water losses, errors in billing data, meter reading errors, etc.

The following subsections summarize the existing base demand development, the process to allocate the base demands to model junctions, the development of the diurnal patterns, and how the demand multipliers are calculated.

1.3.1 Existing System Demand Allocation

The City provided AMI metering data from December 31, 2019 to December 31, 2022, with readings every 60 minutes. This data covered more than 85 percent of the distribution system demand junctions. The remaining 15 percent of the system was estimated based on scaling demands to meet the totalized consumption data for the entire distribution system. Attachment 1A provides a more detailed explanation of the AMI data analysis and workflow. Figure 1.1 outlines the coverage of AMI meter data in the distribution system.

The demands are divided into the following eight customer classes:

- Commercial.
- Construction.
- Industrial.
- Institutional.
- Irrigation.
- Multi-Family Residential.
- Public.
- Single Family Residential.

In addition to the customer classes above the City supplies demands for 35 different large user accounts and nine different Water Districts. Large Users were assigned demands at specific points in the model based on the largest meter data and individual assignments provided by the City. Water District demands were assigned at the nearest model junction and were allocated demands according to AMI metered data. Figure 1.2 shows the locations where base demands were allocated for each customer category. Figure 1.3 shows where Large User and Water District demands were allocated in the model.

Table 1.2 Base Demands per Customer Category

Customer Category	Base Demand (gpm)
Commercial	502.3
Construction	0.1
Industrial	59.9
Institutional	68.7
Irrigation	211.4
Multi-Family Residential	635.5
Public	41.5
Single Family Residential	1,894.0
Water District	215.2
Large Users	597.0
Total	4,395.3

Notes:
gpm - gallons per minute.

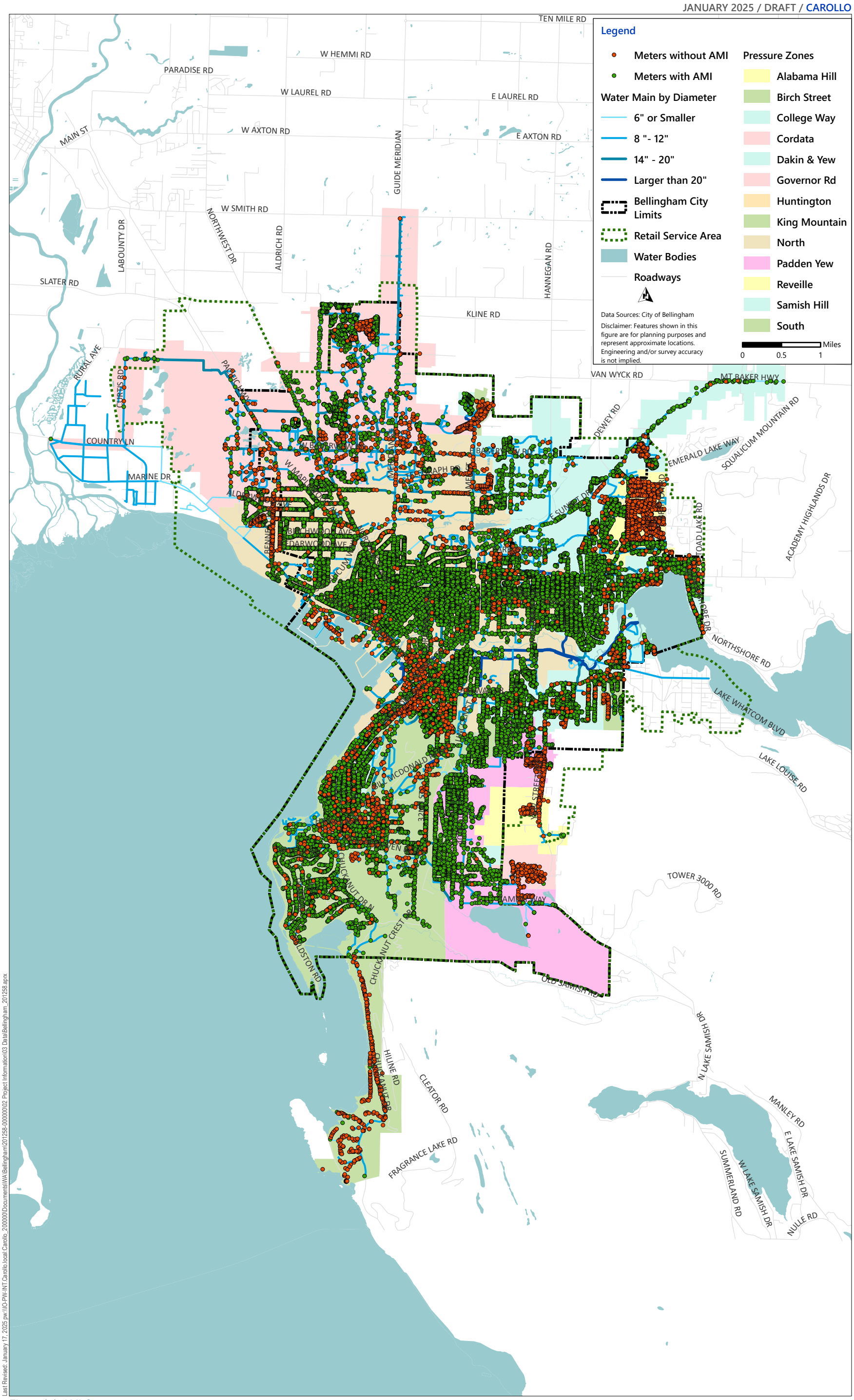
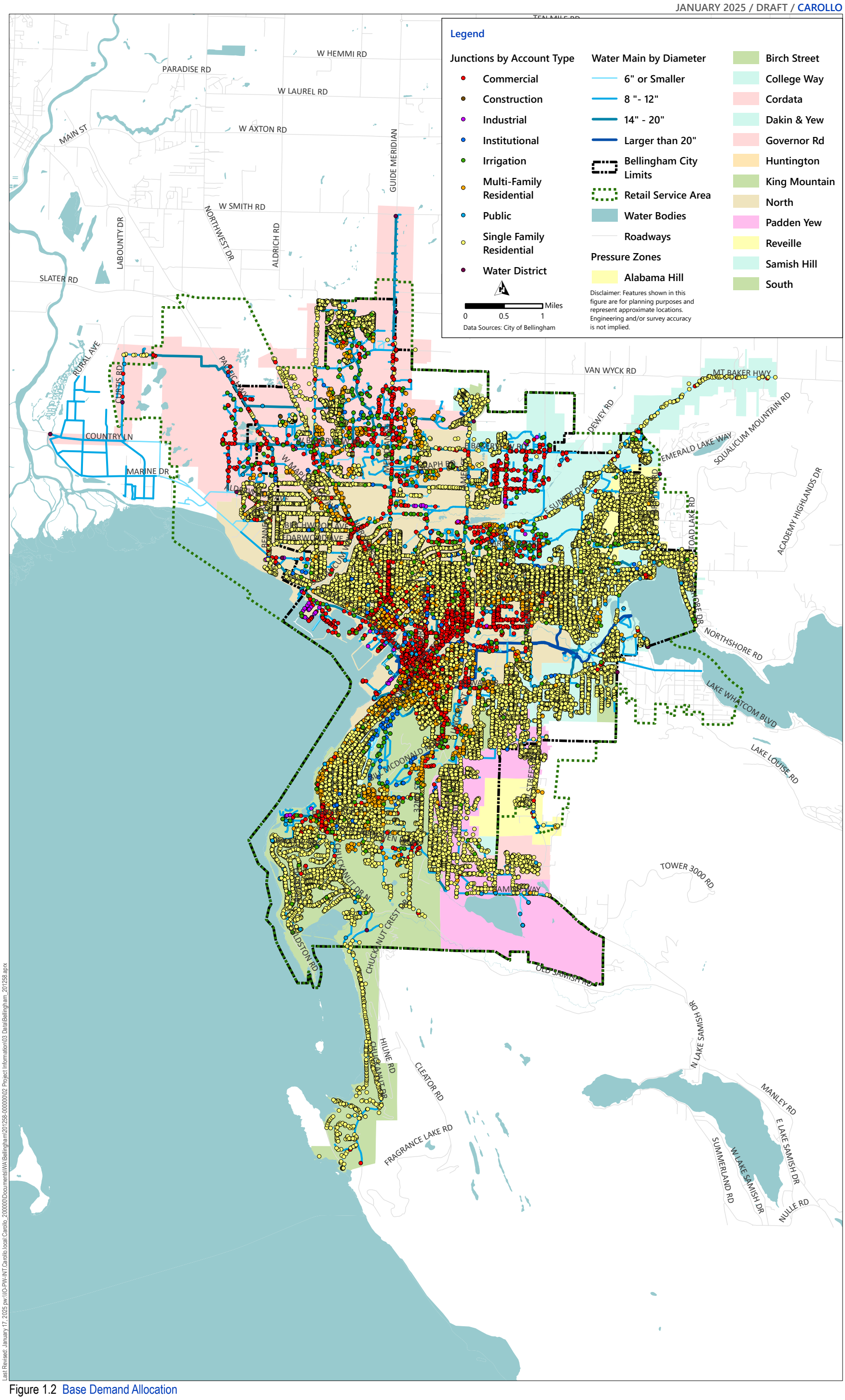


Figure 1.1 AMI Coverage
CITY OF BELLINGHAM
WATER SYSTEM PLAN



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Figure 1.2 Base Demand Allocation

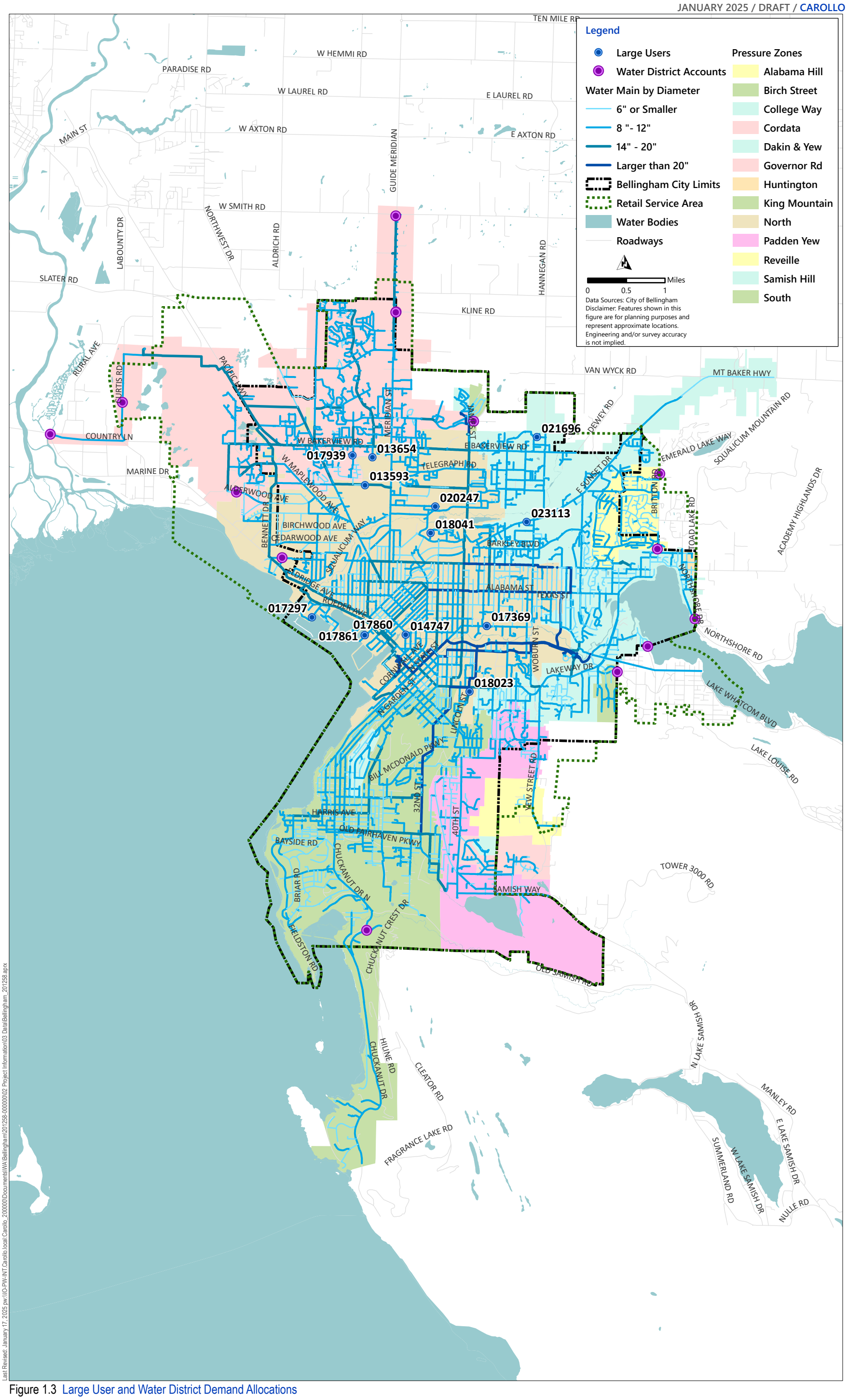


Figure 1.3 Large User and Water District Demand Allocations

1.3.2 Diurnal Pattern Development

Custom diurnal patterns for both winter demands and summer demands were developed for the customer types described in Section 1.3.1. The custom diurnal patterns are based on AMI data provided by the City for winter and summer periods in 2022 and normalized so that the average of the hourly multipliers is equal to one. The diurnal patterns are then multiplied by the 24-hour average demands input at the model nodes to simulate the normal daily demand variations that occur during a typical winter or summer demand condition. Water District diurnal patterns were developed per zone based on AMI data. Large User diurnal patterns were developed to match the distribution system diurnal pattern and were not specific to each large user demand.

The diurnal patterns were developed from hourly AMI data provided by the City for winter 2022/2023 and summer 2022 by averaging the hourly demand for each hour of the day. The data from 2022 was selected because it is the most recent historical year and represents typical water usage. Figure 1.4 shows an example diurnal pattern developed for Single Family Residential average day demand (ADD) in the Padden Yew Zone. A total of 176 custom diurnal patterns were developed to provide a very accurate model representative of EPS operations.

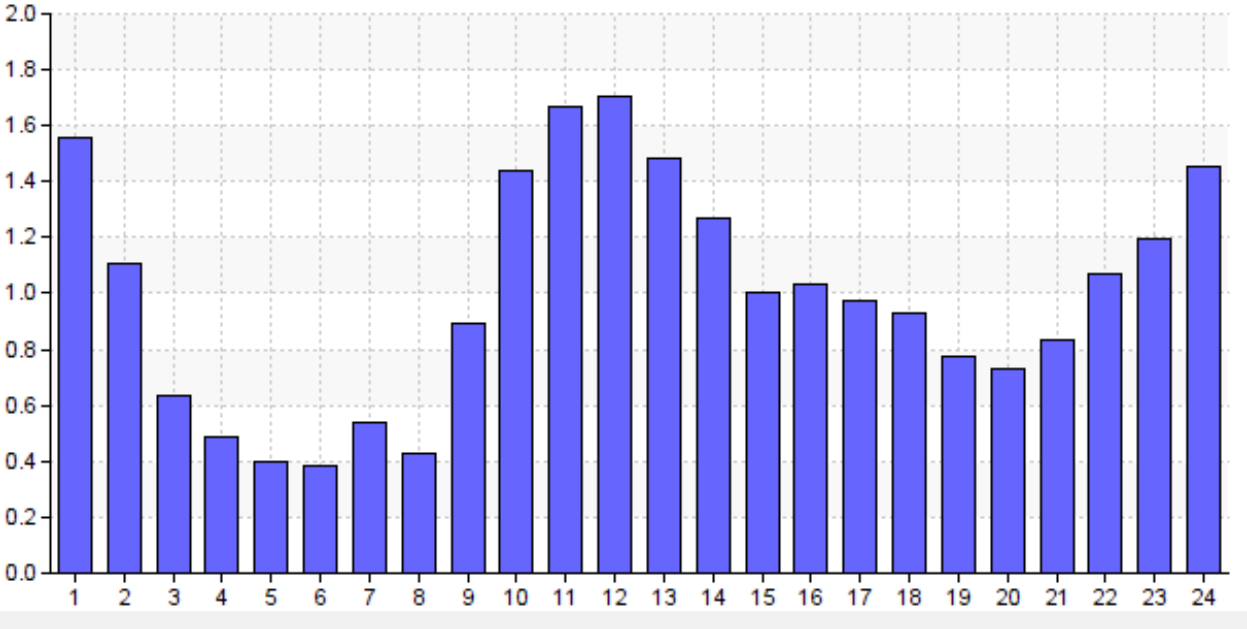


Figure 1.4 Example Diurnal Pattern - Padden Zone Single Family Residential Diurnal

1.3.3 Unaccounted for Water Multiplier

The multiplier is used to adjust the demand from billing to production levels and accounts for water losses, errors in billing data, meter reading errors, etc. The system-wide multiplier is calculated as a 10 percent multiplier that is applied to all demand junctions. The multiplier was selected to match the total consumption to production.

1.4 Hydraulic Model Calibration Overview and Methodology

The purpose of the water system hydraulic model is to show how the water system will respond under a given set of conditions. One way to test the accuracy of the hydraulic model is to create a set of known conditions in the water system and then compare the results observed in the field to the results of the hydraulic model simulation using the same conditions. If the observed model results are not in agreement with the data measured in the field, then model parameter values are adjusted until reasonable agreement between the two is achieved. This iterative process is called calibration.

Two types of calibration were performed to prepare the model for use, which are described in detail in this section:

- **EPS calibration**: The EPS calibration compares supervisory control and data acquisition (SCADA) data and temporary field pressure sensors data to pressures, flows, and tank levels at the City's facilities in the model during a representative period.
- **Fire flow test (steady state) calibration**. Hydrant flow tests stress the distribution system with elevated flows to point to locations creating an HGL differential between the flowing hydrant and neighboring hydrants. This HGL differential generates sufficient losses to better identify roughness and loss coefficients, or the presence of pipe flow constraints (e.g., closed or partially closed valves) within the system.

Additionally, conducting a model calibration provides a greater understanding of how the water system operates, which can reveal errors in the data used to develop the hydraulic model, or show that a condition might exist in the field that was not otherwise known.

1.4.1 EPS Calibration

The EPS calibration of the City's hydraulic model was performed for both winter 2022/2023 and summer 2022 conditions. For each calibration period, a calibration day was selected, and the model was set up to replicate field operating conditions for the calibration period. While the days were chosen to represent average conditions, customer use does vary slightly every day leading to some natural variability in the SCADA data between ADD and maximum day demand (MDD) days during the EPS calibration periods that should be considered when evaluating modeled results. The SCADA data provided by the City was used to populate the hydraulic model with initial boundary conditions. Boundary conditions are known inputs to the model specific to calibration day, such as initial tank levels and pump status. AMI data was also used to calculate demand diurnal patterns and adjust base demands for the calibration days.

Once the model was set up to replicate field operating conditions, a week-long simulation was performed to verify that the model forecasted flow, pressures, and tank levels reasonably match field measured data. Differences between the field and model data were evaluated to determine the appropriate parameters to adjust. The following are descriptions of three general categories of parameters that can be adjusted during calibration, each of which were evaluated and modified as part of the calibration process:

- Physical system data including pipe connectivity, pipe and valve diameters, node elevations, storage and pumping facility information, pump curves, minor loss, and pipe roughness coefficients.

- Operational data including valve pressure settings, pump controls, storage facilities filling rates, open/closed valves, percent open valves, and pipe status.
- Water consumption values and allocation including billing records, flow data for customers, demand patterns, and multipliers. Given the high accuracy of AMI data within the City, adjustments to demands were minimal.

The above categories were iteratively adjusted to improve the match between the model and the SCADA data. After an adjustment to the model was made, a new simulation was executed, and its results compared with the measured data. This process was repeated until the desired goodness-of-fit was achieved, or further adjustments were deemed unjustified or likely to yield negligible improvement.

The following are the three main processes conducted during the EPS model calibration to evaluate what parameters to adjust.

- **Transmission main connectivity:** The connectivity features of the hydraulic modeling software were used to verify the connectivity of the transmission and distribution mains within the distribution system. Proper connectivity verifies that there are no interruptions in the pipe connections.
- **Typical system operational parameters:** The model output reports on system pressures (pound per square inch (psi) at junction), pipe headloss (feet per thousand feet) and velocity (feet per second) were used to locate possible connectivity issues or errors in the model input data that required adjustment. Large areas with values outside of the typical range for these parameters are a good indicator of these issues.
- **Facility physical and operational characteristics:** The hydraulic model results were compared to the available SCADA data at all pump stations and storage facilities and field data collected at temporarily installed pressure loggers to verify that data input into the hydraulic model (e.g., pump curves, operational controls, PRV settings, etc.) produced results comparable to what the system experiences.

1.4.2 Steady State Calibration

The fire flow test calibration was conducted following the EPS calibration. A fire flow test calibration compares model calculated pressure results to field pressures measured for a series of fire flow tests. Fire flow tests create high demand events by releasing a significant amount of water from a fire hydrant to generate more head loss through higher pipe velocities, highlighting the effect of the roughness coefficients and other pipe flow constraints (e.g., closed or partially closed valves) on system losses. The model parameters that are adjusted during this process are primarily the pipeline roughness and local loss coefficients, although other parameters such as pump curves, pipe diameters, and closed valves can also be adjusted to improve calibration results.

Pipeline roughness coefficients have industry-accepted value ranges based on pipeline material, diameter, and age and should be adjusted only within this tolerance of industry accepted roughness coefficient range. Although characteristics specific to the City's water distribution system such as water quality, temperature, construction methodologies, material supplier, and other factors may result in roughness coefficients that differ from the average of the industry accepted ranges, if a model is unable to match the calibration measurement within the acceptable range of roughness coefficient values, there may be cause for further investigation of field conditions to verify there is not an unknown condition. Examples of such conditions, which can be identified during hydraulic model calibration include closed valves, partially

closed or malfunctioning valves, extreme corrosion within pipelines, connectivity and diameter errors, and diurnal patterns of large water users.

The City and Carollo performed hydrant flow tests in the summer of 2022 as part of this project to provide the most current data available for updating and calibrating the model. The sites were selected so that each of the City's pressure zones had at least one fire flow test, and the larger zones had multiple tests in a zone to capture information in different areas. Figure 1.5 shows the 20 hydrant test sites used for steady-state calibration. Attachment 1B summarizes the hydrant testing that was performed with a field write up for each of the 20 sites.

Each fire flow test was conducted by first measuring static pressures at two "pressure" hydrants. Next, one "flowing" hydrant was opened to release a large amount of flow to create a pressure drop by increasing head loss. With the flowing hydrants open, measurements were recorded to quantify the flow rate from each hydrant, and to determine the residual pressure of the two pressure monitor hydrants. Typically, when conducting hydrant flow tests, a minimum of 10 psi pressure drop (static pressure minus residual pressure) is recommended to assist in calibration.

The City SCADA data for the system facilities within the service area of the hydrant test at the time of the fire flow test, including the tank levels and pump station flows and settings.

Two model exports at different periods of the simulation were created in the hydraulic model for each fire flow test:

1. Export 1 or "static" run. This export simulated the water system just prior to each test.
2. Export 2 or "residual" run. This export simulated the system during the test while the hydrants were flowing.

There were a total of 20 hydrants tests, and therefore a total of 40 result exports were created for steady state model calibration.

In both static and residual model scenarios, the summer model demands were used to represent the model demand during the fire flow test. Diurnal patterns were used to identify the specific demands for the hour of the test. Tanks levels were set for each test simulation to match the actual tank levels recorded during the test. Additionally, the initial status of the City's pumps were modified so that they matched actual conditions (i.e., open or closed) recorded during the tests. The residual model scenarios are identical to the appropriate static model scenarios, except that fire flow demands were added to the appropriate nodes.

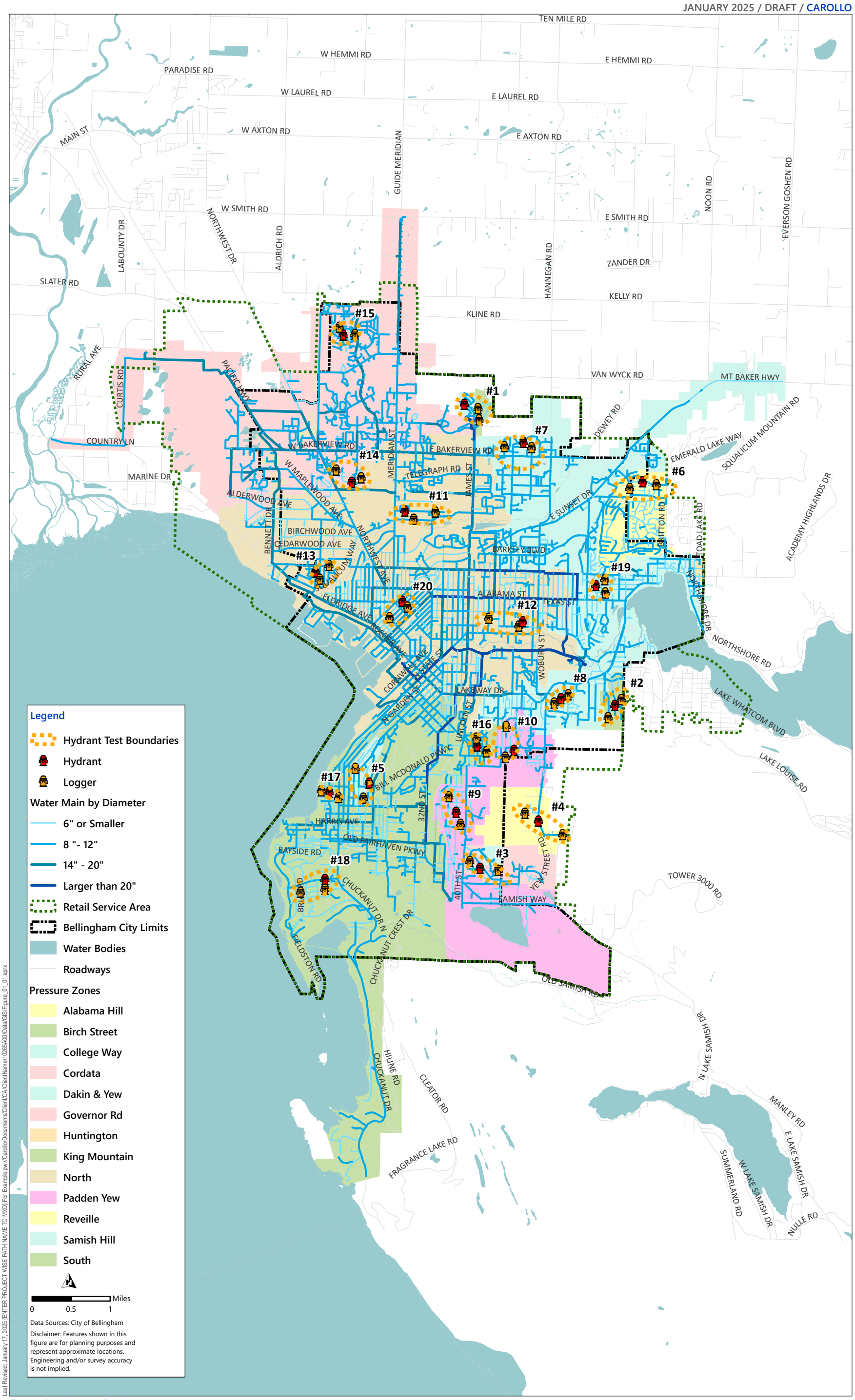


Figure 1.5 Hydrant Test Locations

1.5 Hydraulic Model Calibration Results

In the United States, calibration standards to assess the accuracy of models have yet to be developed and depend heavily on the complexity of the system, availability of data to develop the model, and intended use of the model. The American Water Works Association (AWWA) M32 Computer Modeling of Water Distribution Systems Manual (2018) provides the following recommendations, which were followed for the calibration of the City's all-pipes model:

- HGLs: ± 10 feet (± 4.3 psi).
- Water Levels: ± 6 feet.
- Flows for Distribution pipes (less than or equal to 16 inches): ± 10 percent.
- Flows for Transmission pipes (greater than 16 inches): ± 5 percent.

This section summarizes the results from the EPS and steady state calibrations.

1.5.1 EPS Calibration Results

The EPS calibration of the City's hydraulic model was performed for both winter 2022/2023 and summer 2022 data. Therefore two 24-hour EPS calibration scenarios were created in the model: Summer 2022 and Winter 2022/2023 to represent the two selected calibration days. The winter EPS selected calibration day was February 1, 2023, and the selected summer EPS calibration day was August 27, 2022, which had average day demands of 4,395 gpm and 7,039 gpm respectively. All major infrastructure was in service during the two calibrations days.

For each calibration day scenario, the initial status of tanks, pumps, and valves was populated using the SCADA data provided by the City. The start time of the model runs was set up to midnight, 24 hours prior to the calibration date. The model was then run for 24 hours to further initialize conditions, then pressure, flow, and level results in the model were compared to field recorded data from SCADA and temporary pressure loggers. The model was then run for an additional 5 days to ensure proper tank cycling and no loss tank levels over an extended period. Field data from ten tanks, twelve pump stations, and five loggers (summer calibration only) were used during calibration. Figure 1.6 shows a map with all the SCADA data locations and temporary pressure loggers.

The SCADA data used for EPS calibration included the following calibration points:

- Tank levels at Whatcom Falls I, Dakin 1, Dakin 2, College Way, Padden, 40th St, Consolidation, Reveille, Kearney, and Parkhurst.
- Pump station total flows at the Dakin Pump Station (PS), Woburn PS, Otis PS, Short St PS, College Way PS, 38th St PS, Balsam PS, Birch St PS, and Samish Highland PS.
- Discharge pressure readings from SCADA were available at the nine pump stations that measured flows and at James St PS, Huntington PS, and Governor PS.
- Pressure readings from five pressure loggers that were placed in the system for the summer calibration data period.

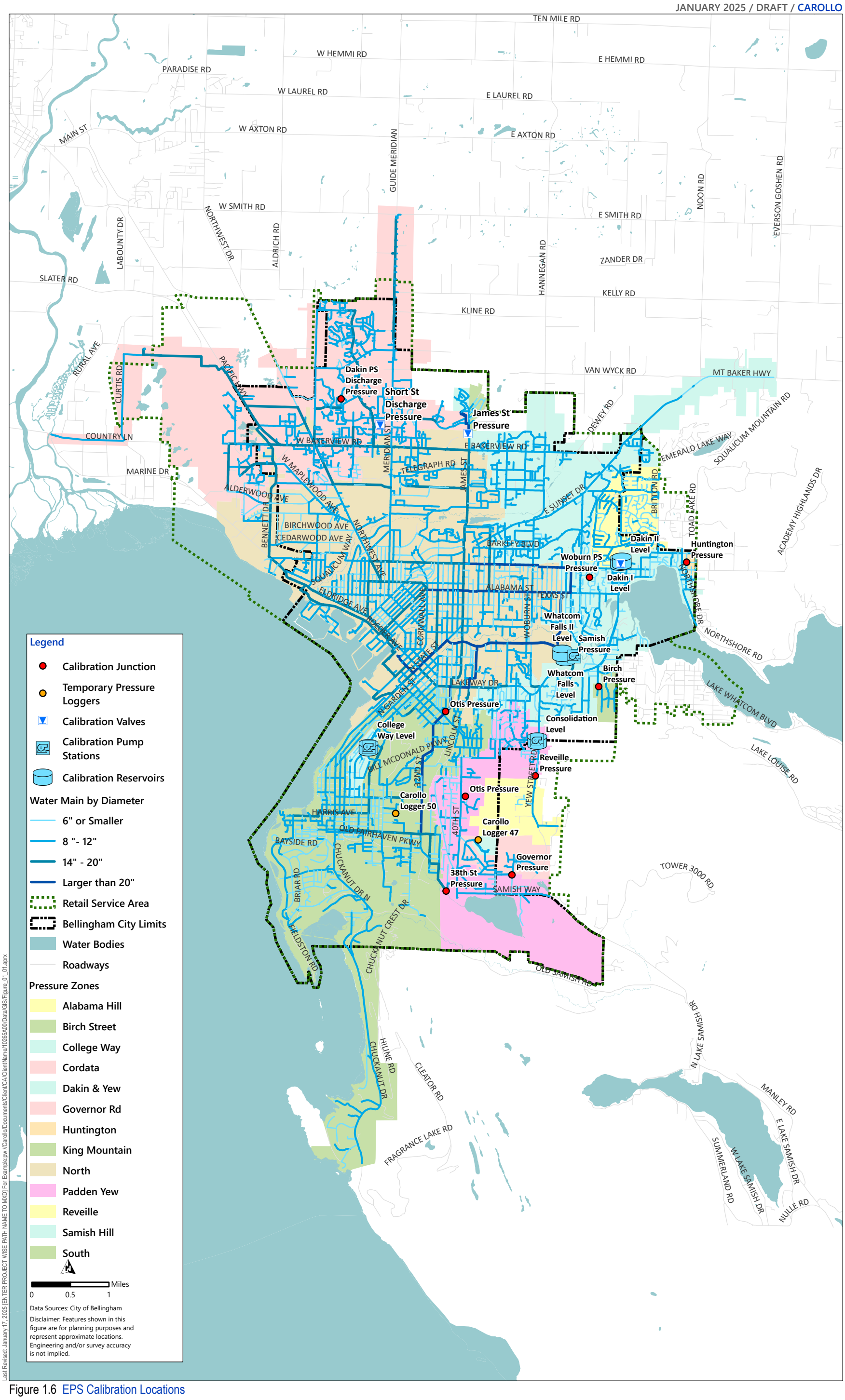


Figure 1.6 EPS Calibration Locations

Calibration graphs were created for each calibration point to compare the field-recorded data and the modeled results. Adjustments were made to facility settings in the hydraulic model so that the model results would better match the field-recorded data. This process was repeated until the desired goodness-of-fit was achieved, or further adjustments were deemed unjustified or likely to yield negligible improvement.

Figure 1.7 shows an example of calibration results for the Whatcom Falls I level for the summer calibration. Attachment 1C includes all the calibration graphs for both the winter 2022/2023 and summer 2022 calibration scenarios.

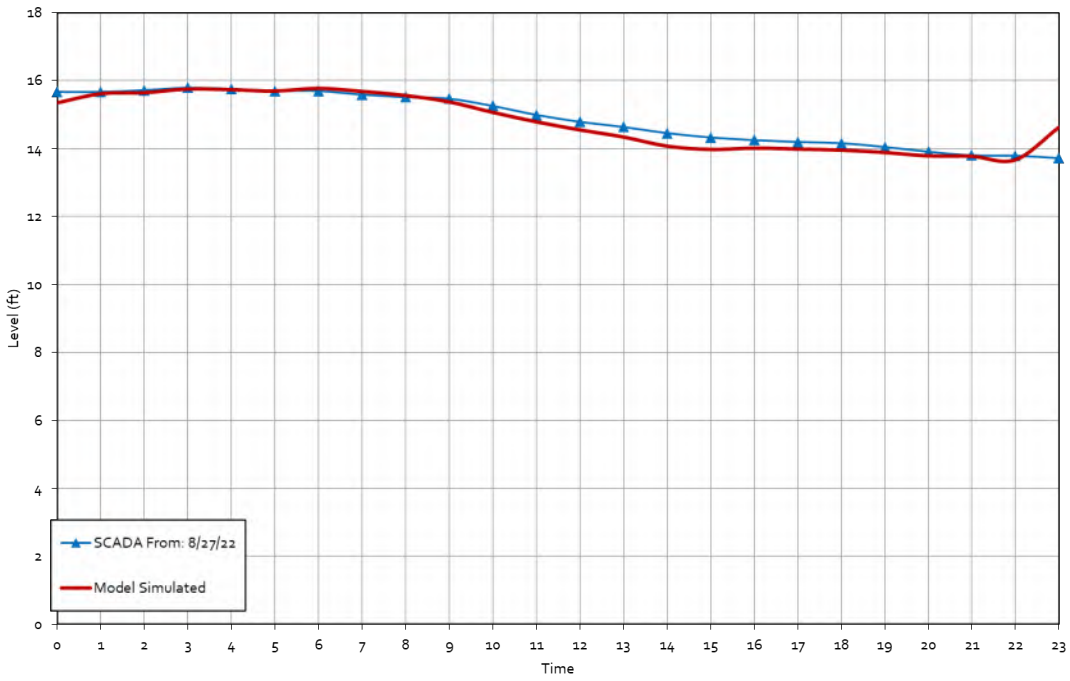


Figure 1.7 EPS Calibration Example

1.5.1.1 Winter EPS Results

In general, the winter EPS calibration model results matched favorably with the data recorded in SCADA, and were within the calibration recommendations. While some values were higher or lower, the general pattern or shape of the model results over time matches well with SCADA. During model calibration it was determined that the SCADA at Otis PS was unreliable and should not be used for model calibration.

After adjustments to the hydraulic model and excluding the known inaccurate SCADA calibration points, approximately 38 percent (3 of 8) of the pump station flows, 85 percent (11 of 13) of the junction pressures, and all tank levels fall within acceptable calibration ranges. The Dakin, 38th St, Balsam, and Samish Highlands PS are all out of criteria for the individual day chosen.

When considering the average flow rate across a two-week period instead of an individual day, the Dakin, Balsam, and Samish Highlands pump station all match the SCADA. Meaning, seven of eight pump stations can be considered within calibration criteria. For the winter EPS only the 38th St PS flows and Samish Highlands and James St pressures were out of criteria.

1.5.1.2 Summer EPS Results

The MDD, summertime scenario showed a similar trend in results as wintertime ADD. In general, the model matched the SCADA well. After adjustments to the hydraulic model and excluding the two known inaccurate SCADA calibration points, approximately 50 percent (4 of 8) of the pump station flows, 89 percent (11 of 13) of the junction pressures, and all tank levels fall within acceptable calibration ranges. Similar to the wintertime EPS, there is a range in daily volumes over the period of summertime SCADA at the pump stations. Of the four pump station flows outside of criteria, all four are within the general range of daily flows, so these sites are considered well calibrated despite falling outside of the acceptable range. The James St and Samish Highland pressures were slightly out of criteria. The summertime calibration also looked at a comparison of modeled pressures to the measured pressures in SCADA loggers over summer. four out of five of the loggers were in criteria, with logger 57 in the Padden Yew Zone slightly outside of the recommended range.

1.5.2 Steady State Calibration Results

Calibration to the hydrant tests is conducted individually in order to specifically represent the conditions of the system at the time of each test, as summarized above. As with EPS calibration, numerous simulations are performed during the fire flow calibration phase. Adjustments are made to the model between runs until the desired goodness-of-fit between the model results and field-recorded data is achieved.

Table 1.3 provides a detailed summary of the calibration results. The table lists the results of each field hydrant test conducted and the corresponding hydraulic model results.

In general, the model results provide an accurate representation of the field fire flow tests. For the pressure hydrants, the results are considered acceptable if the model-simulated pressures are within 10 feet (4.3 psi) when compared to the field-recorded data. Figure 1.8 shows the steady state static pressure calibration results, and Figure 1.9 shows the steady state residual pressure calibration results on a 1 to 1 plot with +/-10 percent error bands. The static pressure calibration results show 95 percent of the total calibration points are within the acceptable range, and the residual calibration results show that 83 percent (33 of 40) of the total calibration points are within the acceptable range. Red text in Table 1.3 indicates if the model simulated pressure is outside 10 feet (4.3 psi) of the field recorded data.

Table 1.3 Steady State Calibration Results

Hydrant Test Data Sheet – Calibration Results								Field Results				Model Results				Comparison				Pressure Drop (psi)		
Test No.	Pressure Zone	Date	Time	Duration (minutes)	Hydrant	Hydrant Number	Flow (gpm)	Static Pressure (psi)	Static HGL (feet)	Residual Pressure (psi)	Residual HGL (feet)	Static Pressure (psi)	Static HGL (feet)	Residual Pressure (psi)	Residual HGL (feet)	Static Pressure Diff (psi)	Residual Pressure Diff (psi)	Static Pressure Error (%)	Residual Pressure Error (%)	Field	Modeled	Diff
1	519 Dakin and Yew	8/15/2022	13:30	1-2	F1	0339246																
					P1	0317229		76	504	30	398	78	510	27	391	-2.5	2.8	-3.2%	9.3%	46	51	-5
					P2	0317203		102	506	57	402	104	510	54	396	-1.6	2.6	-1.6%	4.5%	45	49	-4
2	780 Birch Street	8/16/2022	13:08	1-2	F1	0323798																
					P1	0312206		93	807	20	638	89	798	19	636	3.9	1.0	4.2%	5.1%	73	70	3
					P2	0339304		115	791	40	618	112	783	38	613	3.3	1.9	2.9%	4.8%	75	74	1
3	873 Governor Road	8/16/2022	16:00	1-2	F1	0134811																
					P1	0124339		54	869	40	837	50	861	43	844	3.8	-3.2	7.1%	-8.0%	14	7	7
					P2	0131387		108	898	84	842	104	889	80	833	3.6	4.0	3.3%	4.8%	24	24	0
4	830 Reveille	8/16/2022	14:30	-	F1	011372																
					P1	0121517		88	924	15	755	90	928	16	758	-1.6	-1.0	-1.8%	-6.5%	73	74	-1
					P2	011373		78	879	14	731	82	888	10	722	-4.2	4.0	-5.3%	28.3%	64	72	-8
5	541 College Way	8/16/2022	15:18	1-2	F1	011219																
					P1	0342190		112	558	90	507	111	555	89	504	1.4	1.4	1.3%	1.5%	22	22	0
					P2	0140016		71	548	44	486	74	555	47	492	-2.8	-2.7	-4.0%	-6.0%	27	27	0
6	730 Alabama Hill	8/15/2022	13:37	1	F1	00011888																
					P1	0011895		128	698	54	527	126	693	53	525	1.9	0.9	1.5%	1.7%	74	73	1
					P2	00011892		132	695	40	482	131	693	43	490	0.8	-3.3	0.6%	-8.3%	92	88	4
7	519 Dakin and Yew	8/15/2022	13:00	-	F1	0140840																
					P1	0149162		137	499	90	390	142	509	87	383	**-4.6**	3.4	-3.3%	3.8%	47	55	-8
					P2	0128115		145	520	82	374	140	509	82	375	**4.5**	-0.4	3.1%	-0.5%	63	58	5
8	519 Dakin and Yew	8/15/2022	15:23	1	F1	0010599																
					P1	0010602		77	514	66	488	80	520	69	496	-2.8	-3.2	-3.6%	-4.8%	11	11	0
					P2	0010868		60	512	40	466	64	520	43	473	-3.5	-3.4	-5.9%	-8.4%	20	20	0
9	696 Padden Yew	8/17/2022	8:50	1-2	F1	0011339																
					P1	0011283		138	689	116	638	138	689	105	612	-0.2	**11.0**	-0.2%	9.5%	22	33	-11
					P2	0335092		76	675	64	647	78	679	61	640	-1.6	3.2	-2.1%	5.1%	12	17	-5
10	696 Padden Yew	8/16/2022	11:08	1-2	F1	0107645																
					P1	0298308		61	688	41	641	63	693	43	645	-2.1	-1.5	-3.5%	-3.8%	20	21	-1
					P2	0010792		100	689	80	642	102	693	82	647	-1.7	-2.1	-1.7%	-2.6%	20	20	0
11	276 North	8/15/2022	10:59	1-2	F1	0011487																
					P1	0011005		74	266	70	256	75	268	68	252	-1.2	2.0	-1.6%	2.9%	4	7	-3
					P2	0011517		72	267	58	234	73	268	55	227	-0.7	3.0	-0.9%	5.2%	14	18	-4

Hydrant Test Data Sheet – Calibration Results								Field Results				Model Results				Comparison				Pressure Drop (psi)		
Test No.	Pressure Zone	Date	Time	Duration (minutes)	Hydrant	Hydrant Number	Flow (gpm)	Static Pressure (psi)	Static HGL (feet)	Residual Pressure (psi)	Residual HGL (feet)	Static Pressure (psi)	Static HGL (feet)	Residual Pressure (psi)	Residual HGL (feet)	Static Pressure Diff (psi)	Residual Pressure Diff (psi)	Static Pressure Error (%)	Residual Pressure Error (%)	Field	Modeled	Diff
12	276 North	8/16/2022	10:03	1-2	F1	0128552																
					P1	0010230		87	268	75	240	89	272	66	219	-1.7	**9.3**	-2.0%	12.4%	12	23	-11
					P2	0342288		86	269	84	264	87	271	85	266	-1.0	-0.7	-1.2%	-0.8%	2	2	0
13	276 North	8/16/2022	7:12	1-2	F1	0107574																
					P1	0011826		85	268	75	244	87	273	79	255	-2.2	-4.4	-2.6%	-5.9%	10	8	2
					P2	0010730		83	267	74	247	85	273	78	256	-2.3	-3.9	-2.7%	-5.3%	9	7	2
14	350 Cordata	8/15/2022	10:03	1-2	F1	0010937																
					P1	0011370		88	359	60	294	89	361	56	284	-0.9	4.3	-1.0%	7.2%	28	33	-5
					P2	0558513		79	368	61	326	76	361	60	324	2.8	1.0	3.6%	1.6%	18	16	2
15	350 Cordata	8/15/2022	9:17	1-2	F1	0139492																
					P1	0139494		88	366	61	303	88	367	58	297	-0.5	2.5	-0.5%	4.2%	27	30	-3
					P2	0140212		85	364	63	314	86	367	64	317	-1.0	-1.4	-1.2%	-2.2%	22	22	0
16	457 South	8/16/2022	11:33	1-2	F1	0012165																
					P1	0101877		56	455	36	409	54	451	34	404	1.7	1.9	3.1%	5.3%	20	20	0
					P2	0275656		90	447	75	412	92	451	72	404	-1.8	3.4	-1.9%	4.5%	15	20	-5
17	457 South	8/17/2022	7:40	1-2	F1	0139619																
					P1	0011098		111	447	98	417	113	452	108	441	-2.1	**-10.5**	-1.9%	-10.7%	13	5	8
					P2	0011042		172	448	160	420	174	452	166	433	-2.0	**-5.7**	-1.2%	-3.6%	12	8	4
18	457 South	8/17/2022	8:15	1-2	F1	0011204																
					P1	0011201		101	450	70	378	102	452	71	381	-0.9	-1.2	-0.9%	-1.6%	31	31	0
					P2	0011225		115	458	90	400	113	452	88	396	2.4	1.8	2.1%	2.1%	25	24	1
19	519 Dakin and Yew	8/15/2022	16:04	1-2	F1	0010822																
					P1	0010831		44	508	37	491	47	513	38	493	-2.5	-0.7	-5.7%	-1.9%	7	9	-2
					P2	0295777		46	511	43	504	48	516	45	510	-2.2	-2.4	-4.8%	-5.6%	3	3	0
20	276 North	8/16/2022	8:17	1-2	F1	0012013																
					P1	0010286		84	265	76	247	87	273	85	269	-3.1	-9.4	-3.7%	-12.4%	8	2	6
					P2	0010341		80	274	78	269	79	273	78	269	0.5	0.3	0.7%	0.4%	2	2	0

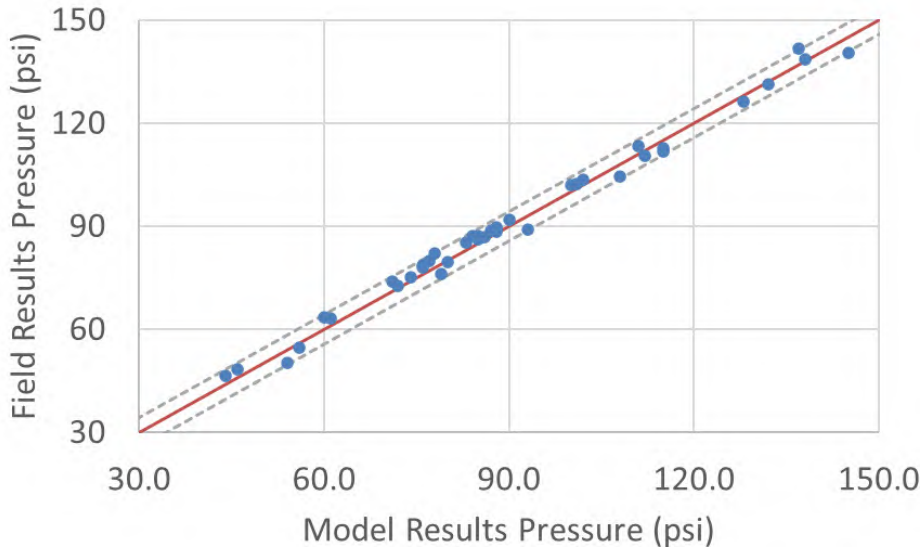


Figure 1.8 Steady State Static Pressure Calibration Results

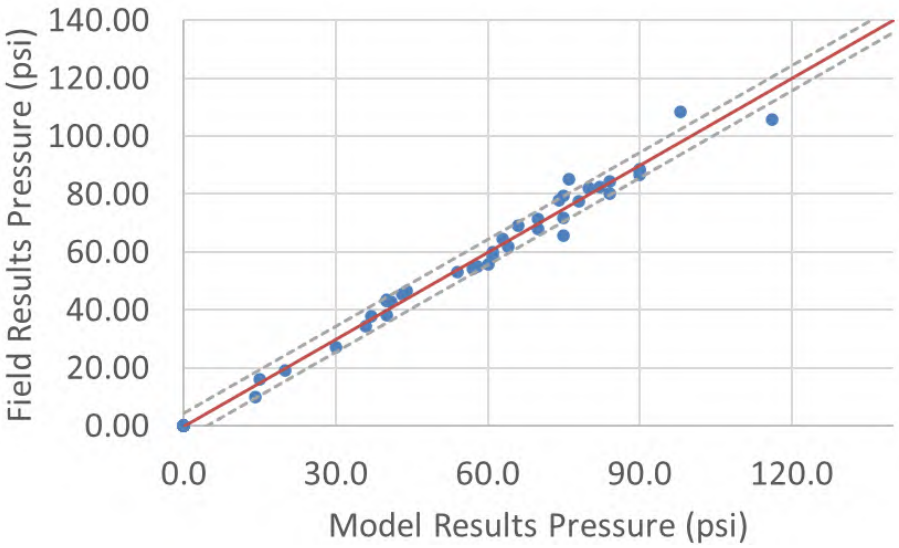


Figure 1.9 Steady State Residual Pressure Calibration Results

1.6 Summary

The purpose of developing and calibrating an all-pipes model of the City's water distribution system was to create a reliable tool for system planning. The focus of the model calibration was to properly represent the flows, pressures, controls, and interactions between facilities. For all the facility SCADA data and all fire flow tests performed by the City, the model simulated pressures, flows, and levels generally meet the calibration guidelines defined for this project, which are based on the AWWA M32. After adjustments to the hydraulic model, approximately 94 percent of pipe flows, 89 percent of junction pressures, and all tank levels fall within acceptable calibration ranges. The model is considered calibrated for the system as it was configured and operated in 2022.

ATTACHMENT 1A

BELLINGHAM AMI DATA ANALYSIS

INTERNAL PROJECT MEMORANDUM

CITY OF BELLINGHAM

Water System Plan

Project Number	201258-000000
Project Manager(s)	Lara Kammereck, Aurelie Nabonnand
Date	January 22, 2025
Prepared By	Pierre Mishra
DWG Supervisor(s)	Shawn Dent
Subject	AMI Data Analysis, Workflow and Data Architecture - DWG Project Description

1.0 OVERVIEW

Digital Water Group (DWG) assisted the internal Carollo Engineers, Inc. (Carollo) team conducting water system planning, modeling, and distribution system analysis for the City of Bellingham (City) on utilizing large amounts of Advanced Meter Infrastructure (AMI) data for project needs.

2.0 DATA DESCRIPTION

Carollo received 1,081 CSV files from the client's AMI vendor, Sensus. The AMI data was about 45 GB in total size spanning over three years from December 31, 2019 to December 31, 2022. The data contained hourly meter reads for about 26,000 accounts. A separate file was provided to DWG containing additional meter attributes such as meter types (may also be referred to as account type or customer class), pressure zones, and model demand nodes associated with each account.

3.0 DATA WORKFLOW

DWG developed a workflow architecture to process all the AMI data. Carollo was provided access to the vendor's Secure File Transfer Protocol (SFTP) server where all the CSV files were stored. The files were downloaded from the SFTP server and dropped into Azure Blob Storage on Carollo's Azure tenant. Azure Data Factory was used to process and analyze the data and the results were pushed to an Azure SQL database. A Power BI dashboard was developed and connected to the Azure SQL database to display summary calculations useful for the project needs. The analysis results were exported to an Excel spreadsheet in the requested format for further demand modeling purposes.

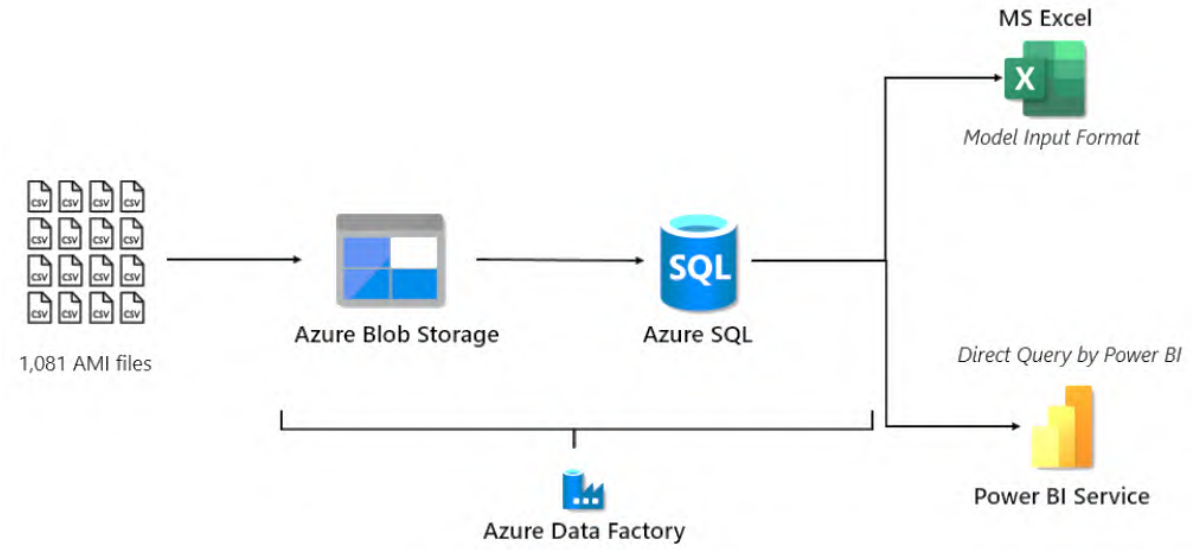


Figure 1 AMI Data Processing Workflow using Microsoft Azure Cloud

3.1 Microsoft Azure Resources

Azure Blob Storage: Blob Storage is an economical yet scalable object-based storage service on cloud to store large amounts of semi-structured and unstructured data. Each file is stored as an object called "blob" (Binary Large Object) within a blob container.

Azure SQL: Azure SQL database is a cloud version of the popular on-prem Microsoft SQL Server database.

Azure Data Factory: Azure Data Factory is a cloud-based data integration service that also allows you to create, schedule, and manage data pipelines for moving and transforming data across various data stores and services. It helps to orchestrate and automate workflows for data movement and data transformation tasks.

4.0 ANALYSIS

The AMI data was filtered for any non-negative and non-zero values and joined with the meter attribute data provided separately.

4.1 Summary Statistics

The AMI files were processed to obtain the total number of accounts by year, total usage by year, and the total number of accounts by usage and customer class.

4.2 Average Day Demand

Hourly meter reads for each individual account were aggregated into daily sums. To drop the individual meter attribute, daily sums were further summed up by grouping into date, model node, meter type, zone, and year. To drop the date level attribute, the sum value was averaged to get average day demands by model node, meter type, pressure zone, and year.

4.3 Average Day Demand - Diurnal Pattern

The hourly meter reads were averaged by meter type, pressure zone, year, and hour of the day. The mean hourly read was divided by mean yearly read to get a mean hourly factor for each of the 24 hours in a day.

4.4 Max Day Demand

Calculating the max day demand was a two-step process. First, the max day system demand was calculated by summing up the hourly meter reads into daily values and taking the maximum sum value for a specific year. Additionally, the date on which the max day system demand occurred was also noted.

Hourly meter reads for each individual account were aggregated into daily sums. To drop the individual meter attribute, daily sums were further summed up by grouping into date, model node, meter type, zone, and year. Only the date on which the max day system demand occurred for a specific year was retained to get the max day demands.

4.5 Max Day Demand - Diurnal Pattern

Hourly meter reads for each individual account were summed up by aggregating into meter type, zone, year, date, and hour. Only the date on which the max day system demand occurred for a specific year was retained. The aggregated sum value was divided by the average demand that occurred on the max day by meter type, zone, year, date, and hour to get the max hour demand factors.

5.0 DELIVERABLES

The analysis results described above were provided to the internal team in the form of an interactive Power BI dashboard and a couple of Excel spreadsheets in the requested format suitable for hydraulic modeling inputs. The results were used to allocate accurate demand throughout the system by parameter adjustments during hydraulic model calibration. Detailed diurnal patterns by customer classes also provided approximation and certain parameter adjustments during hydraulic model calibration.

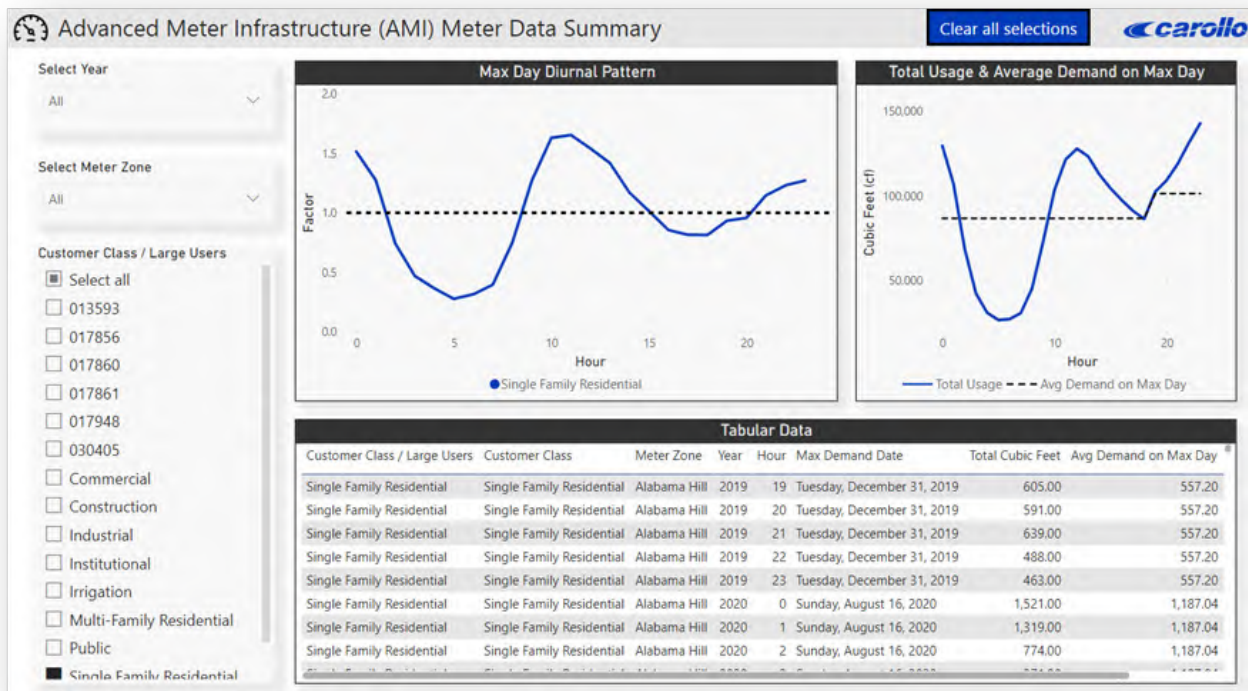


Figure 2 Sample View of Power BI Dashboard, Page Average Day Demand - Diurnal Pattern

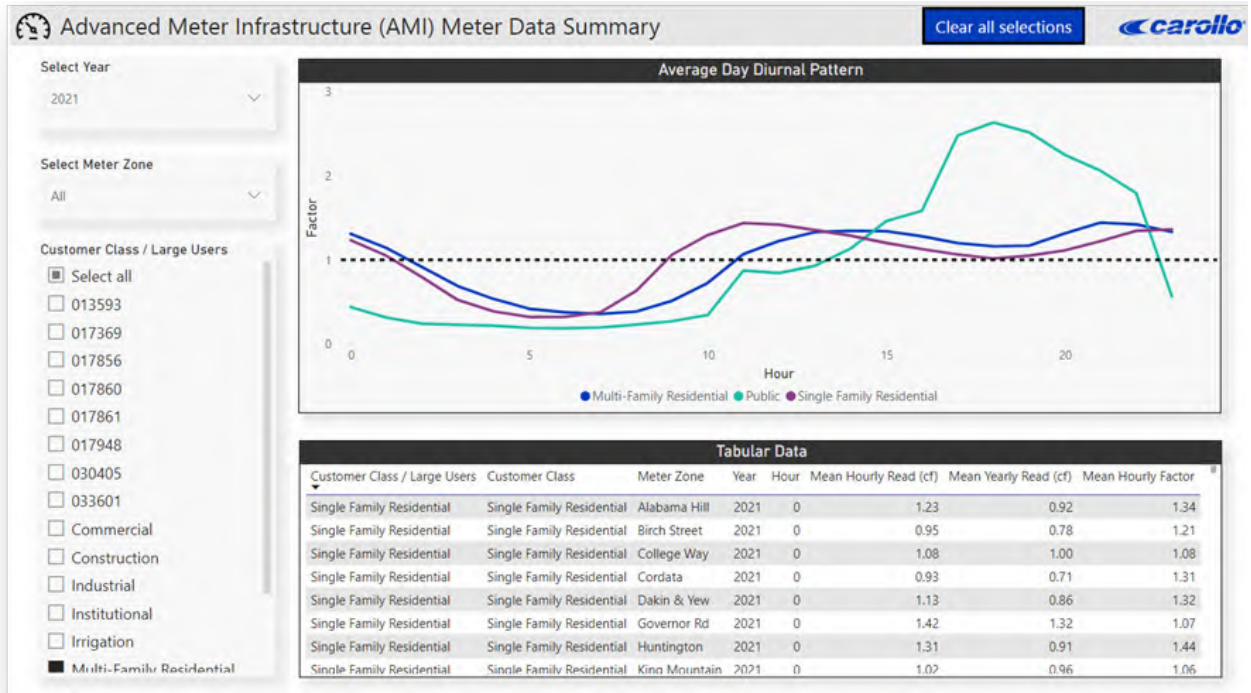


Figure 3 Sample View of Power BI Dashboard, Page Max Day Demand - Diurnal Pattern

ATTACHMENT 1B

HYDRANT TESTING FIELD WRITE-UP

PROJECT MEMORANDUM

2023 WATER SYSTEM PLAN

City of Bellingham

Date: July 6, 2022
Project No.: 201258 (EW-0240)

Prepared By:	Aurelie Nabonnand, Carollo Engineers, Inc.
Subject:	Field Testing for Model Calibration – Hydrant Tests - DRAFT

1.0 Overview

This Calibration Plan focuses on data gathering needs for an accurate and complete calibration of the City of Bellingham's (City's) water system hydraulic model.

1.1 Schedule

Field testing and data gathering for the model calibration will take place the week of August 1, 2022. Below, a preliminary schedule is presented for the data gathering and field testing, detailing the activities within each day. This will allow our team to start the model calibration as soon as possible following the calibration data gathering. The remainder of this plan details the testing procedures for each portion of the calibration tests.

2.0 Fire Flow Testing

2.1 Overview of Fire Flow Calibration Process

Model calibration using fire flow tests is intended to develop a steady state calibrated hydraulic model by closely matching modeled water pressures to field pressures under similar demand and system operating conditions. The primary varied parameter for this calibration will be pipeline roughness coefficients and facility minor loss coefficients, although other parameters may be adjusted as calibration results are generated.

The scope of work for the City's 2023 Water System Plan includes fire flow tests at 20 locations over a one week period. The fire flow tests will consist of one or two flowing hydrants and two pressure hydrants. These field tests will be simulated in the model to calibrate the model under steady state conditions. Pressure loggers will be used to measure static and residual pressure at the pressure hydrants, and a few will also be deployed throughout the system during hydrant tests to better measure the system's reaction to each fire flow.

The fire flow tests will each stress the City's distribution system by creating a differential between the hydraulic grade line (HGL) at the points of hydrant flow and the system HGL at neighboring hydrants. This HGL differential will increase the effect of the roughness coefficients on system losses. The model roughness coefficients will be adjusted to match model pressures to field pressures within an acceptable tolerance. As the model is adjusted to match system pressures, roughness and loss coefficients will be

adjusted only within a tolerance of industry accepted roughness coefficient ranges. If the model is unable to match the calibration results without leaving the acceptable range of roughness coefficient values for a given pipeline material and age, there may be cause for further investigation of a previously unknown field condition. Examples of such conditions, which typically arise during hydraulic model calibration, include closed pipelines, partially closed or malfunctioning valves, extreme corrosion within pipelines, connectivity and diameter errors in GIS/as-builts, and diurnal patterns of large water users.

2.1.1 Fire Flow Test Locations

Carollo Engineers, Inc. (Carollo) has selected 20 preliminary testing sites, which are shown on Figure 1. Each of the testing sites is shown in detail on an individual detail map (Appendix A). Pressure loggers will also be installed in the system during the fire hydrant tests.

The test sites have been selected for accessibility and also such that they create a good geographical coverage of the City's entire distribution system. All tests involve 6-inch to 10-inch diameter pipelines and are located away from major transmission lines to increase the chance that a substantial pressure drop (> 10 pounds per square inch (psi)) is observed during the tests.

The fire test sites were selected using the City's GIS water main database, however, the City should confirm the pipeline and fire hydrant information in the vicinity of each test site (e.g., alignment, diameter, age, and material of the pipelines and location of fire hydrants).

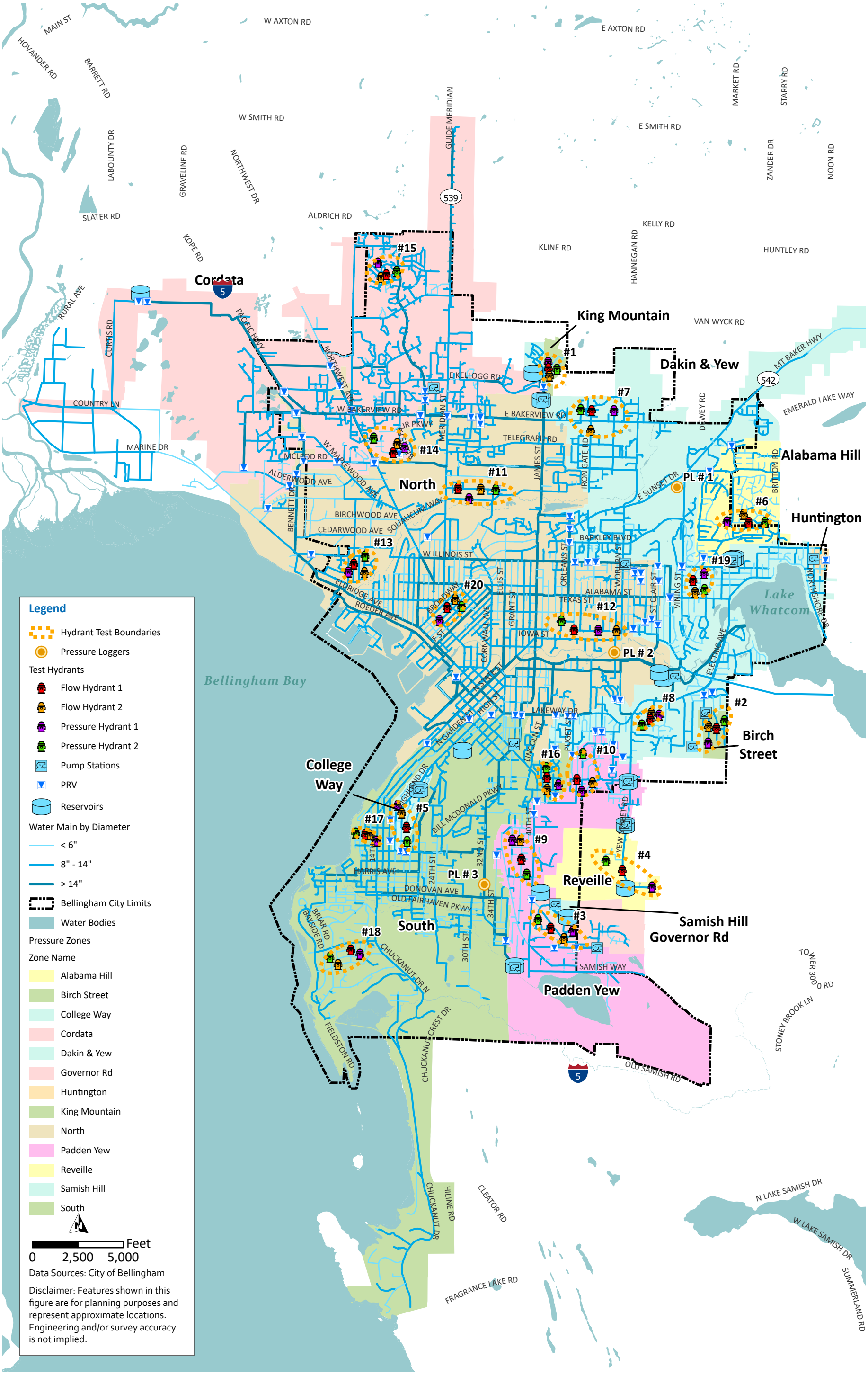


Figure 1 Proposed Hydrant Test Locations

2.1.2 Preliminary Schedule for Testing Days

The equipment testing and fire flow tests are scheduled between Monday, August 1, 2022 and Thursday, August 4, 2022. The following schedule details the events for the day.

August 1, 2022

8:00 am Meet at **TO BE DETERMINED**:

- Introductions.
- Record time difference between field time and supervisory control and data acquisition (SCADA) clock.
- Distribute packets and routing information.
- Check radios, if necessary (or fill in cell phone contact sheet).
- Calibrate pressure gauges on a nearby hydrant and record differences.
- Travel to sites determined for the day.

8:30 am - 3:00 pm:

- Install all pressure loggers as shown on Figure 1.
- Perform fire hydrant tests 15, 14, 11, 7, 1.

August 2, 2022

8:00 am Meet at **TO BE DETERMINED**:

- Distribute packets and routing information.
- Check radios, if necessary (or fill in cell phone contact sheet).
- Travel to sites determined for the day.

8:30 am - 3:00 pm:

- Perform fire hydrant tests 13, 20, 12, 19, 6, 8.

August 3, 2022

8:00 am Meet at **TO BE DETERMINED**:

- Distribute packets and routing information.
- Check radios, if necessary (or fill in cell phone contact sheet).
- Travel to sites determined for the day.

8:30 am - 3:00 pm:

- Perform fire hydrant tests 16, 9, 3, 4, 10, 2.

August 4, 2022

8:00 am Meet at **TO BE DETERMINED**:

- Distribute packets and routing information.
- Check radios, if necessary (or fill in cell phone contact sheet).
- Travel to sites determined for the day.

8:30 am - 3:00 pm:

- Perform fire hydrant tests 18, 17, 5.
- Remove all pressure loggers installed.

2.1.3 Standard Fire Flow Test Protocol

2.1.3.1 Required Equipment / Staff

Required Staff

A minimum of 6 people should be available during the hydrant flow testing for the following tasks:

- 3 City staff members at the flowing and pressure hydrant(s).
- 3 Carollo staff members at the flowing and pressure hydrants.

City staff shall be responsible for installation/removal of data loggers on hydrants, operation of valves, driving City vehicles or any other function involving City property.

Required Equipment (City)

- 3 pressure gauges (1 primary, 1 secondary, 1 spare).
- 3 flow gauges and diffusers (1 primary, 1 secondary, 1 spare).
- Dechlorinating equipment for the discharged water.
- Signage and cones for traffic safety.
- Sand bags as needed for control of discharged water.
- 6 hand-held radios or cell phones (1 per person and 1 spare).
- Wrenches and equipment to open/flow each hydrant and necessary valves.

Required Equipment (Carollo)

- Maps and field testing forms (including routing and order of testing).
- Data collection sheets.
- Means to pull data from pressure loggers.
- 5 Dickson pressure loggers.

2.1.3.2 Fire Flow Testing Procedure

1. Calibrate Meters. On the day of fire flow testing, all the pressure and flow meters should be calibrated by comparing readings when attached to the same hydrant.
2. Take Positions. Position everyone at their respective locations with their clipboard and field-testing forms and confirm that everyone is at their place via radio/cell phone/hand signals.
3. Install Pressure Loggers. Attach the pressure loggers to the pressure hydrants (P-1 and P-2) and Flow hydrant (F-1).
4. Record Pre-flow Conditions:
   a. Carollo coordinator will log the time, date and location in the testing form.
   b. Carollo coordinator will record the static pressure reading from each hydrant, one-by-one (before opening the flowing hydrant), and record in the field testing form.
5. Install Flow Gauge. Attach the flow gauge to the flow hydrant (F-1).
6. Start Hydrant Flow. Carollo coordinator will have a City staff member open the flowing hydrant (F-1) until a steady stream is flowing (divert into gutters).
7. Confirm Pressure Drop Target is Met and Record Flow Conditions:
   a. Carollo coordinator will ask for the flow from the flowing hydrant (F-1) and record in the field testing form.

   b. Carollo coordinator will obtain pressure drop from person at pressure hydrants (P-1 and P-2).
   c. Carollo coordinator will confirm that pressure is stabilized and at least 10 psi less than static pressure:
      i. If ΔP≥10 psi: go to next step.
      ii. If ΔP<10 psi: Carollo coordinator will ask person at flowing hydrant (F-1) to close the hydrant, repeat steps above with both flowing hydrants (F-1 and F-2).
      iii. If ΔP≥5 psi: go to next step (10 psi is preferred, but 5 psi is still acceptable).
      iv. If ΔP<5 psi: move to next site (test failed).
8. Close Flowing Hydrant. Carefully and slowly close the flowing hydrant. If two hydrants are flowing, close one at a time.
9. Check Results. Carollo coordinator will check for any anomalies (such as a gauge stuck on a high pressure or consistently showing significantly higher pressure than the rest of the readings). If results are irregular, repeat the test one more time.
10. Move to Next Site. If all looks good, Carollo coordinator will notify all field personnel to move on to the next hydrant flow test site.

3.0 Extended Period Calibration

The extended period calibration (EPS) improves the model's ability to simulate long-period operation of the system. The calibration is done by closely matching the model pressures, flows, and tank levels to field conditions over a 24-hour period of similar demand and system boundary conditions. Pressure data, tank levels, and flows from the water supplies, booster stations, and the pressure reducing stations will be recorded for several days in order to obtain EPS calibration data. The primary varied parameters for this calibration will be operational controls and pipeline roughness coefficients; although other parameters may also be adjusted as calibration results are generated.

3.1 Data Required for Extended Period Calibration

The calibration data required for the extended period calibration consists of records of system pressures, tank levels, and flows from the plant, interconnections, pump stations, and the pressure reducing stations throughout the distribution system. These system pressures will be gathered both by the City's existing sensor network and by temporary pressure loggers, which will be attached to hydrants throughout the distribution system. Additional data, including system controls and operational details, will be required to establish boundary conditions for the model. This data will be gathered over the course of two weeks.

A target system interval of 15 minutes will be used for data gathering. If any facilities listed lack the capabilities for 15 minute interval data gathering (e.g., they use circular charts or flow totalizers), assumptions will be necessary to interpolate data for the calibration.

3.2 Temporary Pressure Loggers

Carollo will provide 5 temporary pressure loggers to be attached to hydrants within the City's distribution system. The City has 1 pressure logger that can also be used for this field test. Our team has indicated hydrant locations for the 6 pressure loggers on Figure 2. City staff will install near these locations as local meters and appurtenances allow, tentatively between August 8, and September 7, 2022.

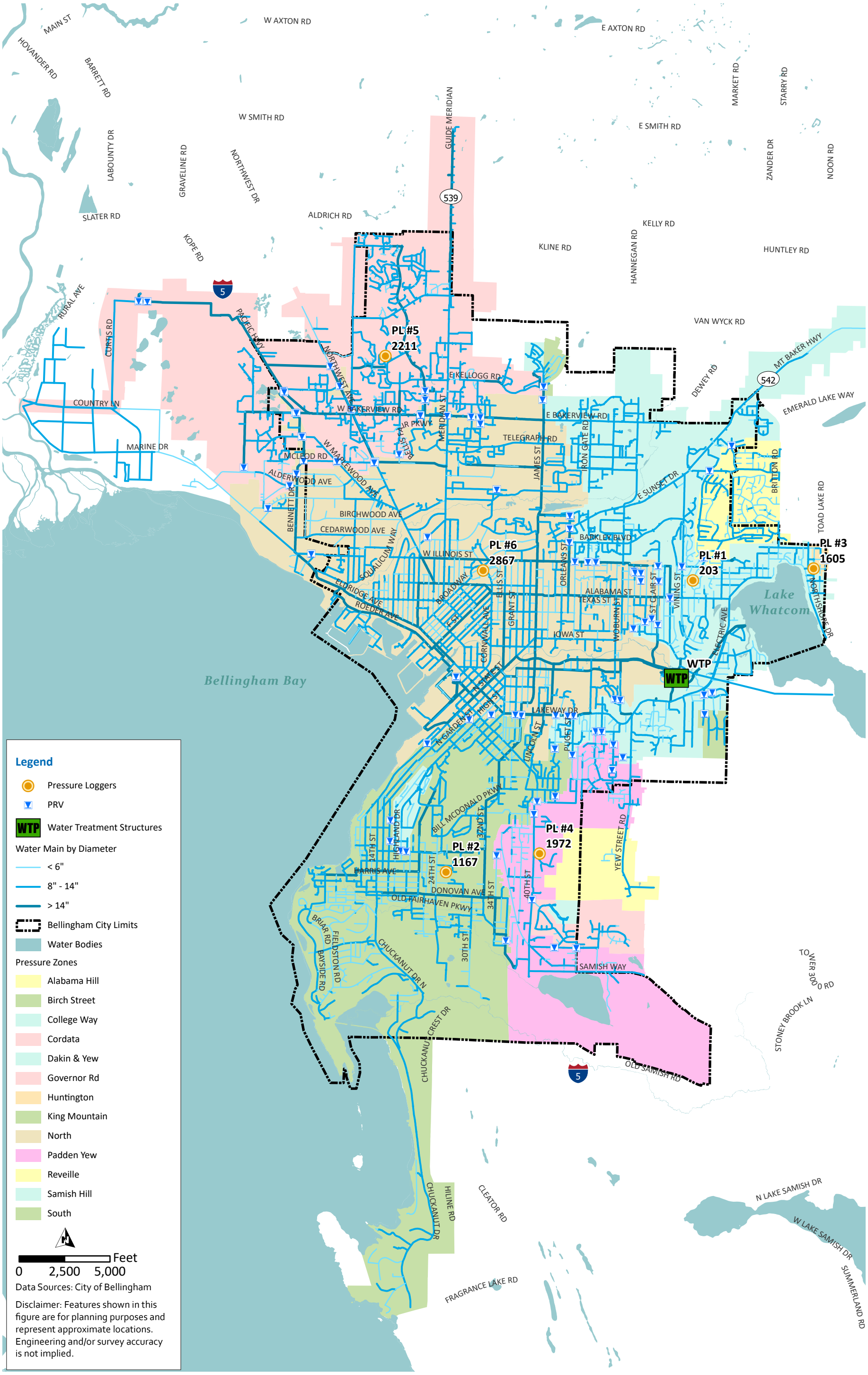


Figure 2 Pressure Logger Locations for EPS Calibration

3.2.1 Required Equipment / Staff

Required Staff (City)

City staff shall be responsible for installation/removal of data loggers on hydrants, driving City vehicles, or any other function involving City property. At the end of the testing (tentatively September 7) the City staff shall remove the loggers and Carollo will have a courier pick up the pressure loggers at **TO BE DETERMINED**.

Required Equipment (City)

- Appropriate wrenches and equipment to place loggers at each location.
- 1 pressure loggers.

Required Equipment (Carollo)

- 5 pressure loggers.

3.2.2 Models and Intermediate Readings

The sampling interval for all pressure loggers should be set to 5 minutes. Each pressure logger will require approximately 8,640 data points (12 data points per hour over 30 days).

The internal capacity of the Dickson PR125 pressure loggers is limited to 60,000 data points, and the internal capacity of Track-IT 150 pressure loggers is limited to 64,000 data points, all of which are sufficient to record 21 days of data in 5-minute intervals.

4.0 Overall Plan

The projected timeline for delivering this Calibration Plan to the City, completing hydrant testing, and collecting EPS calibration is:

- Calibration Plan to the City by July 5, 2022.
- Comments back from the City by July 15, 2022.
- Revised Plan to the City by July 22, 2022.
- Hydrant testing from August 1, 2022 to August 4, 2022.
- EPS pressure loggers from August 8, 2022 to September 7, 2022.
- Remove all loggers September 7, 2022 and courier back to Carollo.

This document is released for the purpose of information exchange review and planning only under the authority of
Aurelie Nabonnand,
July 6, 2022, WA, 56703

Prepared by:

Aurelie Nabonnand:

APPENDIX A
HYDRANT TEST SITE



Legend

Test Hydrants
- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2
- PRV
- Reservoirs

Water Main by Diameter
- < 6"
- 8" - 14"
- > 14"
- Bellingham City Limits
- Water Bodies

Feet
0 300 600

Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: Dakin & Yew
James St, Gooding Ave, and King Ave

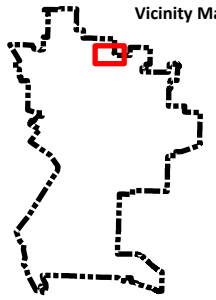
Date/Time: 08/15/2022 at 1:30 PM

Temperature: 75 F

Notes/Observations: FH - Hilly, residential neighborhood. Newer development
PH1 - Pressure up to 116 peak when hydrant closing
PH2 Hydrant is on little mound/hill, but flat nevertheless

Flowing Hydrant		**Pressure Hydrant 1**		**Pressure Hydrant 2**		**Back-up Hydrant 2**	
Hydrant #:	0339246	Hydrant #:	0317229	Hydrant #:	0317203	Hydrant #:	
Make:		Make:	Mueller	Make:		Make:	
Main Size:	12-in	Main Size:	8-in	Main Size:	8-in	Main Size:	
Static PSI:		Static PSI:	78	Static PSI:	102	Static PSI:	
Residual PSI:		Residual PSI:	30	Residual PSI:	52	Residual PSI:	
Pitot PSI:		Logger #:	51	Logger #:	50	Pitot PSI:	
Flow GPM:	500					Flow GPM:	
Duration:	1-2 mins					Duration:	

Vicinity Map



Notes/Photographs: (Test 1)

Location of pressure hydrant P1



Logger setup for pressure hydrant P1



Location of pressure hydrant P2



Logger setup for pressure hydrant P2



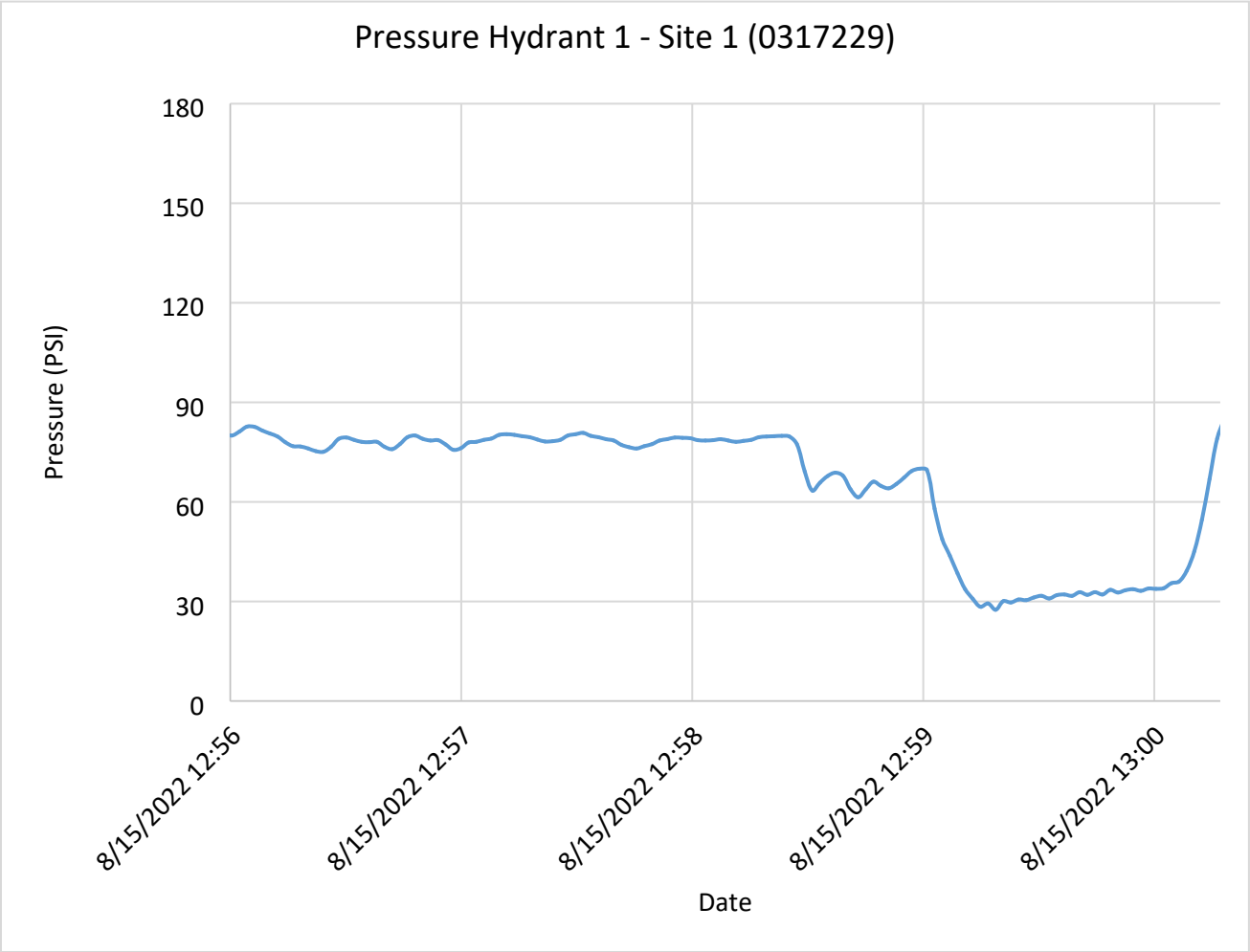
Surrounding area of flowing hydrant F1

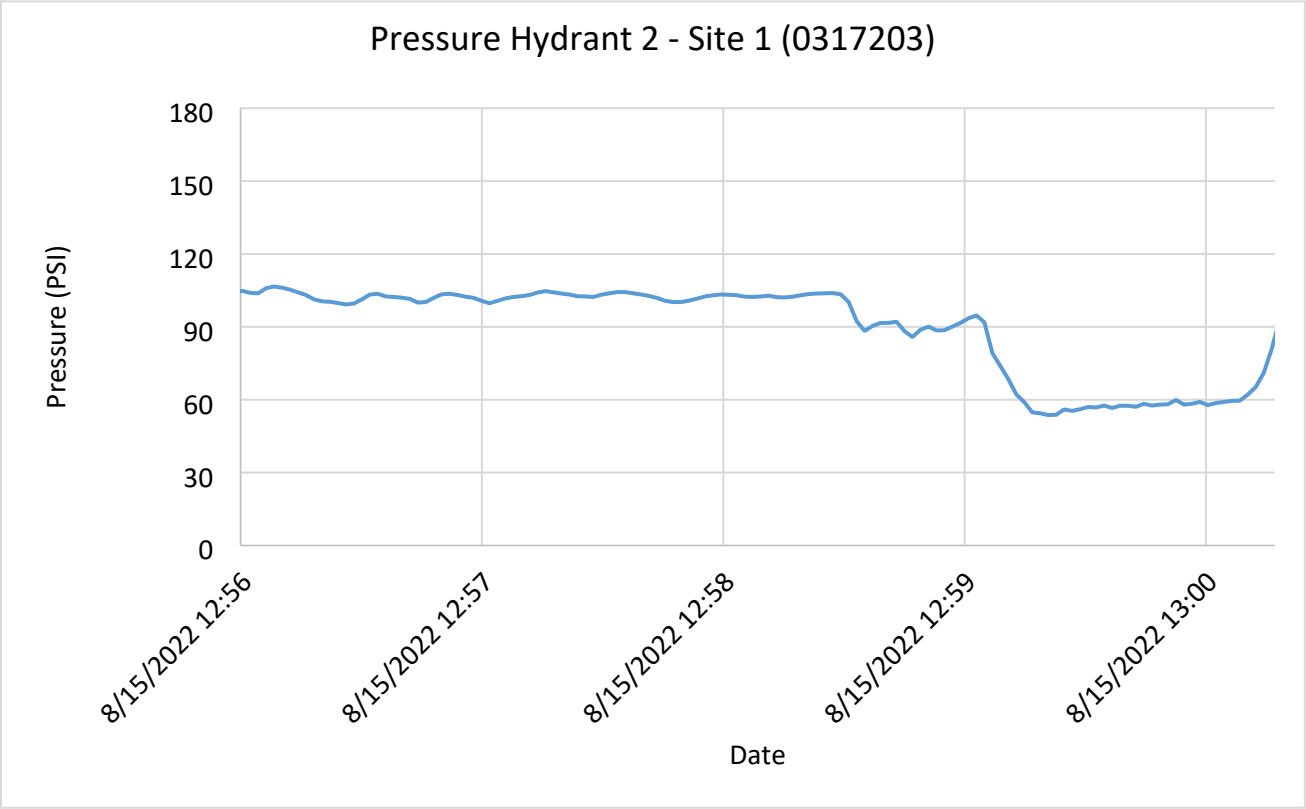


Diffuser setup of flowing hydrant F1

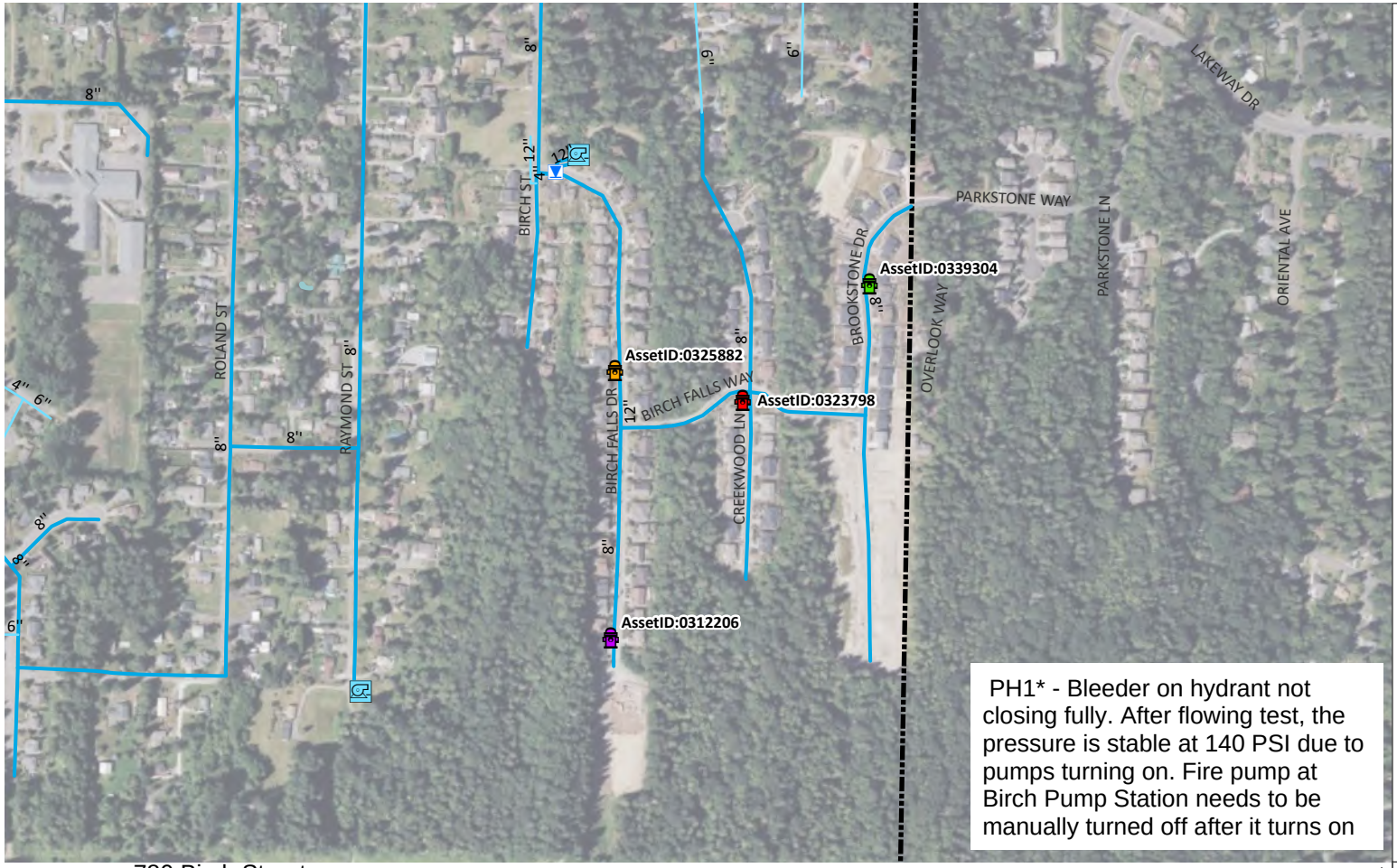


Pressure at Data Loggers:





Test notes:
For first attempt on 8/15/20222, flow meter at flowing hydrant was not working. Pump 3 tripped at Birch St PS and stopped test. Abandoning test and will retry tomorrow.
Second attempt for Test 2 on 8/16/2022, coordinated with techs at Birch St PS to monitor pumps.



PH1* - Bleeder on hydrant not closing fully. After flowing test, the pressure is stable at 140 PSI due to pumps turning on. Fire pump at Birch Pump Station needs to be manually turned off after it turns on

Legend

Test Hydrants
- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2
- Pump Stations
- PRV

Water Main by Diameter
- < 6"
- 8" - 14"
- Bellingham City Limits
- Water Bodies

Feet
0 300 600

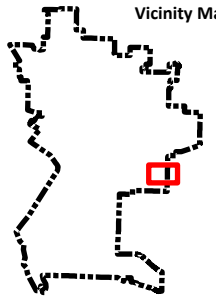
Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 780 Birch Street
Birch Falls Dr, Birch Falls Way, and Brookstone Dr
Date/Time: 08/16/2022 at 1:08 PM
Temperature: Warm
Notes/Observations:
FH - hilly, residential area
PH1 - top of hill, residential area
PH2 - street is at an incline

Flowing Hydrant	Pressure Hydrant 1	Pressure Hydrant 2	Back-up Hydrant 2
Hydrant #: 0323798	Hydrant #: 0312206	Hydrant #: 0339304	Hydrant #:
Make:	Make: M&H - 929	Make:	Make:
Main Size: 12-in	Main Size: 8-in	Main Size: 8-in	Main Size:
Static PSI:	Static PSI: 93	Static PSI: 114	Static PSI:
Residual PSI:	Residual PSI: 18	Residual PSI: 36	Residual PSI:
Pitot PSI:	Logger #: 51	Logger #: 50	Pitot PSI:
Flow GPM: 530			Flow GPM:
Duration: 1-2 mins			Duration:

Vicinity Map



Notes/Photographs: (Test 2)

Location of pressure hydrant P1



Logger setup for pressure hydrant P1



Location of pressure hydrant P2



Logger setup for pressure hydrant P2



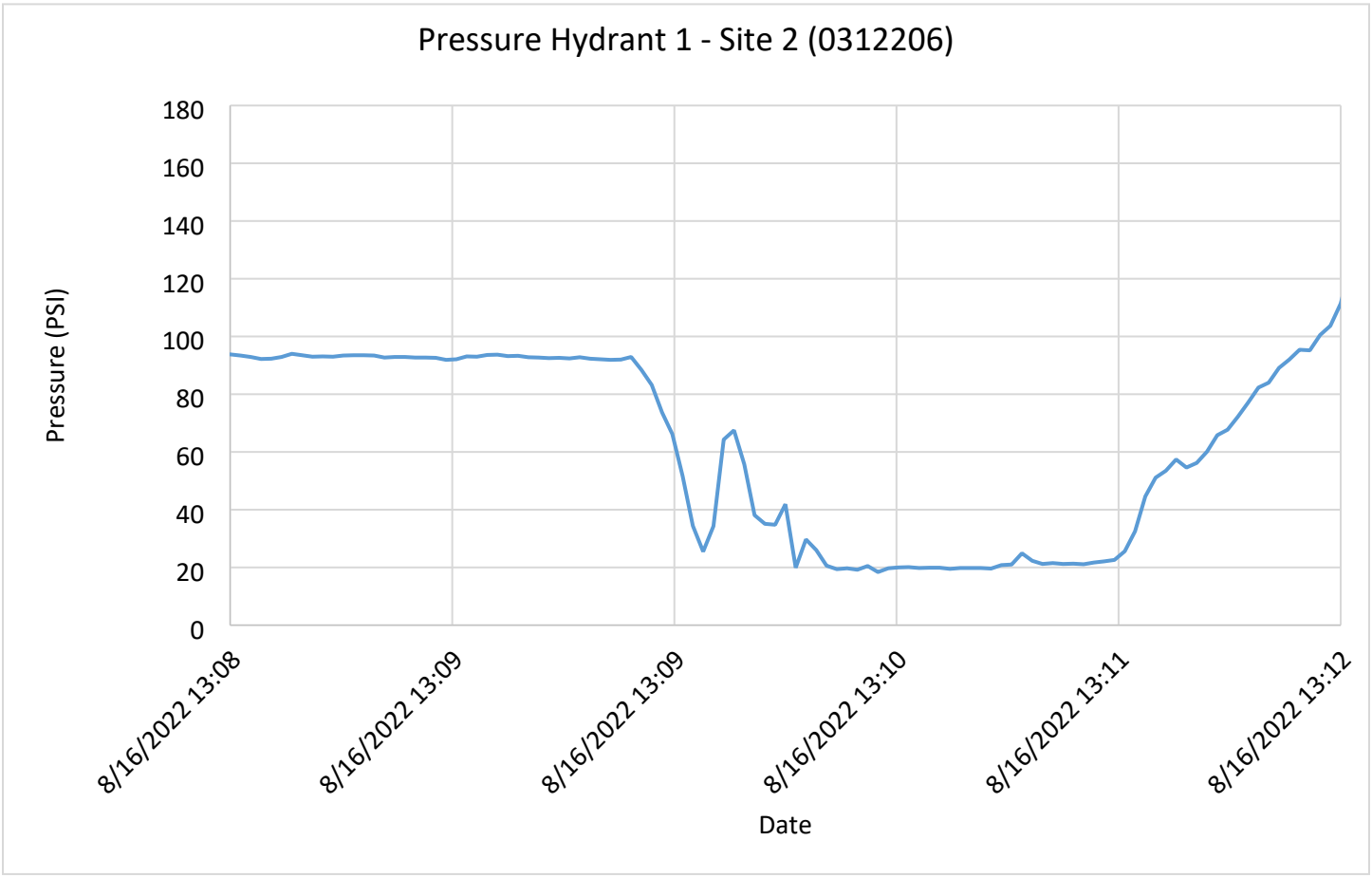
Surrounding area of flowing hydrant F1

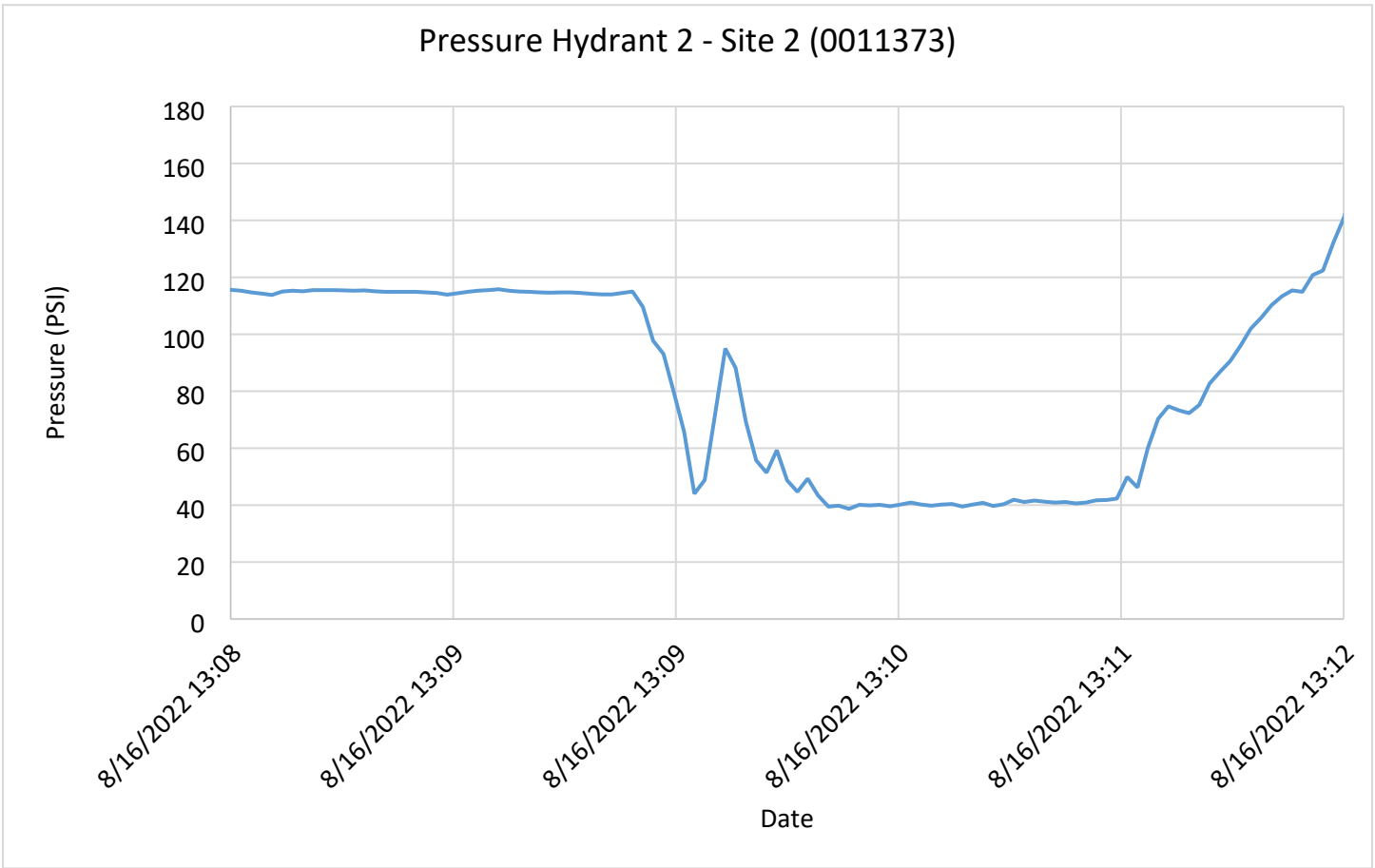


Diffuser setup of flowing hydrant F1



Pressure at Data Loggers:







Legend

Test Hydrants
- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2

Pump Stations

PRV

Reservoirs

Water Main by Diameter
- < 6"
- 8" - 14"

Bellingham City Limits

Water Bodies

N

0 300 600 Feet

Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 873 Governor Road
40th St, Parkhurst Dr, and Raptor Ln

Date/Time: 08/16/2022 at 4PM

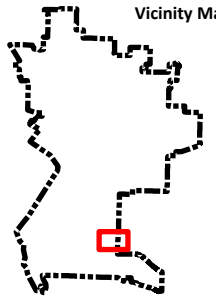
Temperature: 80 F

Notes/Observations:

PH1 - Top of hilly residential area, hydrant on flat/slight incline road
PH2 - on slightly sloped hill
FH - Hydrant on a sloped street in hilly neighborhood. Flush for a min after test

Flowing Hydrant	**Pressure Hydrant 1**	**Pressure Hydrant 2**	**Back-up Hydrant 2**
Hydrant #: 0314811	Hydrant #: 0124339	Hydrant #: 0131387	Hydrant #:
Make:	Make:	Make:	Make:
Main Size: 8-in	Main Size: 8-in	Main Size: 8-in	Main Size:
Static PSI:	Static PSI: 56	Static PSI: 108	Static PSI:
Residual PSI:	Residual PSI: 40	Residual PSI: 84	Residual PSI:
Pitot PSI:	Logger #: 51	Logger #: 50	Pitot PSI:
Flow GPM: 700			Flow GPM:
Duration: 1-2 mins			Duration:

Vicinity Map



Notes/Photographs: (Test 3)

Location of pressure hydrant P1



Logger setup for pressure hydrant P1



Location of pressure hydrant P2



Logger setup for pressure hydrant P2



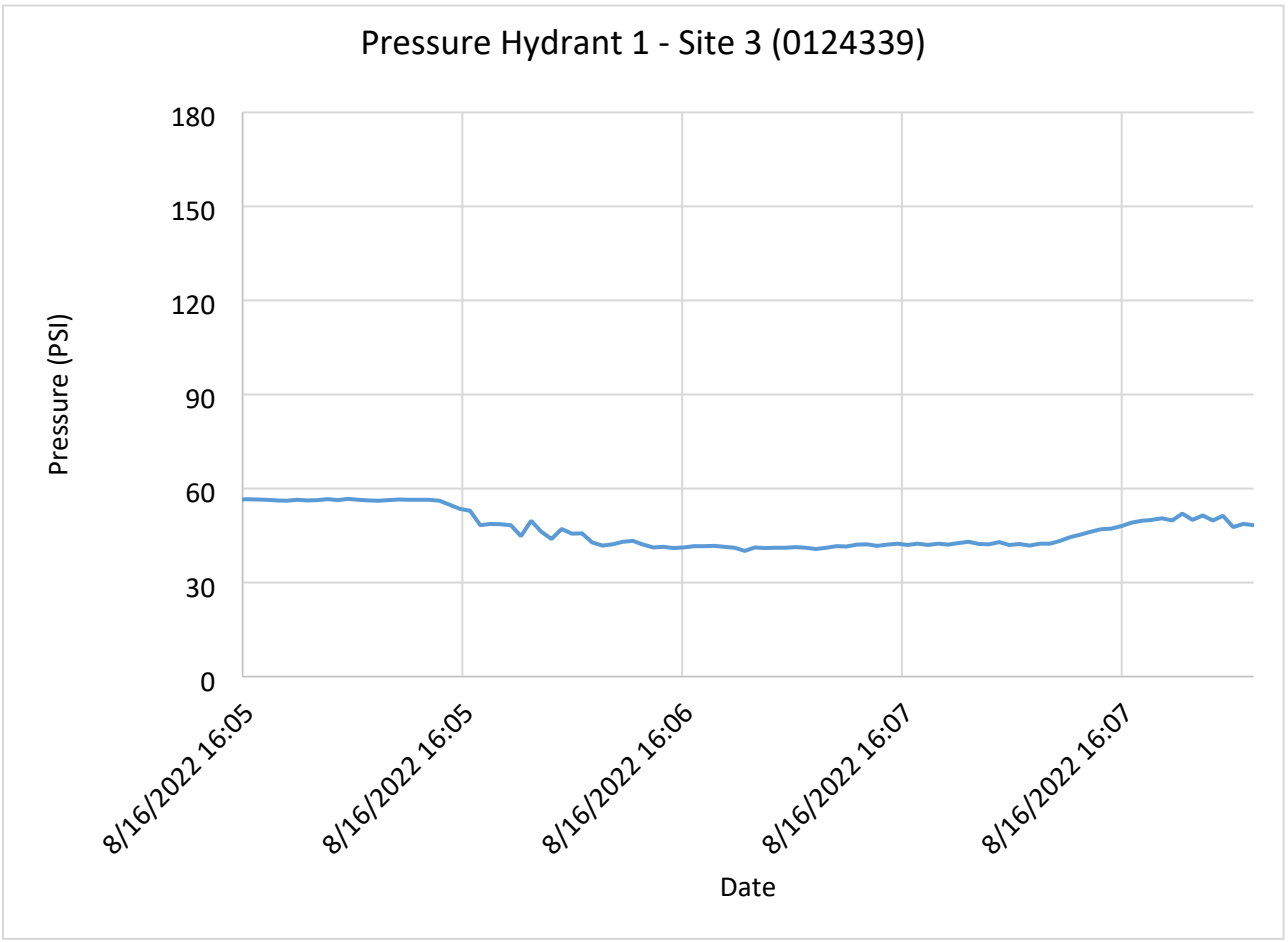
Surrounding area of flowing hydrant F1

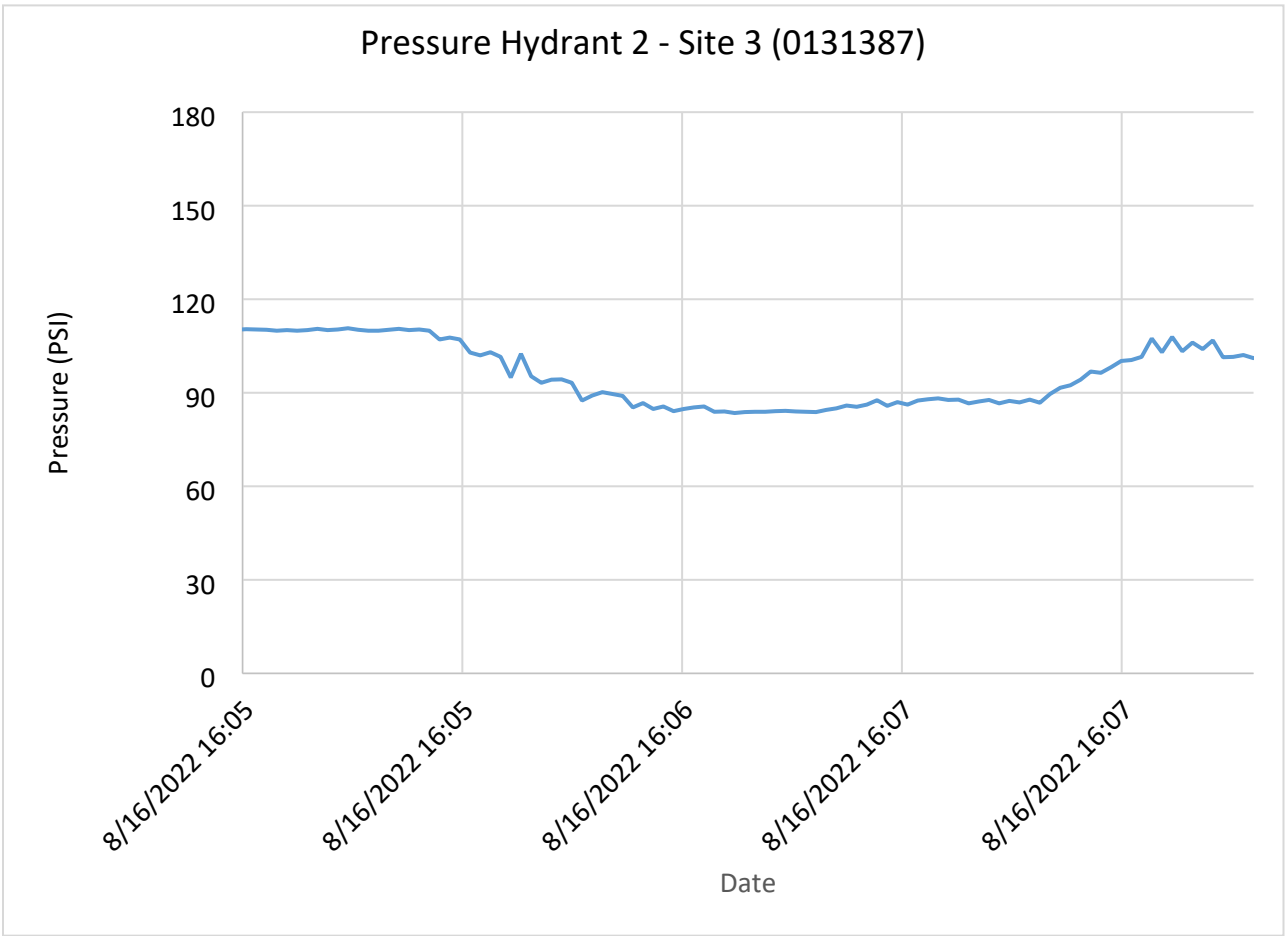


Diffuser setup of flowing hydrant F1



Pressure at Data Loggers:





Test notes:
2:27PM Turned on flowing hydrant to full flow: Not much flow from hydrant, large pressure drop at pressure hydrant, stopped test.
2:32 PM Restarted flow slowly: large pressure drop at pressure hydrant (14 psi and 24 psi) with very low flow from hydrant, tech confirmed fire flow pumps are on at PS when the hydrant is open, but there was no boost in pressure seen as the pressure hydrants.
Closed flowing hydrant: regained pressure at pressure hydrants, FF pumps turn off.
Flow meter not registering due to low flow. Will need to look at AMI data to approximate test flow.



Legend

Test Hydrants
- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2

Reservoirs

Water Main by Diameter
- < 6"
- 8" - 14"

Water Bodies

Feet
0 350 700

Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 830 Reveille
Yew St, E Douglas Ave, and Kingsmill St

Date/Time: 08/16/2022 at 2:30PM

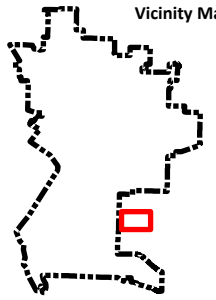
Temperature: Warm

Notes/Observations:

FH - rural/residential
PH1 - In gravel road, up steep road then on a flat unmaintained in the forest. Hydrant in the bush.

Flowing Hydrant	Pressure Hydrant 1	Pressure Hydrant 2	Back-up Hydrant 2
Hydrant #: 0011372	Hydrant #: 0121517	Hydrant #: 0011373	Hydrant #:
Make:	Make: M&H	Make:	Make:
Main Size: 8-in	Main Size: 8-in	Main Size: 4-in	Main Size:
Static PSI:	Static PSI: 91	Static PSI: 78	Static PSI:
Residual PSI:	Residual PSI: 28	Residual PSI: 14	Residual PSI:
Pitot PSI:	Logger #: 51	Logger #: 50	Pitot PSI:
Flow GPM:			Flow GPM:
Duration:			Duration:

Vicinity Map



Notes/Photographs: (Test 4)

Location of pressure hydrant P1



Logger setup for pressure hydrant P1



Location of pressure hydrant P2



Logger setup for pressure hydrant P2



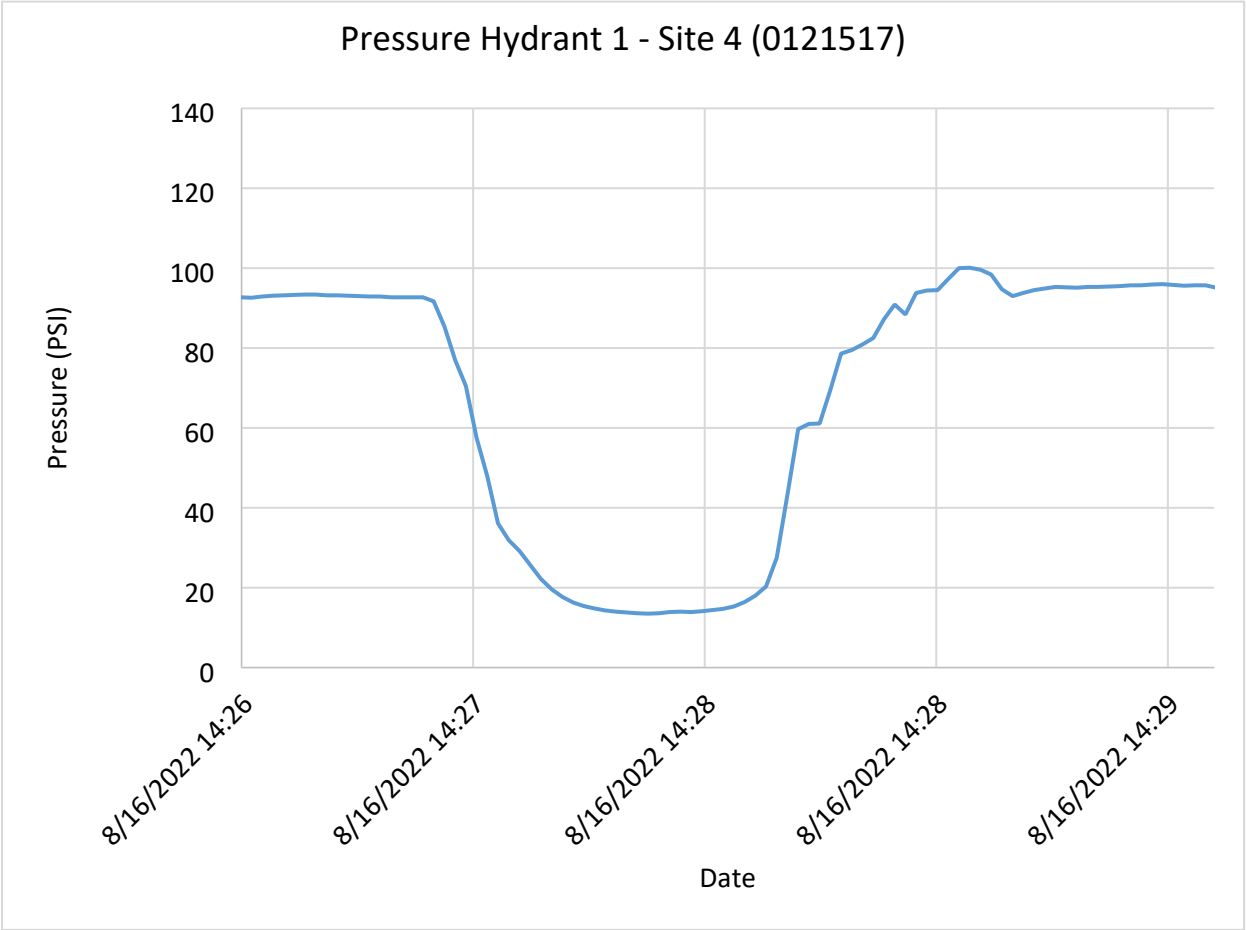
Surrounding area of flowing hydrant F1

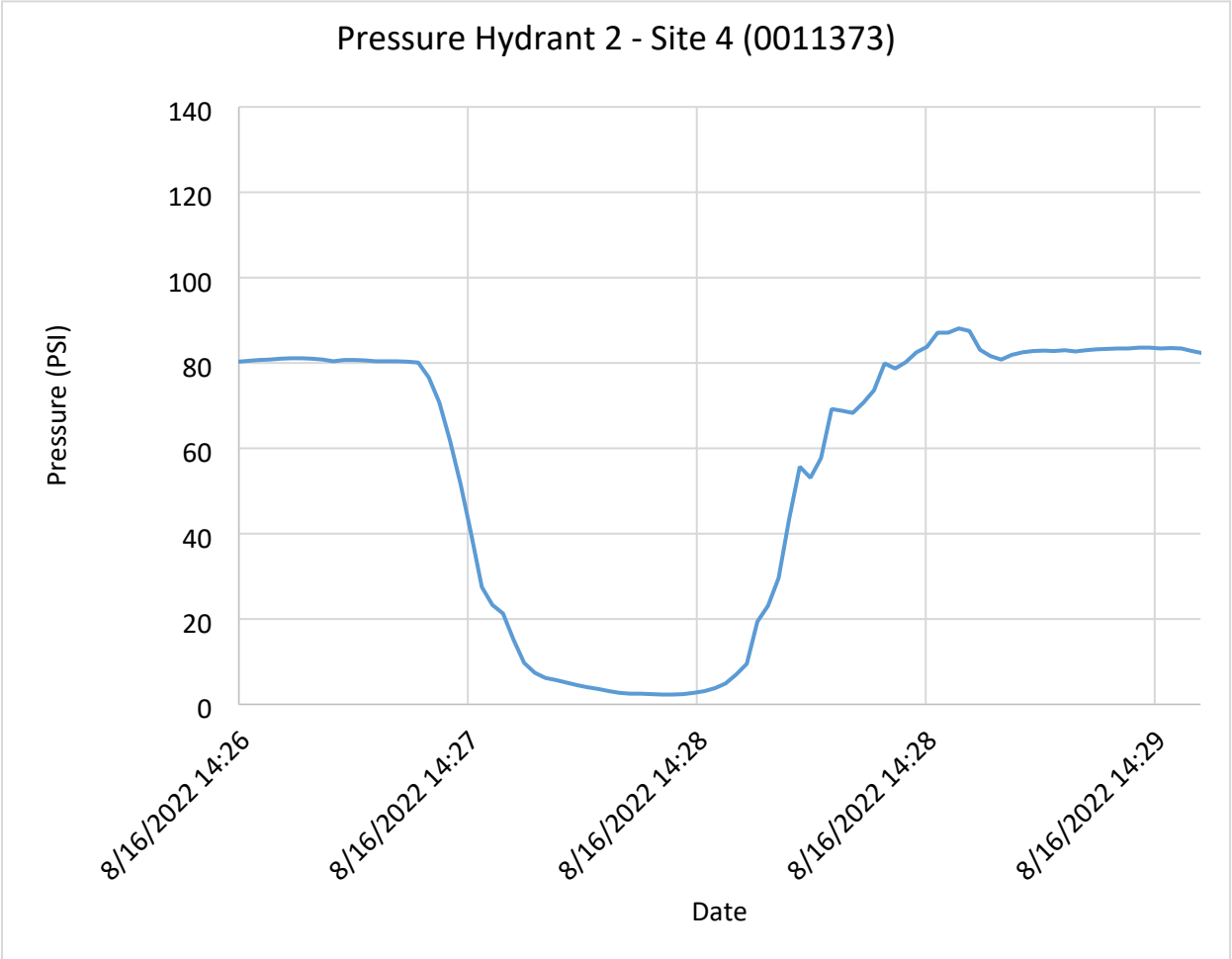


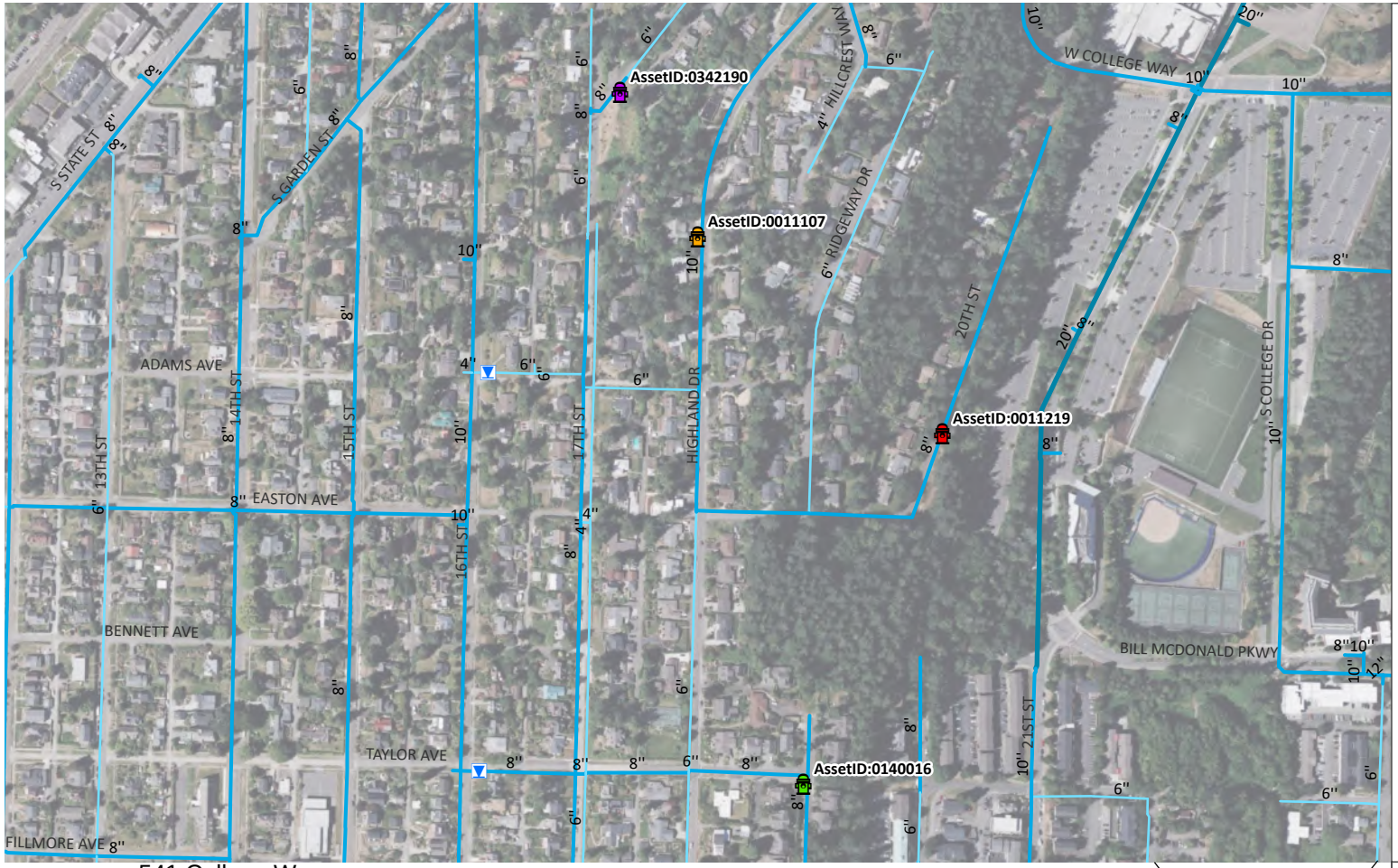
Diffuser setup of flowing hydrant F1



Pressure at Data Loggers:







Legend

Test Hydrants

- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2
- PRV

Water Main by Diameter

- < 6"
- 8" - 14"
- > 14"
- Bellingham City Limits

N

0 250 500 Feet

Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 541 College Way
17th St, Highland Dr, and 20th St

Date/Time: 08/16/2022 at 3:18PM

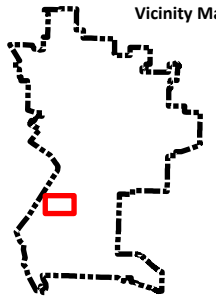
Temperature: 75 F

Notes/Observations:

FH - Residential one side of street, forest another
PH1 - Very hilly area on steep hill near construction
PH2 - Flat ground, at bottom of little slope

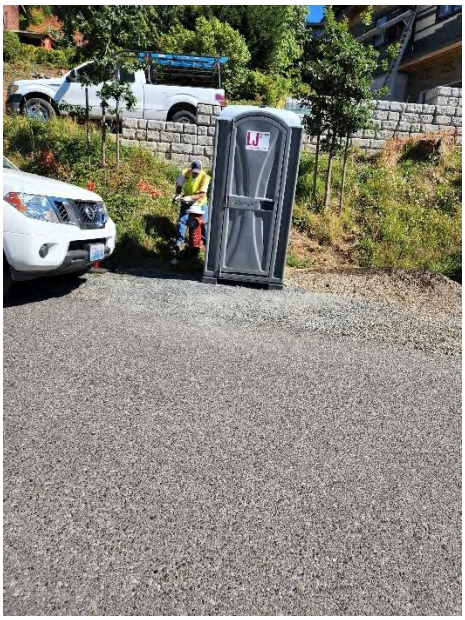
Flowing Hydrant		**Pressure Hydrant 1**		**Pressure Hydrant 2**		**Back-up Hydrant 2**	
Hydrant #:	0011219	Hydrant #:	0342190	Hydrant #:	0140016	Hydrant #:	
Make:		Make:	Clow	Make:		Make:	
Main Size:	8-in	Main Size:	8-in	Main Size:	8-in	Main Size:	
Static PSI:		Static PSI:	112/110	Static PSI:	71	Static PSI:	
Residual PSI:		Residual PSI:	90	Residual PSI:	20	Residual PSI:	
Pitot PSI:		Logger #:	51	Logger #:	50	Pitot PSI:	
Flow GPM:	530					Flow GPM:	
Duration:	1-2 mins					Duration:	

Vicinity Map



Notes/Photographs: (Test 5)

Location of pressure hydrant P1



Logger setup for pressure hydrant P1



Location of pressure hydrant P2



Logger setup for pressure hydrant P2



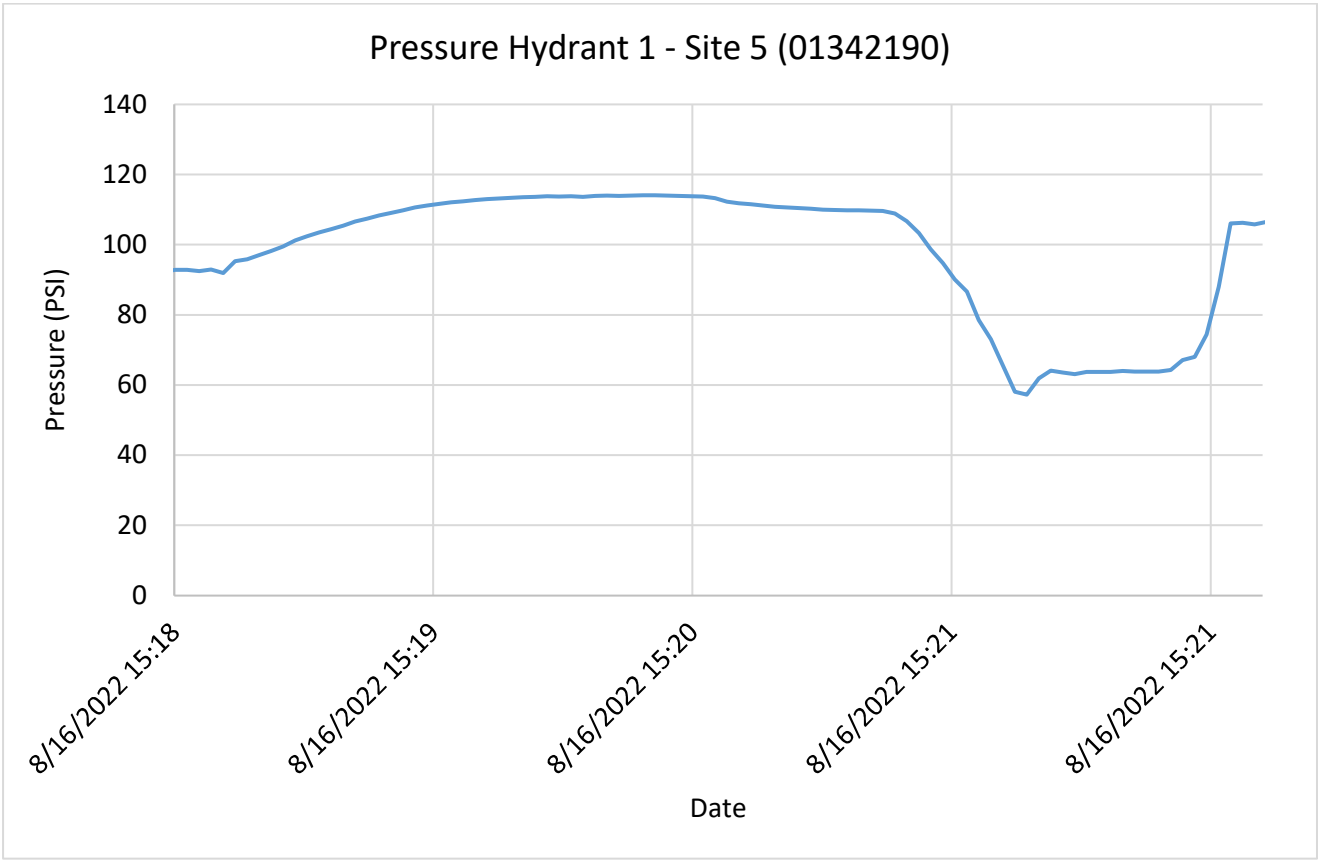
Surrounding area of flowing hydrant F1

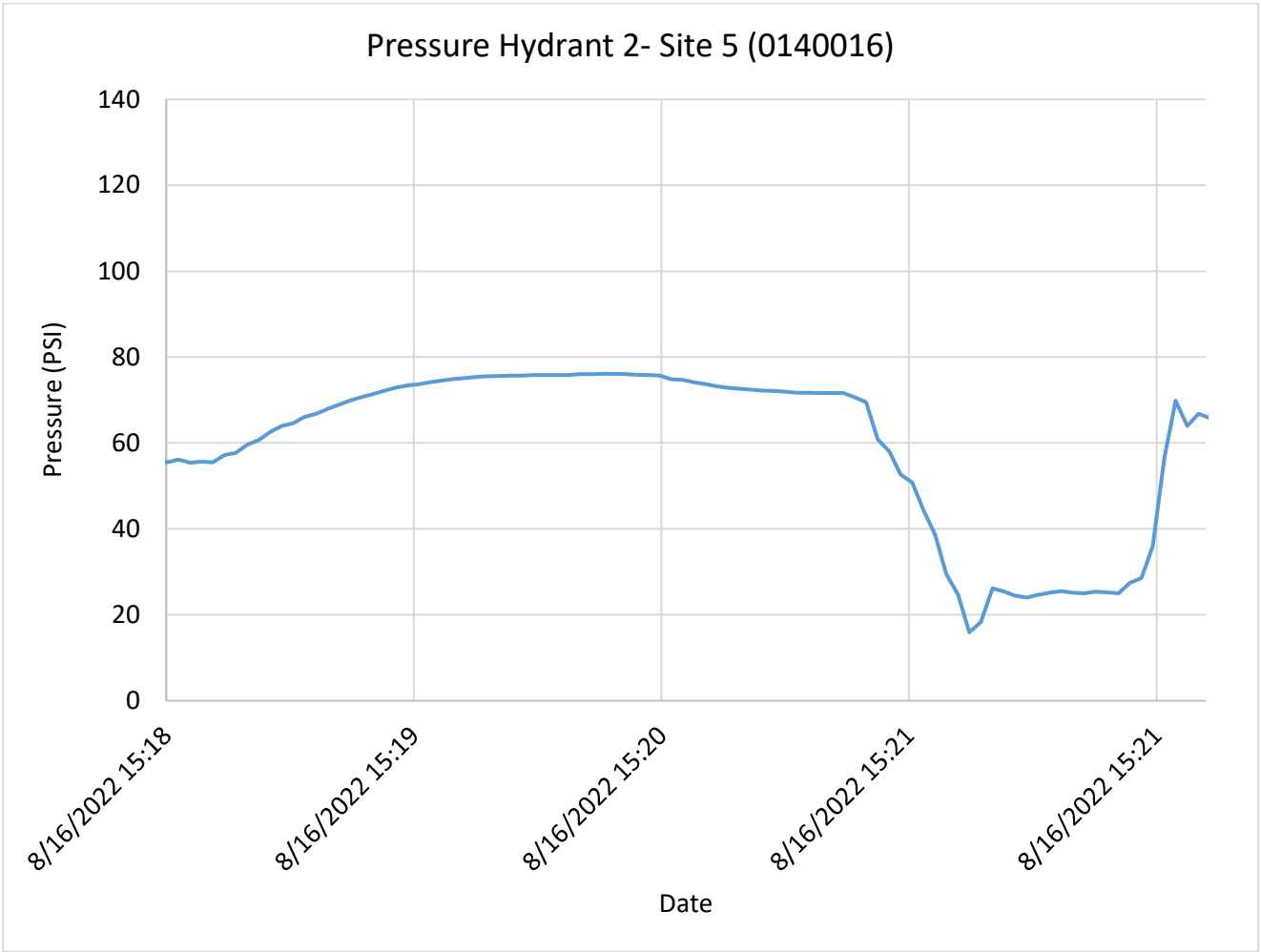


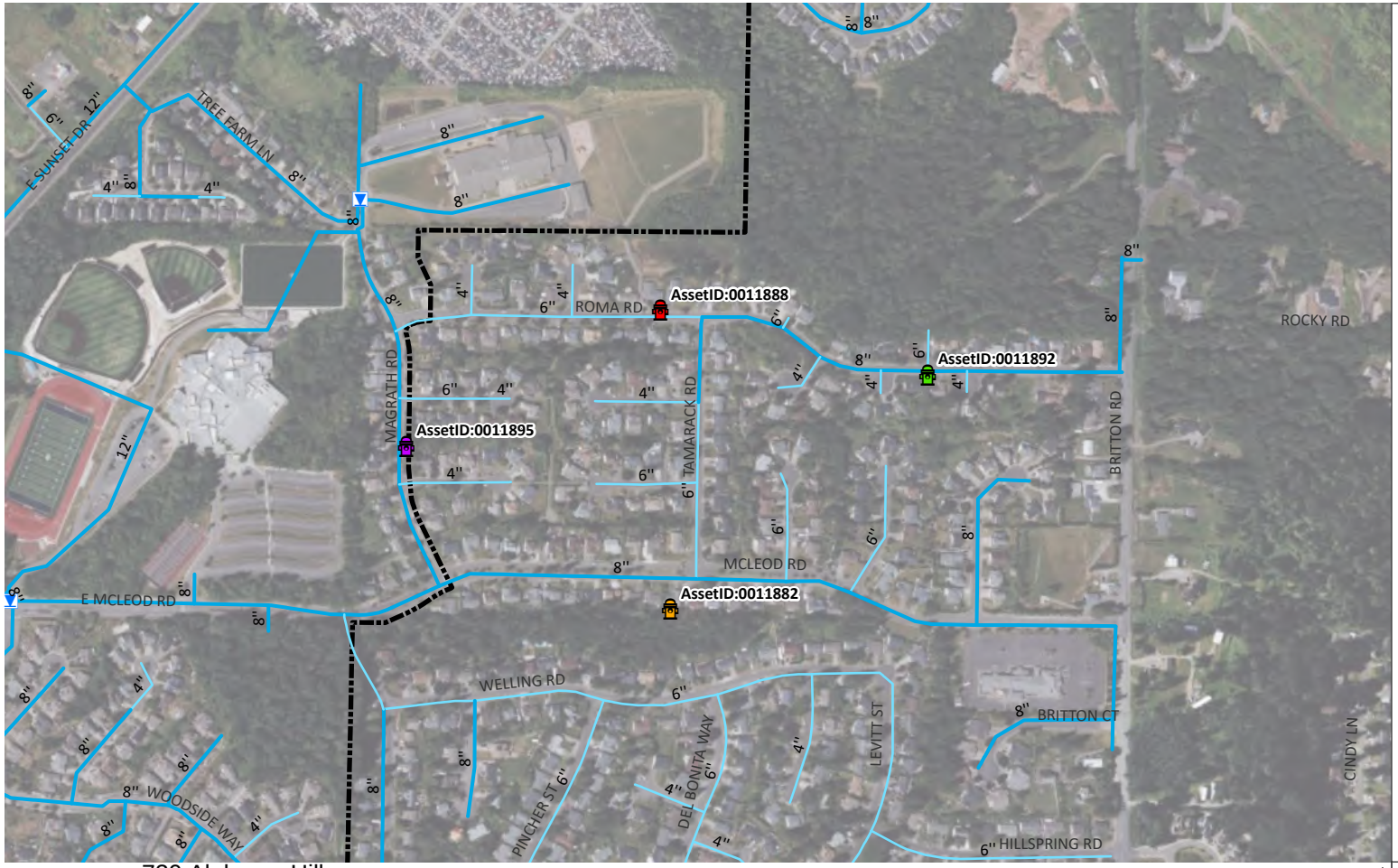
Diffuser setup of flowing hydrant F1



Pressure at Data Loggers:







Legend

Test Hydrants

- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2
- PRV

Water Main by Diameter

- < 6"
- 8" - 14"
- Bellingham City Limits

Feet
0 300 600

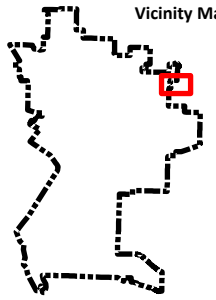
Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 730 Alabama Hill
Roma Rd and Magrath Rd
Date/Time: 8/15/2022 at 1:37 PM
Temperature: 77 F
Notes/Observations:
FH - Relatively flat street
PH1 - End psi of 133 after test
PH2 - Hydrant at bottom of slope

Flowing Hydrant	Pressure Hydrant 1	Pressure Hydrant 2	Back-up Hydrant 2
Hydrant #: 0011888	Hydrant #: 0011895	Hydrant #: 0011892	Hydrant #:
Make:	Make: Clow	Make:	Make:
Main Size: 6-in	Main Size: 8-in	Main Size: 8-in	Main Size:
Static PSI:	Static PSI: 128	Static PSI: 132	Static PSI:
Residual PSI:	Residual PSI: 54	Residual PSI: 40	Residual PSI:
Pitot PSI:	Logger #: 51	Logger #: 50	Pitot PSI:
Flow GPM: 530			Flow GPM:
Duration: 1 min			Duration:

Vicinity Map



Notes/Photographs: (Test 6)

Location of pressure hydrant P1



Logger setup for pressure hydrant P1



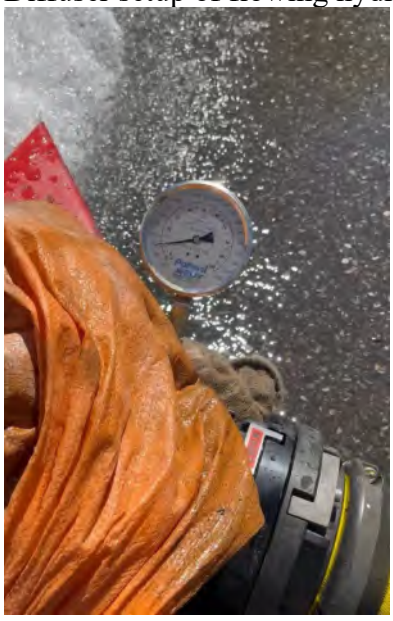
Location of pressure hydrant P2



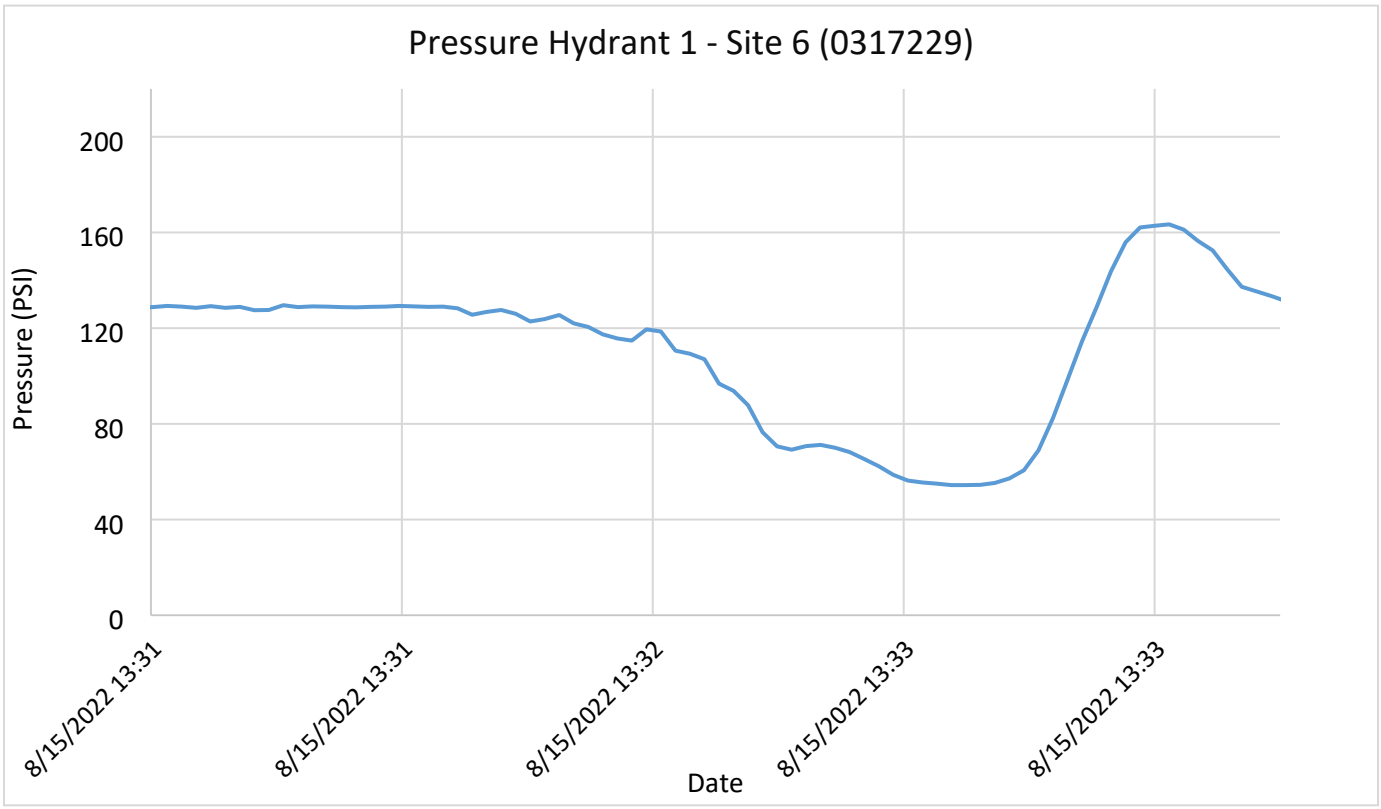
Surrounding area of flowing hydrant F1

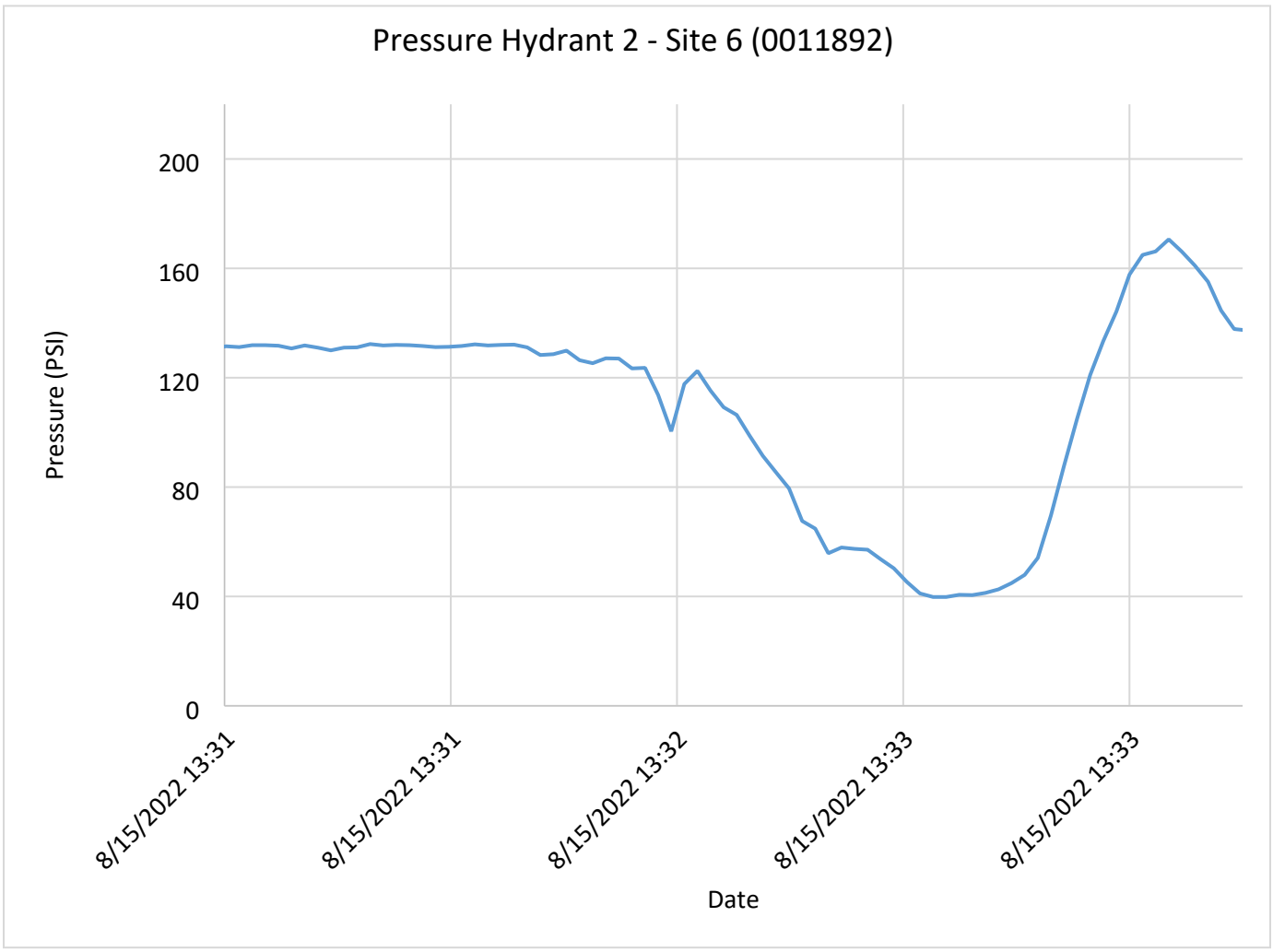


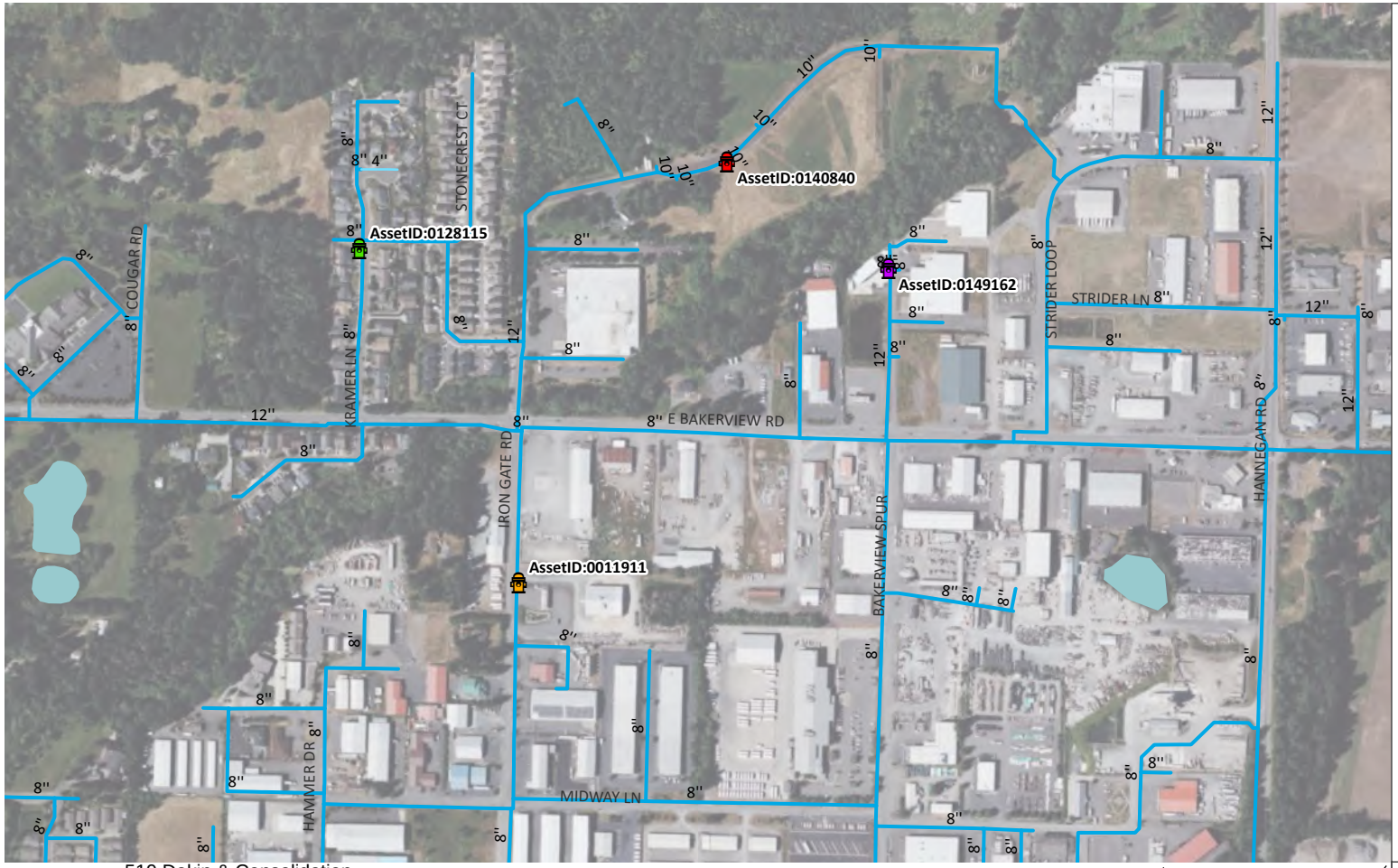
Diffuser setup of flowing hydrant F1



Pressure at Data Loggers:







Legend

Test Hydrants

- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2

Water Main by Diameter

- < 6"
- 8" - 14"

- Bellingham City Limits
- Water Bodies

0 300 600 Feet

Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 519 Dakin & Consolidation Iron Gate Rd, Bakerview Spur, and Kramer Ln

Date/Time: 8/15/2022 at 11:36 AM

Temperature: 72 F

Notes/Observations:

FH - Top of hill, dry, isolated residential
PH1 - Generally flat, light industrial area, hydrant was difficult to open
PH2 - Flat ground

Flowing Hydrant

Hydrant #: 0140840
Make: M&H
Main Size: 10-in
Static PSI:
Residual PSI:
Pitot PSI:
Flow GPM: 675
Duration: 1-2 minutes

Pressure Hydrant 1

Hydrant #: 0149162
Make:
Main Size: 12-in
Static PSI: 139
Residual PSI: 80
Logger #: 51

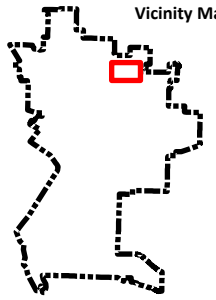
Pressure Hydrant 2

Hydrant #: 0128115
Make:
Main Size: 8-in
Static PSI: 140
Residual PSI: 90
Logger #: 50

Back-up Hydrant 2

Hydrant #:
Make:
Main Size:
Static PSI:
Residual PSI:
Pitot PSI:
Flow GPM:
Duration:

Vicinity Map



Notes/Photographs: (Test 7)

Location of pressure hydrant P1



Logger setup for pressure hydrant P1



Location of pressure hydrant P2



Logger setup for pressure hydrant P2



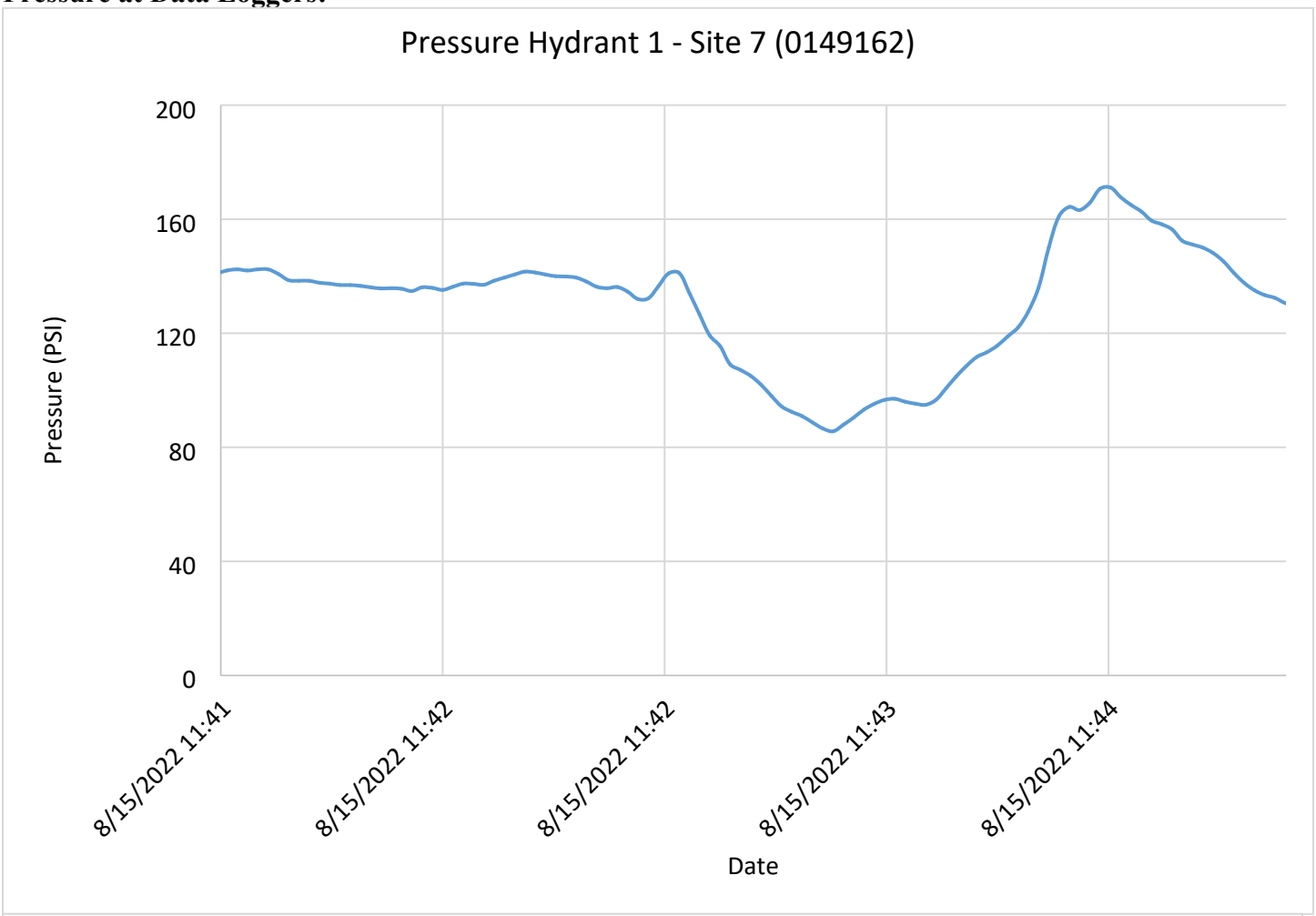
Surrounding area of flowing hydrant F1

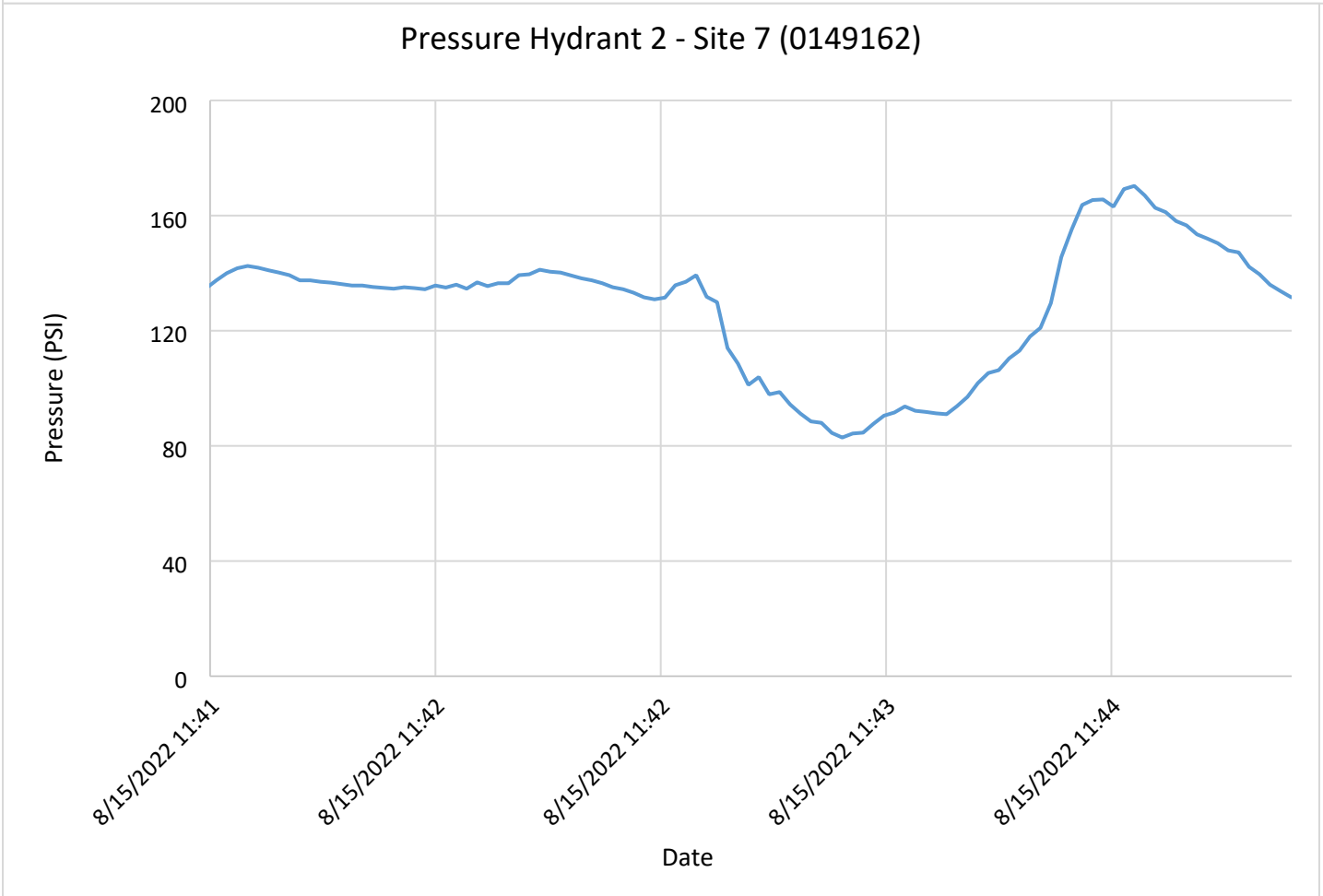


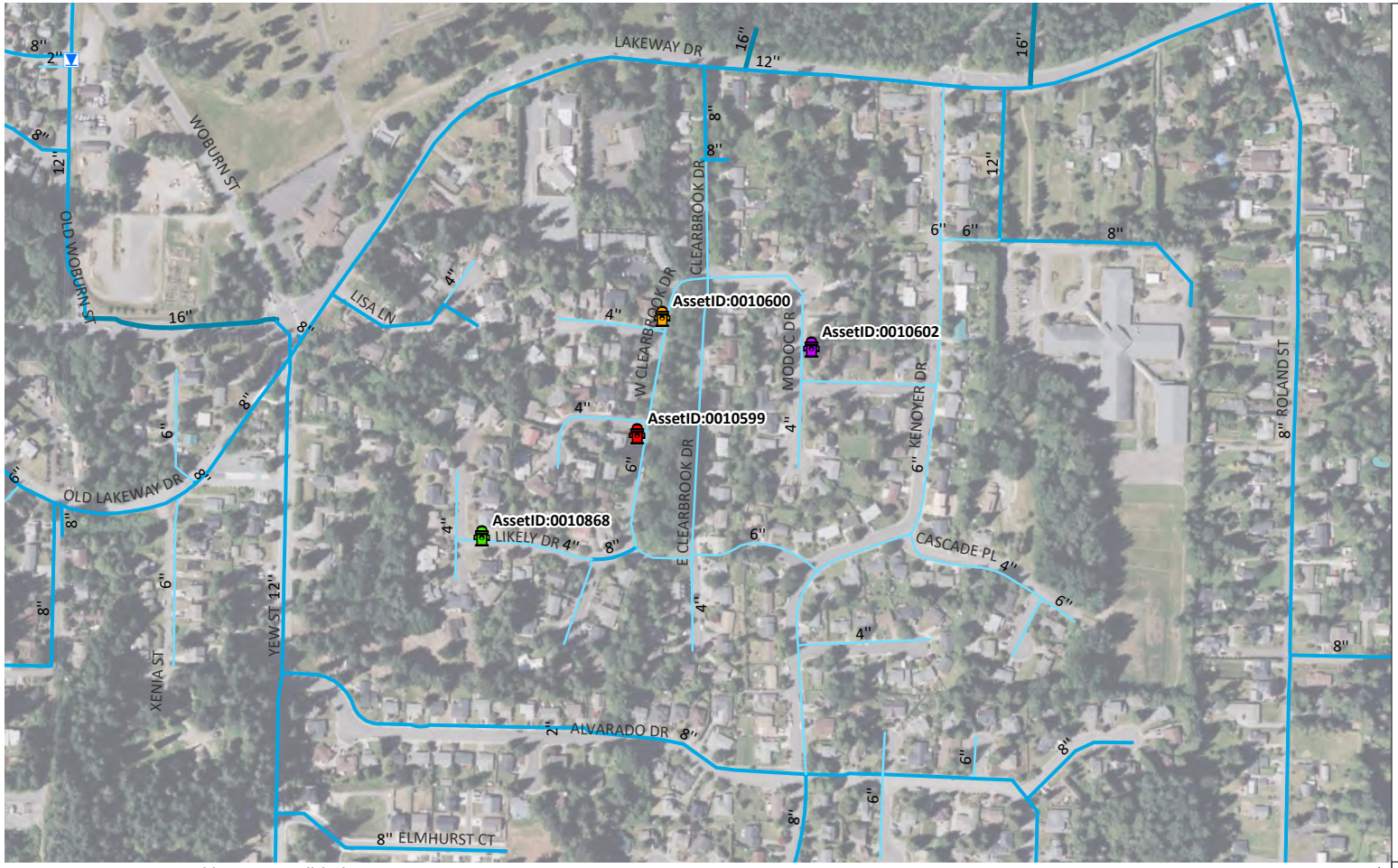
Diffuser setup of flowing hydrant F1



Pressure at Data Loggers:







Legend

Test Hydrants
- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2
- PRV

Water Main by Diameter
- < 6"
- 8" - 14"
- > 14"

- Bellingham City Limits
- Water Bodies

Feet
0 250 500

Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 519 Dakin & Consolidation
W Clearbrook Dr, Likely Dr, and Modoc Dr

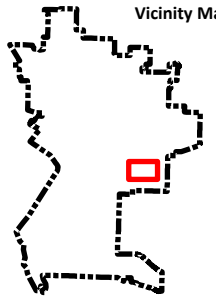
Date/Time: 8/15/2022 at 3:23 PM

Temperature: 79 F

Notes/Observations:
FH - Residential neighborhood on street west of steam. slightly sloping street
PH1 - Sloping hill, hydrant in the middle of hill
PH2 - Flat ground

Flowing Hydrant		**Pressure Hydrant 1**		**Pressure Hydrant 2**		**Back-up Hydrant 2**	
Hydrant #:	0010599	Hydrant #:	0010602	Hydrant #:	0010868	Hydrant #:	
Make:		Make:		Make:		Make:	
Main Size:		Main Size:	4-in	Main Size:	6-in	Main Size:	
Static PSI:		Static PSI:	77	Static PSI:	56	Static PSI:	
Residual PSI:		Residual PSI:	66	Residual PSI:	30	Residual PSI:	
Pitot PSI:		Logger #:	51	Logger #:	50	Pitot PSI:	
Flow GPM:	405					Flow GPM:	
Duration:	1-2 minutes					Duration:	

Vicinity Map



Notes/Photographs: (Test 8)

Location of pressure hydrant P1



Logger setup for pressure hydrant P1



Location of pressure hydrant P2



Logger setup for pressure hydrant P2



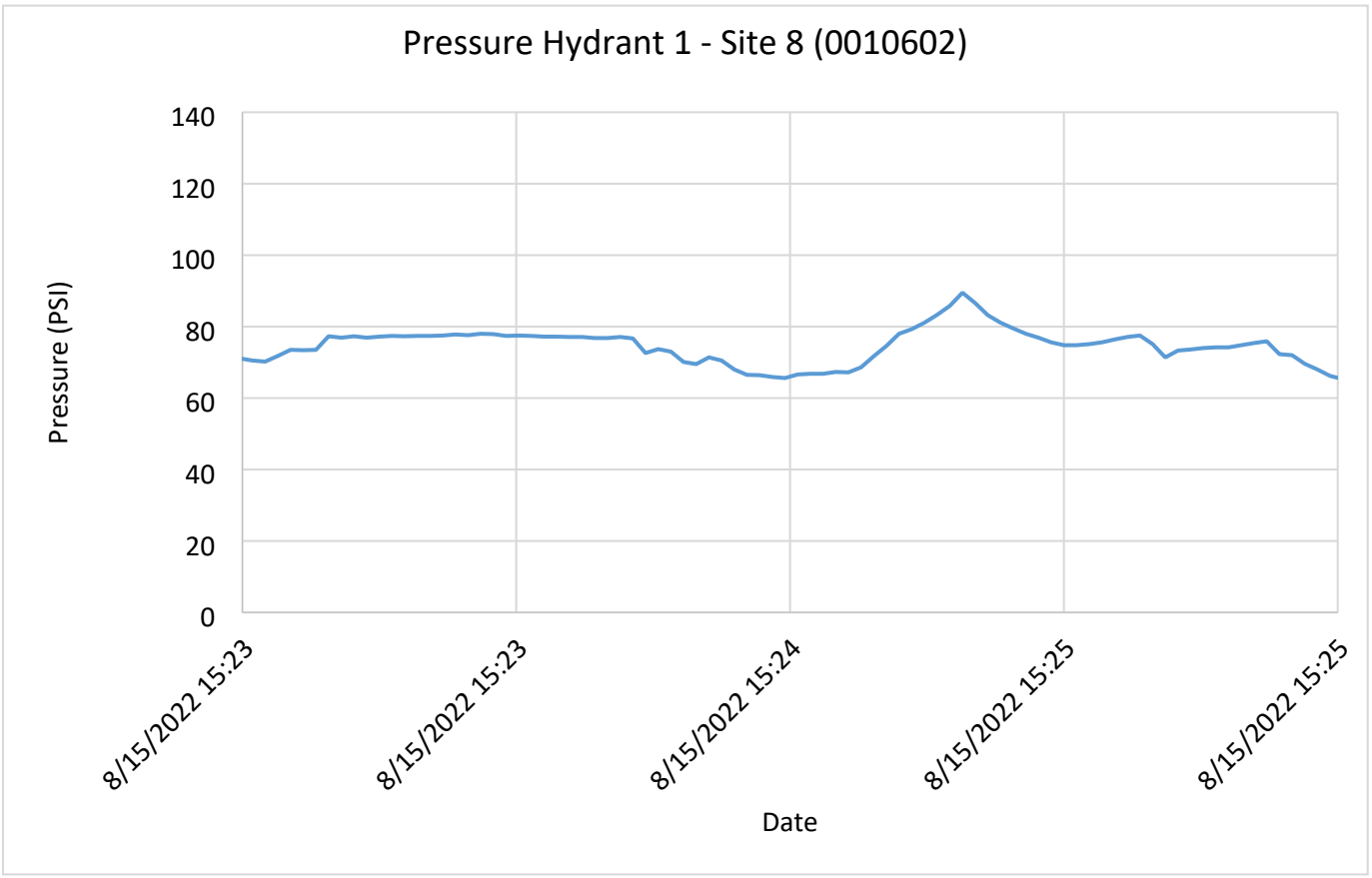
Surrounding area of flowing hydrant F1

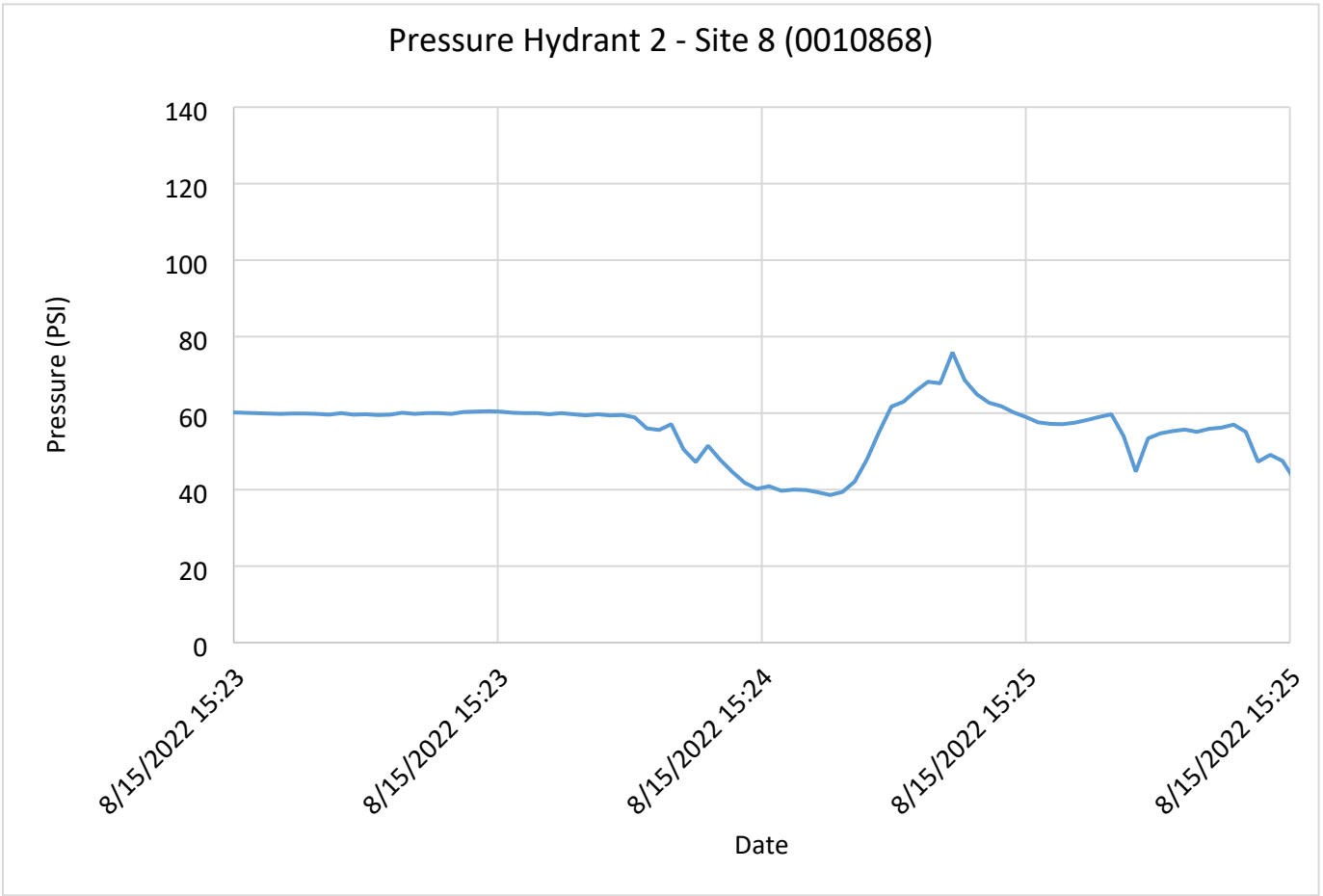


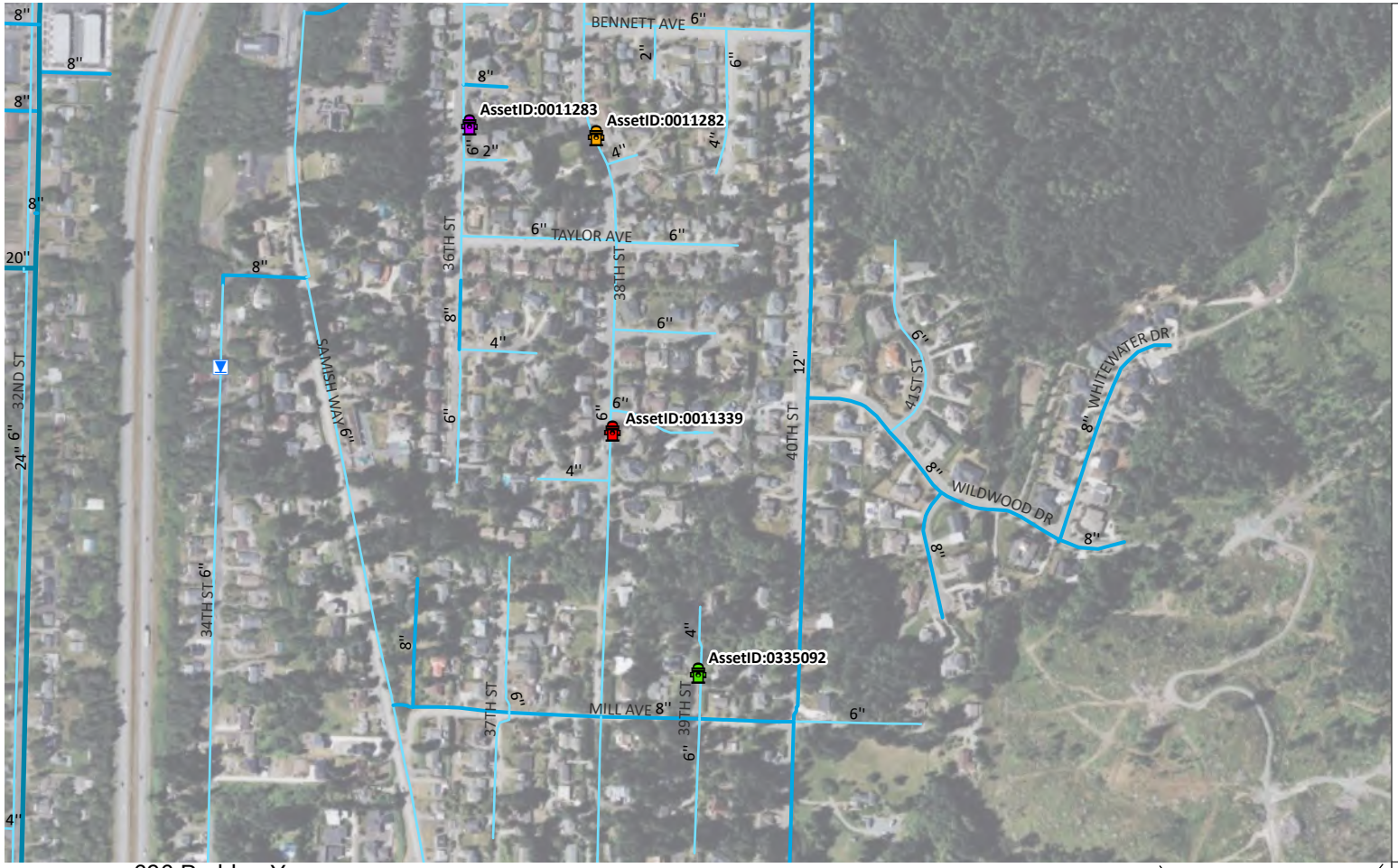
Diffuser setup of flowing hydrant F1



Pressure at Data Loggers:







Legend

Test Hydrants

- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2
- PRV

Water Main by Diameter

- < 6"
- 8" - 14"
- > 14"
- Bellingham City Limits

Feet
0 300 600

Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 696 Padden Yew
36th St, 38th St, and 39th St

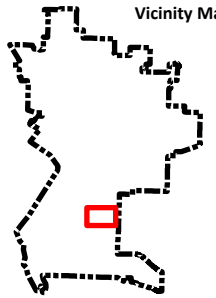
Date/Time: 8/17/2022 at 9:05 AM

Temperature: 66 F

Notes/Observations:
FH - Hilly residential area. Hydrant difficult to open
PH1 - Hilly residential
PH2 - Flat ground but raised off of street level

Flowing Hydrant	**Pressure Hydrant 1**	**Pressure Hydrant 2**	**Back-up Hydrant 2**
Hydrant #: 0011339	Hydrant #: 0011283	Hydrant #: 0335092	Hydrant #:
Make:	Make: Mueller	Make:	Make:
Main Size: 6-in	Main Size: 6-in	Main Size: 6-in	Main Size:
Static PSI:	Static PSI: 139/140	Static PSI: 75	Static PSI:
Residual PSI:	Residual PSI: 118	Residual PSI: 61/62	Residual PSI:
Pitot PSI:	Logger #: 51	Logger #: 50	Pitot PSI:
Flow GPM: 530	PH1* - Bleeder open		Flow GPM:
Duration: 1-2 mins			Duration:

Vicinity Map



Notes/Photographs: (Test 9)

Location of pressure hydrant P1



Logger setup for pressure hydrant P1



Location of pressure hydrant P2



Logger setup for pressure hydrant P2



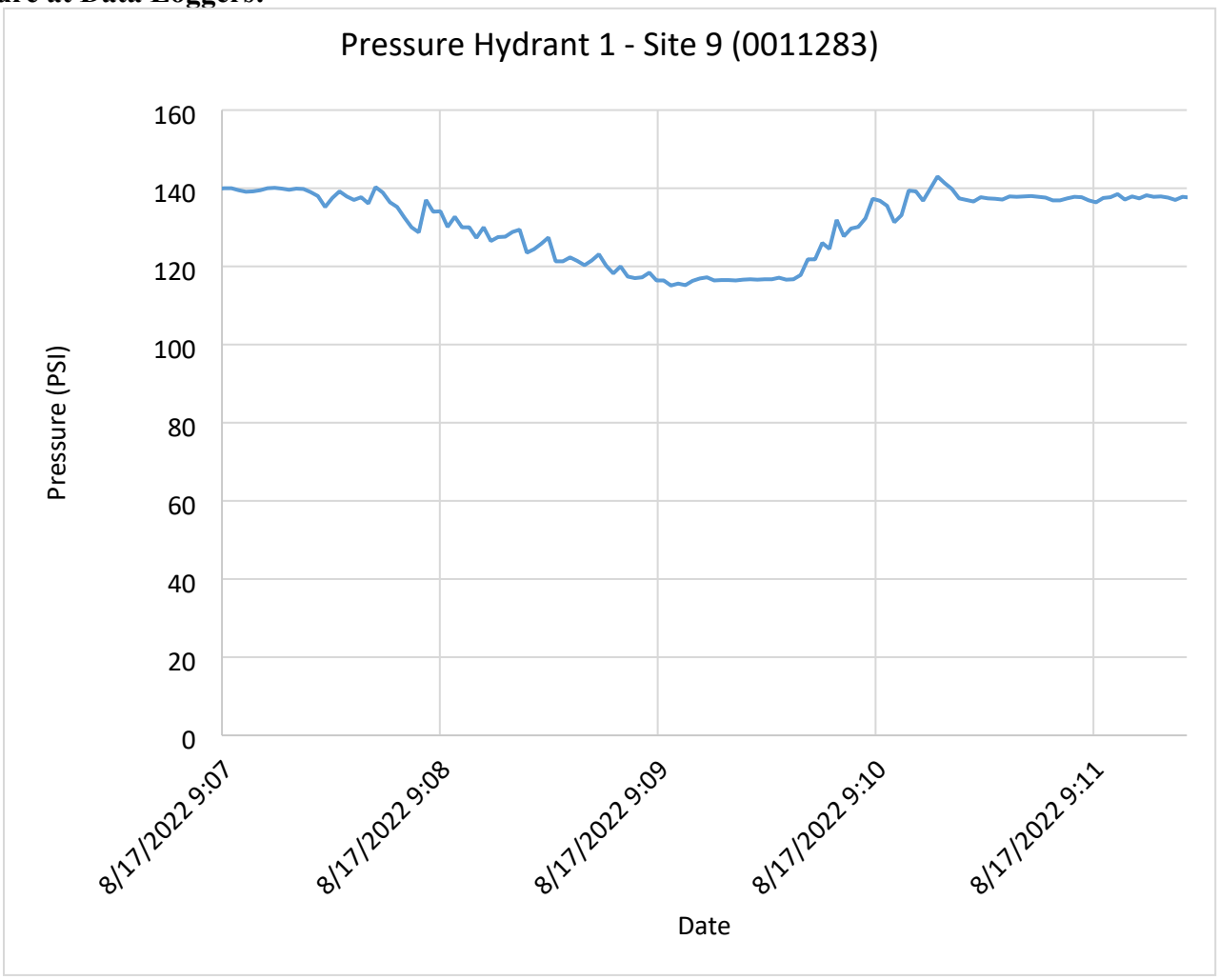
Surrounding area of flowing hydrant F1

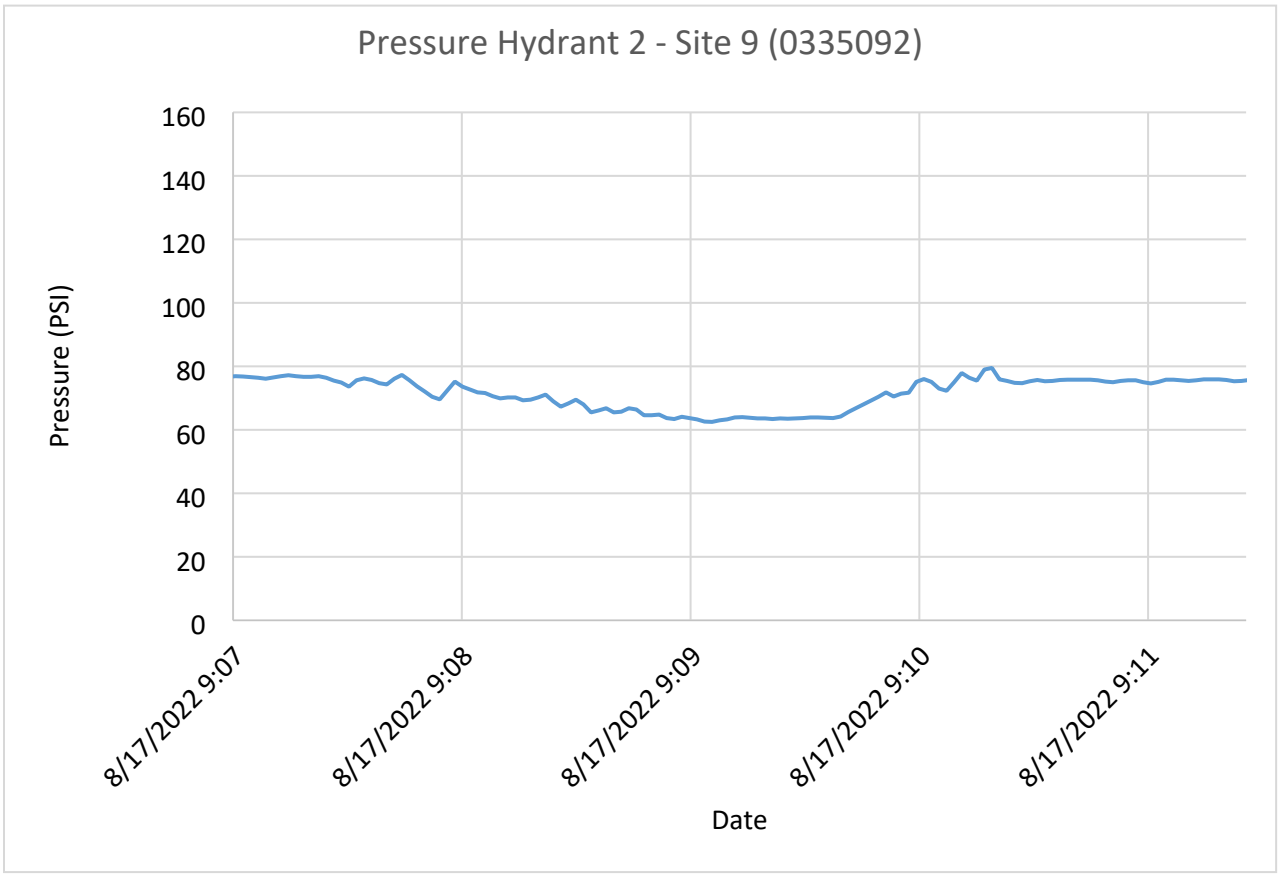


Diffuser setup of flowing hydrant F1



Pressure at Data Loggers:







Legend

Test Hydrants

- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2
- PRV

Water Main by Diameter

- < 6"
- 8" - 14"
- Bellingham City Limits

0 300 600 Feet

Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 696 Padden Yew
E Pacificview Dr and Racine St

Date/Time: 8/16/2022 at 11:03 AM

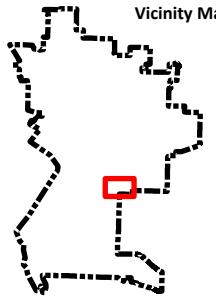
Temperature: warm

Notes/Observations:

FH - Hilly residential area, flowing hydrant at flat spot
PH1 - Flat/top of hill
PH2 - Slight slope in the area

Flowing Hydrant		Pressure Hydrant 1		Pressure Hydrant 2		Back-up Hydrant 2	
Hydrant #:	0107645	Hydrant #:	0298308	Hydrant #:	0010792	Hydrant #:	
Make:		Make:	M&H	Make:		Make:	
Main Size:	8-in	Main Size:	8-in	Main Size:	8-in	Main Size:	
Static PSI:		Static PSI:	62	Static PSI:	97	Static PSI:	
Residual PSI:		Residual PSI:	38	Residual PSI:	78	Residual PSI:	
Pitot PSI:		Logger #:	51	Logger #:	50	Pitot PSI:	
Flow GPM:	405					Flow GPM:	
Duration:	1-2 mins					Duration:	

Vicinity Map



Notes/Photographs: (Test 10)

Location of pressure hydrant P1



Logger setup for pressure hydrant P1



Location of pressure hydrant P2



Logger setup for pressure hydrant P2



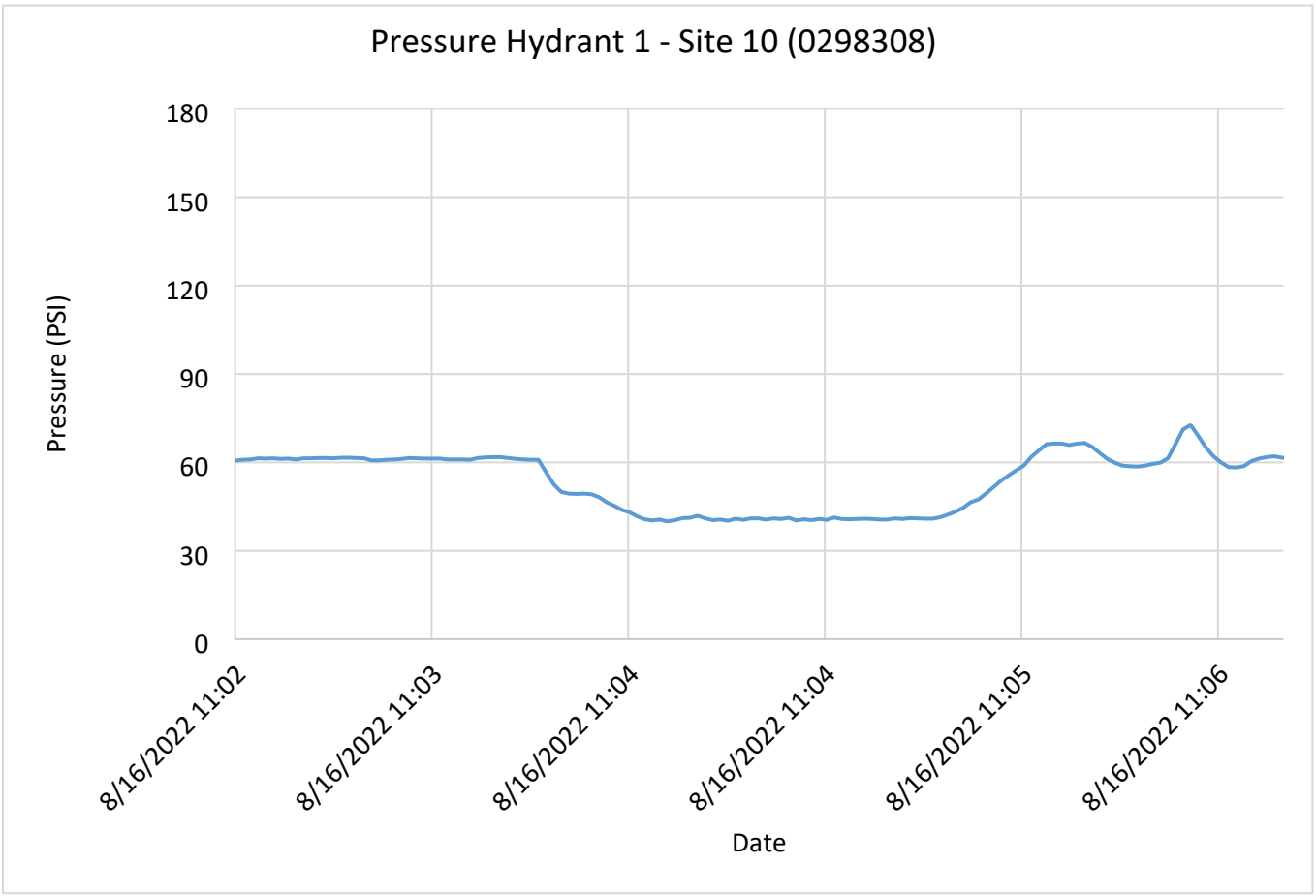
Surrounding area of flowing hydrant F1

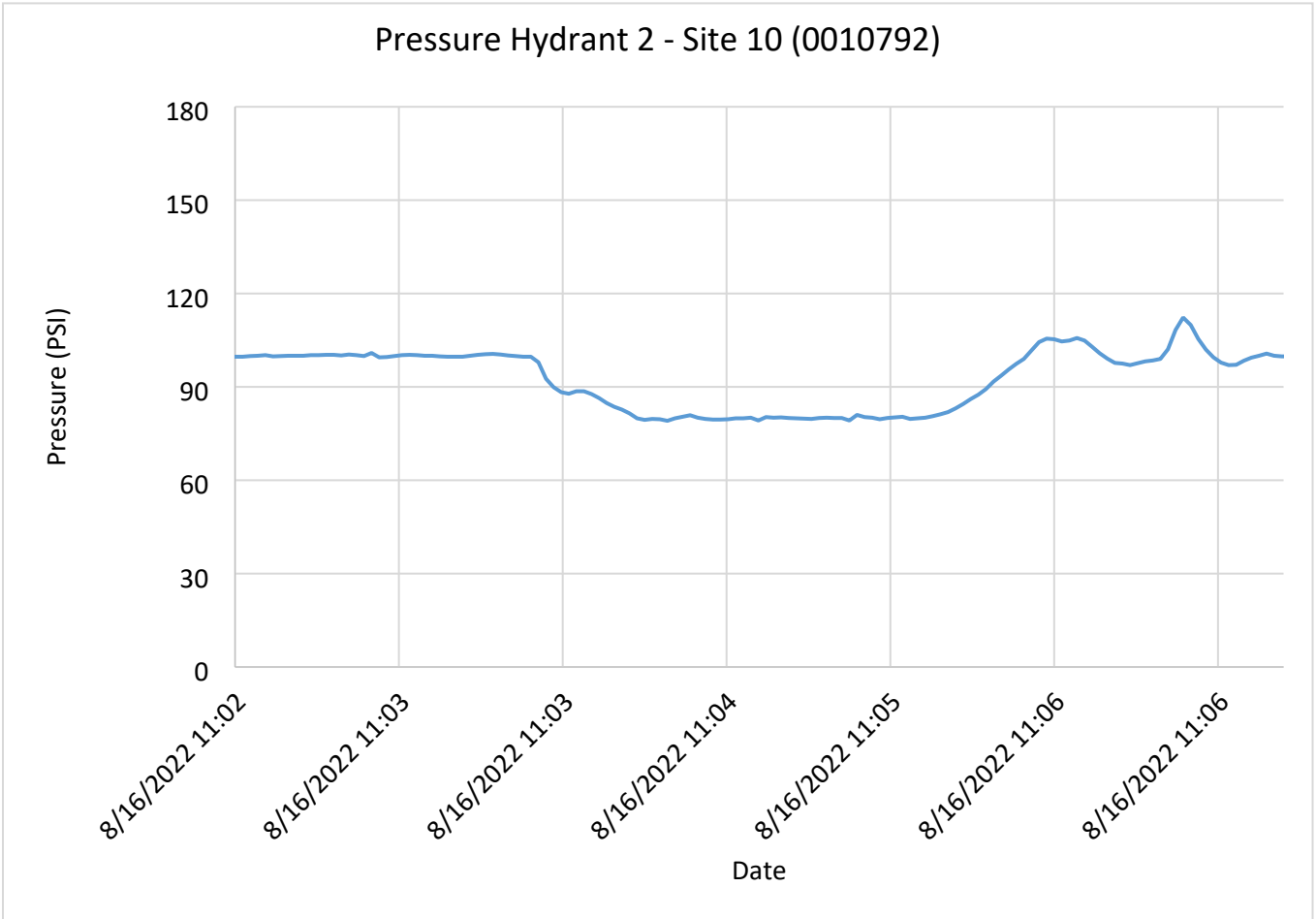


Diffuser setup of flowing hydrant F1



Pressure at Data Loggers:







Legend

Test Hydrants
- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2
- PRV

Water Main by Diameter
- < 6"
- 8" - 14"
- > 14"
- Bellingham City Limits
- Water Bodies

Feet
0 300 600

Data Sources: City of Bellingham

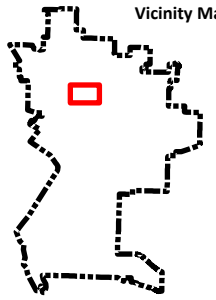
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 276 North W Orchard Dr, Orchard Pl, and Birchwood Ave
Date/Time: 8/15/2022 10:53 AM
Temperature: 70 F
Notes/Observations:

FH: flat ground
PH1: flat, industrial
PH2: flat, industrial area, large processing plants

Flowing Hydrant	Pressure Hydrant 1	Pressure Hydrant 2	Back-up Hydrant 2
Hydrant #: 0011487	Hydrant #: 0011005	Hydrant #: 0011517	Hydrant #:
Make: M&H	Make: Dresser	Make:	Make:
Main Size: 10-in DI	Main Size: 12" DI	Main Size:	Main Size:
Static PSI: 70	Static PSI: 74/76	Static PSI: 69	Static PSI:
Residual PSI:	Residual PSI: 65/70	Residual PSI: 58	Residual PSI:
Pitot PSI:	Logger #: 51	Logger #: 50	Pitot PSI:
Flow GPM: 700			Flow GPM:
Duration: 1-2 minutes			Duration:

Vicinity Map



Notes/Photographs: (Test 11)

Location of pressure hydrant P1



Logger setup of pressure hydrant P1



Location of pressure hydrant P2



Logger setup of pressure hydrant P2



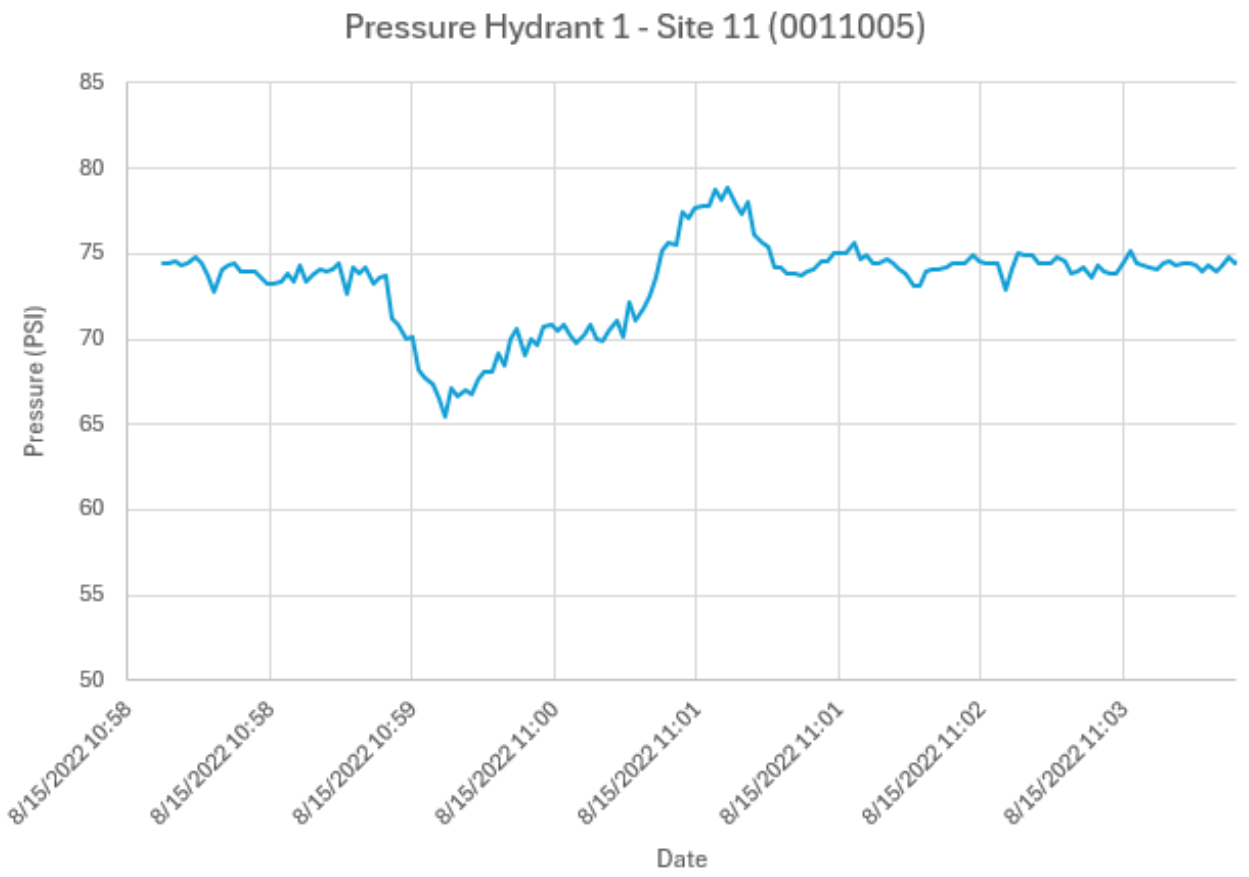
Surrounding area of flowing hydrant F1

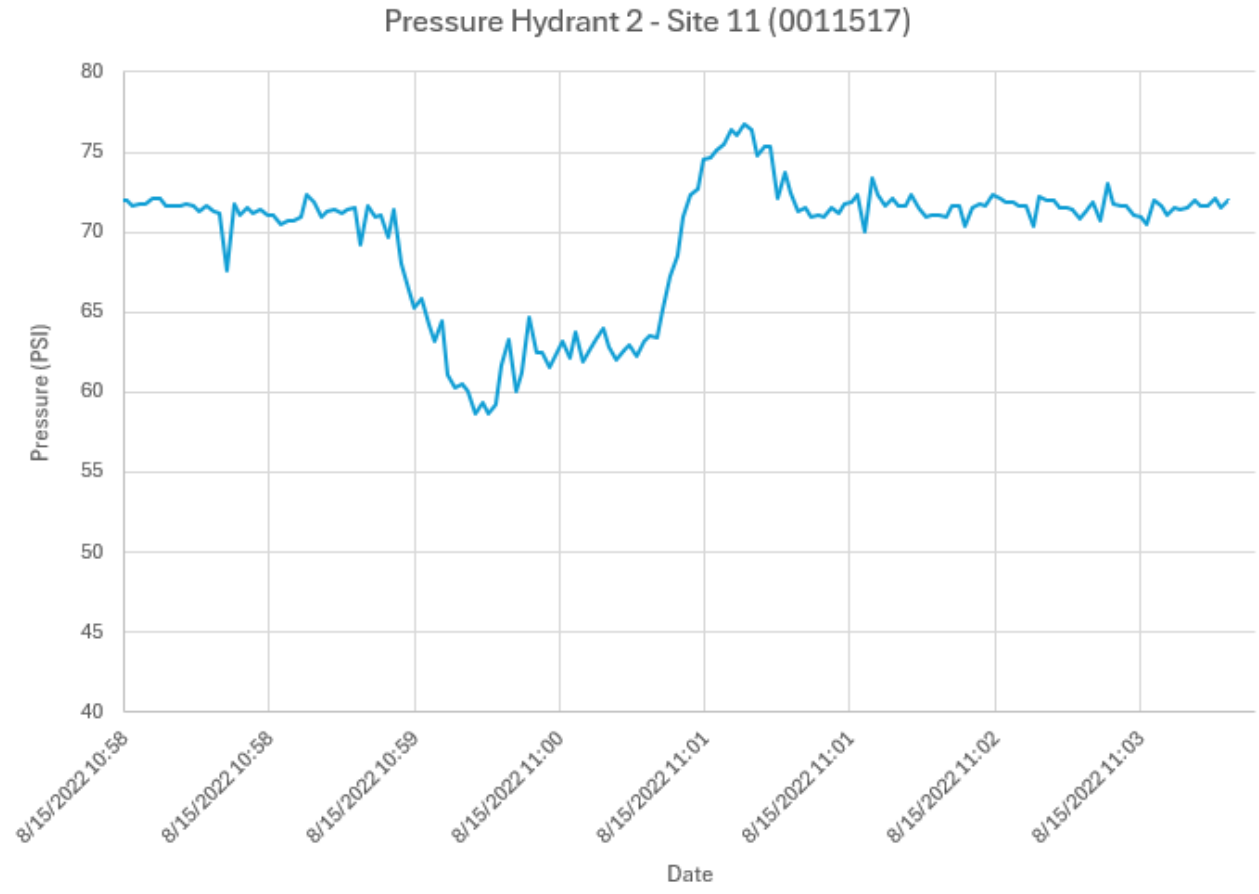


Diffuser setup of flowing hydrant F1

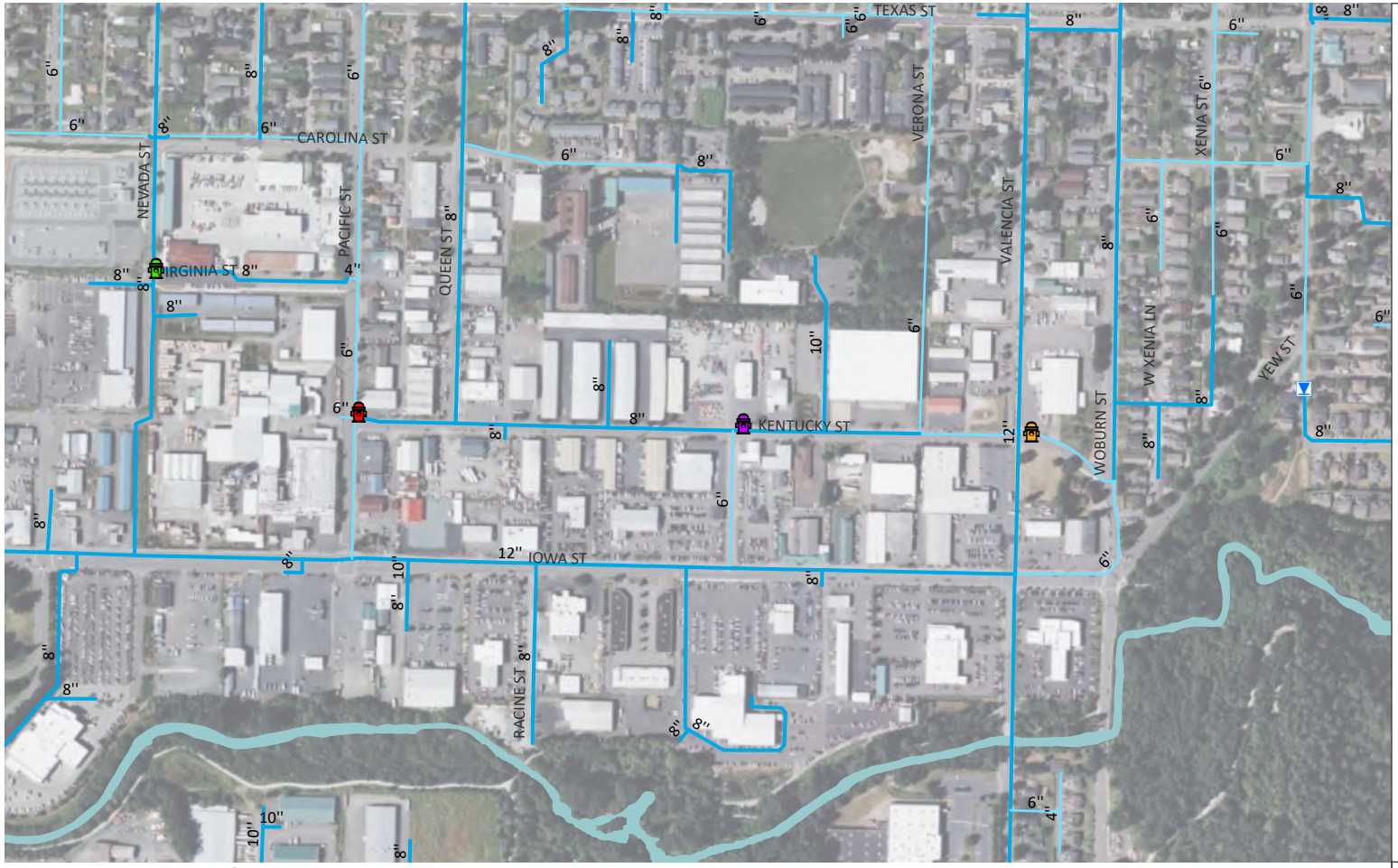


Pressure at Data Loggers:





Test notes:
First attempt with flow hydrant 1 open but not enough pressure drop.
Second attempt with flow hydrant 1 and back-up hydrant open but still not enough pressure drop.
Third attempt with only back-up hydrant open got enough pressure drop.



Legend

Test Hydrants
- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2
- PRV

Water Main by Diameter
- < 6"
- 8" - 14"
- Bellingham City Limits
- Water Bodies

Feet
0 300 600

Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 276 North Virginia St, Pacific St, and Kentucky St

Date/Time: 8/16/2022 10:03 AM

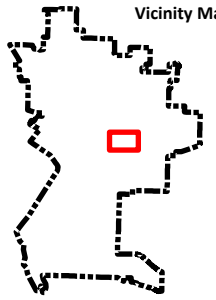
Temperature: 67

Notes/Observations:

FH: flat industrial area
PH1: flat
PH2: in active construction site, flat area (City operations new building site)

Flowing Hydrant	**Pressure Hydrant 1**	**Pressure Hydrant 2**	**Back-up Hydrant 2**
Hydrant #: 0010226	Hydrant #: 0010230	Hydrant #: 0342288	Hydrant #: 0010243
Make:	Make:	Make: M&H	Make:
Main Size:	Main Size:	Main Size: 8-in	Main Size:
Static PSI:	Static PSI: 85	Static PSI: 84	Static PSI:
Residual PSI:	Residual PSI: 73	Residual PSI: 81	Residual PSI:
Pitot PSI:	Logger #: 51	Logger #: 50	Pitot PSI:
Flow GPM:			Flow GPM: 725
Duration:			Duration:

Vicinity Map



Notes/Photographs: (Test 12)

Location of pressure hydrant P1



Logger setup of pressure hydrant P1



Location of pressure hydrant P2



Logger setup of pressure hydrant P2



Notes/Photographs: (Test 12)

Surrounding area of flowing hydrant F1



Diffuser setup of flowing hydrant F1



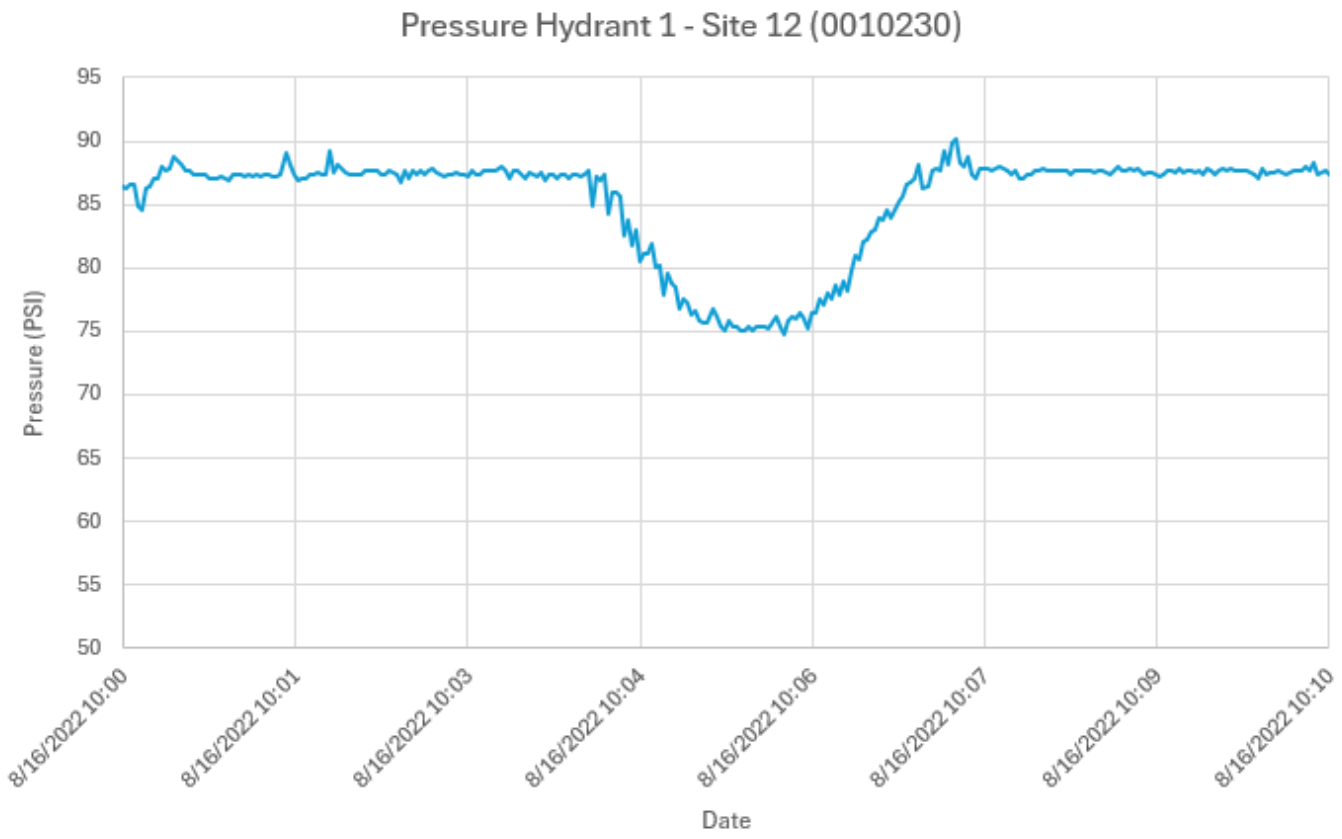
Surrounding area of flowing hydrant F2

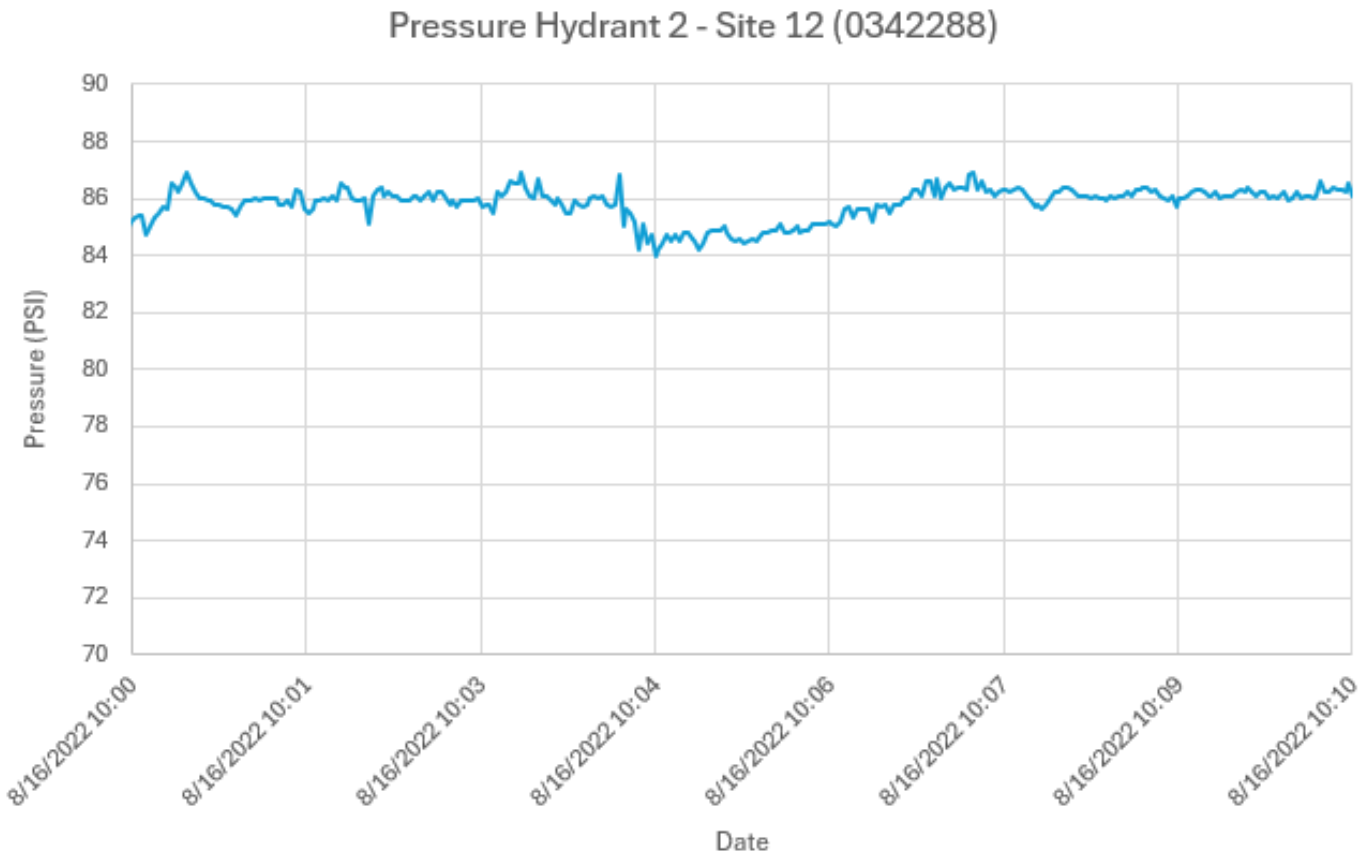


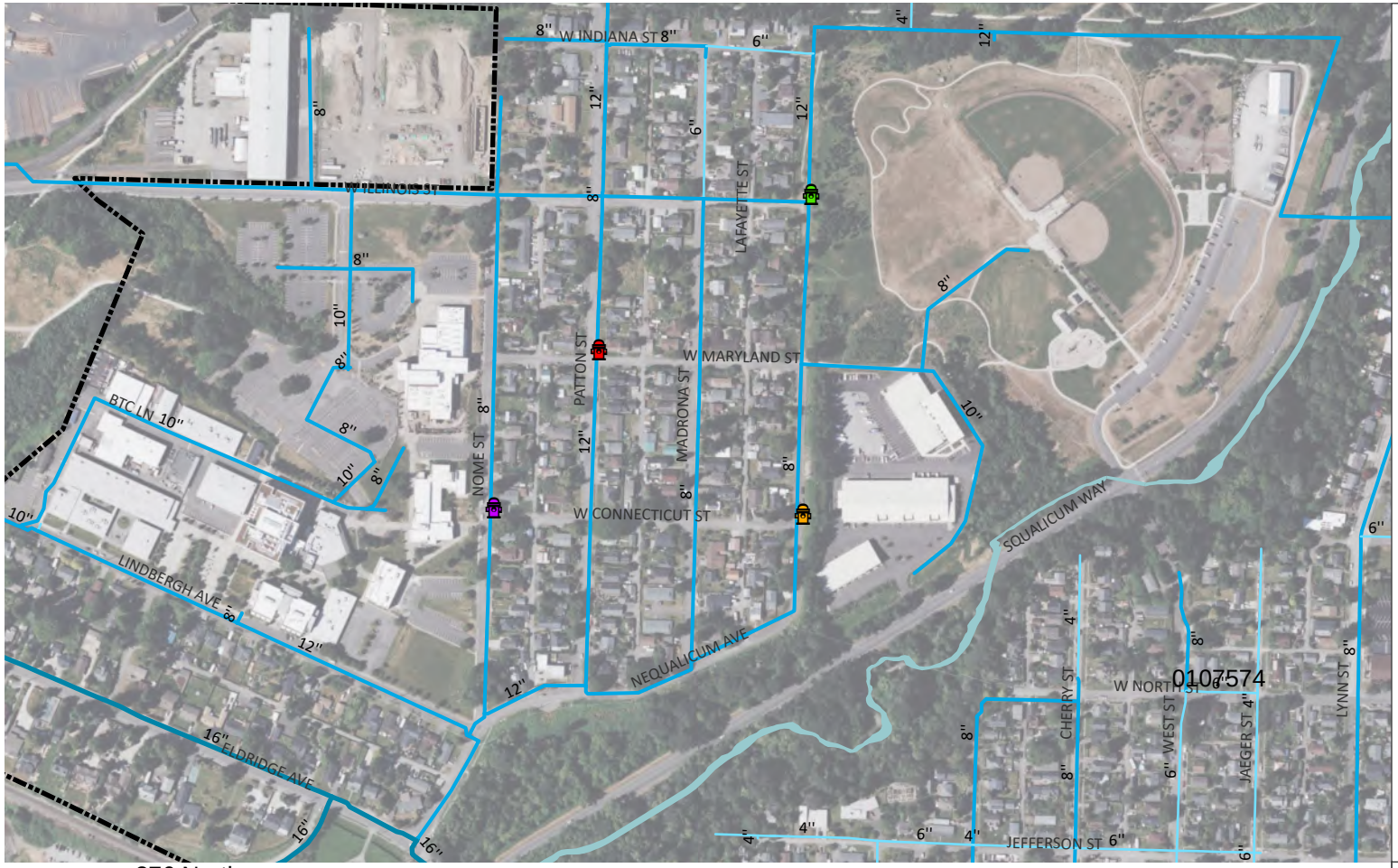
Diffuser setup of flowing hydrant F2



Pressure at Data Loggers:







Legend

Test Hydrants

- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2

Water Main by Diameter

- < 6"
- 8" - 14"
- > 14"
- Bellingham City Limits
- Water Bodies

Feet
0 250 500

Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 276 North Nome St, Patton St, and Nequalicum Ave

Date/Time: 8/16/2022 7:13 AM

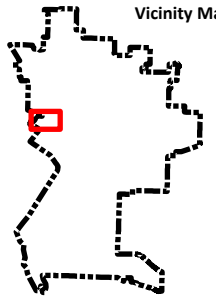
Temperature: 62 F

Notes/Observations:

PH1: very flat area
PH2: located in bushes, older style hydrant, flat ground

Flowing Hydrant	**Pressure Hydrant 1**	**Pressure Hydrant 2**	**Back-up Hydrant 2**
Hydrant #: 0107574	Hydrant #: 0011826	Hydrant #: 0010730	Hydrant #:
Make:	Make:	Make:	Make:
Main Size:	Main Size:	Main Size:	Main Size:
Static PSI:	Static PSI: 84	Static PSI: 80	Static PSI:
Residual PSI:	Residual PSI: 78	Residual PSI: 72	Residual PSI:
Pitot PSI:	Logger #: 51	Logger #: 50	Pitot PSI:
Flow GPM: 840			Flow GPM:
Duration: 1-2 minutes			Duration:

Vicinity Map



Notes/Photographs: (Test 13)

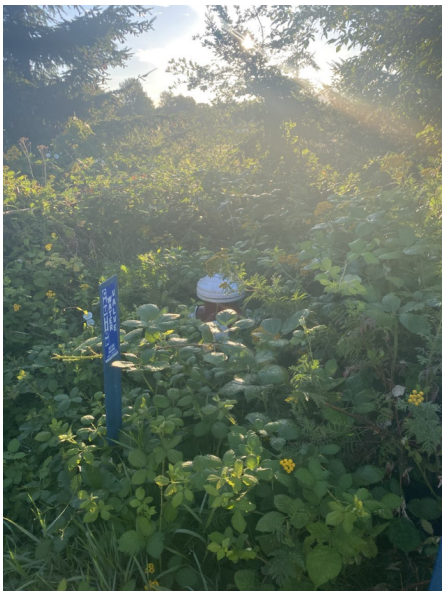
Location of pressure hydrant P1



Logger setup of pressure hydrant P1



Location of pressure hydrant P2



Logger setup of pressure hydrant P2



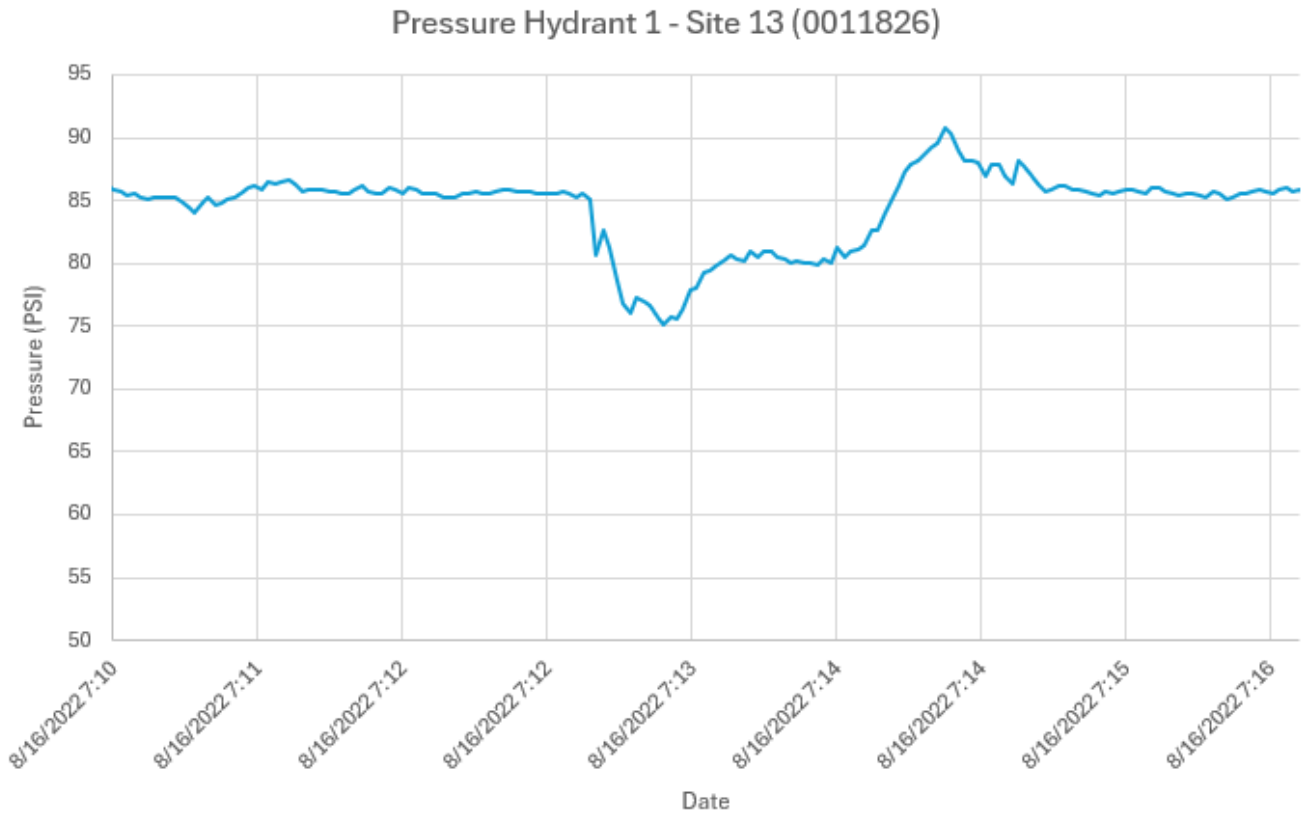
Surrounding area of flowing hydrant F1

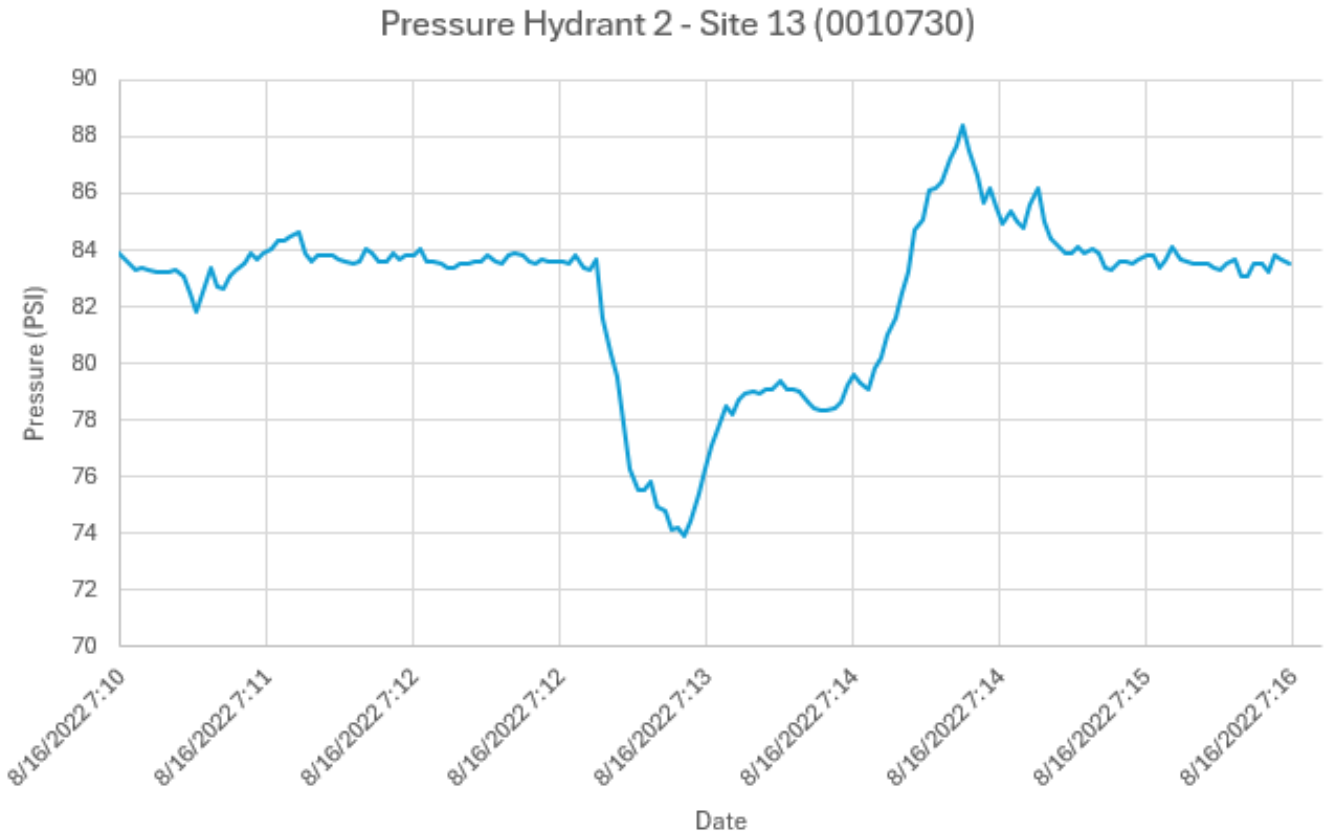


Diffuser setup of flowing hydrant F1



Pressure at Data Loggers:







Legend

Test Hydrants
- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2
- PRV

Water Main by Diameter
- < 6"
- 8" - 14"
- > 14"
- Bellingham City Limits

0 250 500 Feet

Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 350 Cordata Sterling Dr and Pana Vista Dr

Date/Time: 8/15/2022 9:45 AM

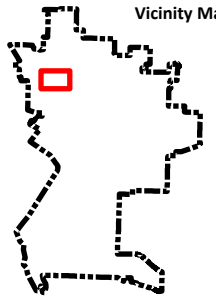
Temperature: 67 F

Notes/Observations:

PH1: relatively flat
PH2: new development, parking lot of new apartment construction. hydrant was initially not live and had to be turned on

	Flowing Hydrant	Pressure Hydrant 1	Pressure Hydrant 2	Back-up Hydrant 2
Hydrant #:	0010937	0011370	0558513	
Make:				
Main Size:				
Static PSI:		88	78	
Residual PSI:		60	60	
Pitot PSI:				
Flow GPM:	455			
Duration:	1-2 minutes			
Logger #:		51	50	

Vicinity Map



Notes/Photographs: (Test 14)

Location of pressure hydrant P1



Logger setup of pressure hydrant P1



Location of pressure hydrant P2



Logger setup of pressure hydrant P2



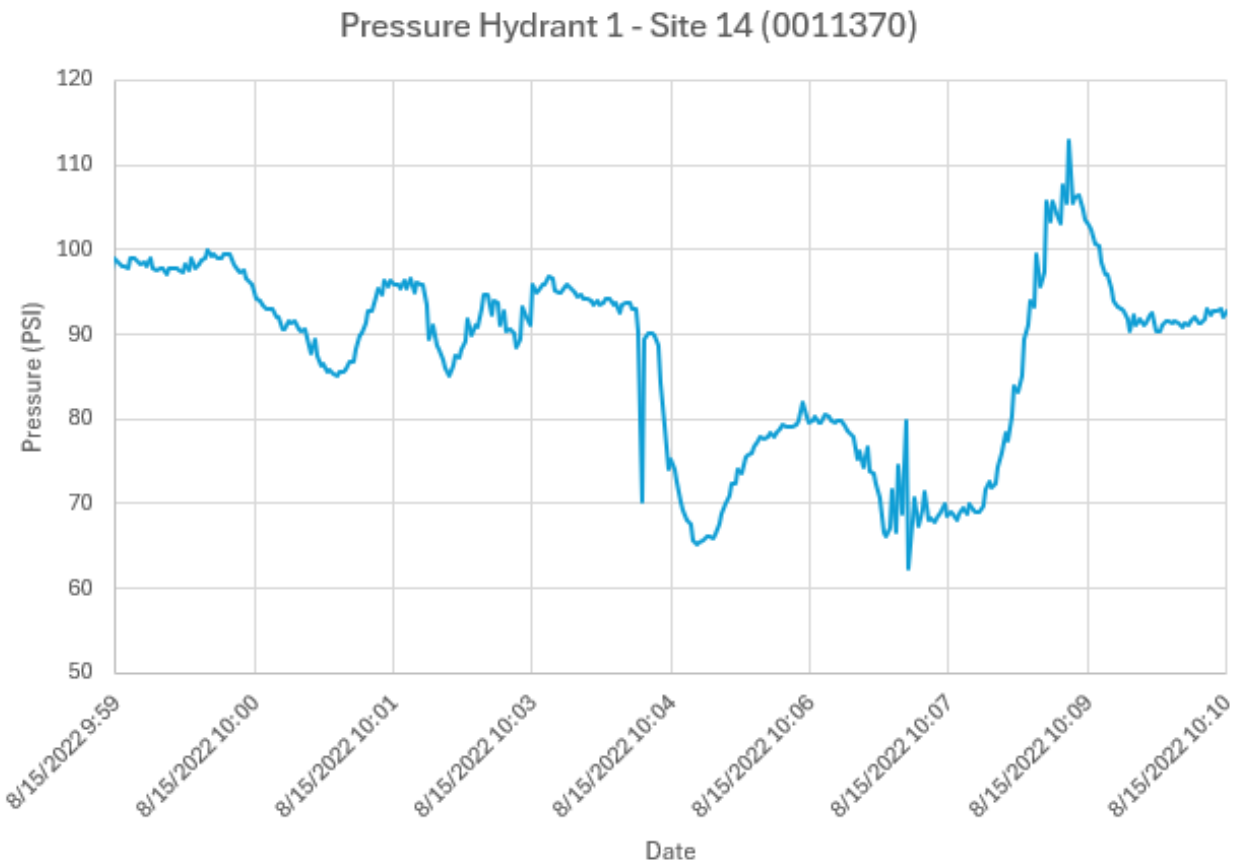
Surrounding area of flowing hydrant F1

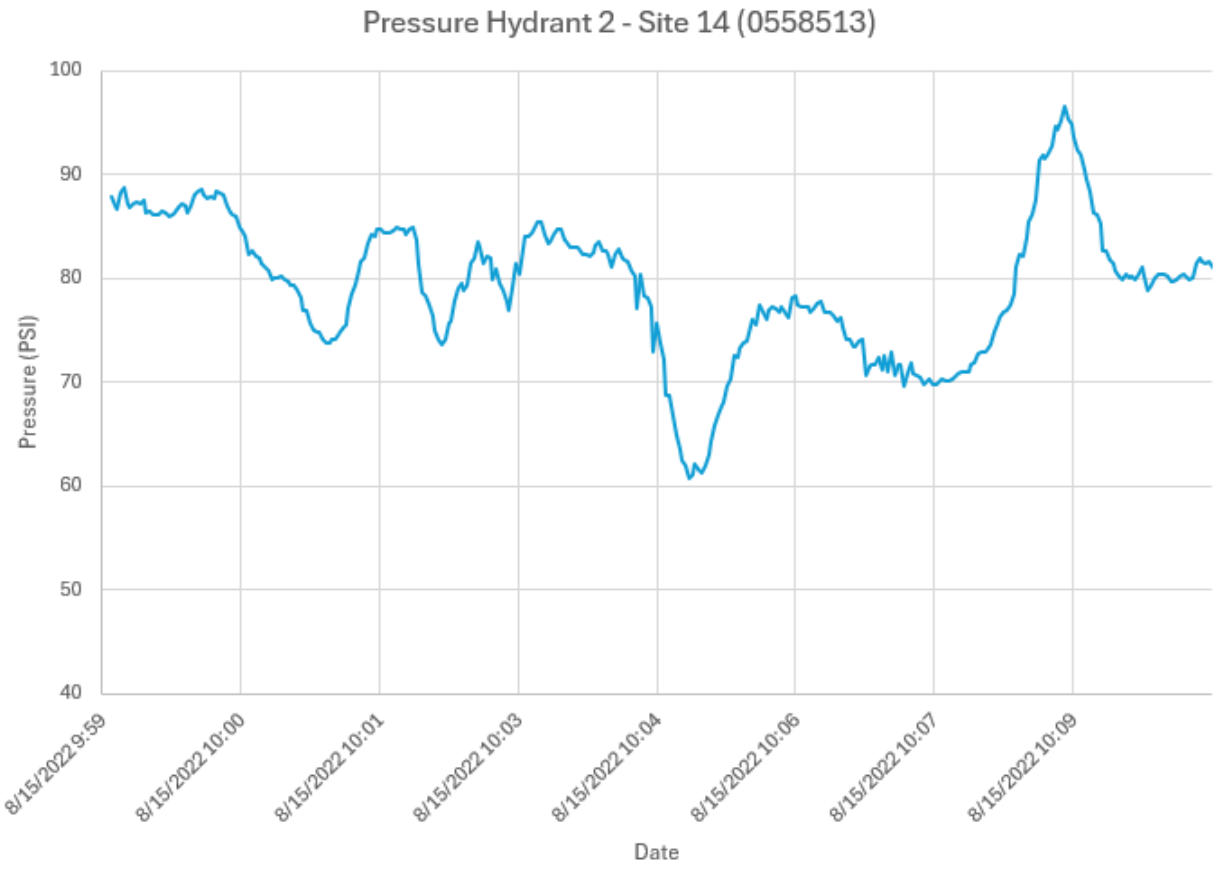


Diffuser setup of flowing hydrant F1



Pressure at Data Loggers:







Legend

Test Hydrants

- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2

Water Main by Diameter

- < 6"
- 8" - 14"
- > 14"
- Bellingham City Limits

Feet
0 200 400

Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 350 Cordata
Bedford Ave, Corona Ct, and Majestic Dr

Date/Time: 8/15/2022 9:17 AM

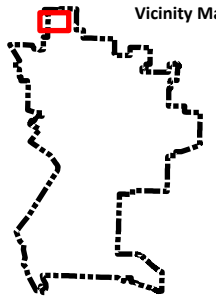
Temperature: 66 F

Notes/Observations:

Multiple attempts for this test to get flow meter working correctly (first test completed)
PH1: slight incline towards road
PH2: flat, residential neighborhood

Flowing Hydrant		**Pressure Hydrant 1**		**Pressure Hydrant 2**		**Back-up Hydrant 2**	
Hydrant #:	0139492	Hydrant #:	0139494	Hydrant #:	0140212	Hydrant #:	
Make:		Make:	Waterous (1999)	Make:		Make:	
Main Size:		Main Size:	8-in	Main Size:		Main Size:	
Static PSI:		Static PSI:	80	Static PSI:	82	Static PSI:	
Residual PSI:		Residual PSI:	61	Residual PSI:	60	Residual PSI:	
Pitot PSI:		Logger #:	51	Logger #:	50	Pitot PSI:	
Flow GPM:	560					Flow GPM:	
Duration:	1-2 minutes					Duration:	

Vicinity Map



Notes/Photographs: (Test 15)

Location of pressure hydrant P1



Logger setup of pressure hydrant P1



Location of pressure hydrant P2



Logger setup of pressure hydrant P2



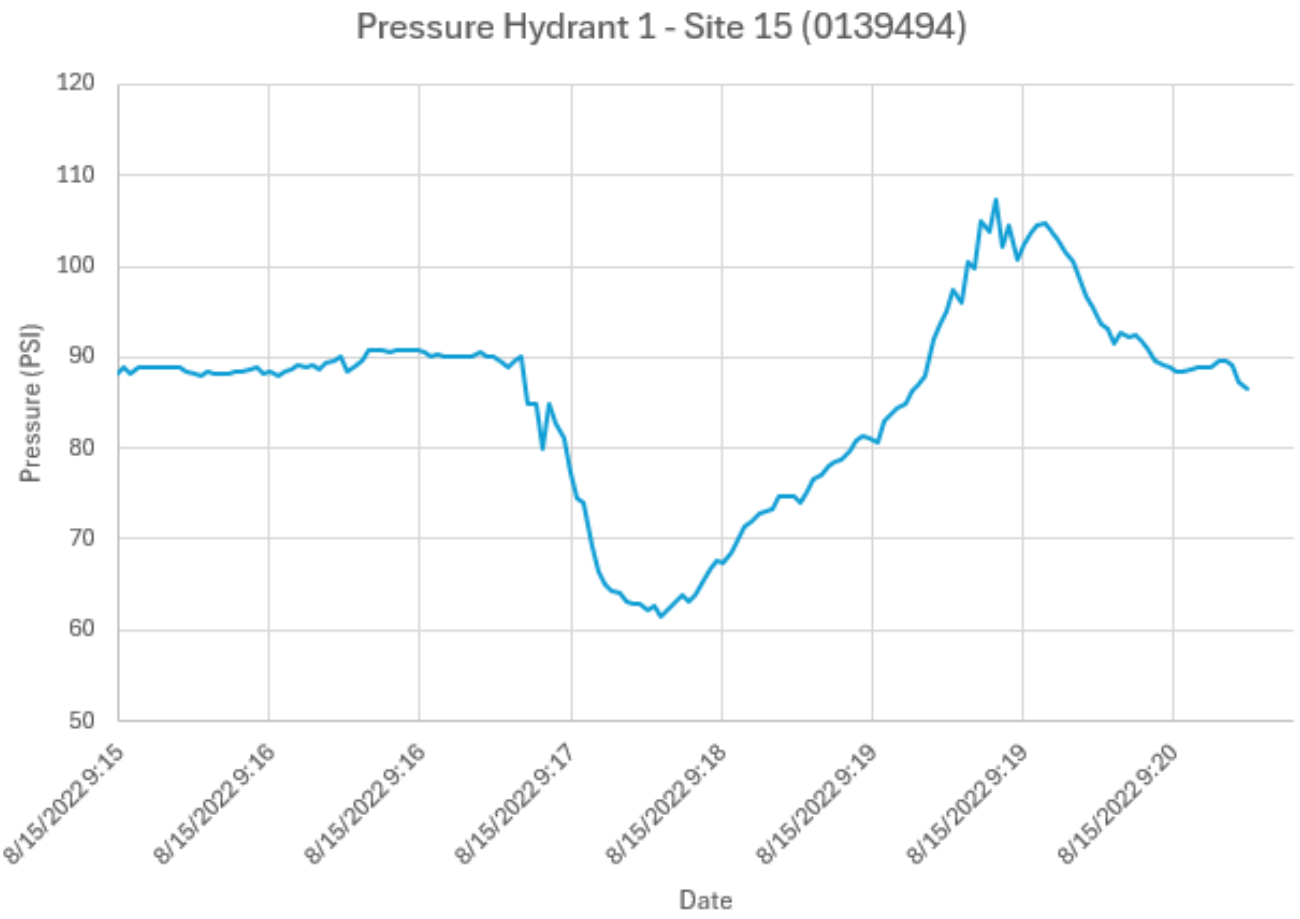
Surrounding area of flowing hydrant F1

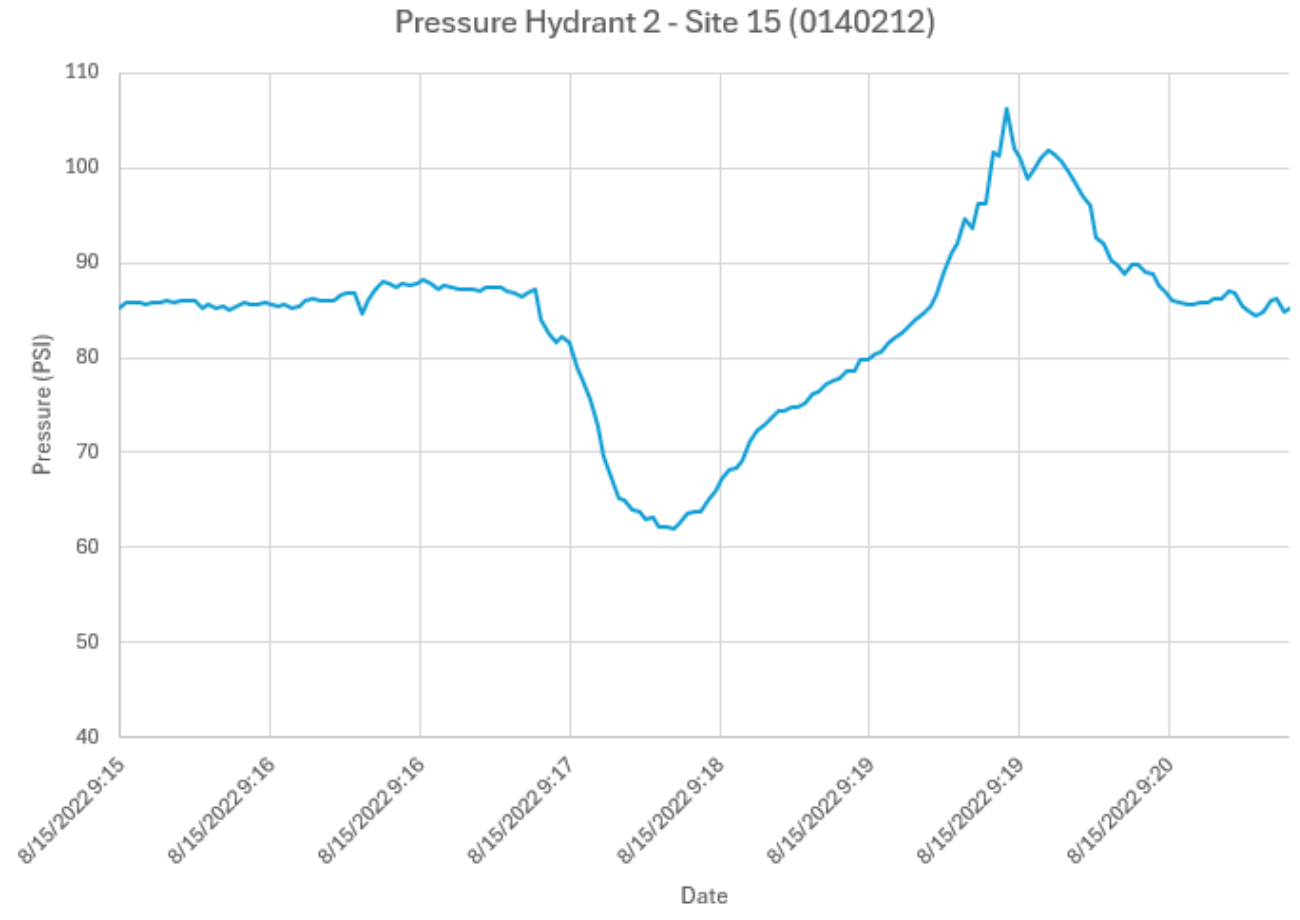


Diffuser setup of flowing hydrant F1



Pressure at Data Loggers:







Legend

Test Hydrants

- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2
- PRV

Water Main by Diameter

- < 6"
- 8" - 14"
- Bellingham City Limits

Feet
0 250 500

Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 457 South Byron Ave, Consolidation Ave, and 44th St

Date/Time: 8/16/2022 11:30AM

Temperature: 74 F

Notes/Observations:

FH: in hilly, residential neighborhood, hydrant on sloping street
PH1: in an apartment/ townhouse parking lot
PH2: flat ground

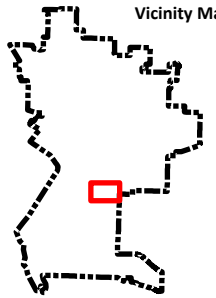
Flowing Hydrant	
Hydrant #:	0012165
Make:	
Main Size:	
Static PSI:	
Residual PSI:	
Pitot PSI:	
Flow GPM:	450
Duration:	1-2 minutes

Pressure Hydrant 1	
Hydrant #:	0101877
Make:	M&H
Main Size:	8-in
Static PSI:	90
Residual PSI:	75
Logger #:	50

Pressure Hydrant 2	
Hydrant #:	0275656
Make:	
Main Size:	
Static PSI:	56
Residual PSI:	36
Logger #:	

Back-up Hydrant 2	
Hydrant #:	
Make:	
Main Size:	
Static PSI:	
Residual PSI:	
Pitot PSI:	
Flow GPM:	
Duration:	

Vicinity Map



Notes/Photographs: (Test 16)

Location of pressure hydrant P1



Logger setup of pressure hydrant P1



Location of pressure hydrant P2



Logger setup of pressure hydrant P2



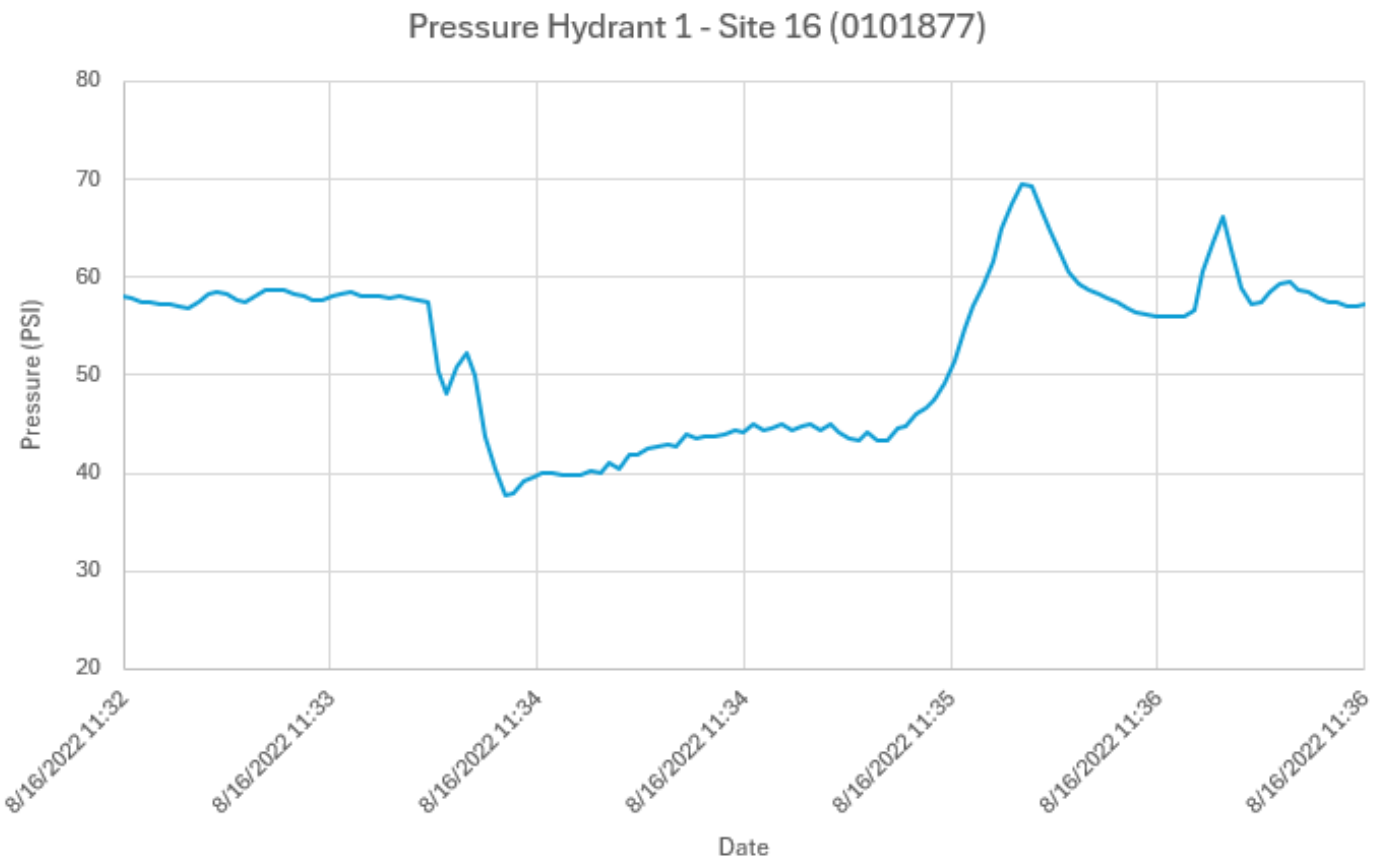
Surrounding area of flowing hydrant F1

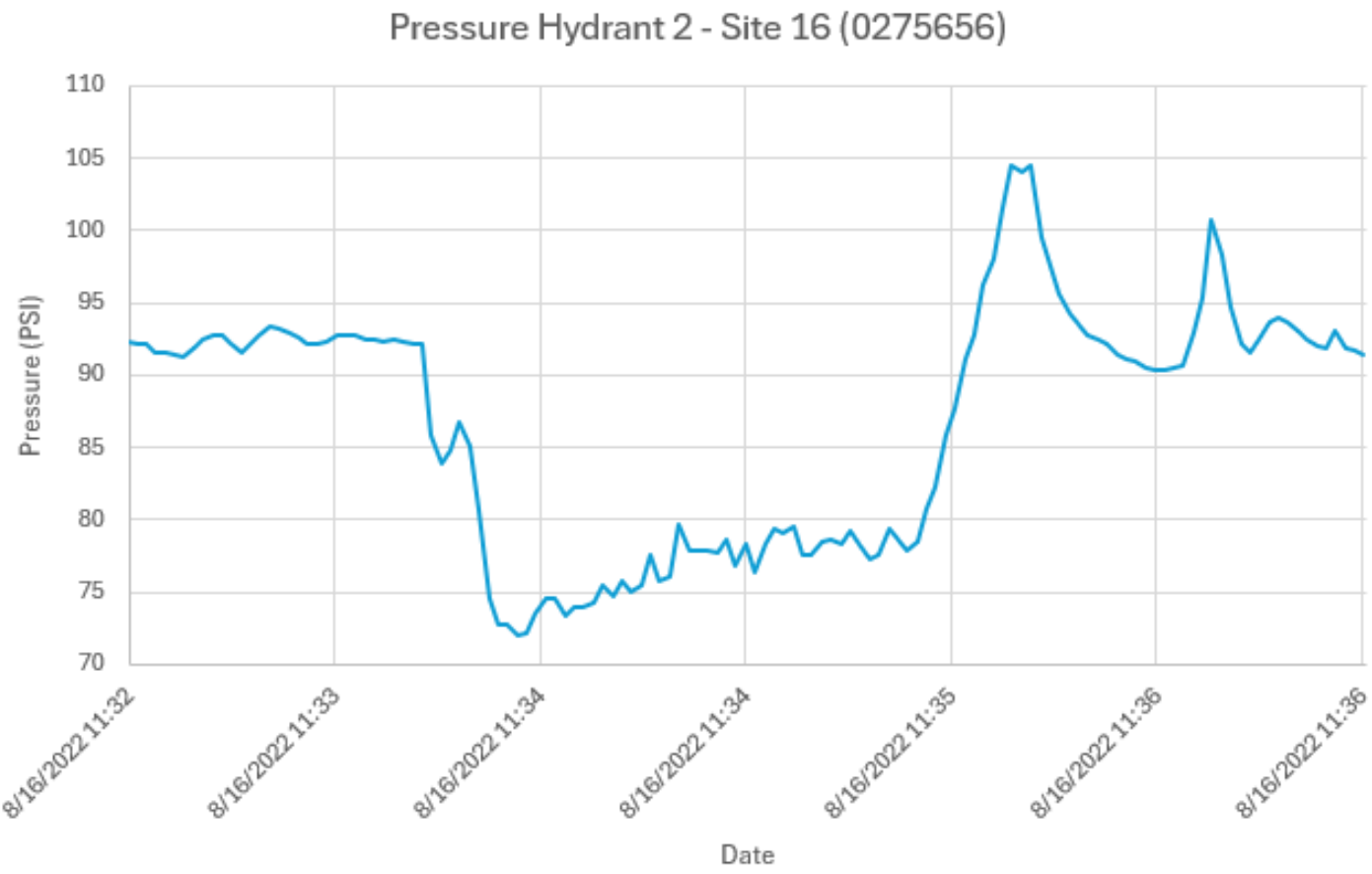


Diffuser setup of flowing hydrant F1



Pressure at Data Loggers:







Legend

Test Hydrants
- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2
- PRV

Water Main by Diameter
- < 6"
- 8" - 14"
- Bellingham City Limits
- Water Bodies

N

0 200 400 Feet

Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 457 South 10th St, 12th St, 13th St, and 14th St

Date/Time: 8/17/2022 7:40 AM

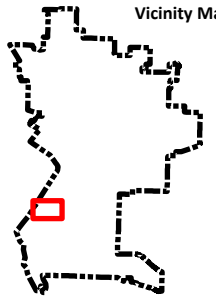
Temperature: 63 F

Notes/Observations:

FH: very hilly, residential area, very steep down toward water, hydrant not fully open (3/4 open) but large amount of flow
PH1: flat street, in this area N/S is flat but E/W is steep, higher elevation than FH

Flowing Hydrant	**Pressure Hydrant 1**	**Pressure Hydrant 2**	**Back-up Hydrant 2**
Hydrant #: 0139619	Hydrant #: 0011098	Hydrant #: 0011042	Hydrant #:
Make:	Make: Corey	Make:	Make:
Main Size: 8-inch	Main Size: 8-in	Main Size:	Main Size:
Static PSI:	Static PSI: 111	Static PSI: 172	Static PSI:
Residual PSI:	Residual PSI: 98	Residual PSI: 160	Residual PSI:
Pitot PSI:	Logger #: 51	Logger #: 50	Pitot PSI:
Flow GPM: 750			Flow GPM:
Duration: 1-2 minutes			Duration:

Vicinity Map



Notes/Photographs: (Test 17)

Location of pressure hydrant P1



Logger setup of pressure hydrant P1



Location of pressure hydrant P2



Logger setup of pressure hydrant P2



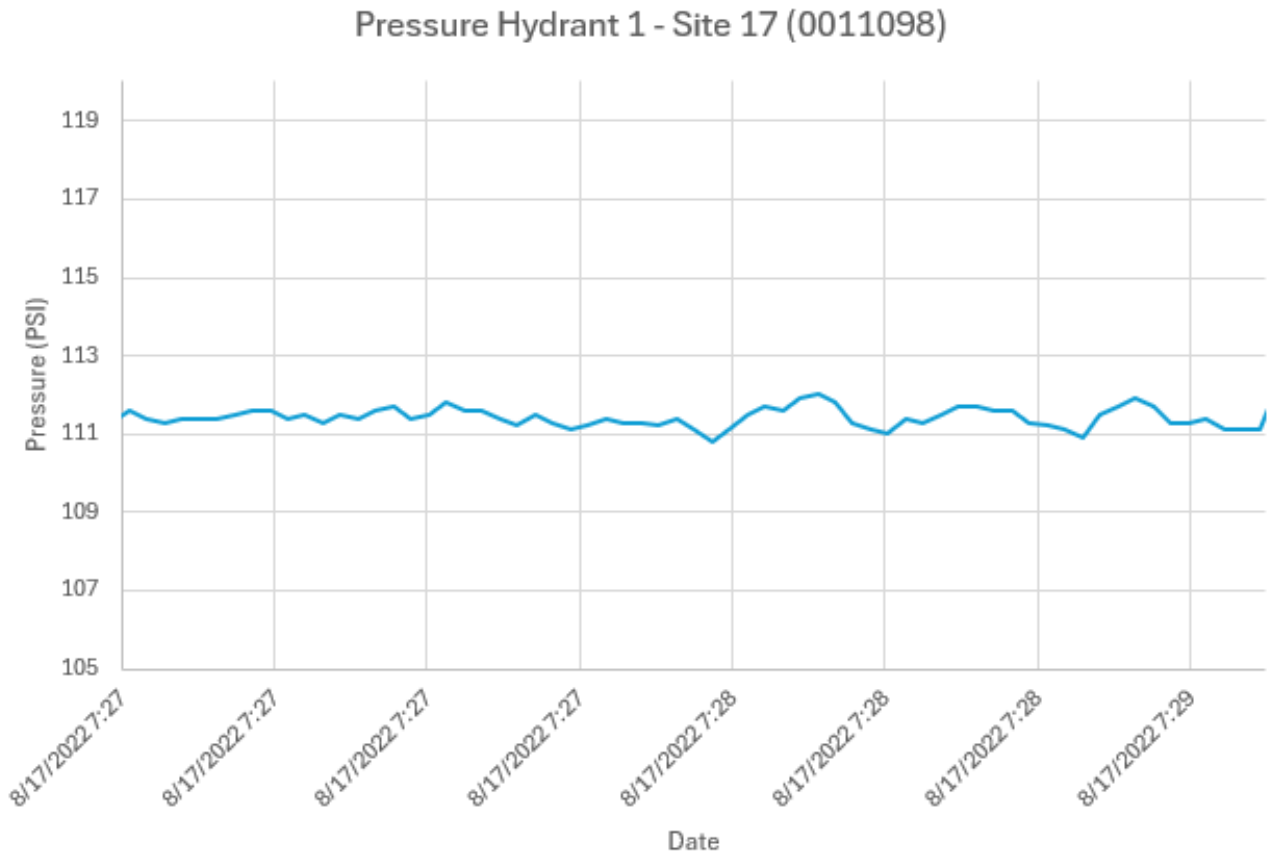
Surrounding area of flowing hydrant F1

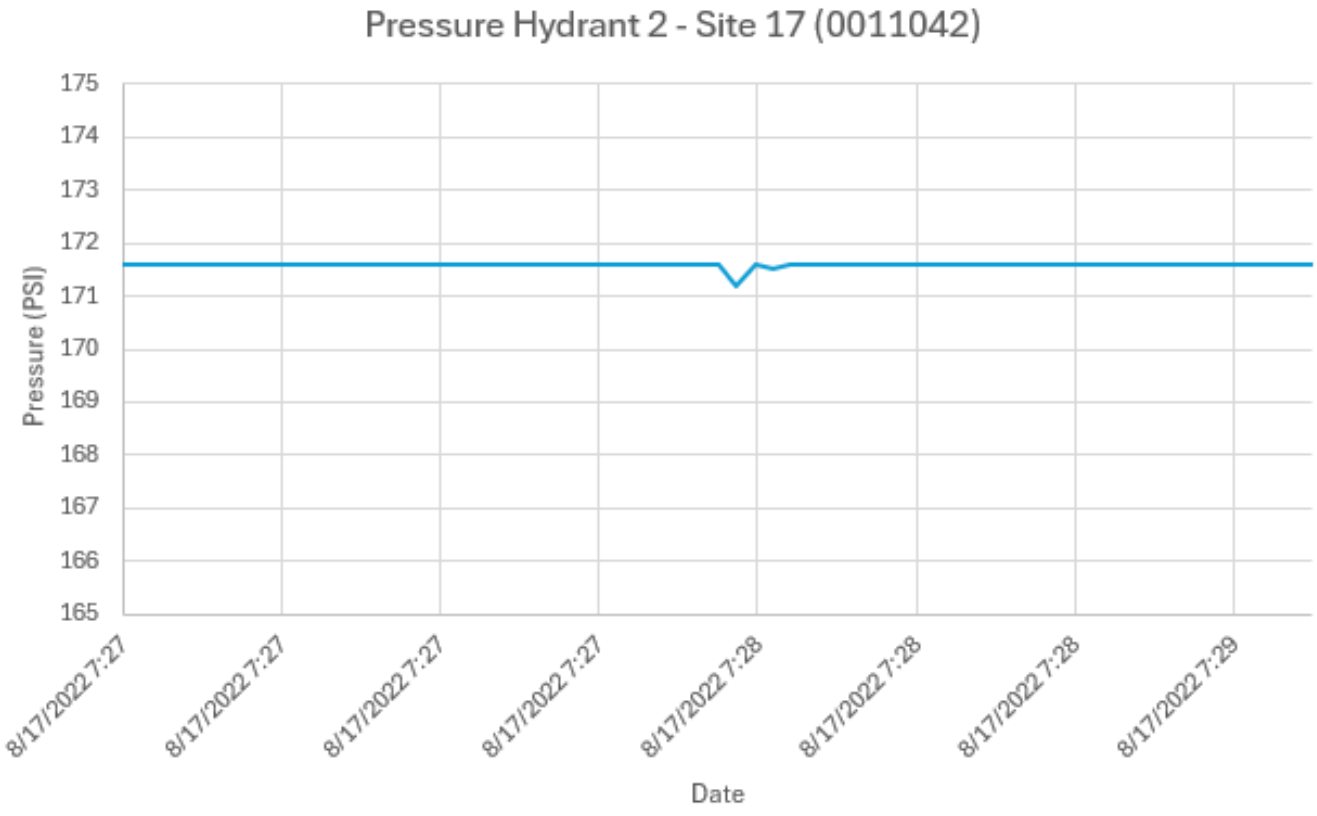


Diffuser setup of flowing hydrant F1



Pressure at Data Loggers:







Legend

Test Hydrants

- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2

Water Main by Diameter

- < 6"
- 8" - 14"
- Bellingham City Limits

Feet
0 200 400

Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 457 South Fieldston Rd, Willow Rd, and Cypress Rd

Date/Time: 8/17/2022 8:16 AM

Temperature: 63 F

Notes/Observations:

FH: rolling hills, residential area. homeowner noted hydrant is leaky, grass is wet and green near hydrant
PH1: top of hill from flowing hydrant in hilly area
PH2: flat, hidden in bushes

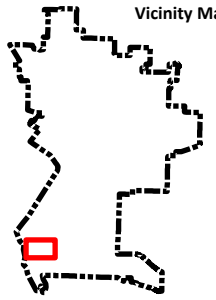
Flowing Hydrant	
Hydrant #:	0011204
Make:	
Main Size:	
Static PSI:	
Residual PSI:	
Pitot PSI:	
Flow GPM:	750
Duration:	1-2 minutes

Pressure Hydrant 1	
Hydrant #:	0011201
Make:	Iowa
Main Size:	6-in
Static PSI:	101
Residual PSI:	70
Logger #:	50

Pressure Hydrant 2	
Hydrant #:	0011225
Make:	
Main Size:	
Static PSI:	115
Residual PSI:	90
Logger #:	51

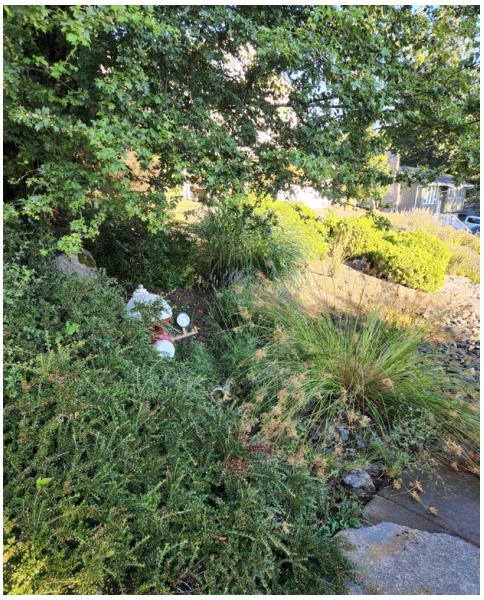
Back-up Hydrant 2	
Hydrant #:	
Make:	
Main Size:	
Static PSI:	
Residual PSI:	
Pitot PSI:	
Flow GPM:	
Duration:	

Vicinity Map



Notes/Photographs: (Test 18)

Location of pressure hydrant P1



Logger setup of pressure hydrant P1



Location of pressure hydrant P2



Logger setup of pressure hydrant P2



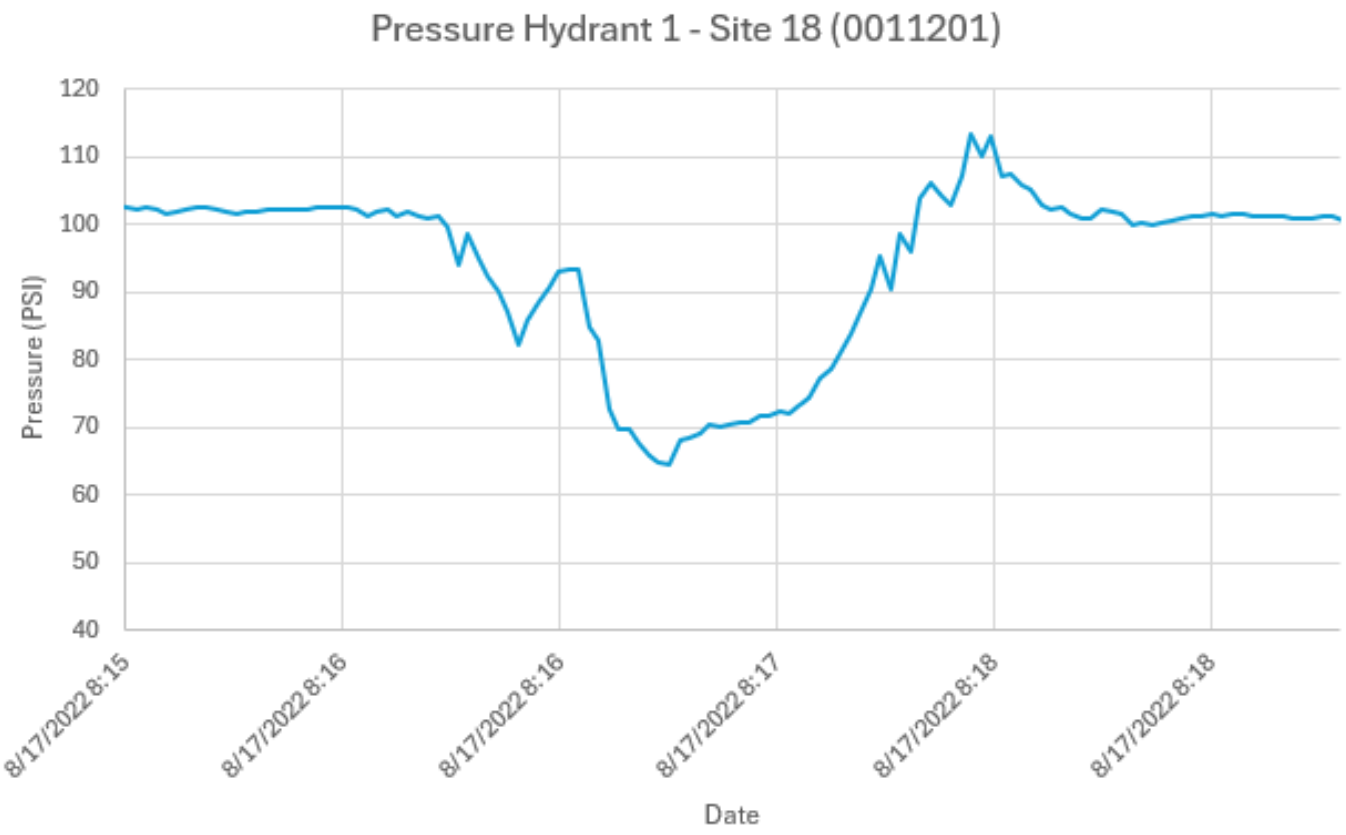
Surrounding area of flowing hydrant F1

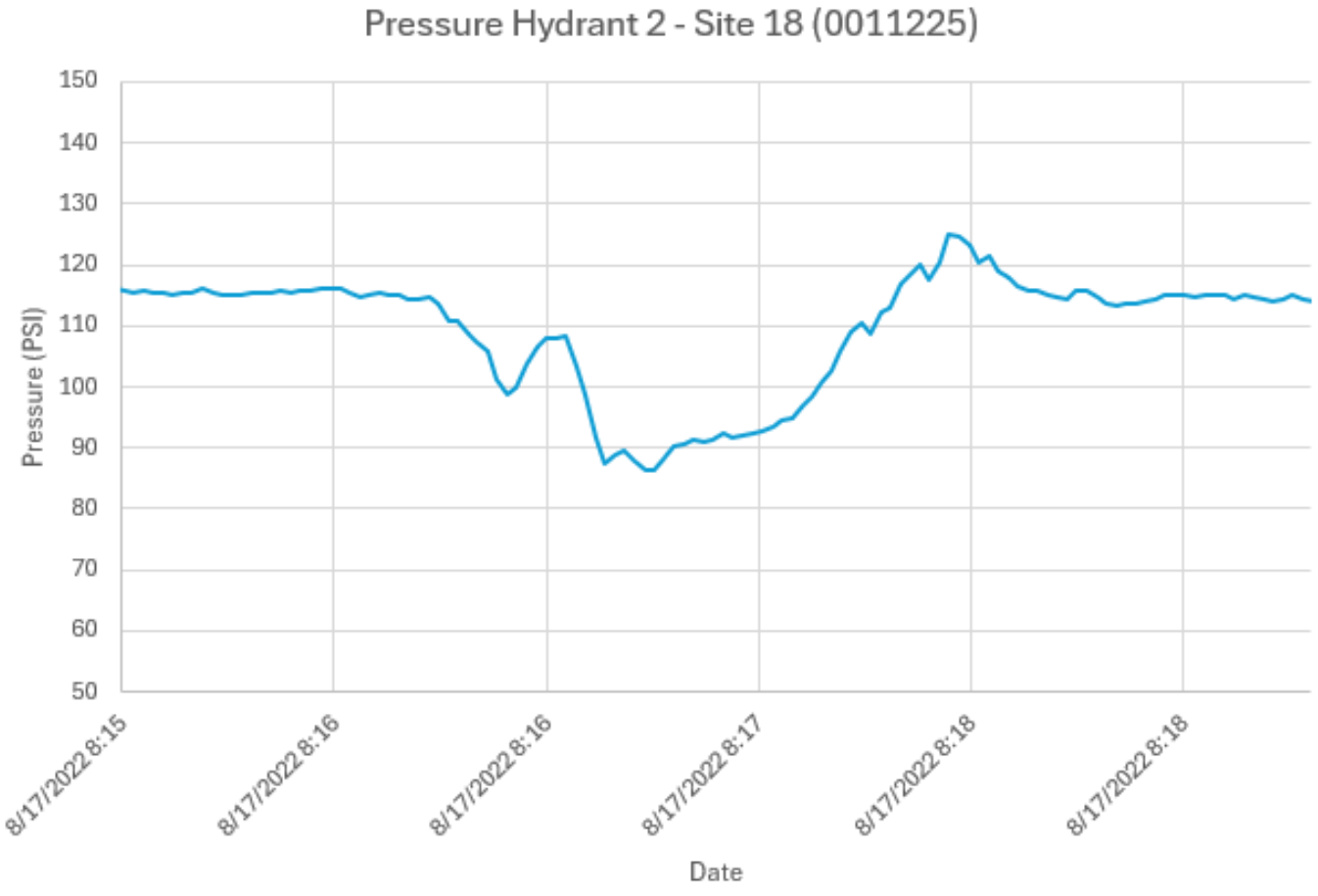


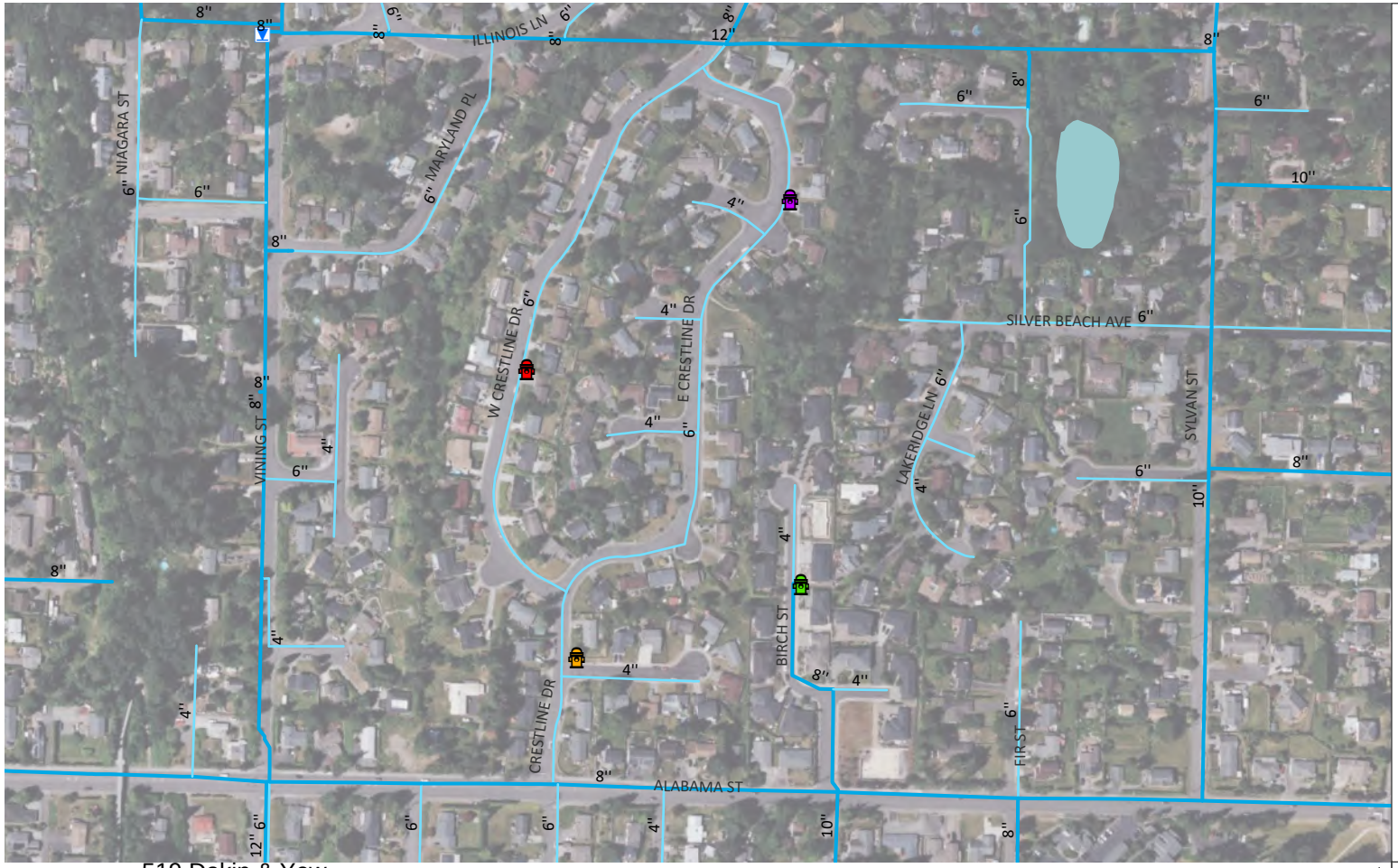
Diffuser setup of flowing hydrant F1



Pressure at Data Loggers:







Legend

Test Hydrants

- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2
- PRV

Water Main by Diameter

- < 6"
- 8" - 14"
- Bellingham City Limits
- Water Bodies

Feet
0 200 400

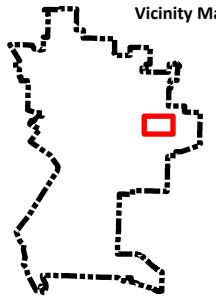
Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 519 Dakin & Yew
W Crestline Dr, E Crestline Dr, and Birch St
Date/Time: 8/15/2022 2:02 PM
Temperature: 76 F
Notes/Observations:
PH1: residential, relatively flat
PH2: very small slope hill

Flowing Hydrant	Pressure Hydrant 1	Pressure Hydrant 2	Back-up Hydrant 2
Hydrant #: 0010822	Hydrant #: 0010831	Hydrant #: 0295777	Hydrant #:
Make:	Make: Clow	Make:	Make:
Main Size:	Main Size: 6-in	Main Size:	Main Size:
Static PSI:	Static PSI: 41	Static PSI: 44	Static PSI:
Residual PSI:	Residual PSI: 34	Residual PSI: 40	Residual PSI:
Pitot PSI:	Logger #: 51	Logger #: 50	Pitot PSI:
Flow GPM: 400			Flow GPM:
Duration: 2-3 minutes			Duration:

Vicinity Map



Notes/Photographs: (Test 19)

Location of pressure hydrant P1



Logger setup of pressure hydrant P1



Location of pressure hydrant P2



Logger setup of pressure hydrant P2



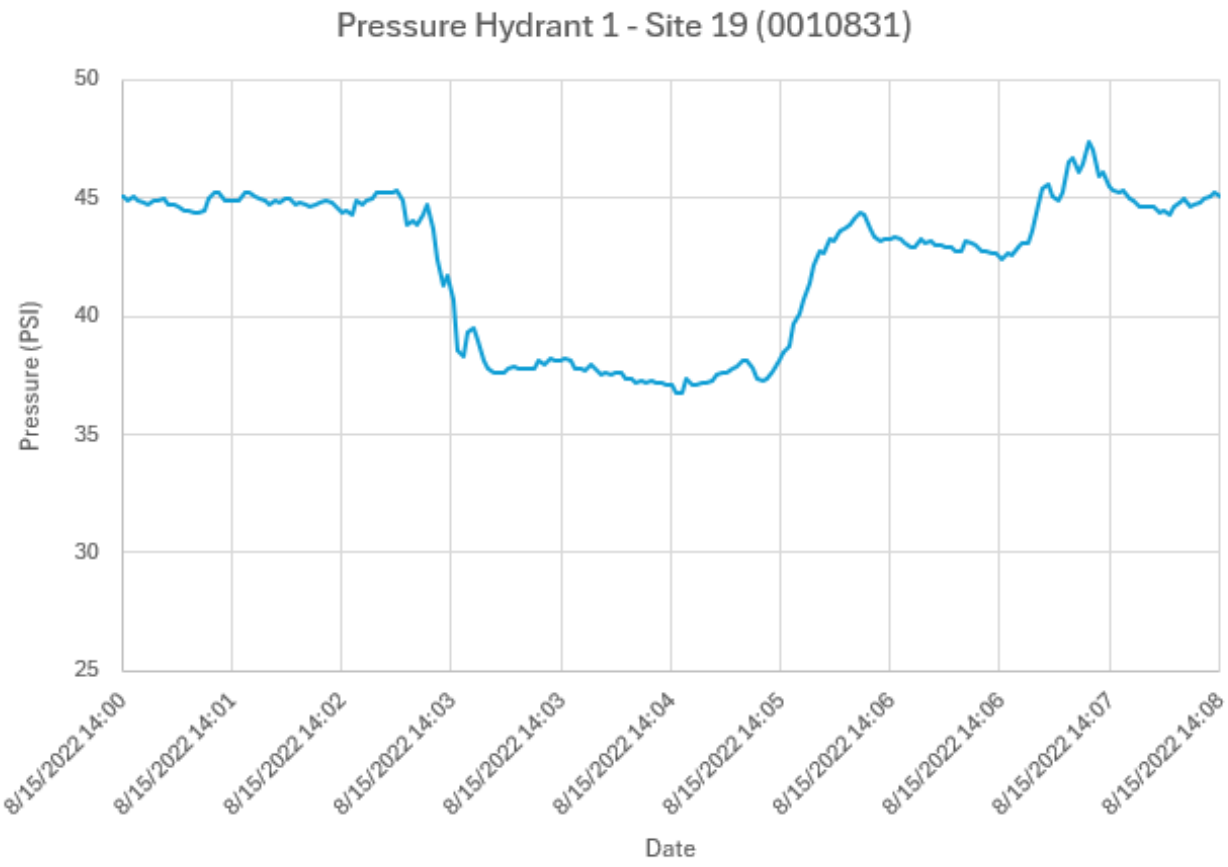
Surrounding area of flowing hydrant F1

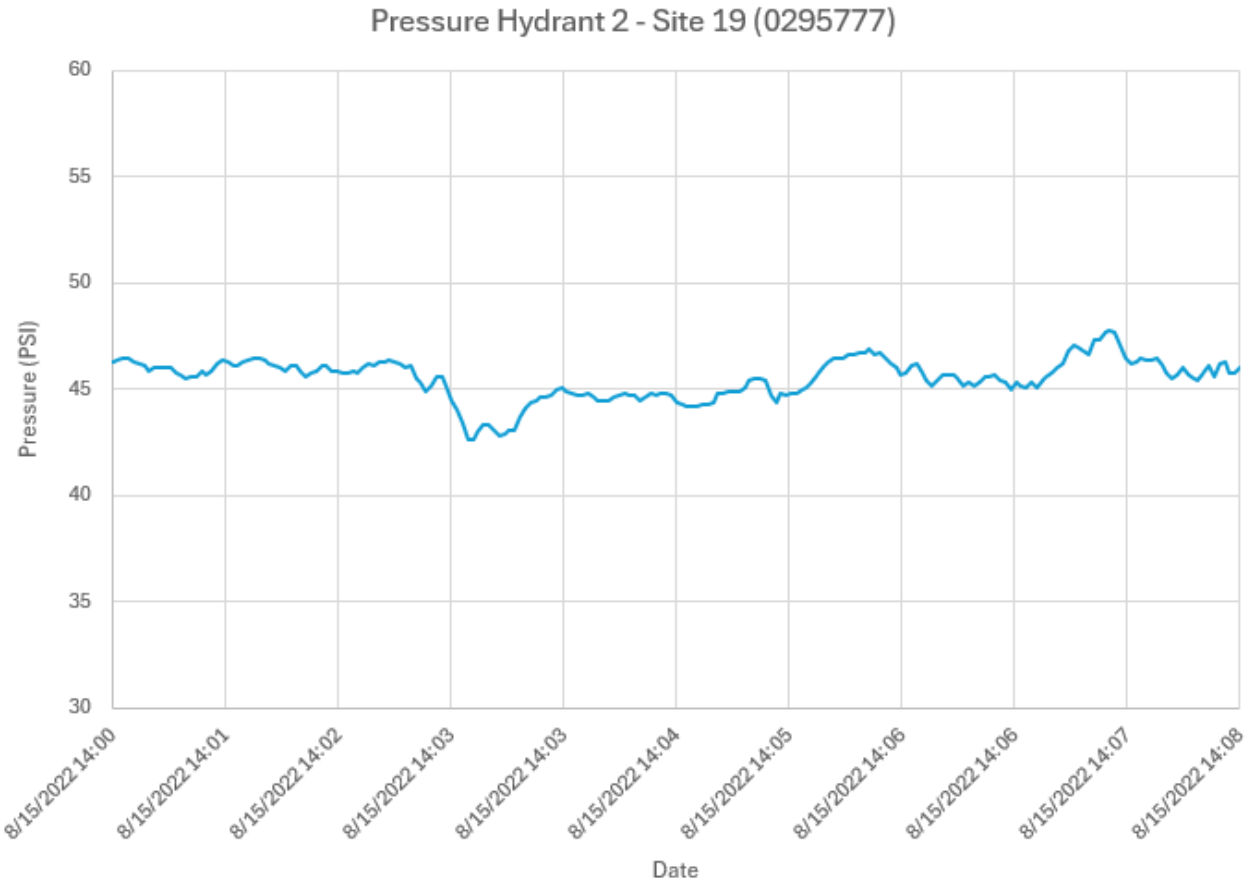


Diffuser setup of flowing hydrant F1

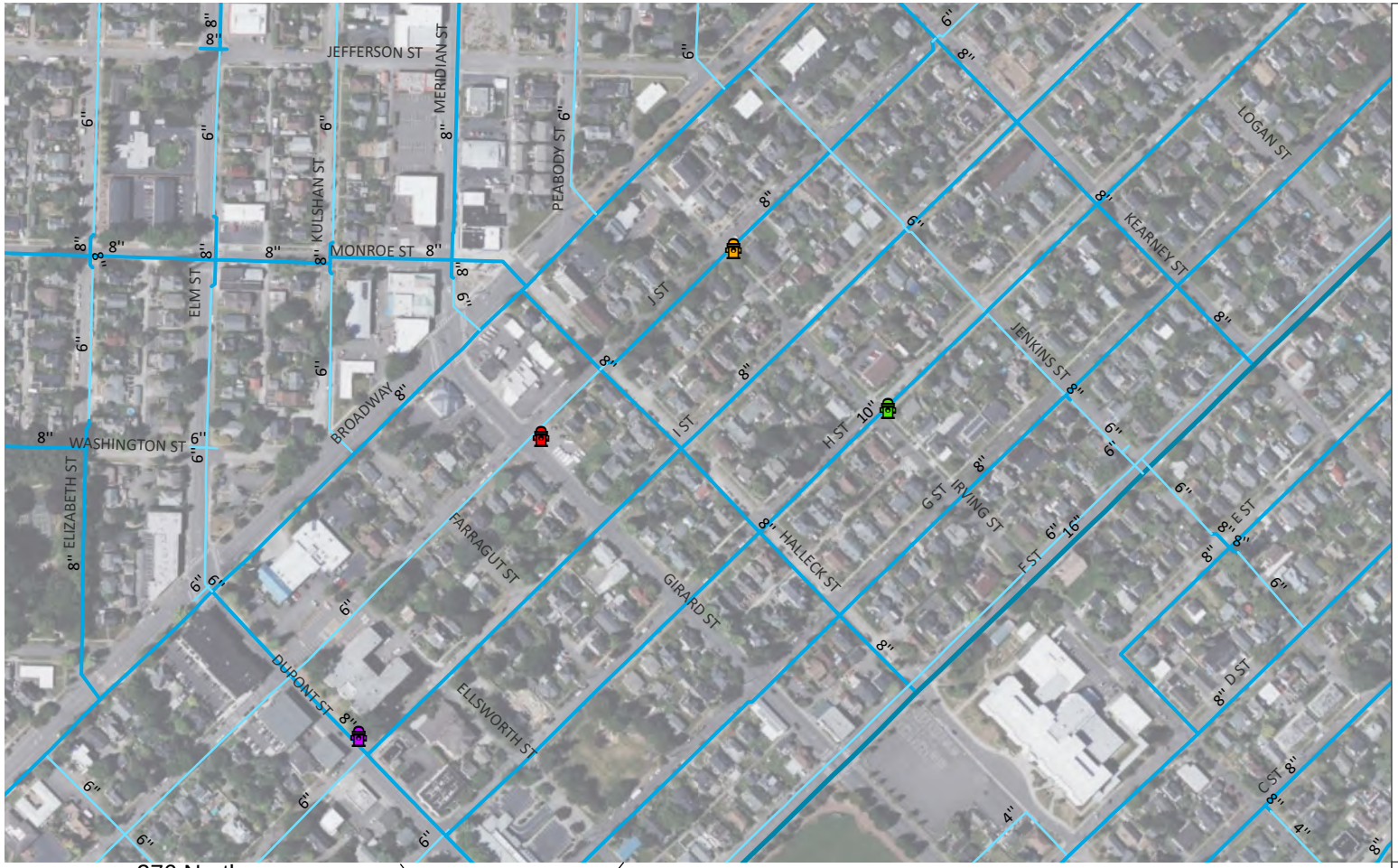


Pressure at Data Loggers:





Test notes:
On first attempt there was not much flow from hydrant. Closed flow hydrant 1 and trying flow hydrant 2.
Second attempt with flow hydrant 2 got more flow.



Legend

Test Hydrants
- Flow Hydrant 1
- Flow Hydrant 2
- Pressure Hydrant 1
- Pressure Hydrant 2

Water Main by Diameter
- < 6"
- 8" - 14"
- > 14"
- Bellingham City Limits

N

0 200 400 Feet

Data Sources: City of Bellingham

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Test Location: 276 North Dupont St, I St, and H St

Date/Time: 8/16/2022 8:17 AM

Temperature: 66 F

Notes/Observations: PH1: on main road, flat gravity flow from WTP

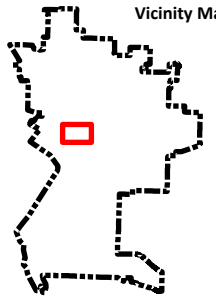
Flowing Hydrant
Hydrant #:
Make:
Main Size:
Static PSI:
Residual PSI:
Pitot PSI:
Flow GPM:
Duration:

Pressure Hydrant 1
Hydrant #: 0010286
Make: Waterous
Main Size: 8-in
Static PSI: 82
Residual PSI: 76
Logger #: 51

Pressure Hydrant 2
Hydrant #: 0010341
Make:
Main Size:
Static PSI: 80
Residual PSI: 78
Logger #: 50

Back-up Hydrant 2
Hydrant #: 0012013
Make:
Main Size:
Static PSI:
Residual PSI:
Pitot PSI:
Flow GPM: 650
Duration: 1-2 minutes

Vicinity Map



Notes/Photographs: (Test 20)

Location of pressure hydrant P1



Logger setup of pressure hydrant P1



Location of pressure hydrant P2



Logger setup of pressure hydrant P2



Notes/Photographs: (Test 20)

Surrounding area of flowing hydrant F1



Diffuser setup of flowing hydrant F1



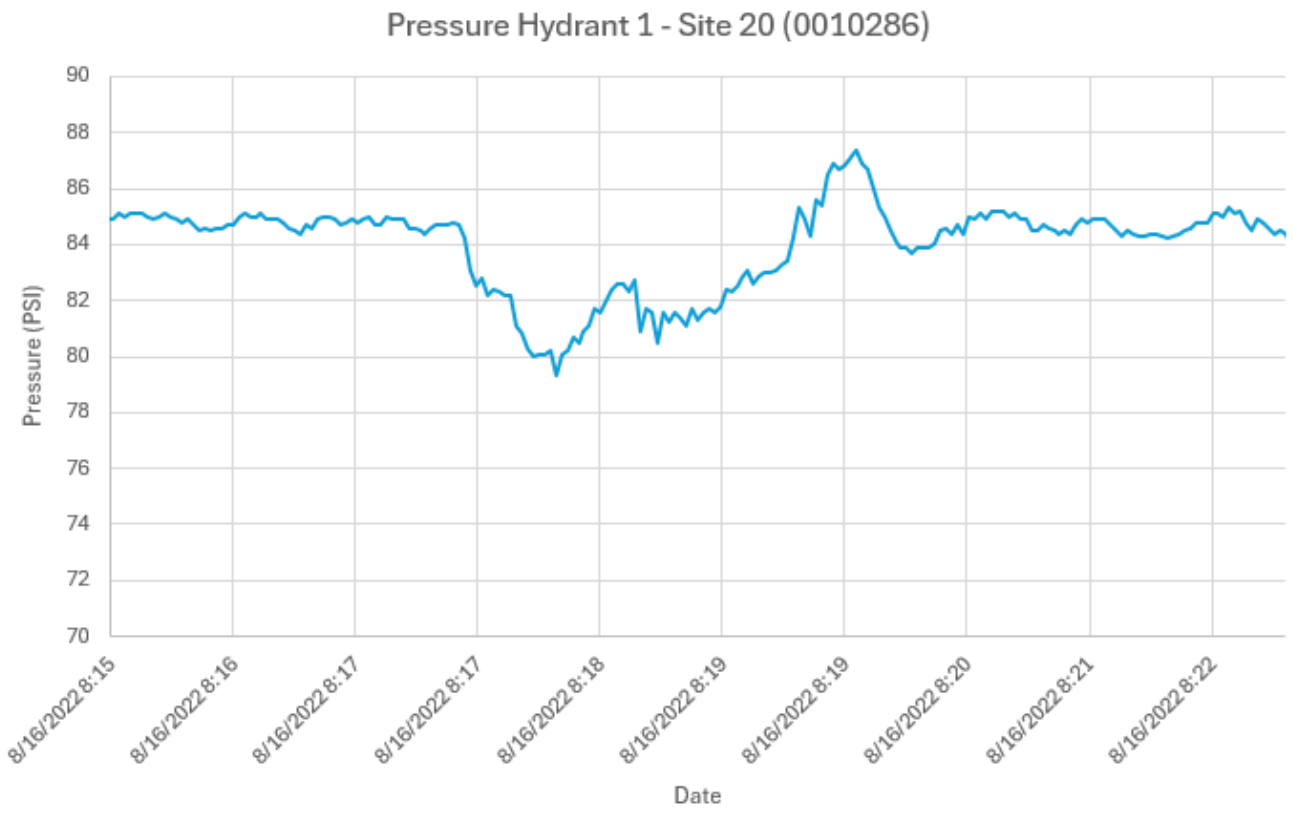
Surrounding area of flowing hydrant F2

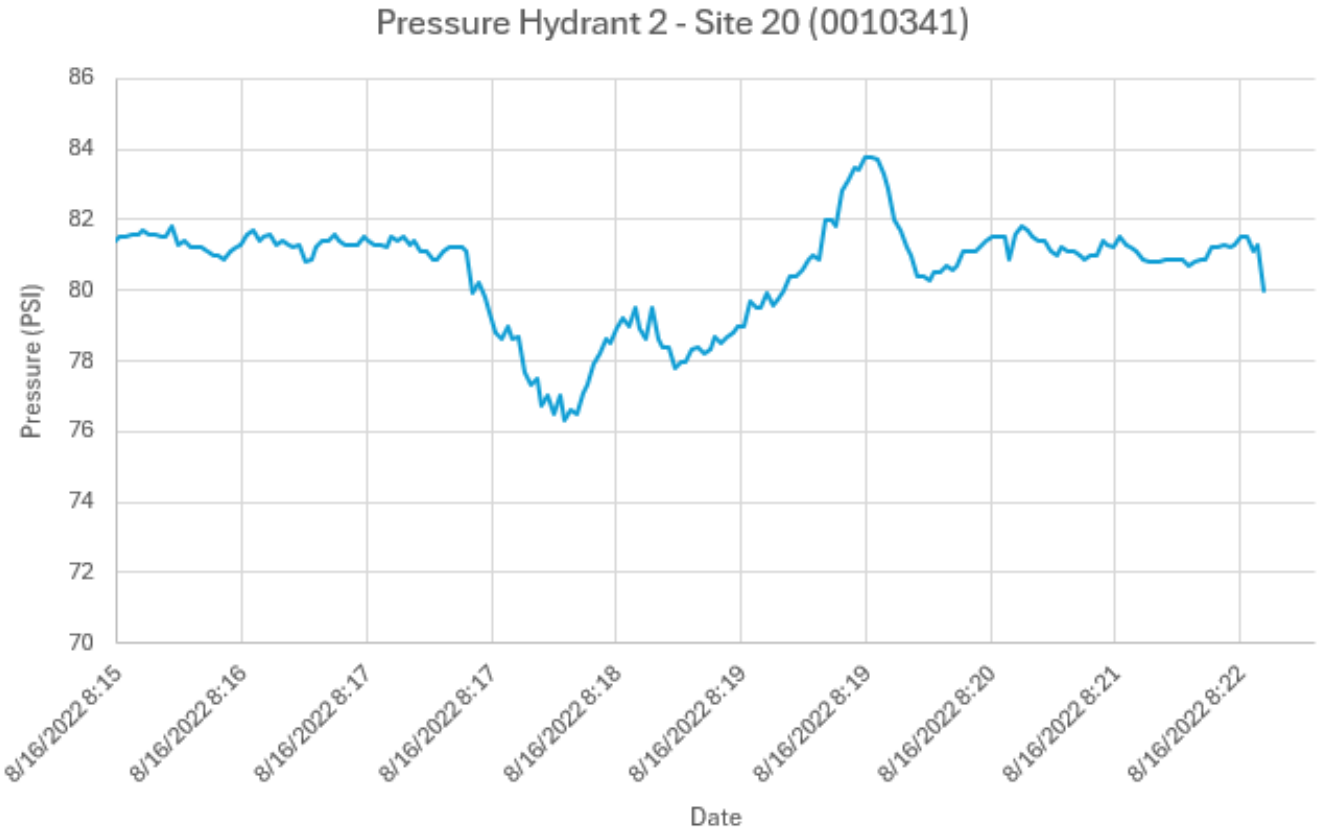


Diffuser setup of flowing hydrant F2



Pressure at Data Loggers:





ATTACHMENT 1C

EPS CALIBRATION FIGURES

EPS CALIBRATION FIGURES

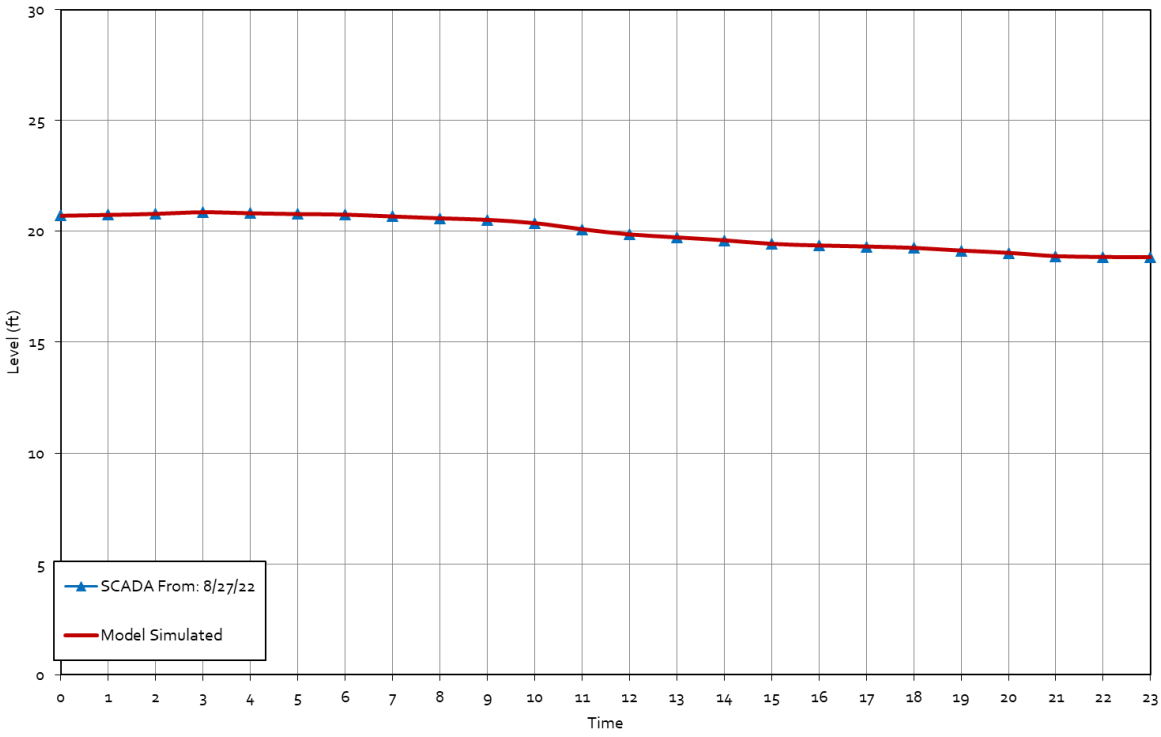


Figure 1C.1 Summer EPS Calibration – Whatcom Falls II Level

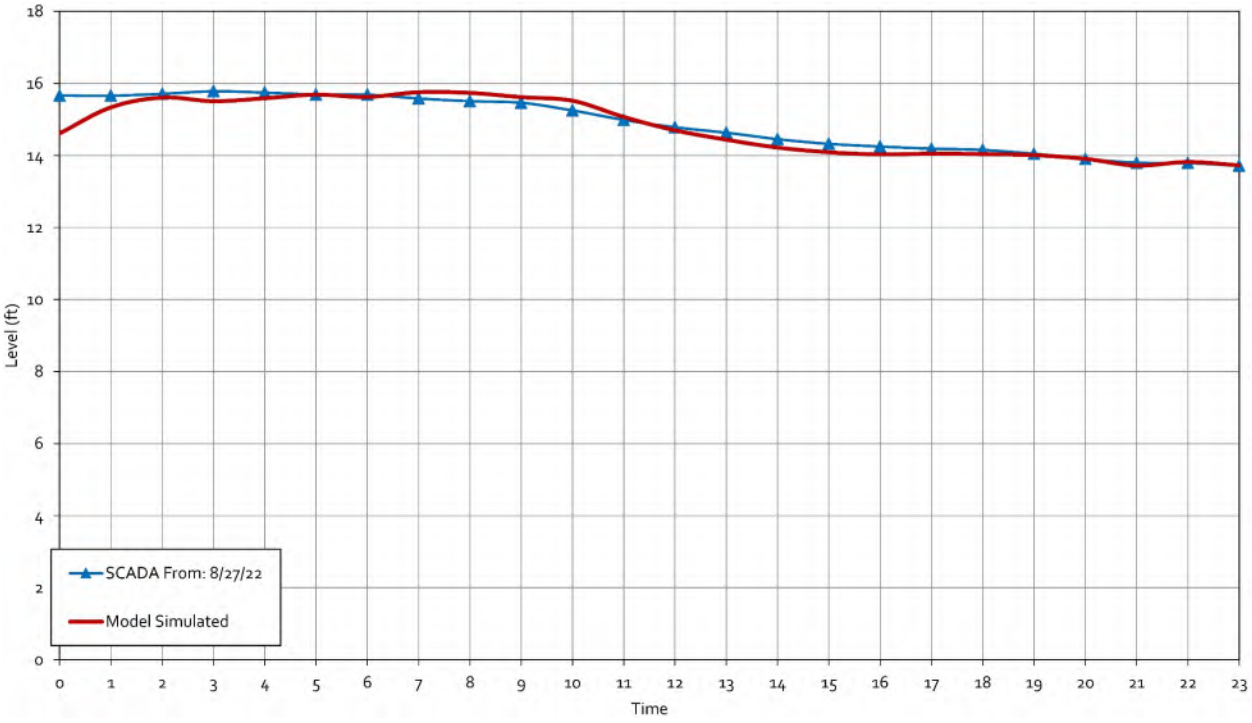


Figure 1C.2 Summer EPS Calibration - Whatcom Falls I Level

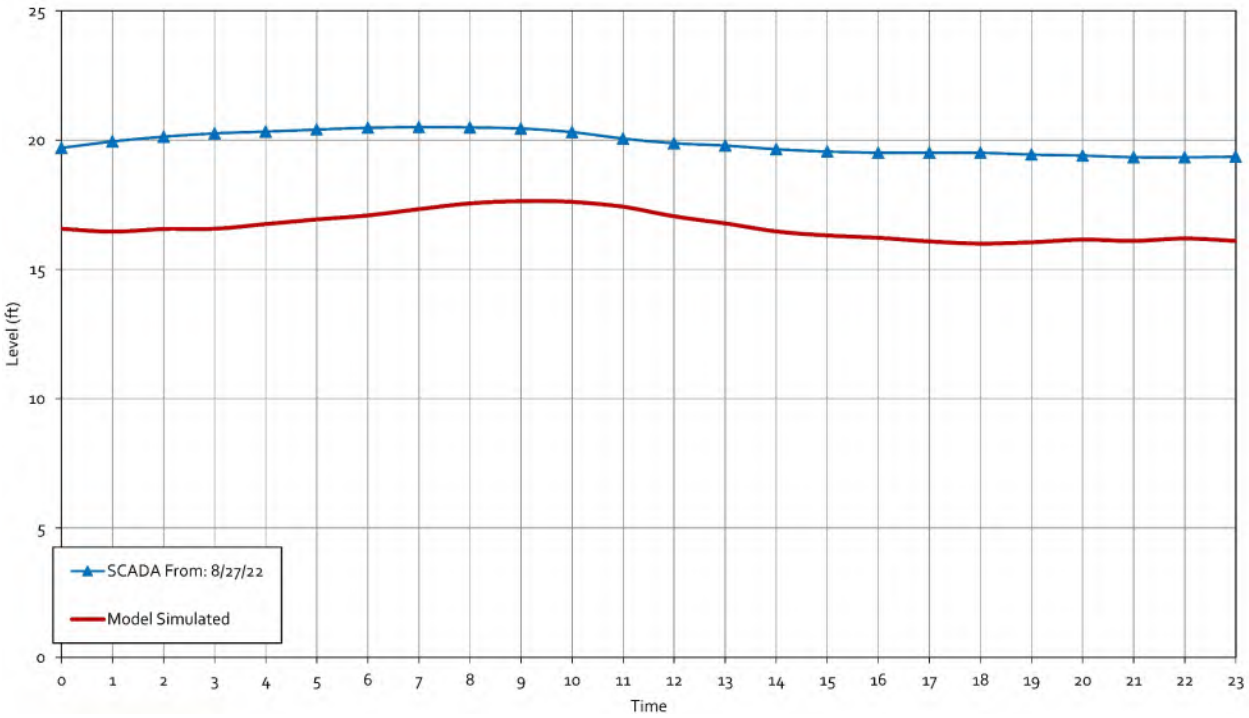


Figure 1C.3 Summer EPS Calibration – Kearney Res Level

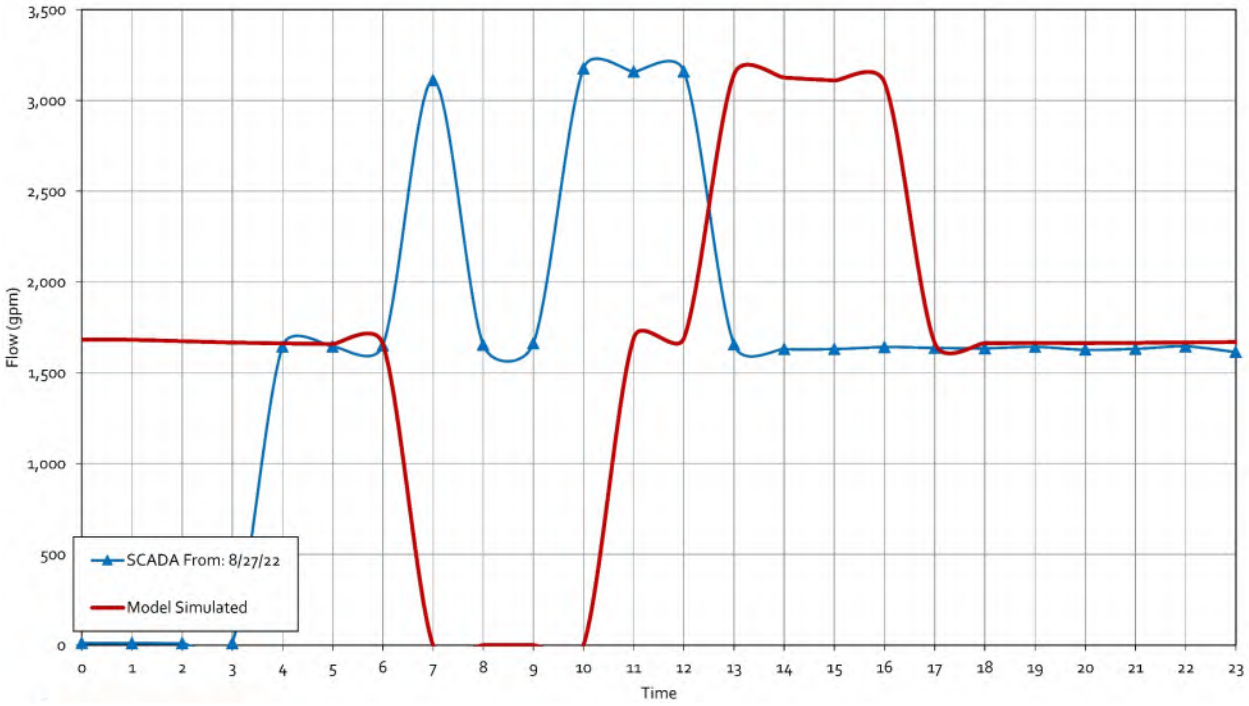


Figure 1C.4 Summer EPS Calibration – Dakin PS Flow

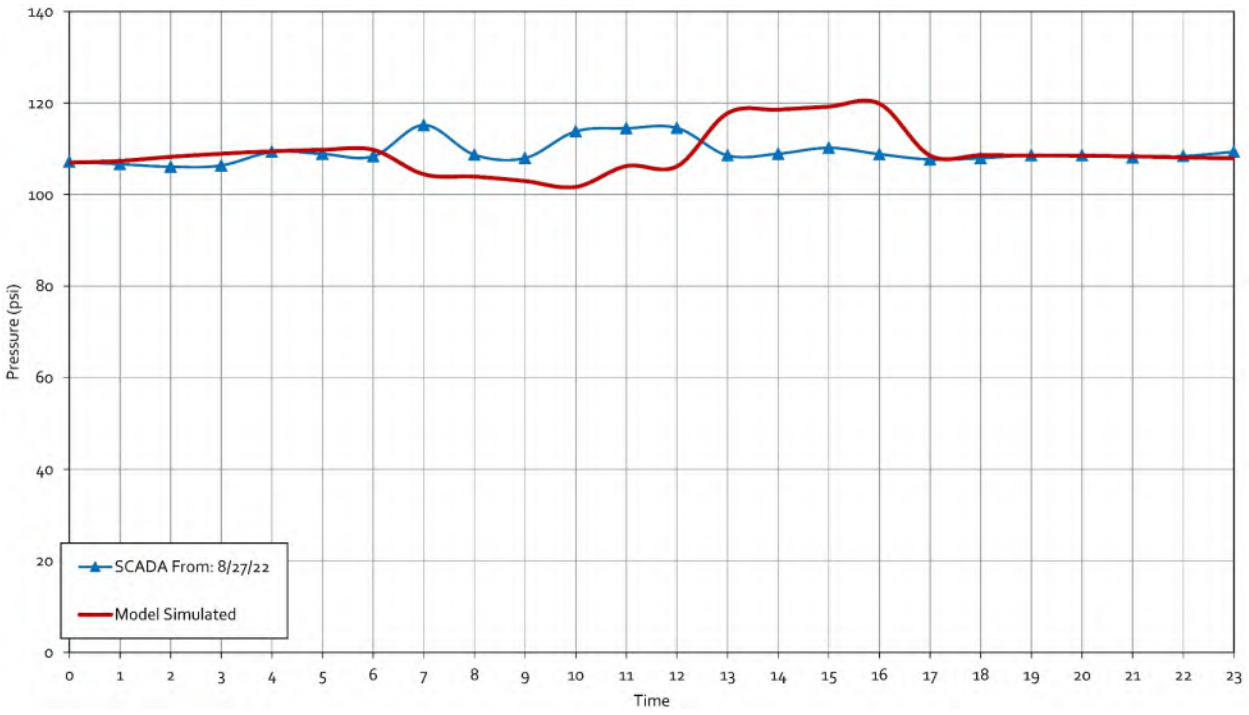


Figure 1C.5 Summer EPS Calibration – Dakin PS Discharge Pressure

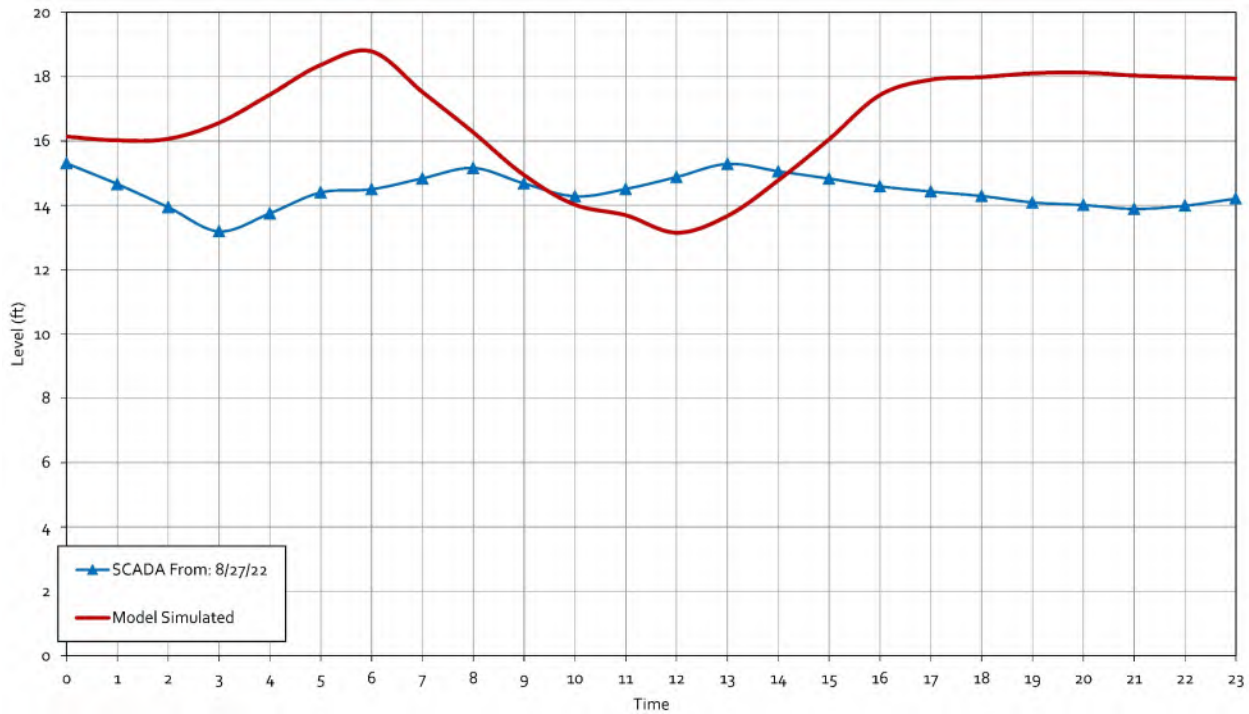


Figure 1C.6 Summer EPS Calibration – Dakin I Level

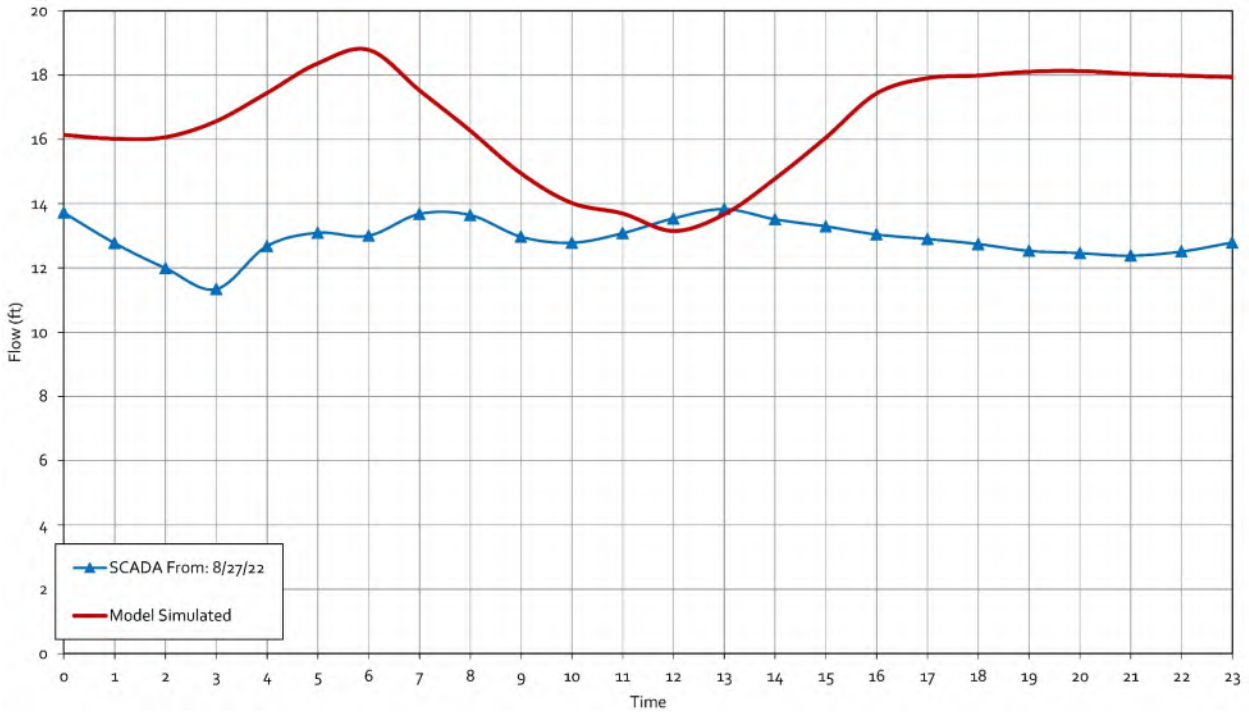


Figure 1C.7 Summer EPS Calibration – Dakin II Level

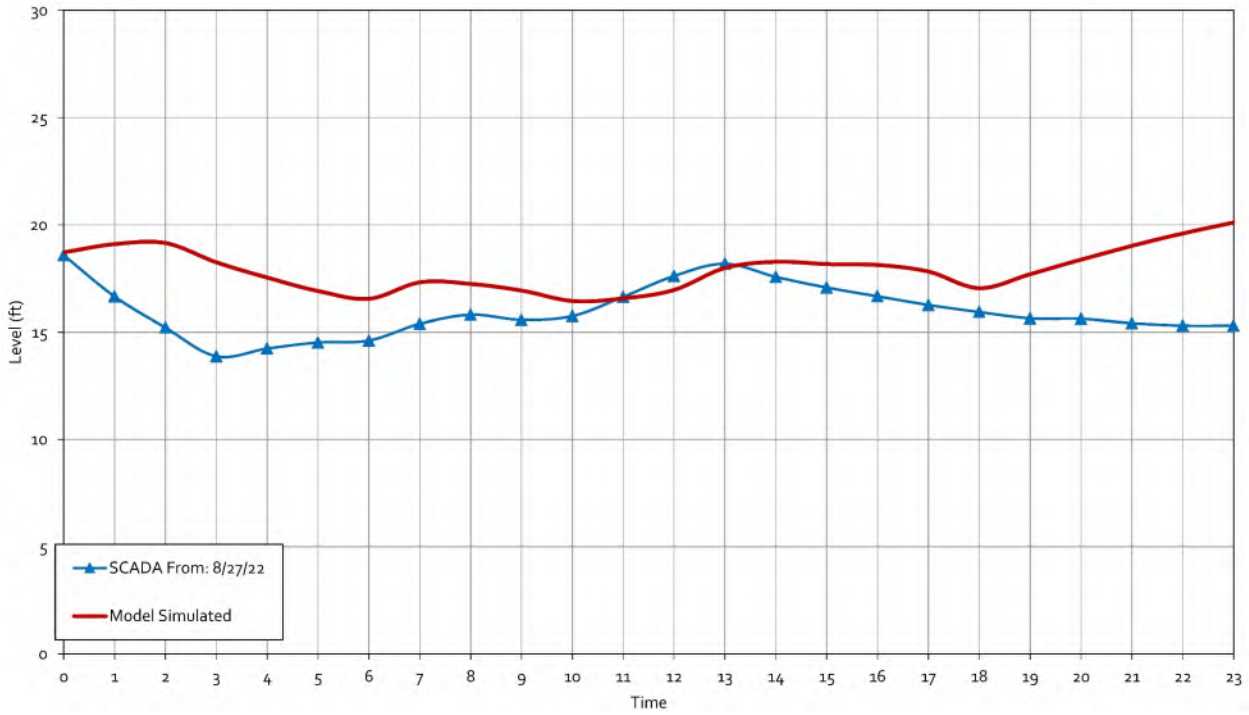


Figure 1C.8 Summer EPS Calibration – Consolidation Level

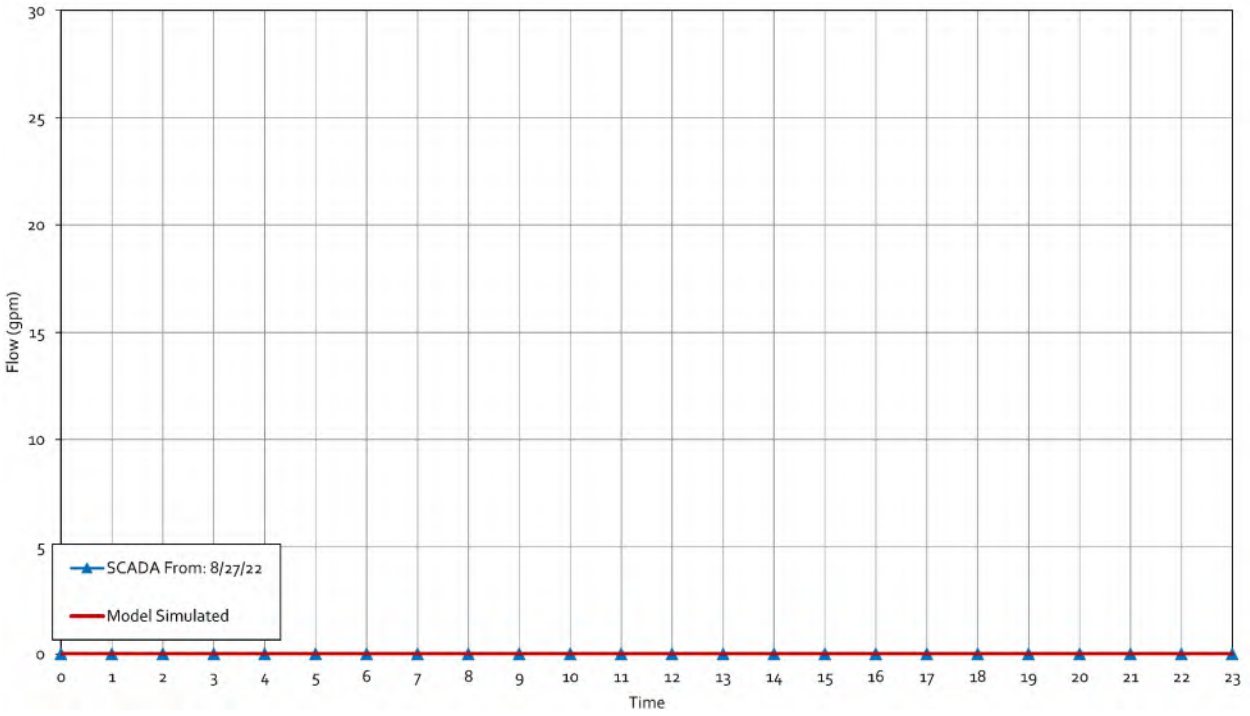


Figure 1C.9 Summer EPS Calibration – Woburn PS Flow

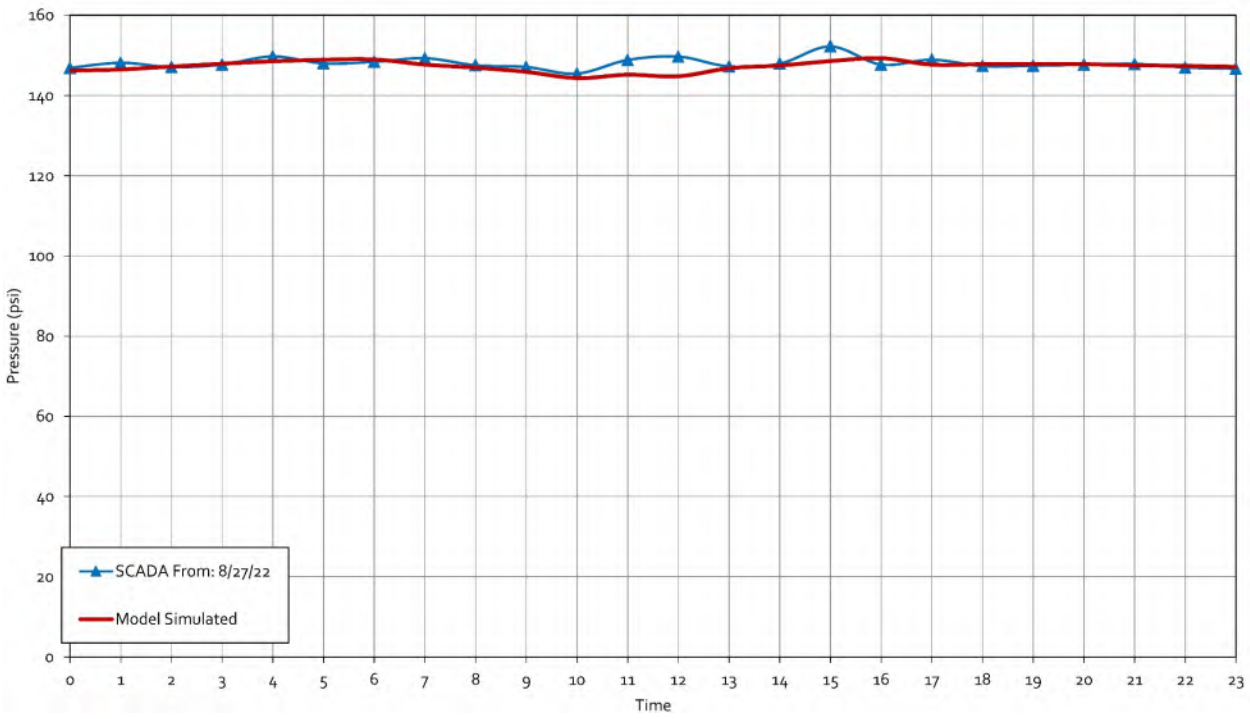


Figure 1C.10 Summer EPS Calibration – Woburn PS Pressure

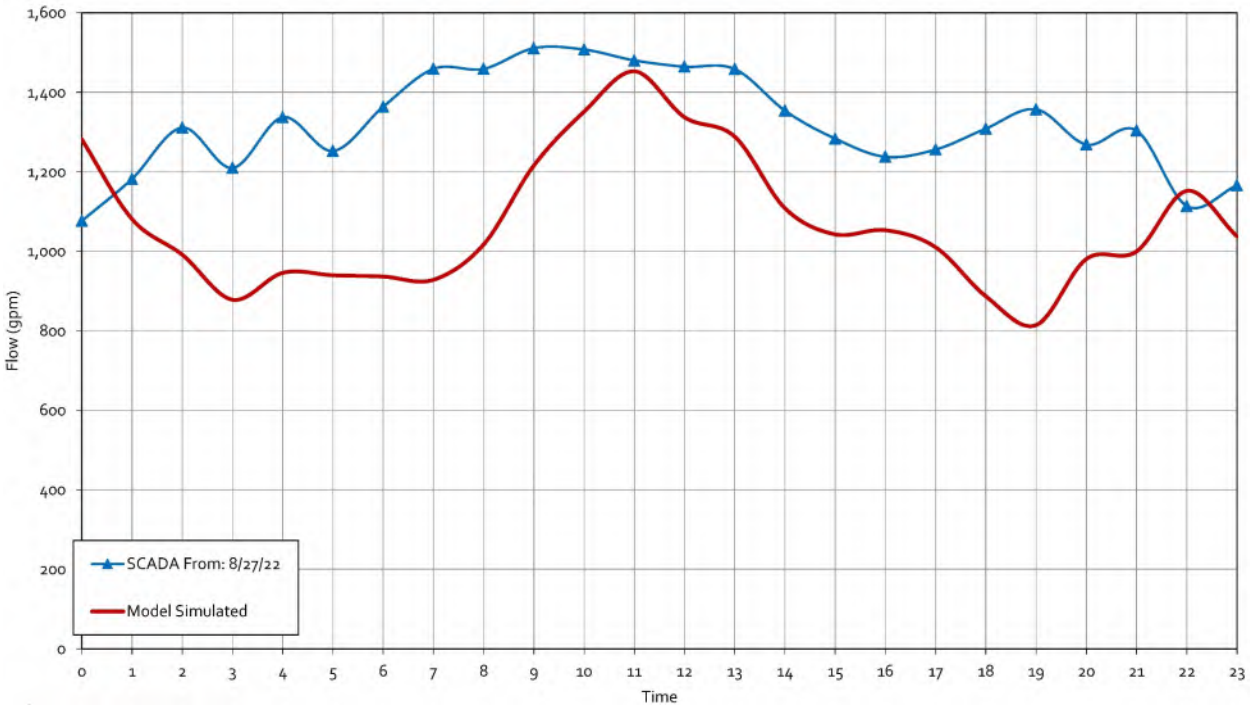


Figure 1C.11 Summer EPS Calibration – Short St Flow

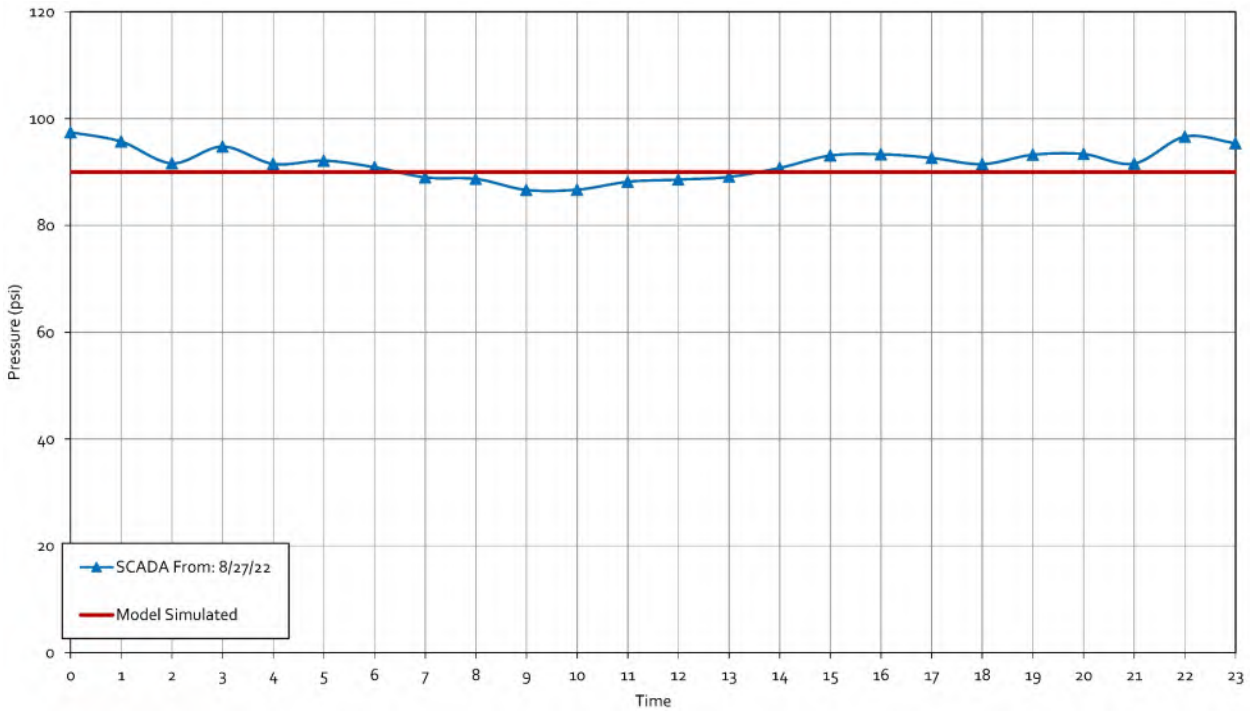


Figure 1C.12 Summer EPS Calibration – Short St Discharge Pressure

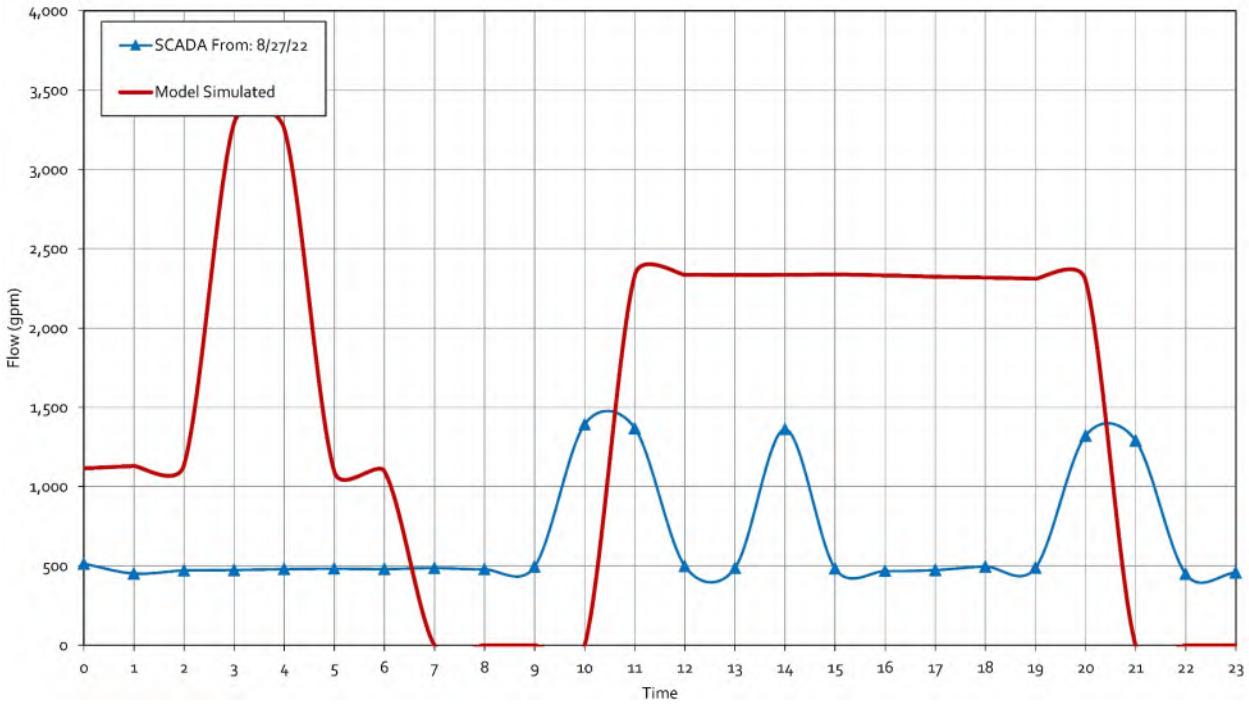


Figure 1C.13 Summer EPS Calibration – Otis Flow

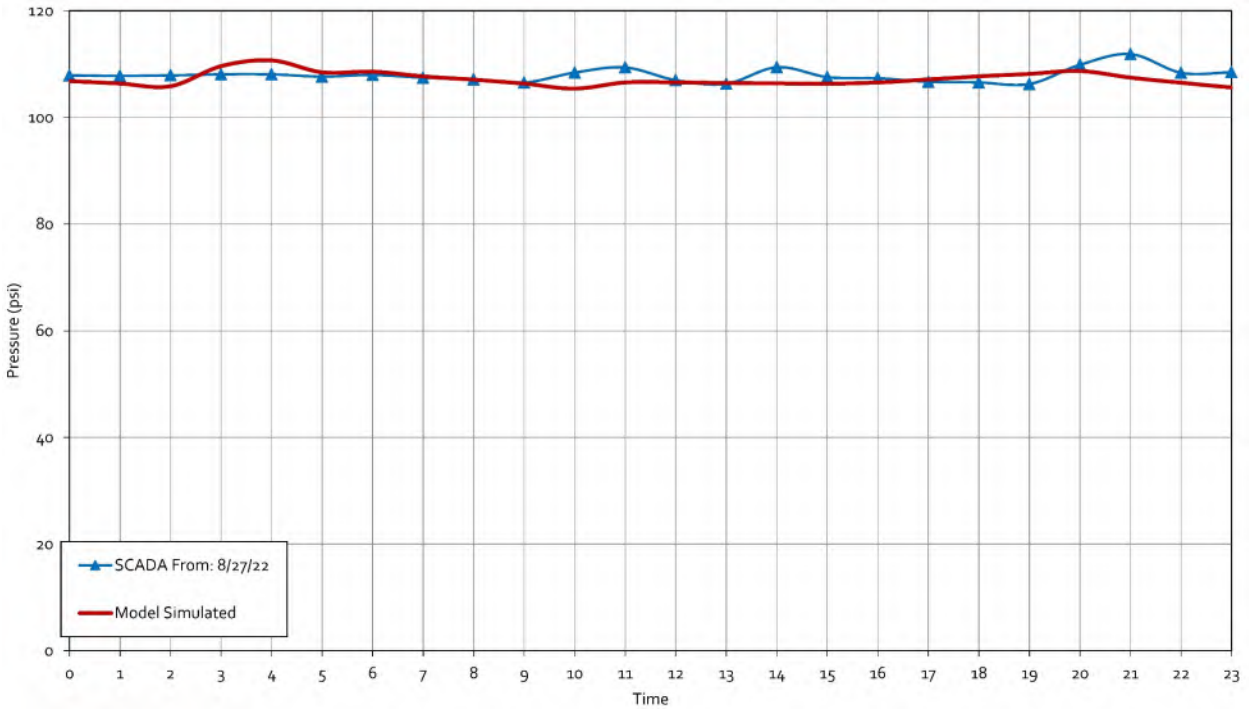


Figure 1C.14 Summer EPS Calibration – Otis Pressure

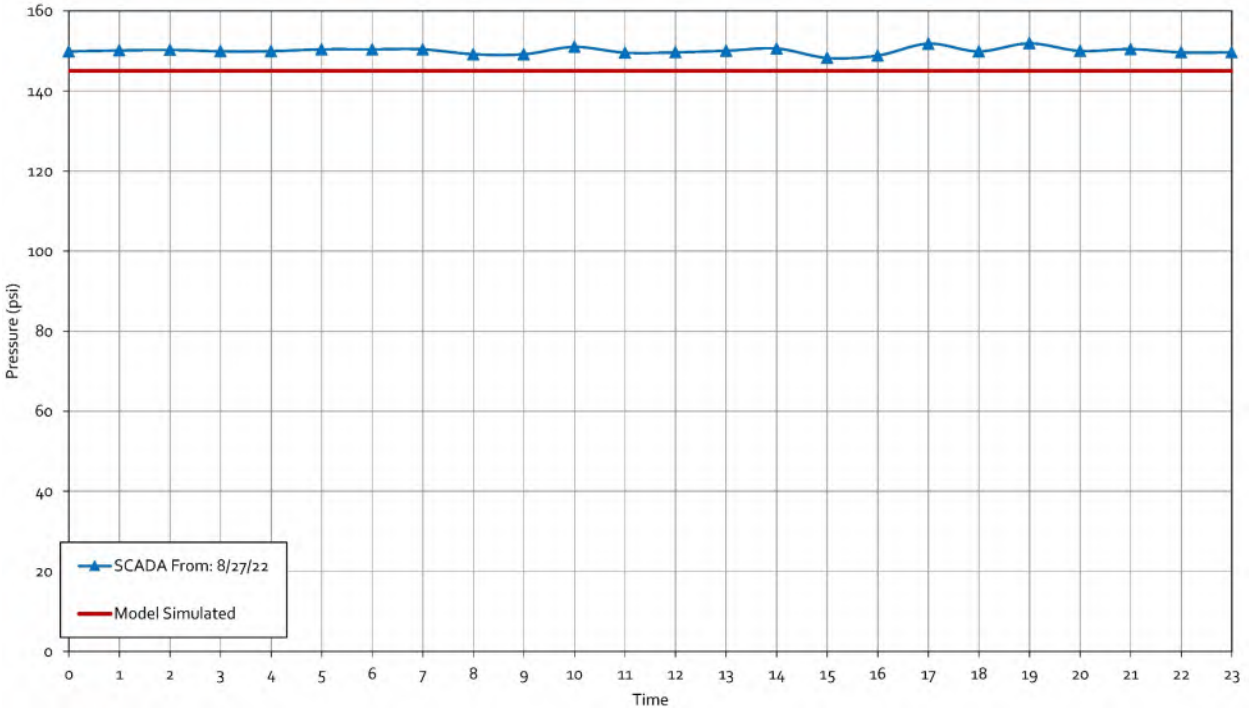


Figure 1C.15 Summer EPS Calibration – James St Pressure

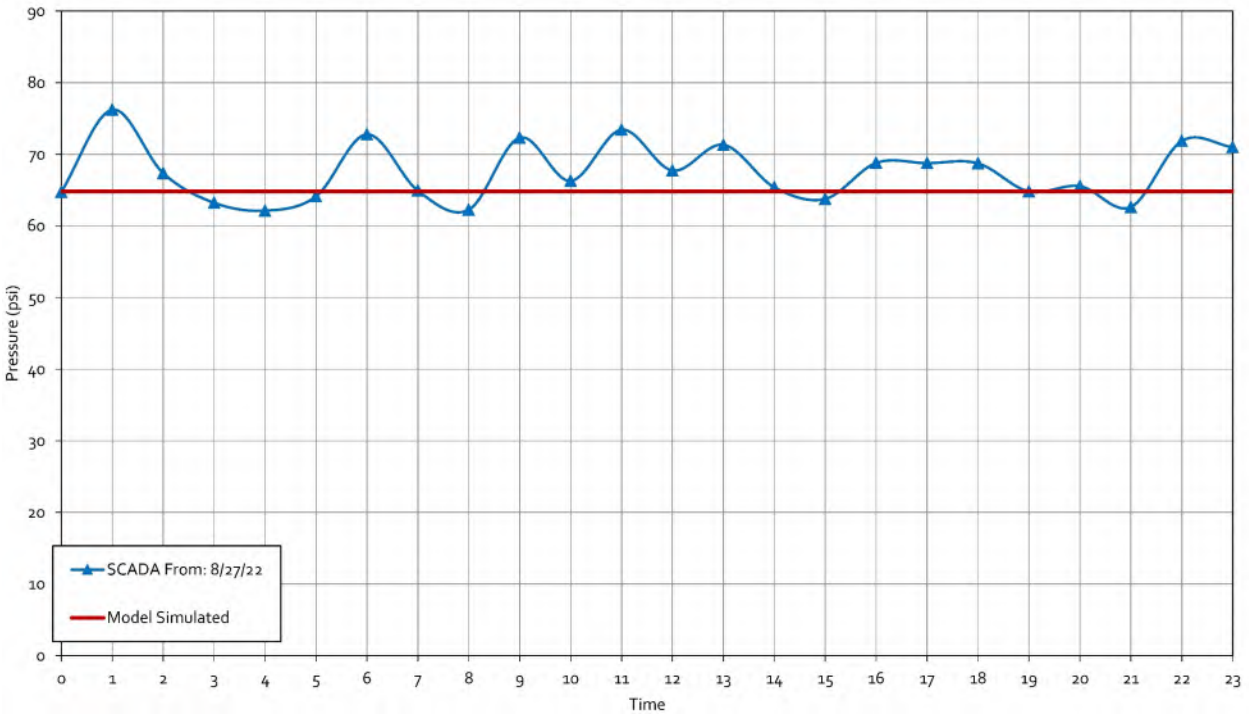


Figure 1C.16 Summer EPS Calibration – Huntington Pressure

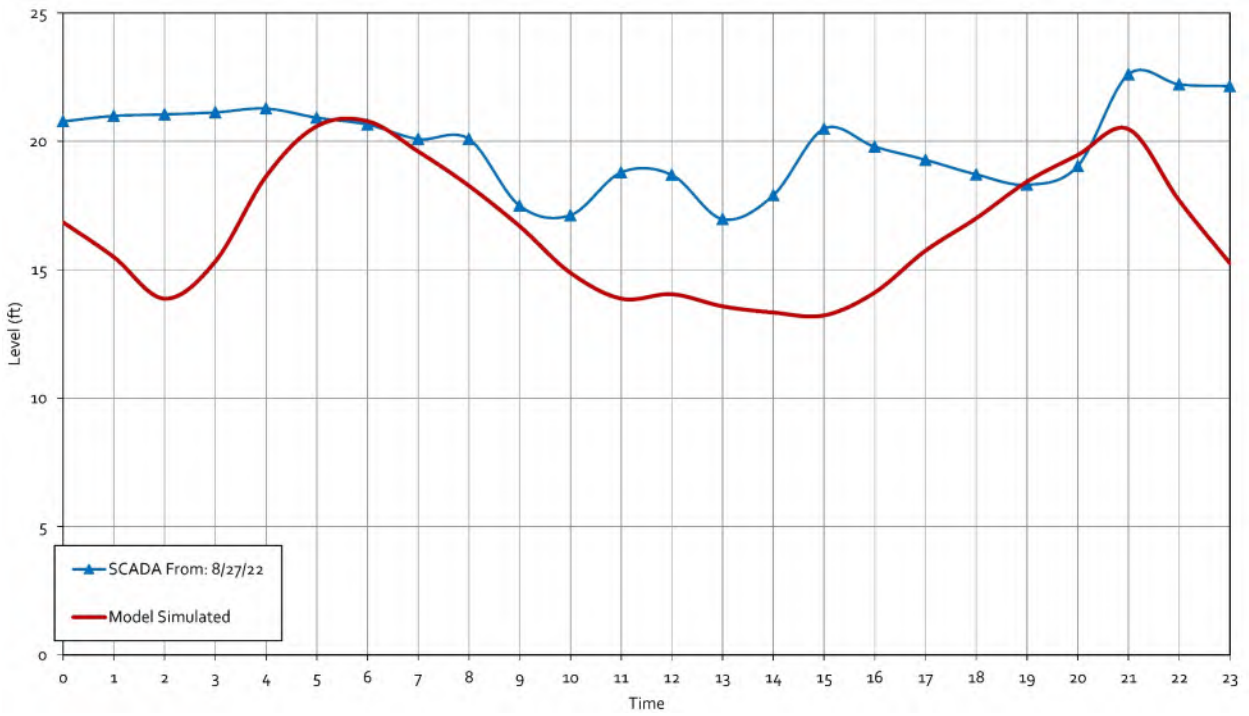


Figure 1C.17 Summer EPS Calibration – Padden Level

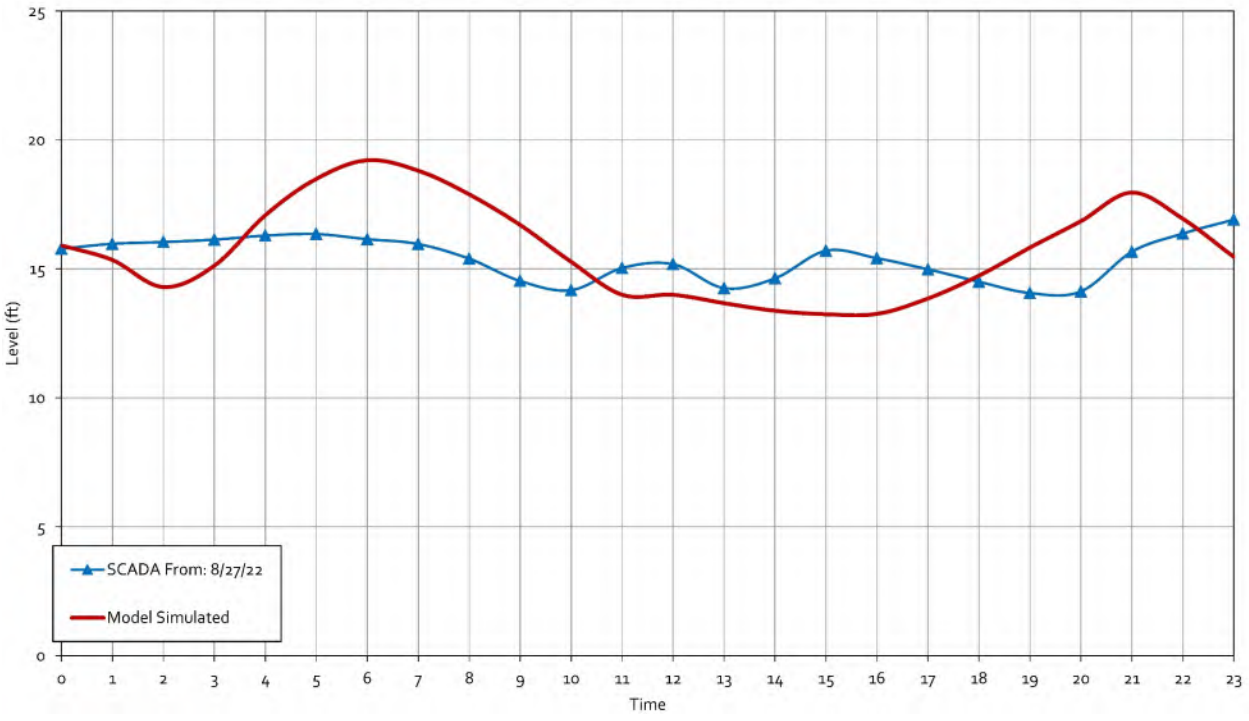


Figure 1C.18 Summer EPS Calibration – College Way Level

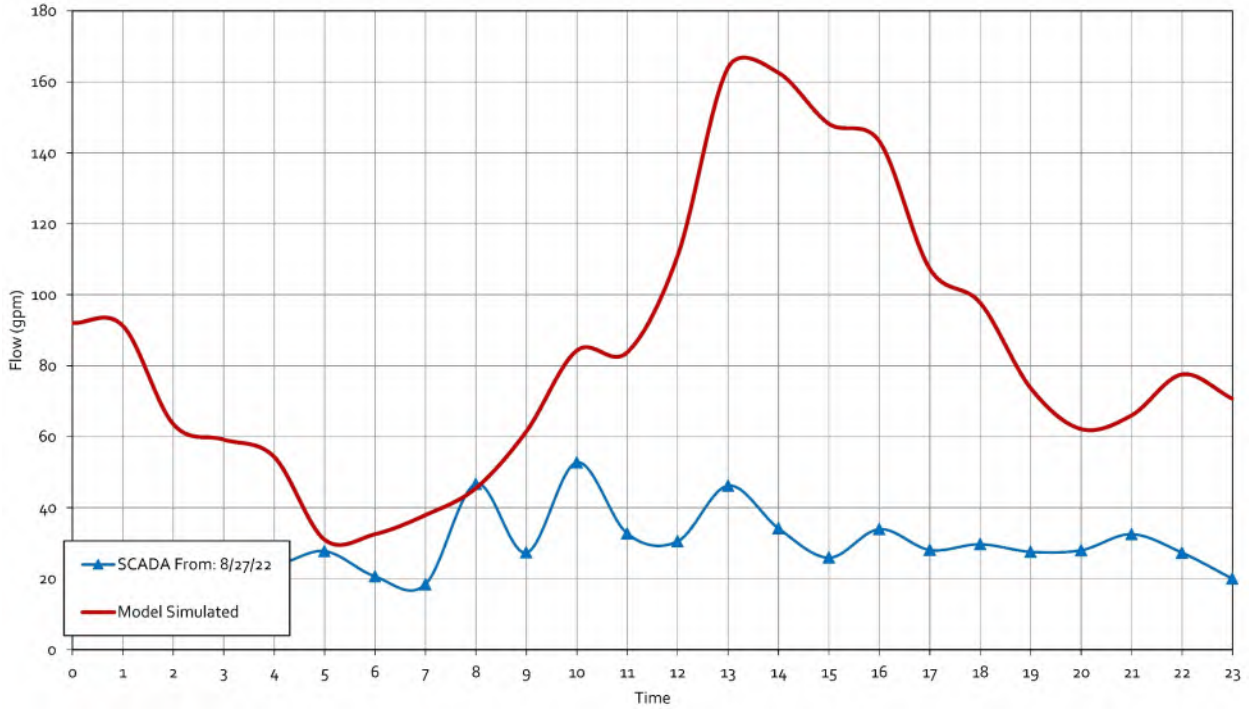


Figure 1C.19 Summer EPS Calibration – College Way Flow

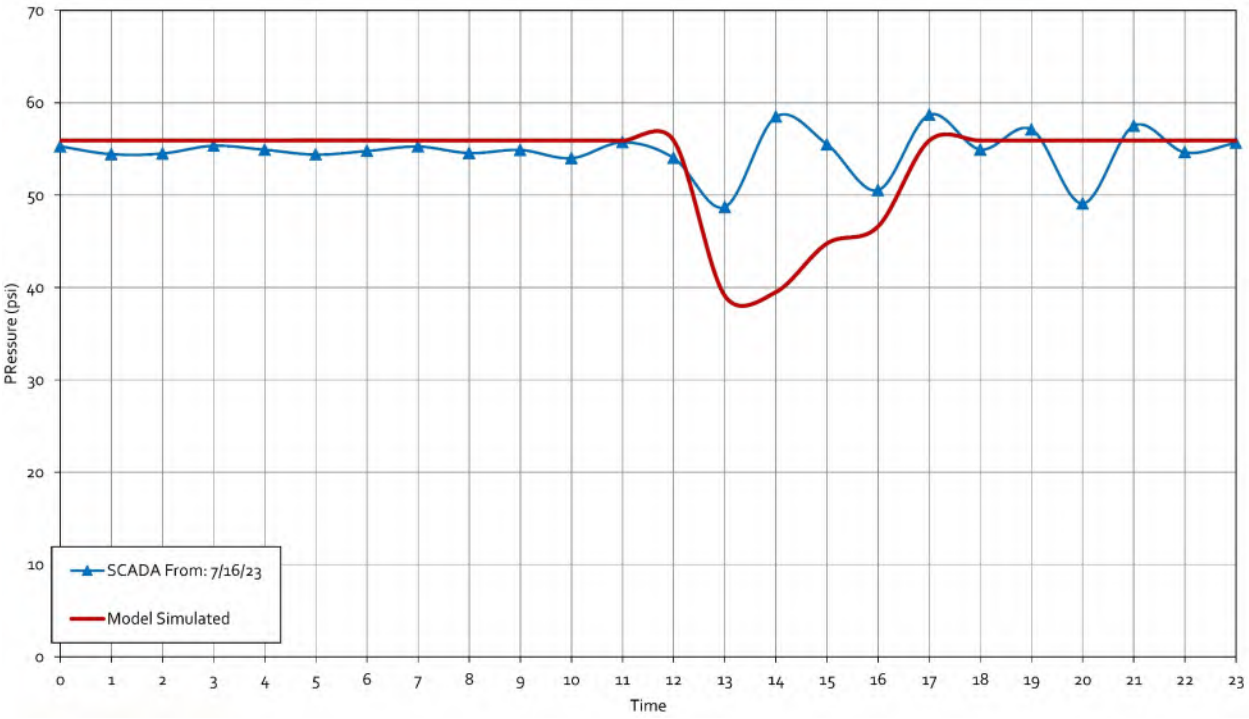


Figure 1C.20 Summer EPS Calibration – College Way Pressure

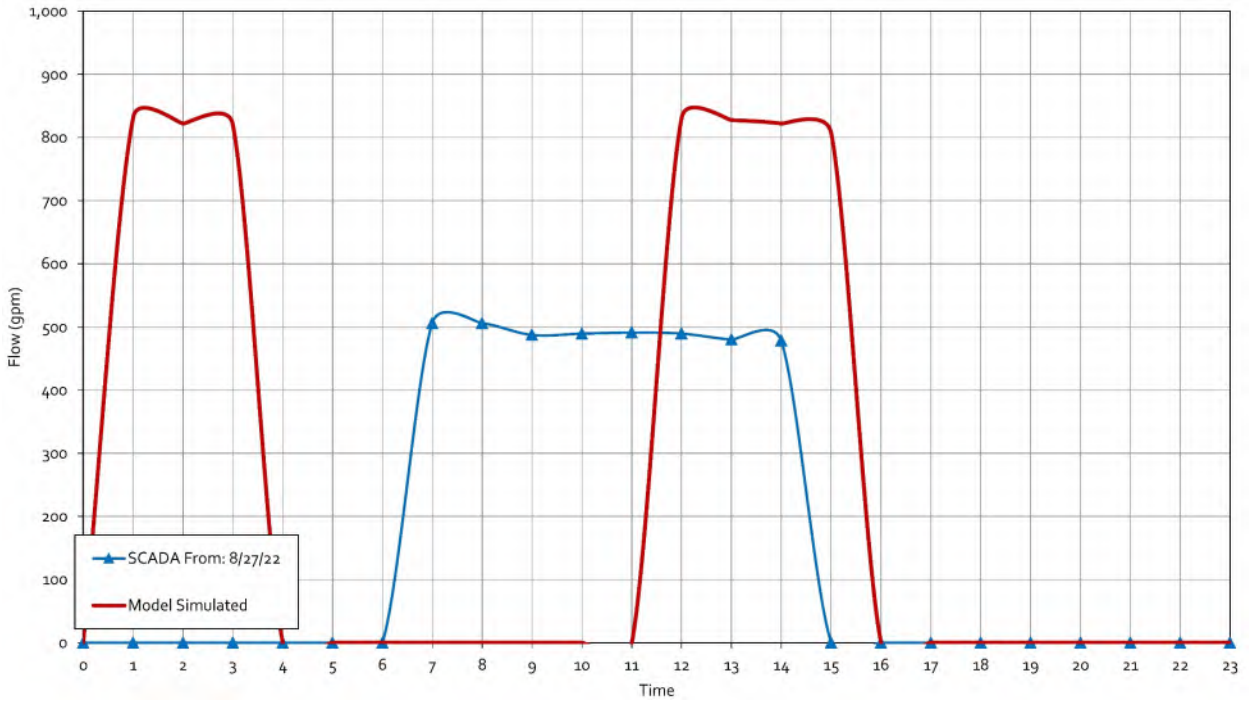


Figure 1C.21 Summer EPS Calibration – 38th St Flow

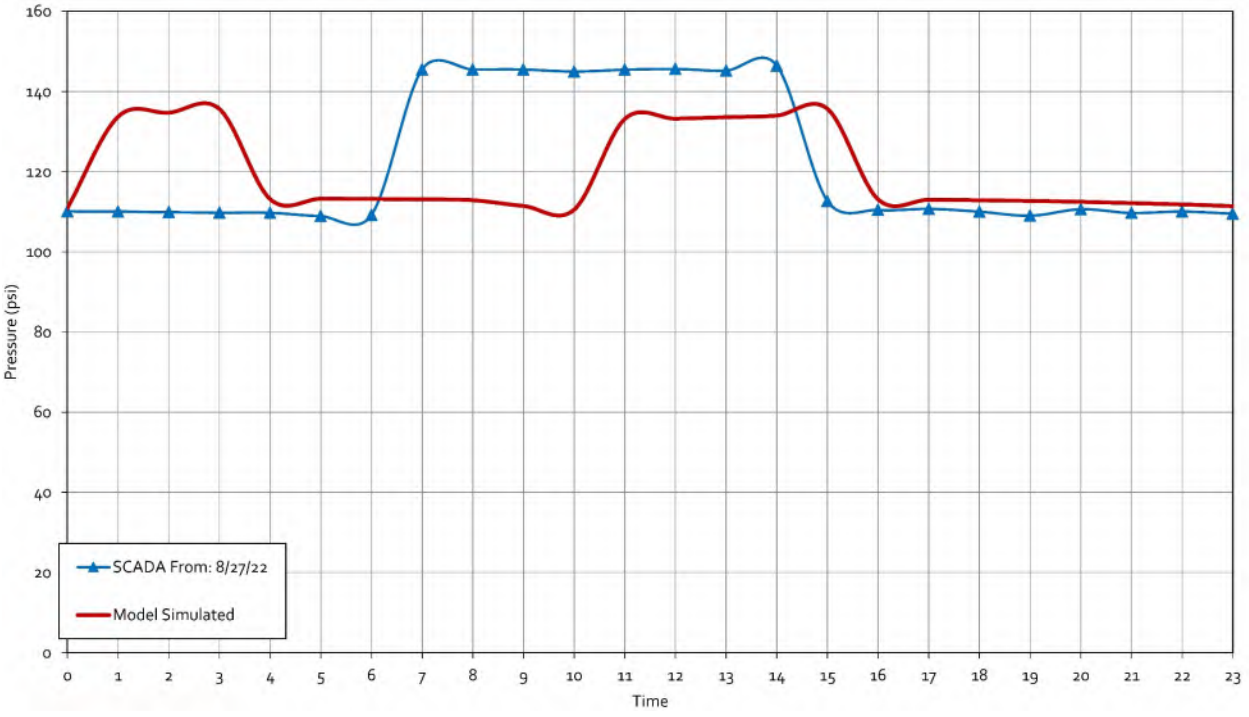


Figure 1C.22 Summer EPS Calibration – 38th St Pressure

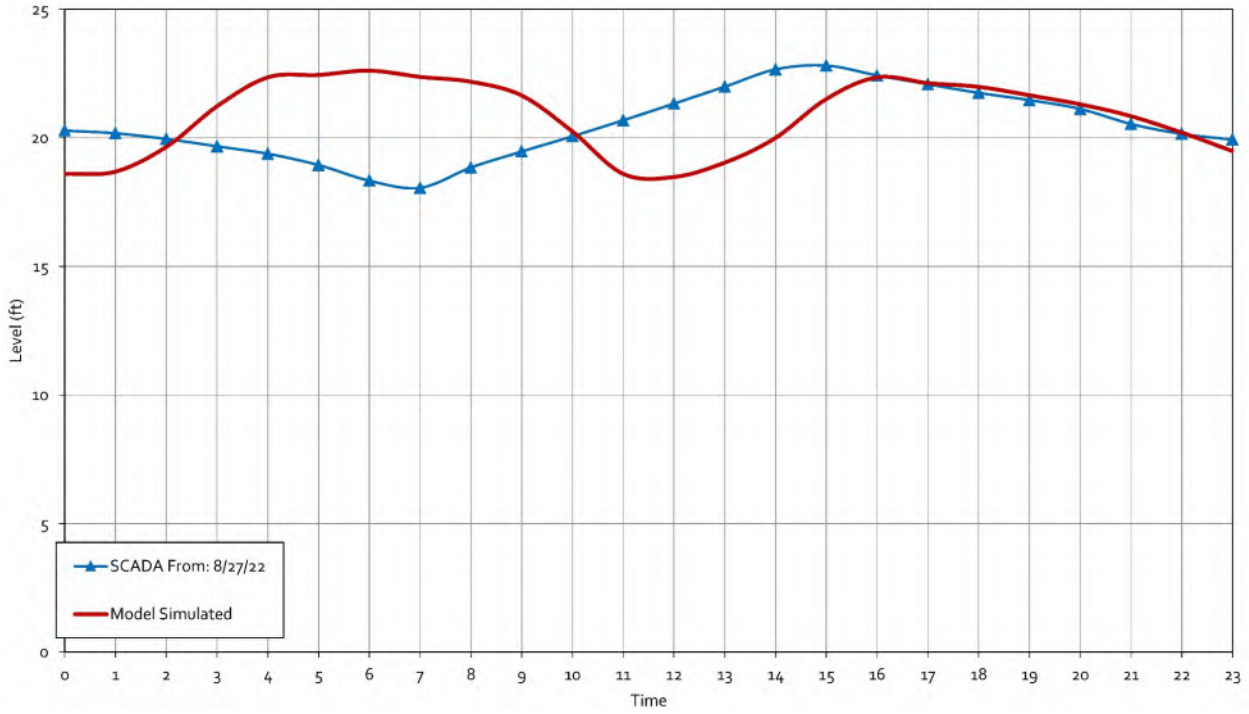


Figure 1C.23 Summer EPS Calibration – 40th Level

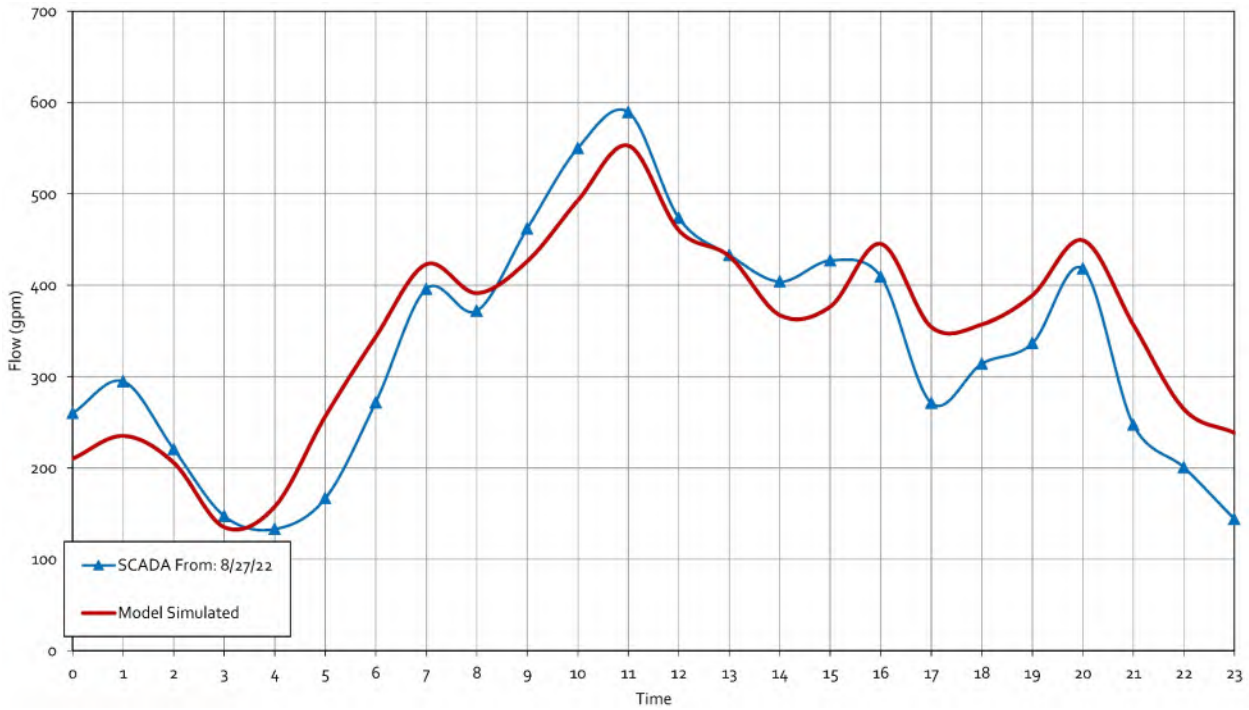


Figure 1C.24 Summer EPS Calibration – Balsam Flow

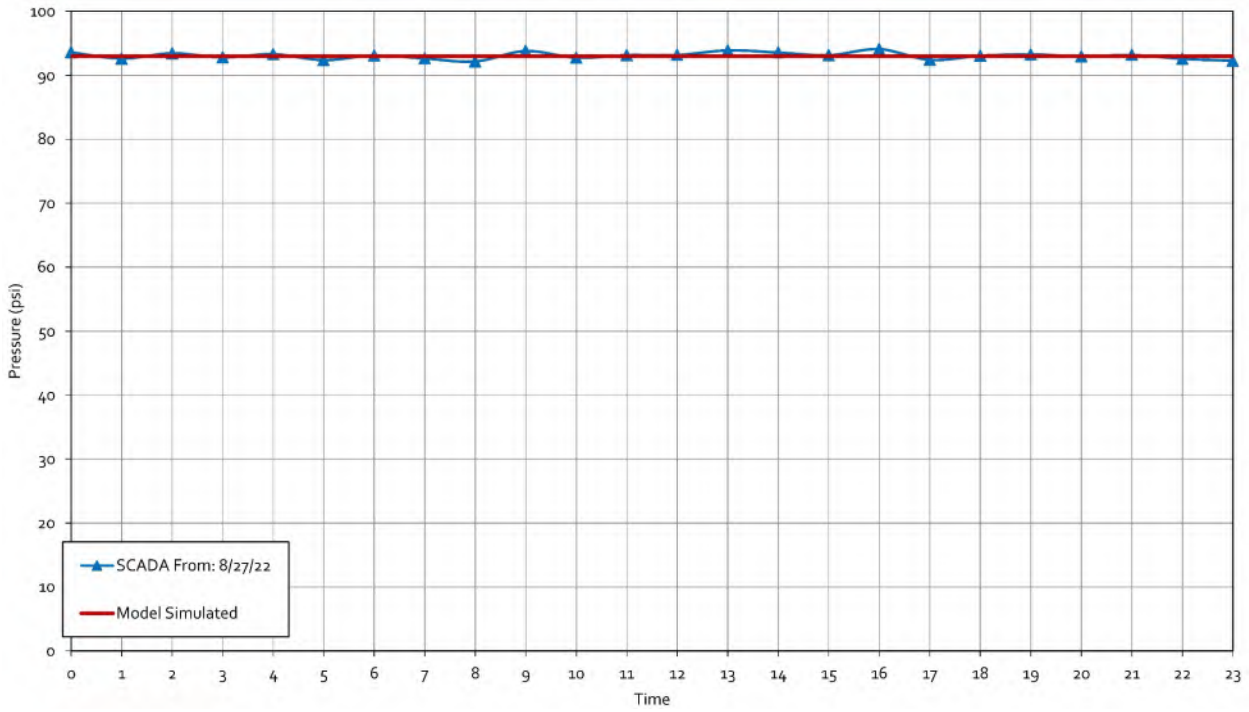


Figure 1C.25 Summer EPS Calibration – Balsam Pressure

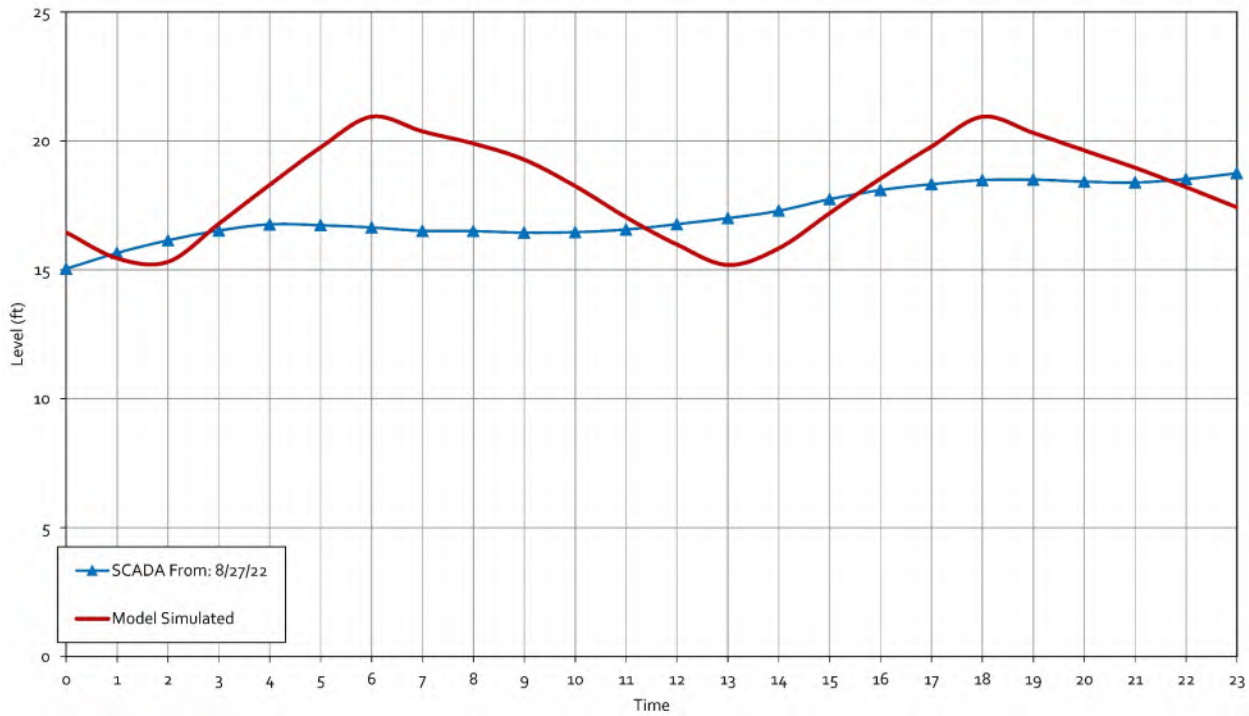


Figure 1C.26 Summer EPS Calibration – Reveille Level

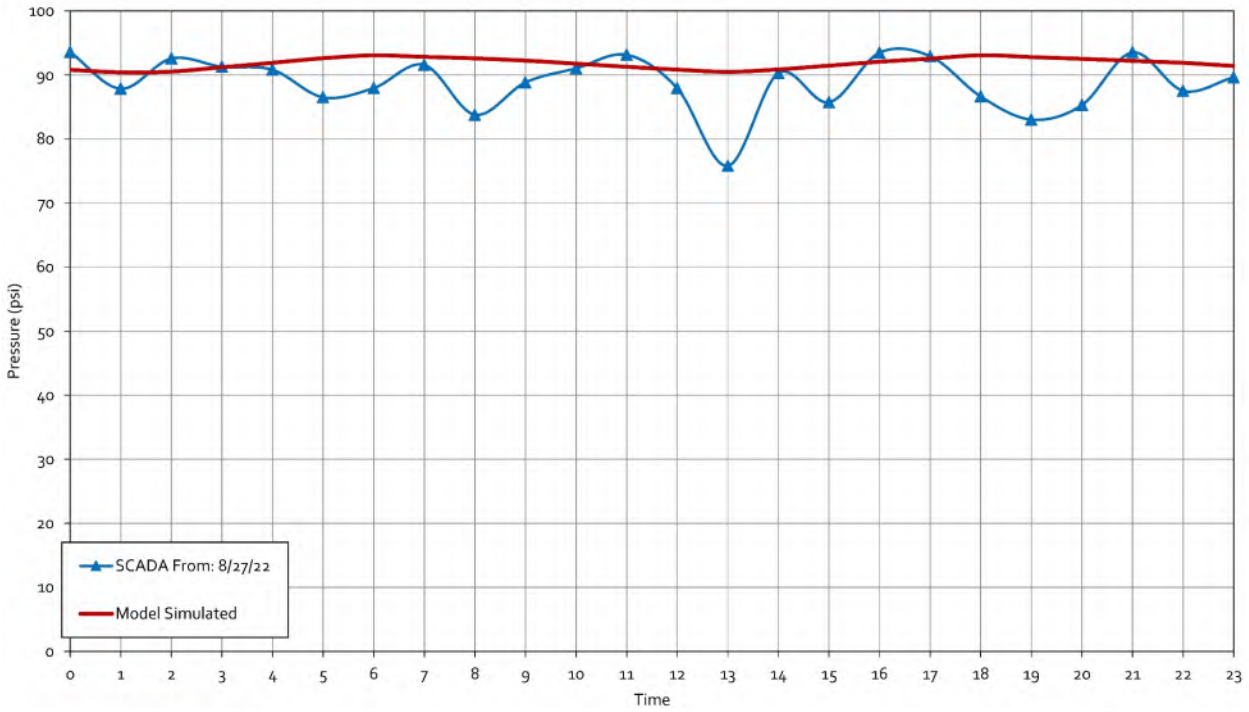


Figure 1C.27 Summer EPS Calibration – Reveille Pressure

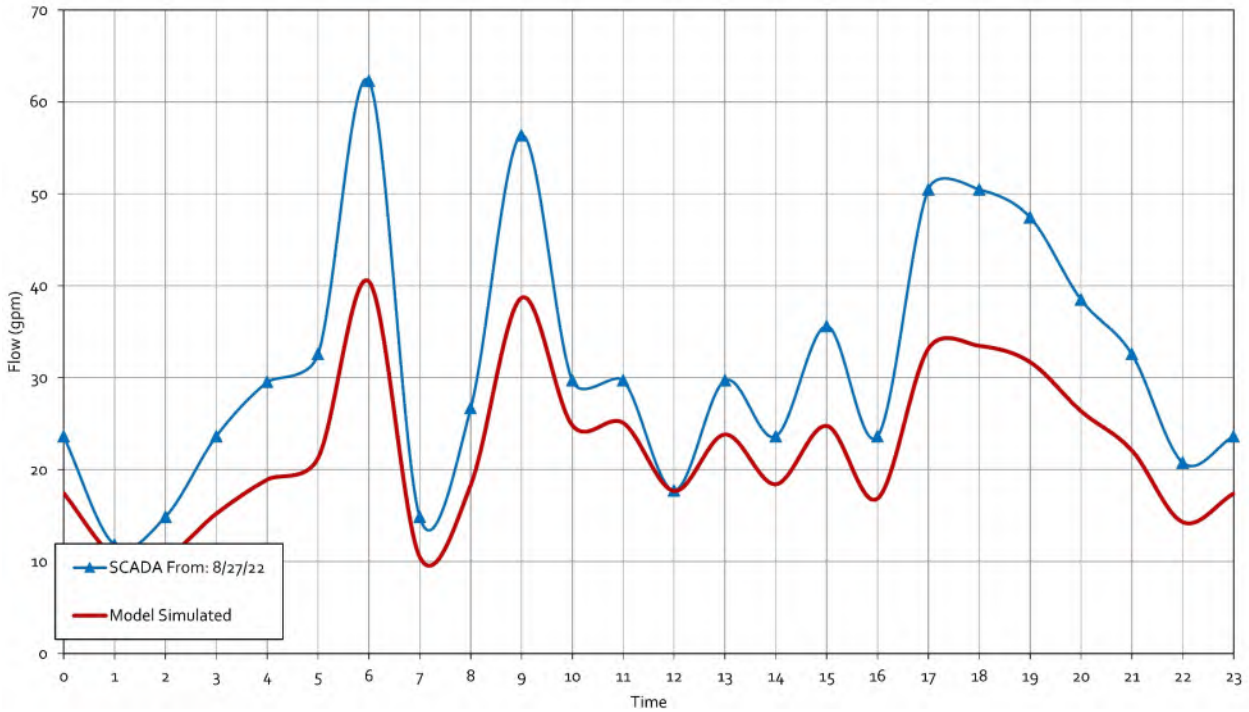


Figure 1C.28 Summer EPS Calibration – Birch Flow

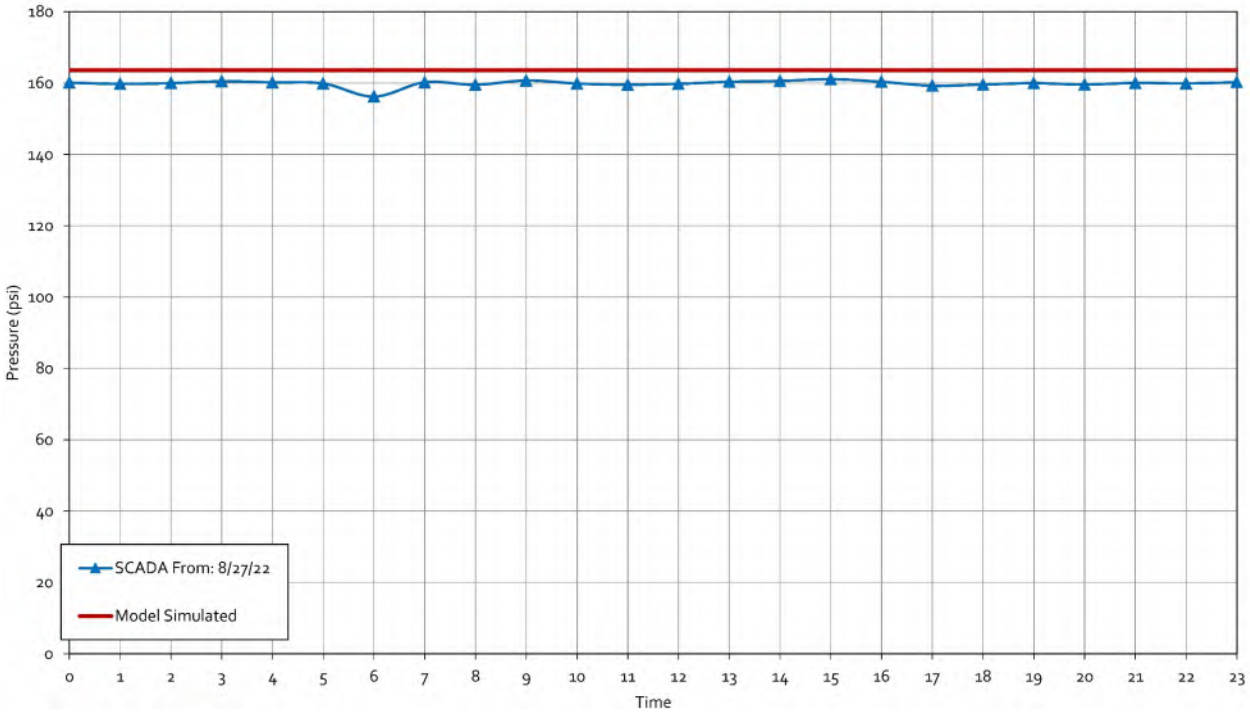


Figure 1C.29 Summer EPS Calibration – Birch Pressure

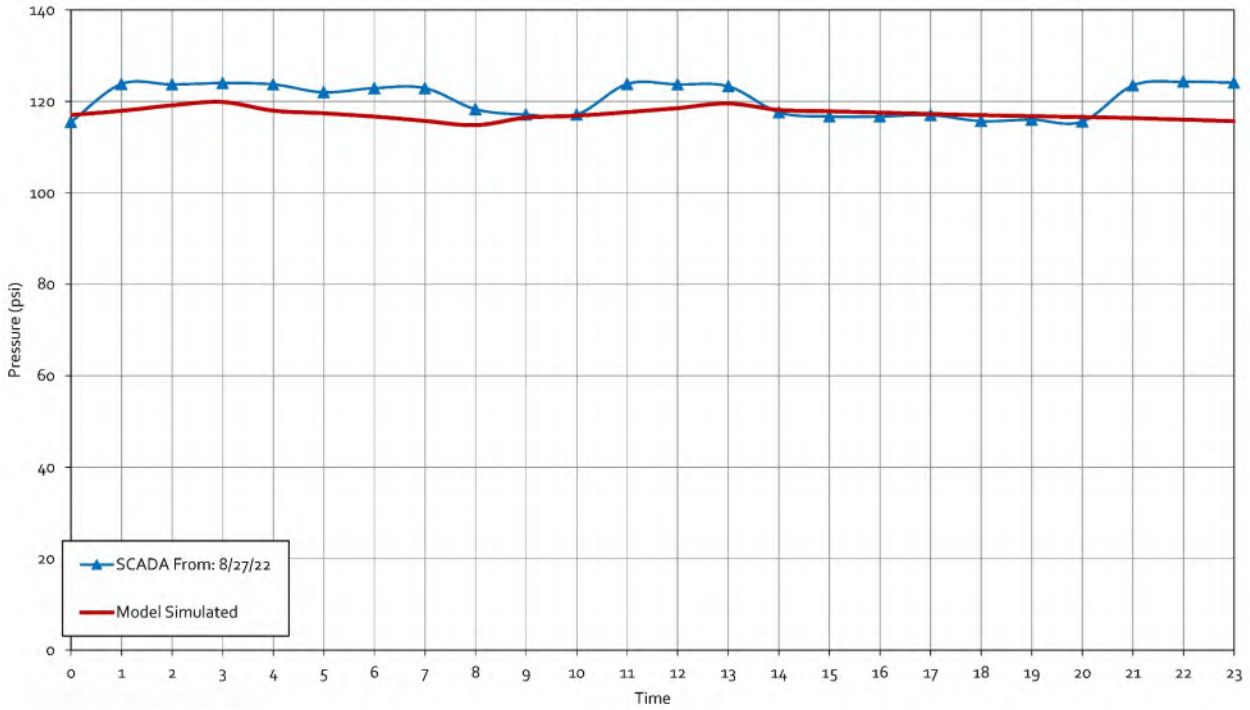


Figure 1C.30 Summer EPS Calibration – Governor Pressure

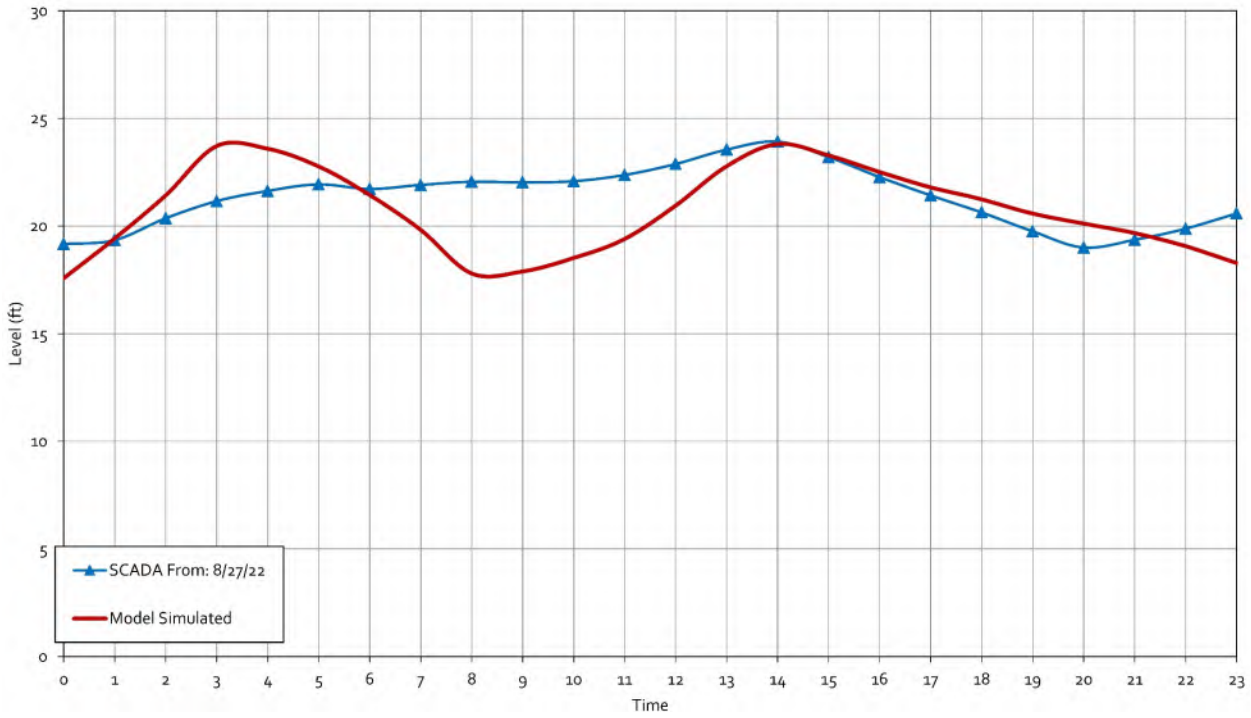


Figure 1C.31 Summer EPS Calibration – Parkhurst Level

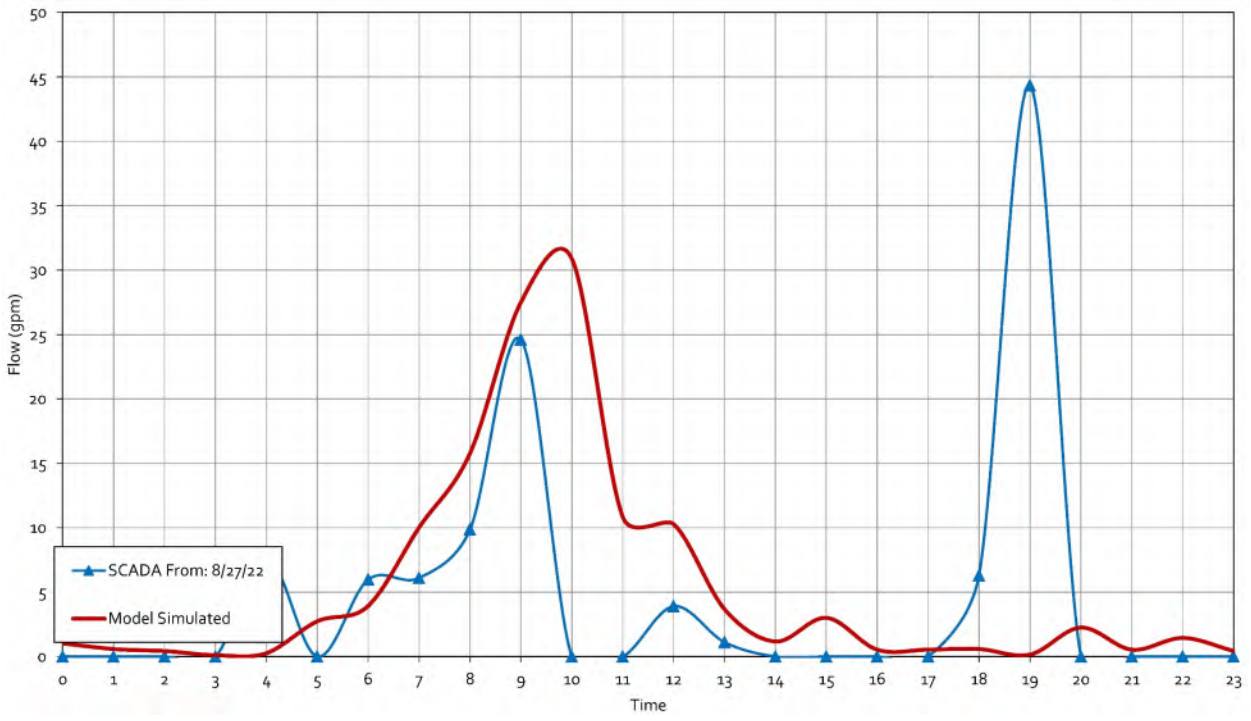


Figure 1C.32 Summer EPS Calibration – Samish Highlands Flow

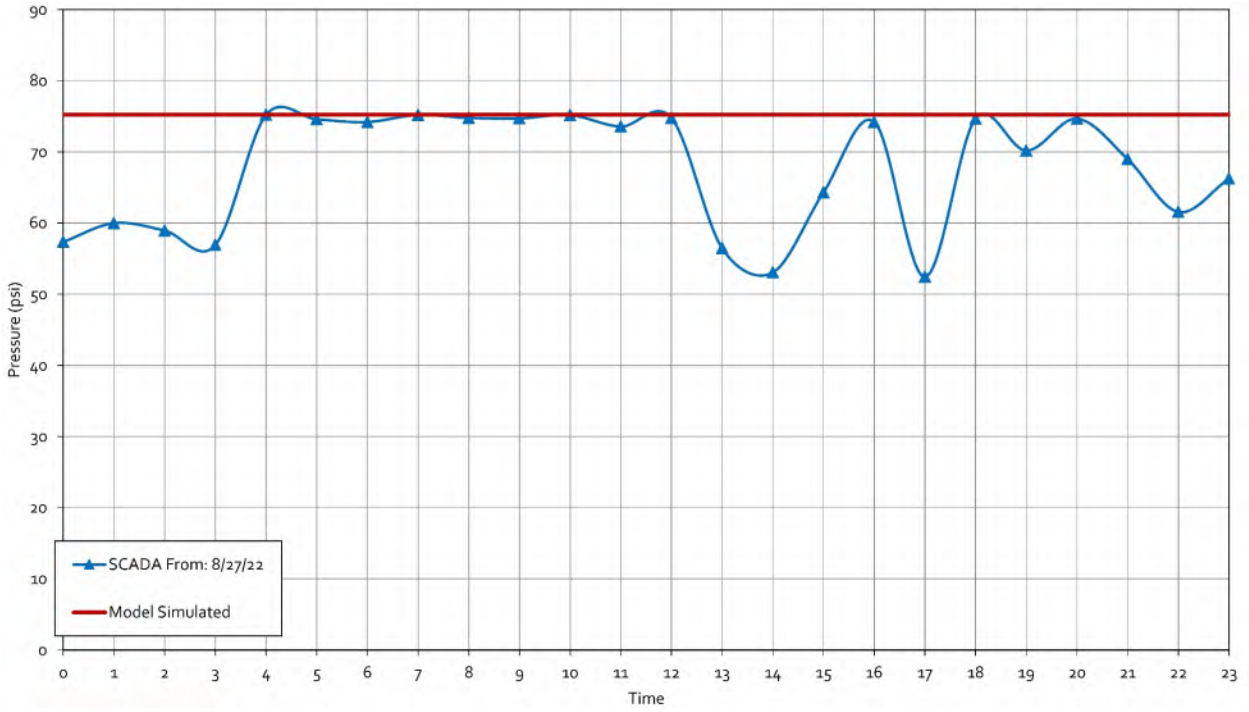


Figure 1C.33 Summer EPS Calibration – Samish Pressure

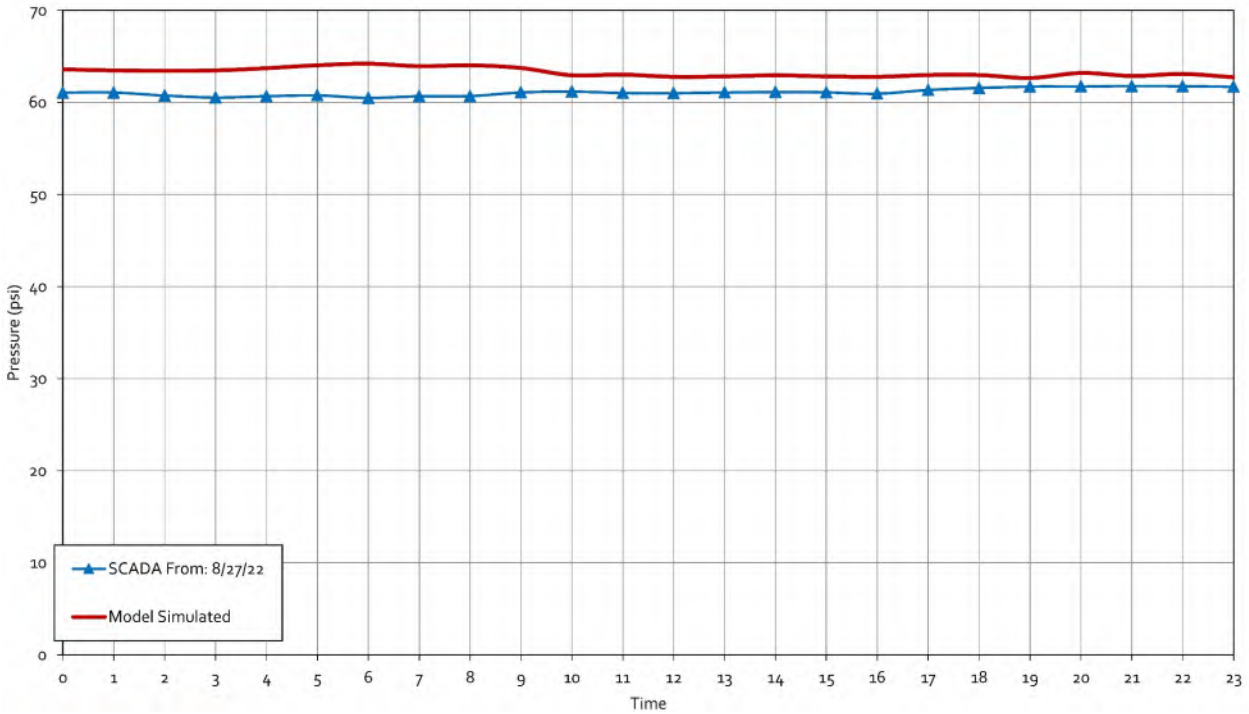


Figure 1C.34 Summer EPS Calibration – Carollo Logger 47

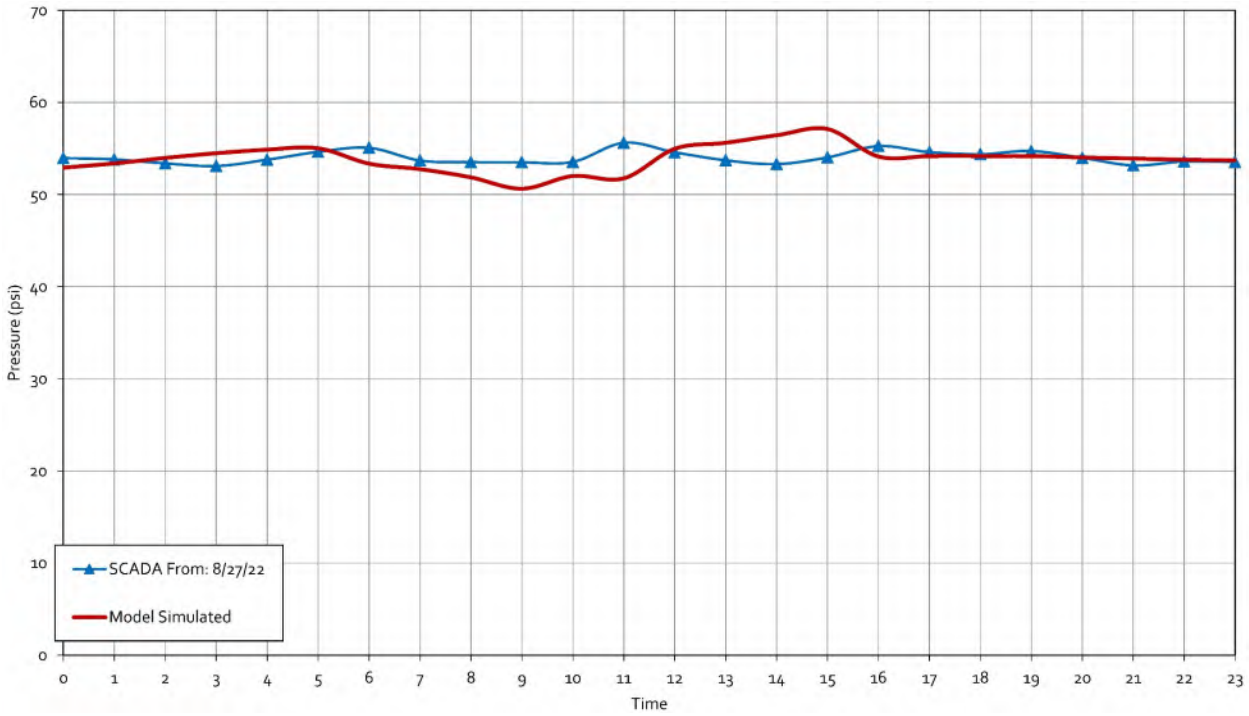


Figure 1C.35 Summer EPS Calibration – Carollo Logger 50

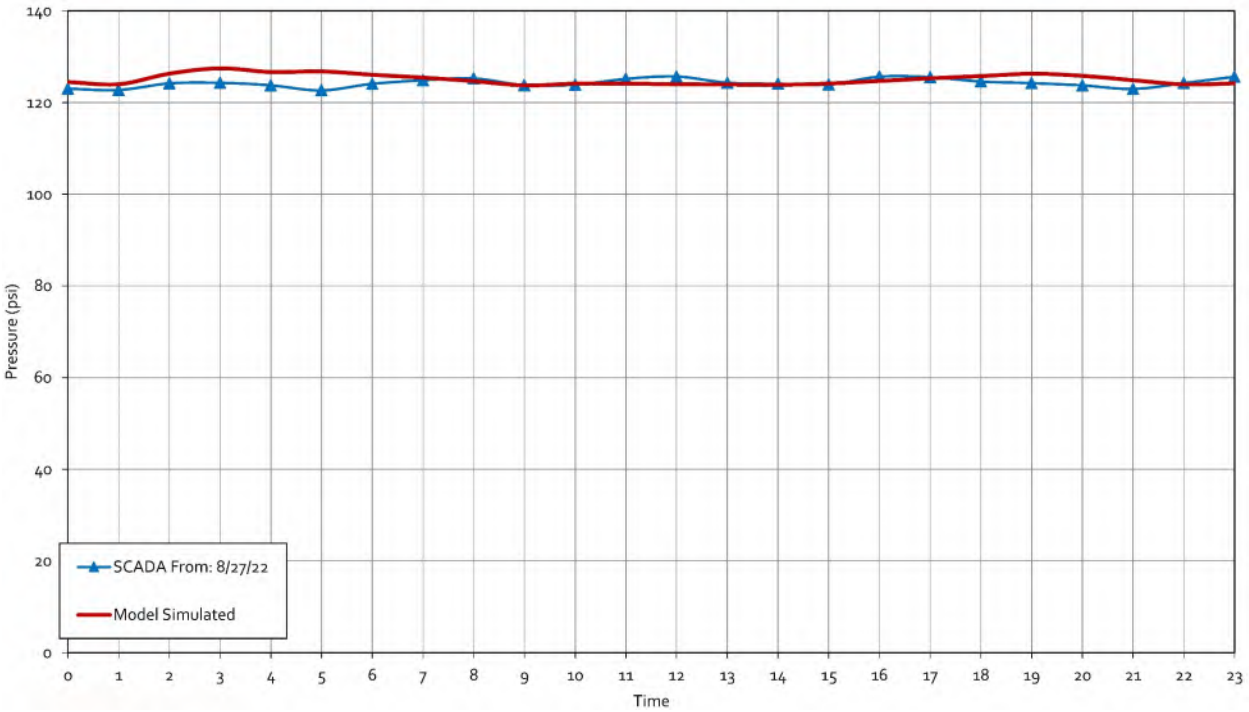


Figure 1C.36 Summer EPS Calibration - Carollo Logger 46

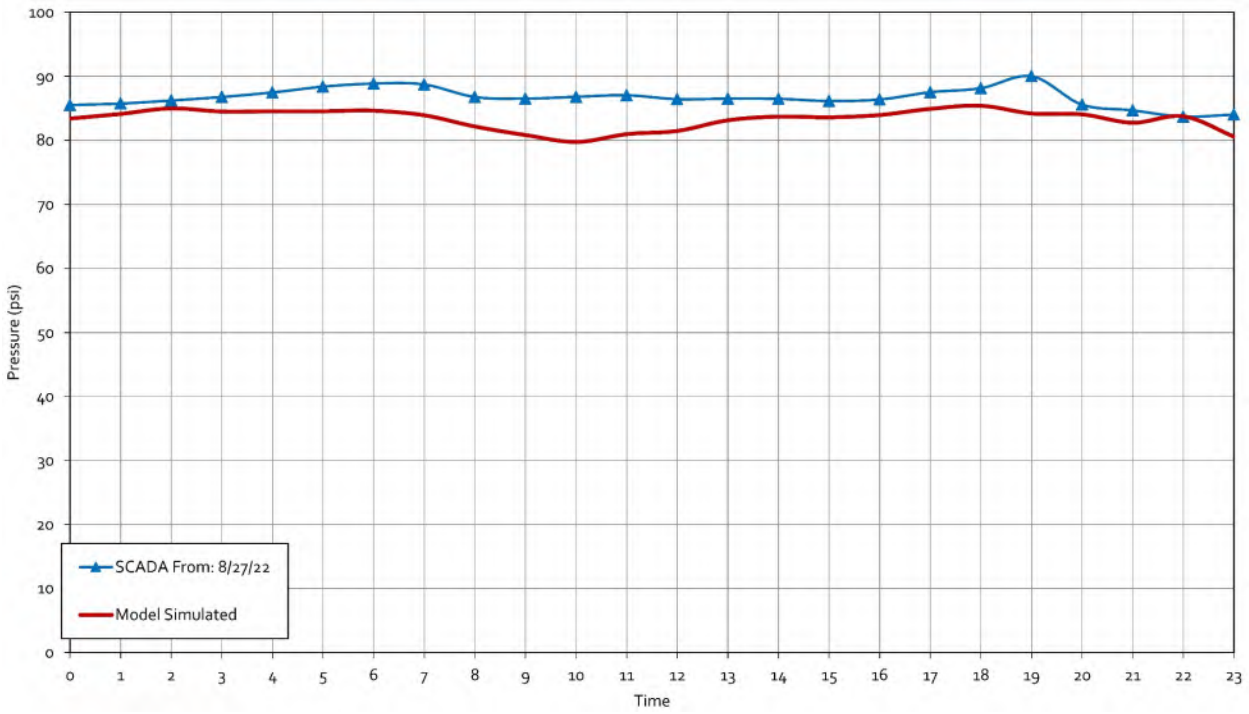


Figure 1C.37 Summer EPS Calibration - Carollo Logger 51

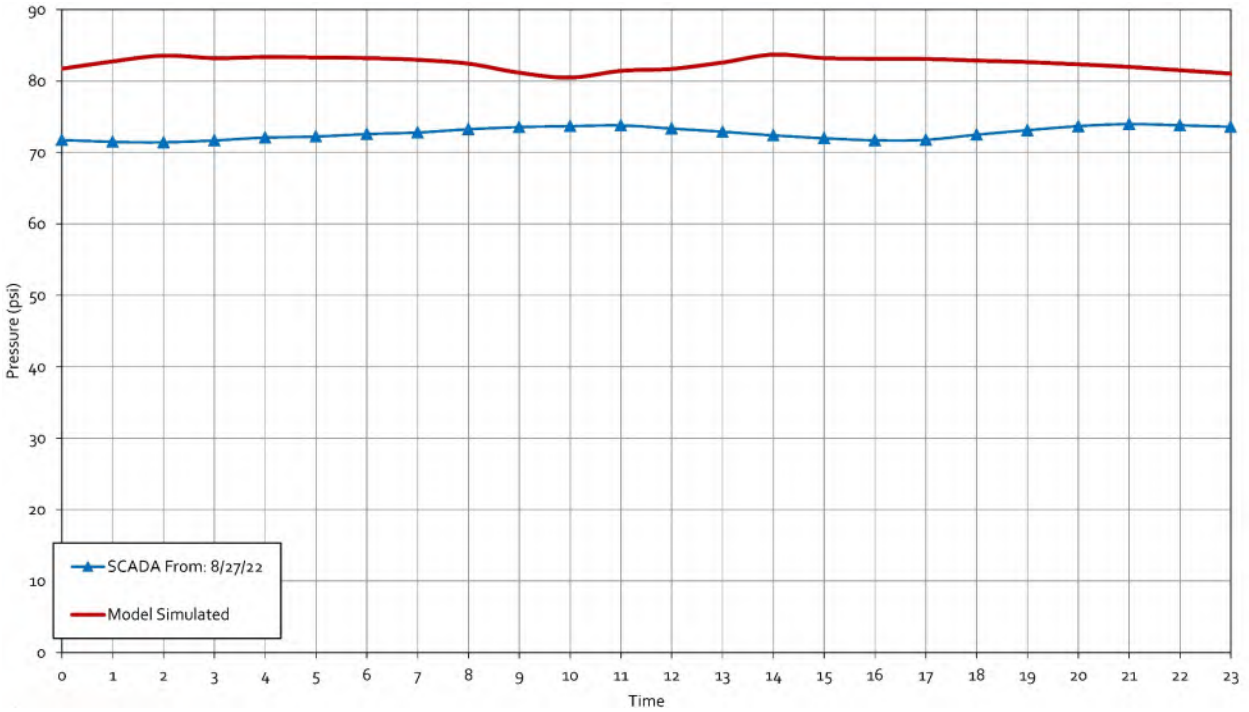


Figure 1C.38 Summer EPS Calibration - Carollo Logger 57

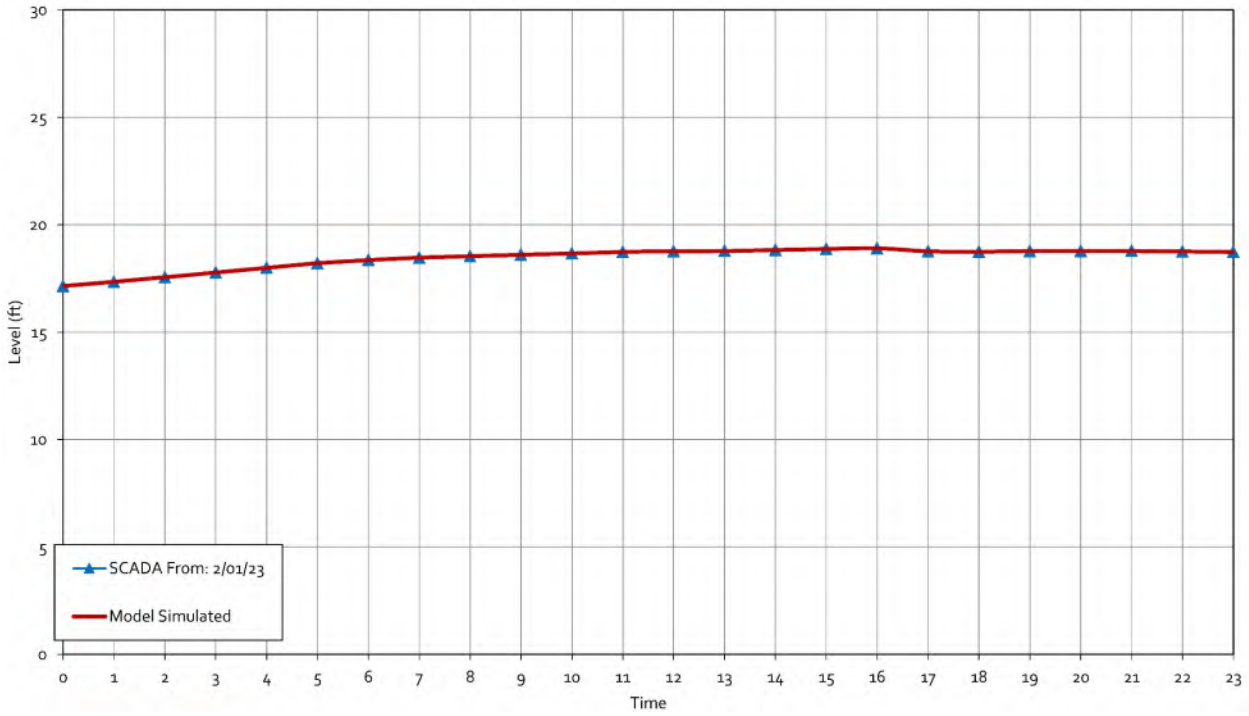


Figure 1C.39 Winter EPS Calibration – Whatcom Falls II Level

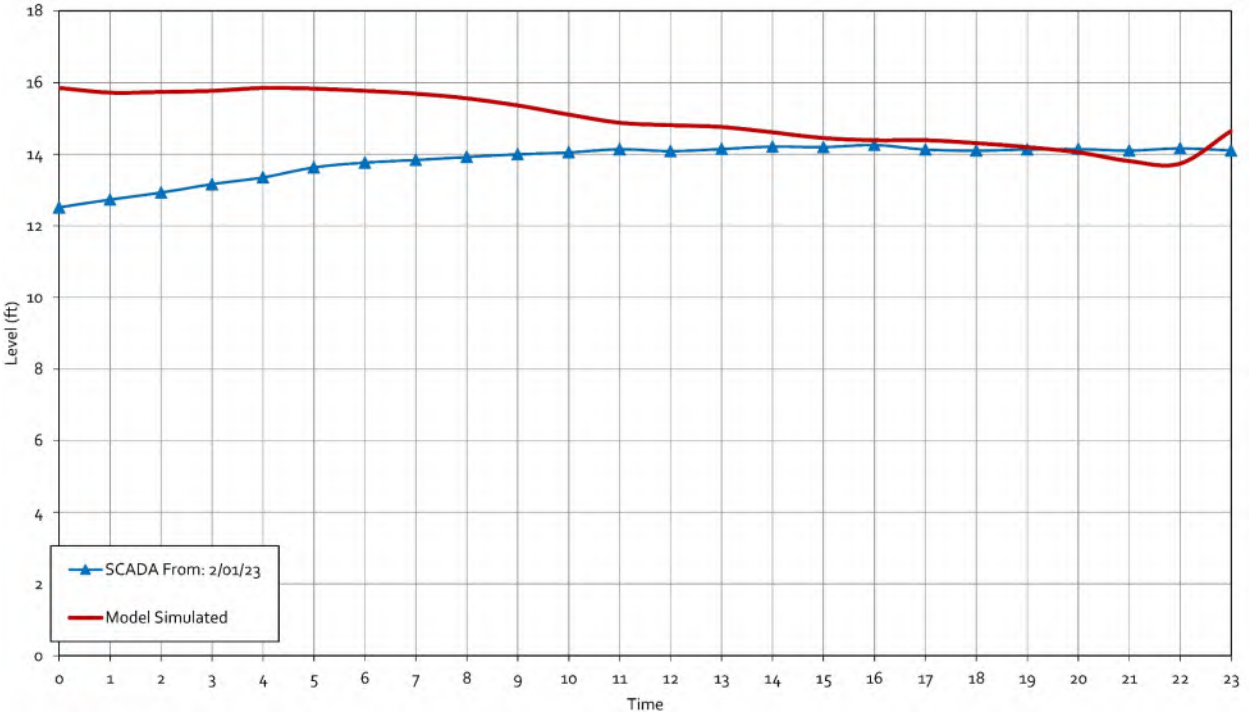


Figure 1C.40 Winter EPS Calibration - Whatcom Falls I Level

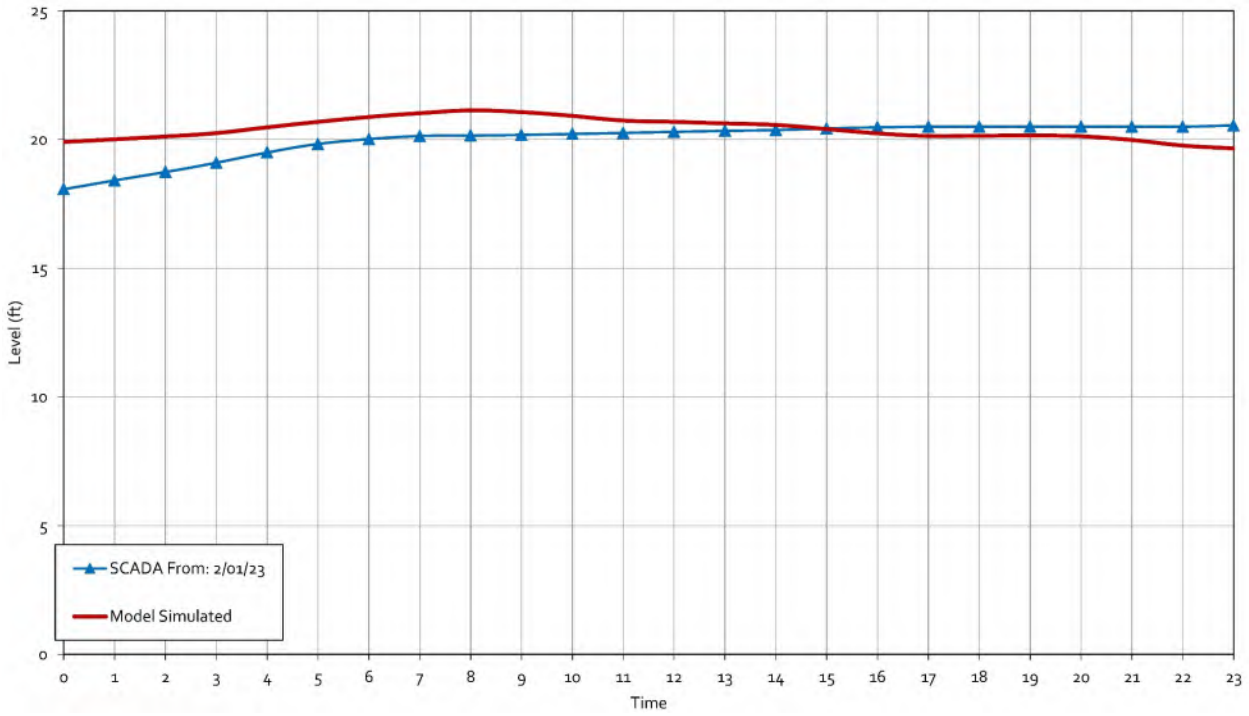


Figure 1C.41 Winter EPS Calibration – Kearney Res Level

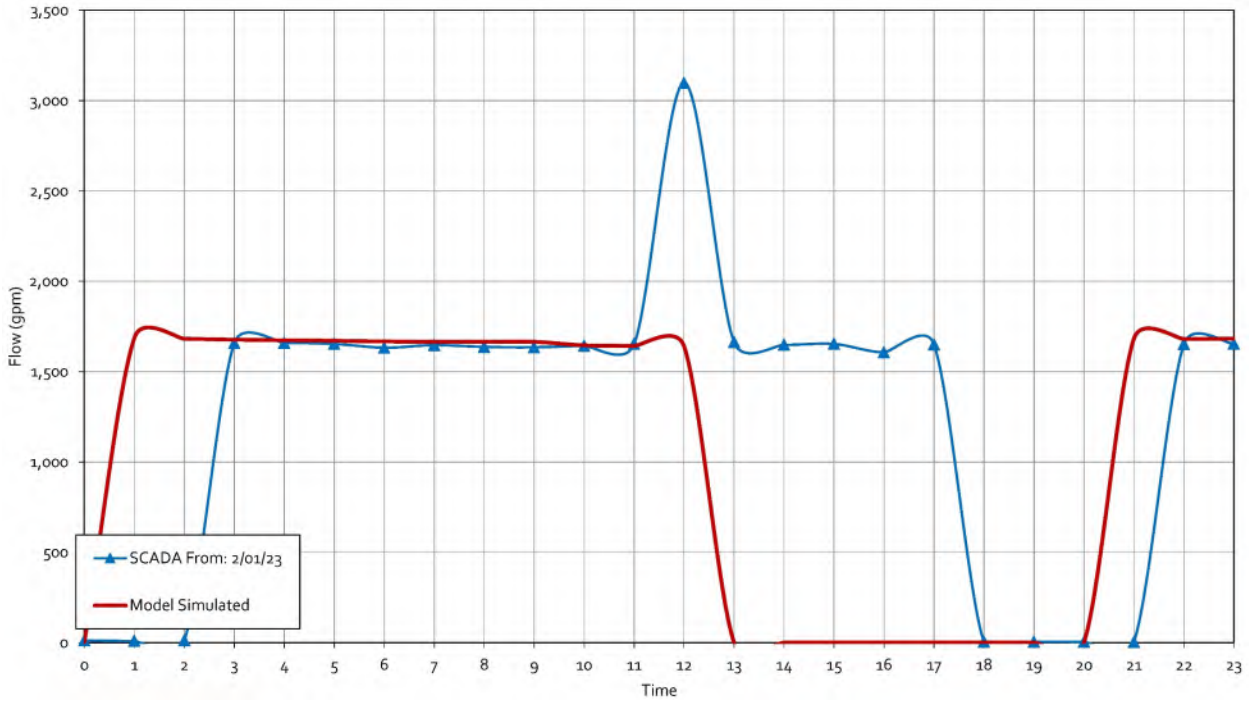


Figure 1C.42 Winter EPS Calibration – Dakin PS Flow

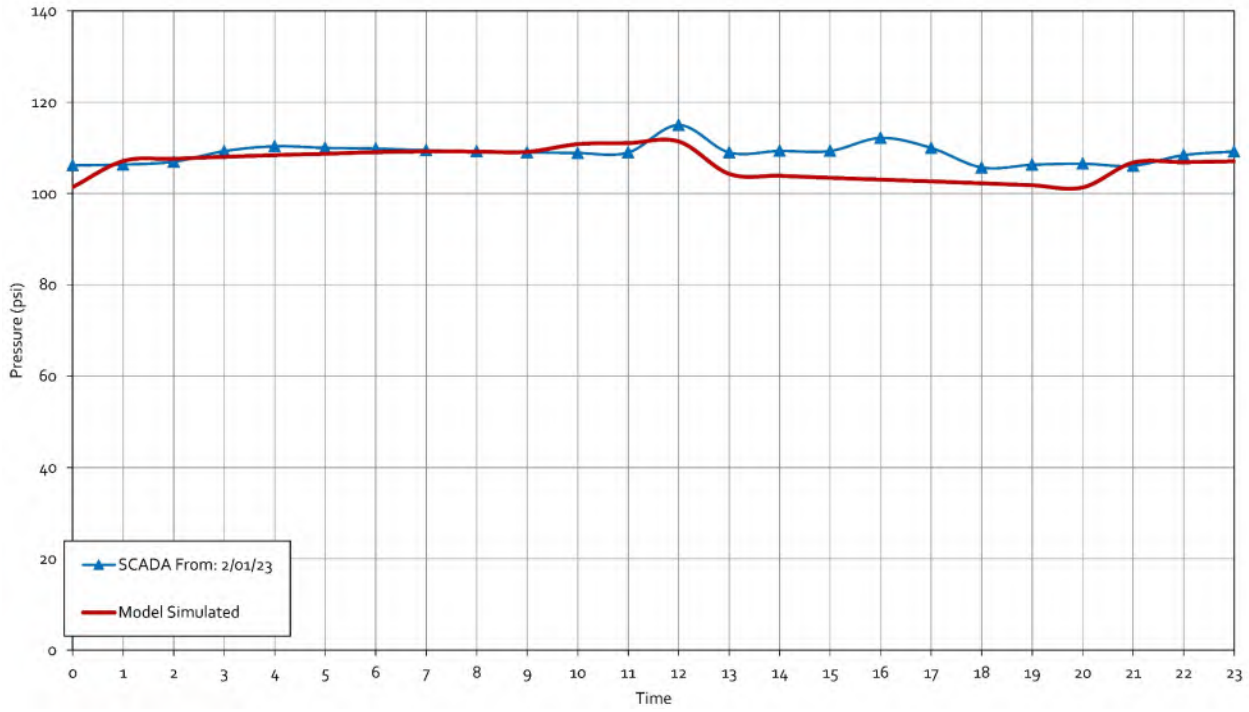


Figure 1C.43 Winter EPS Calibration – Dakin PS Discharge Pressure

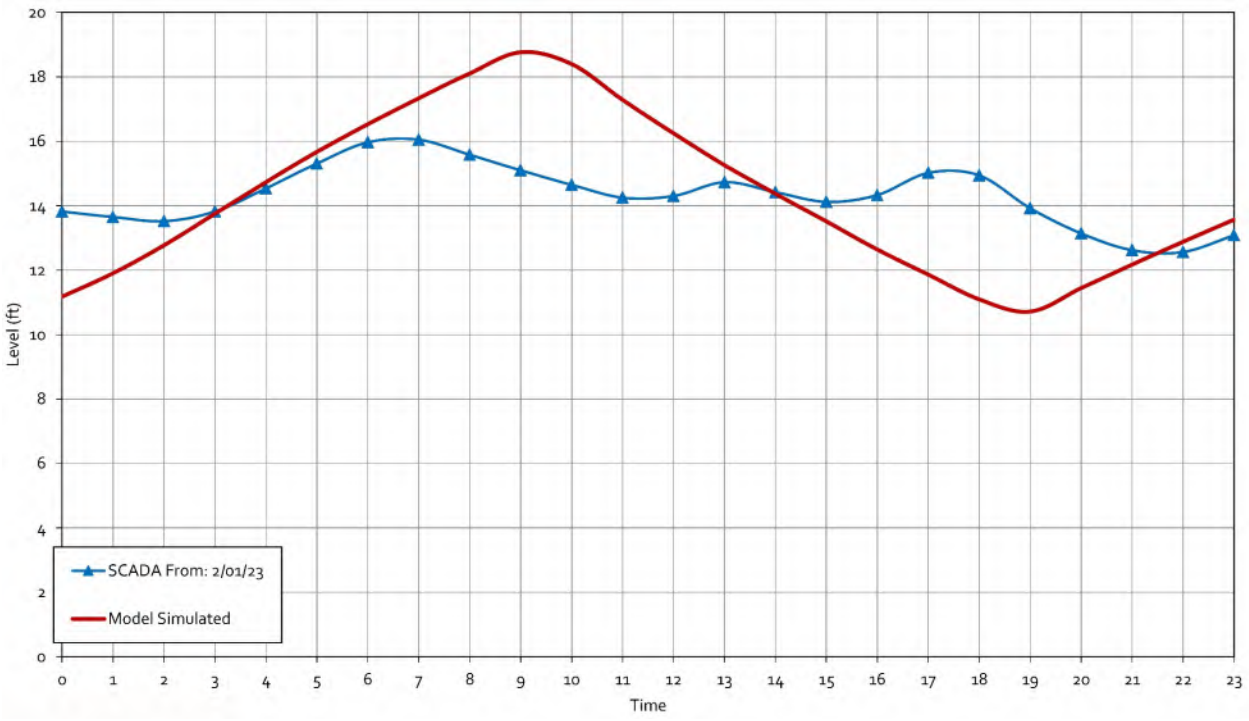


Figure 1C.44 Winter EPS Calibration – Dakin I Level

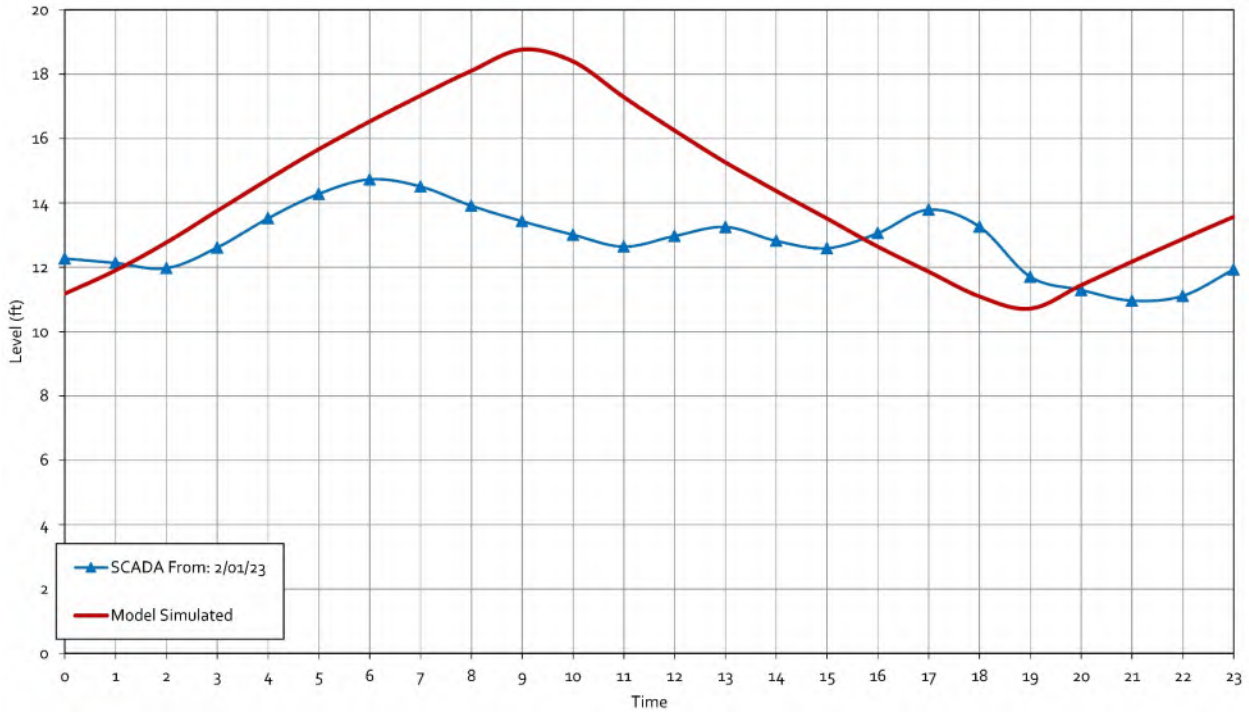


Figure 1C.45 Winter EPS Calibration - Dakin II Level

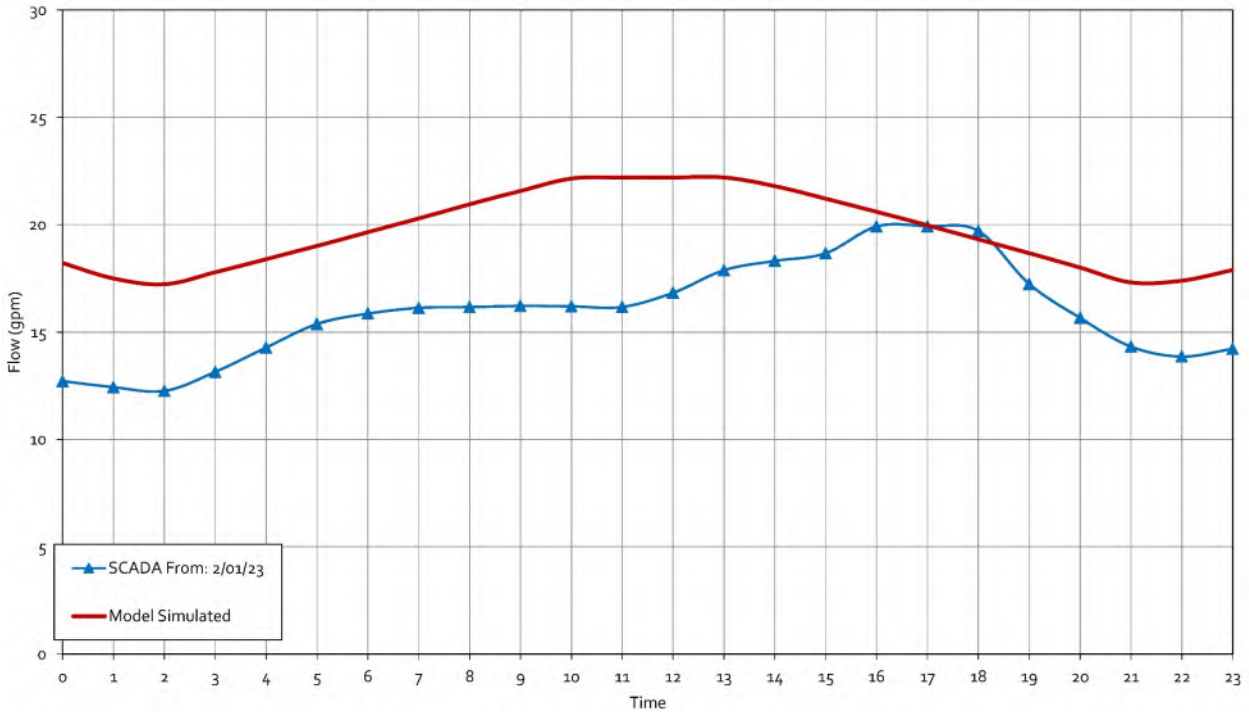


Figure 1C.46 Winter EPS Calibration – Consolidation Level

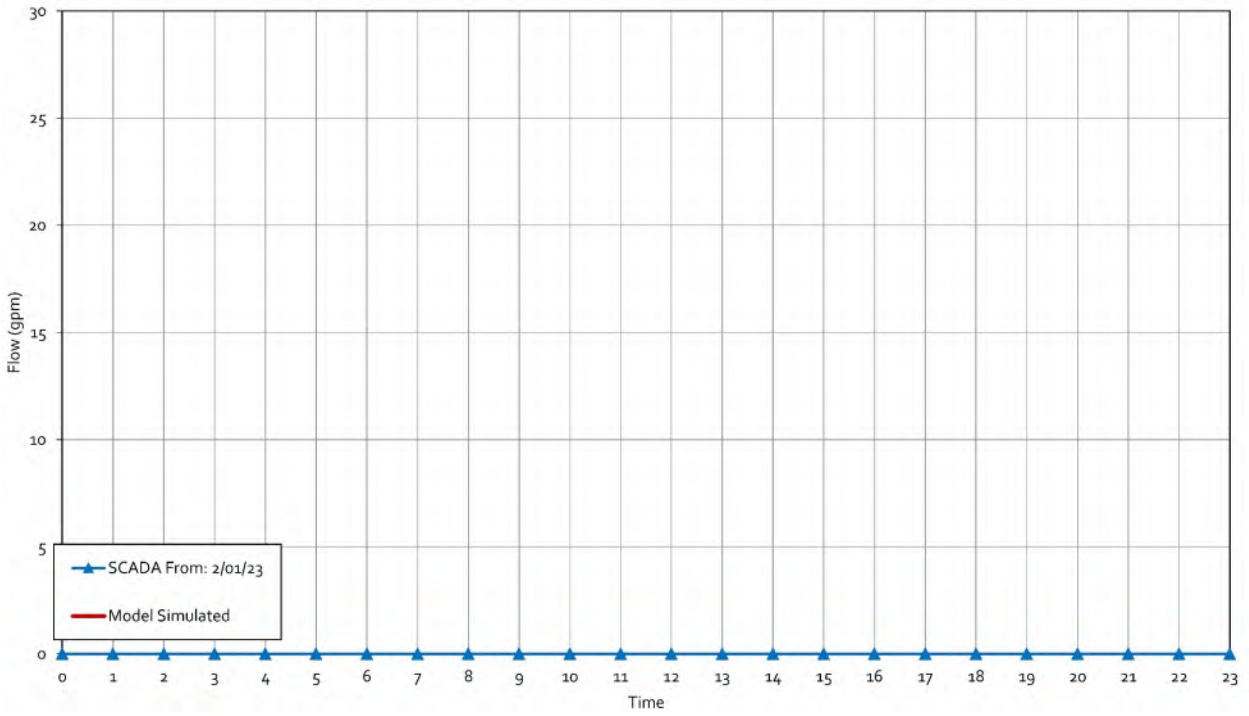


Figure 1C.47 Winter EPS Calibration – Woburn PS Flow

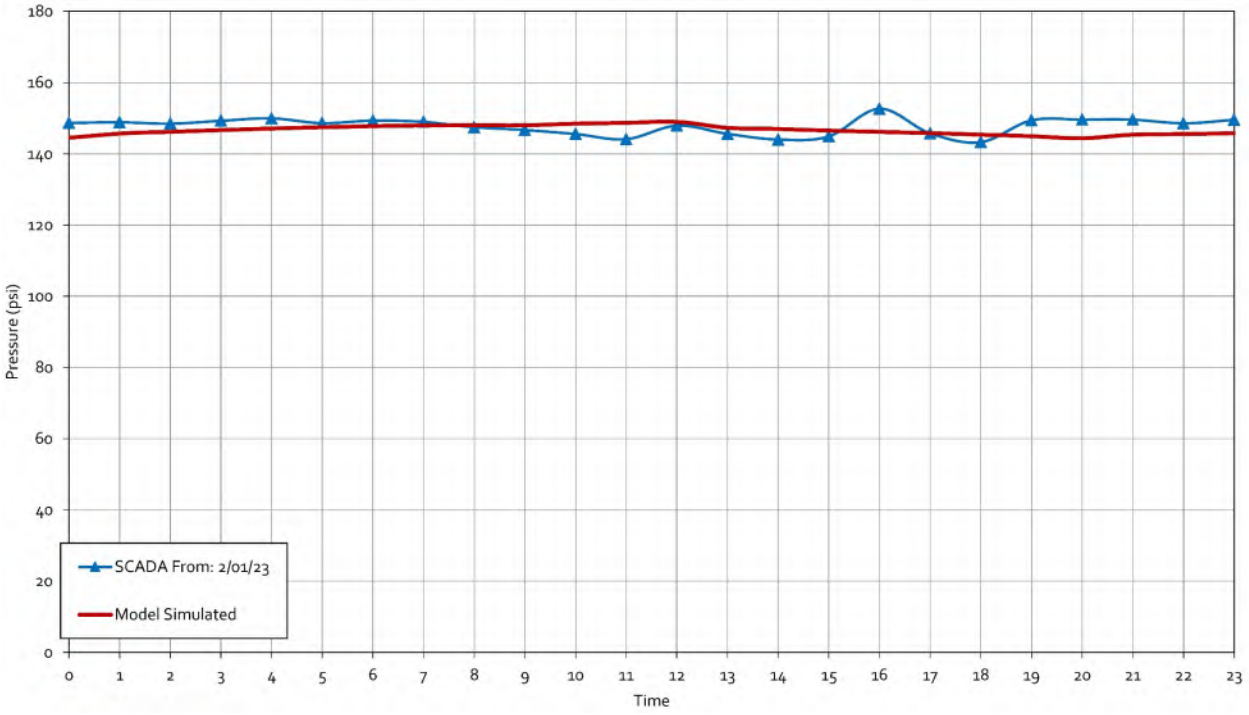


Figure 1C.48 Winter EPS Calibration – Woburn PS Pressure

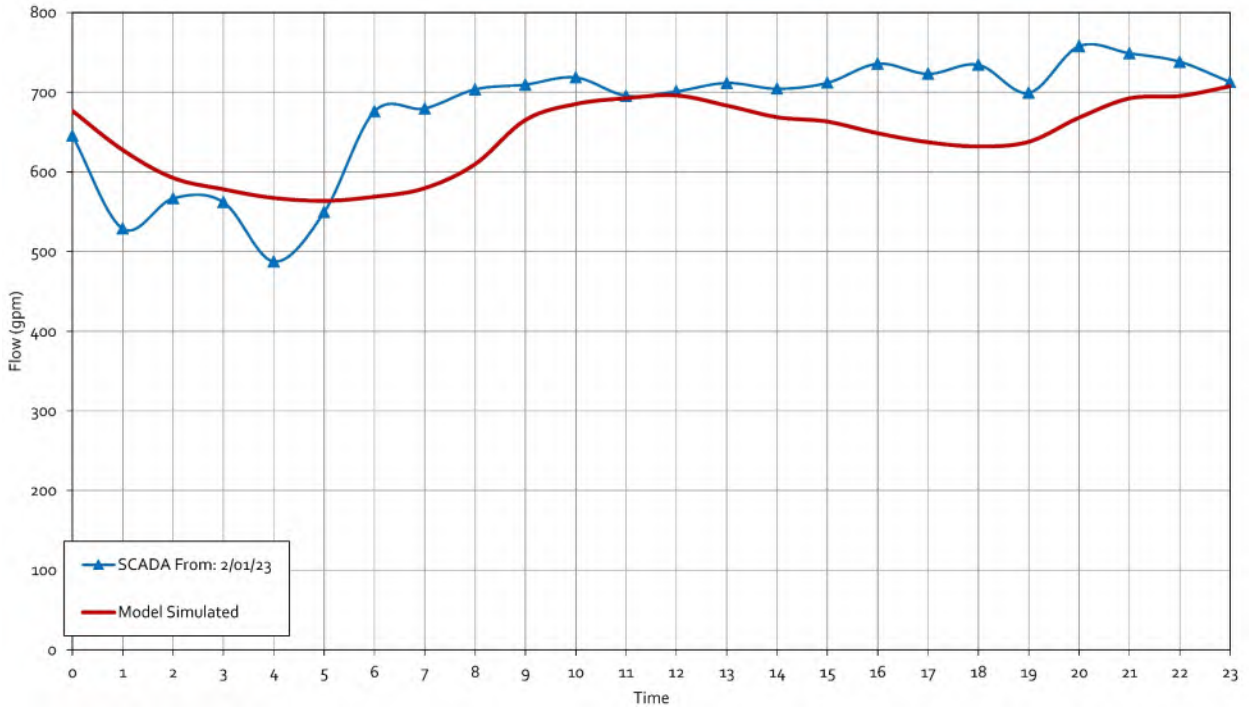


Figure 1C.49 Winter EPS Calibration – Short St Flow

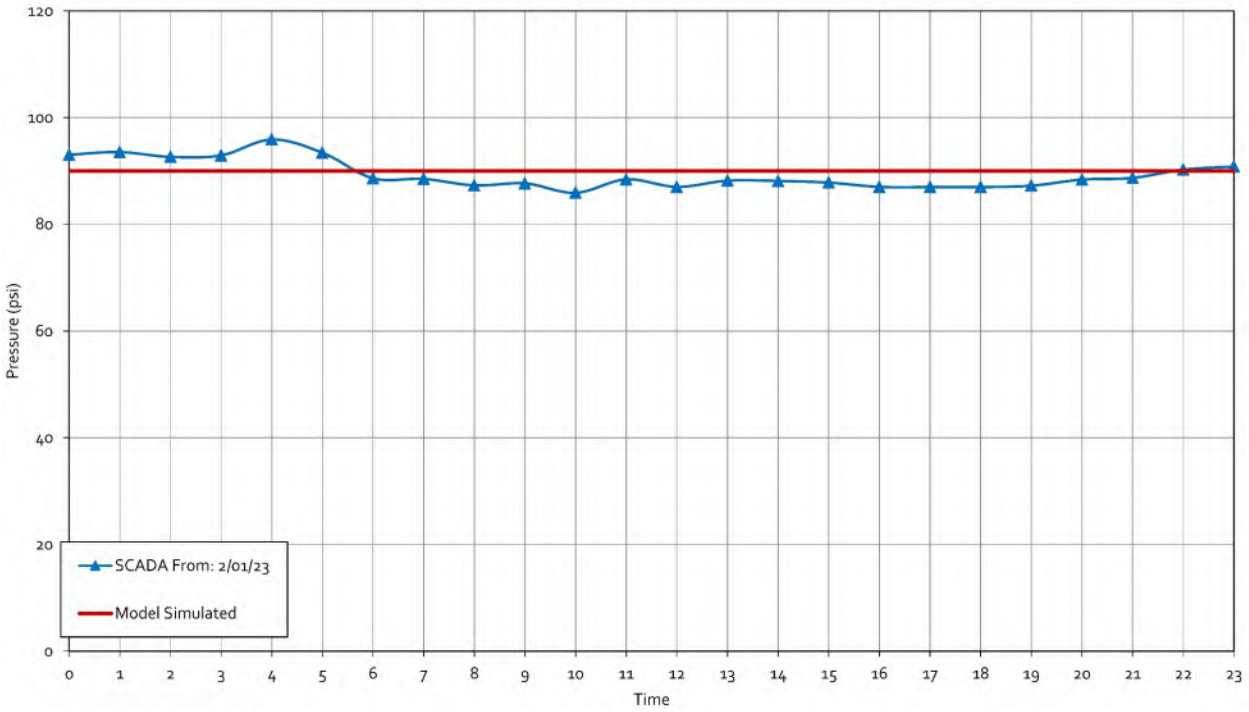


Figure 1C.50 Winter EPS Calibration - Short St Discharge Pressure

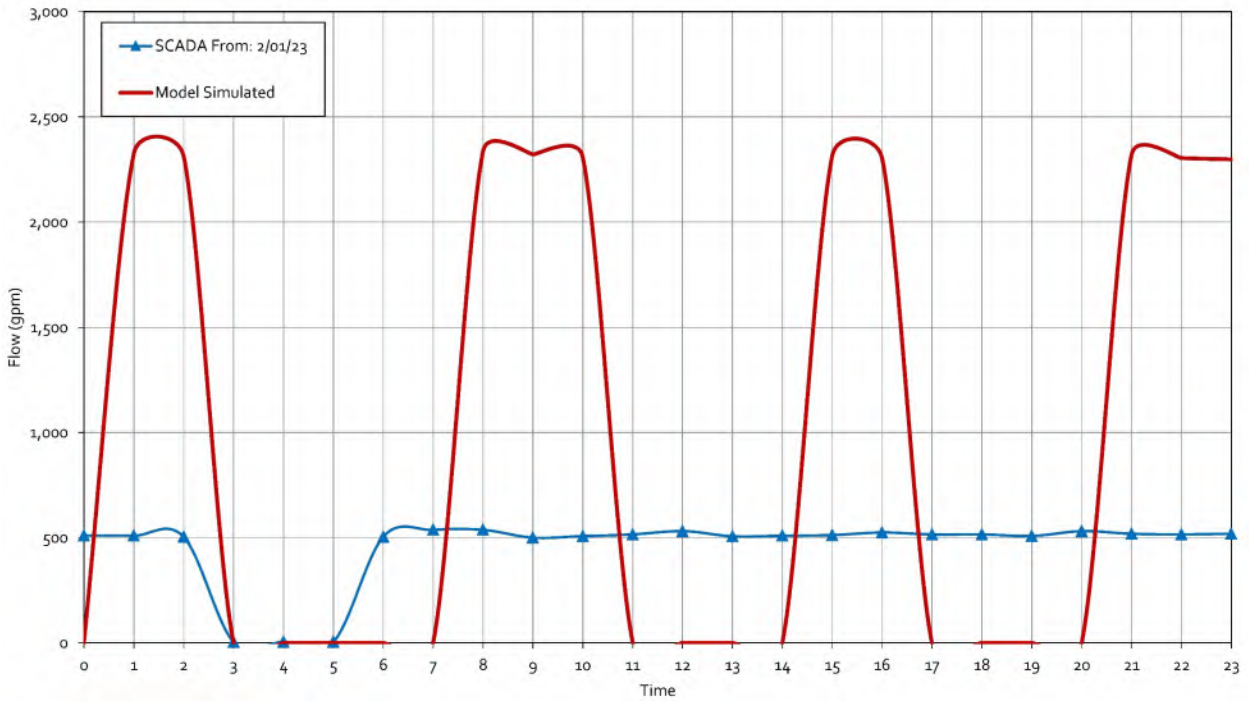


Figure 1C.51 Winter EPS Calibration – Otis Flow

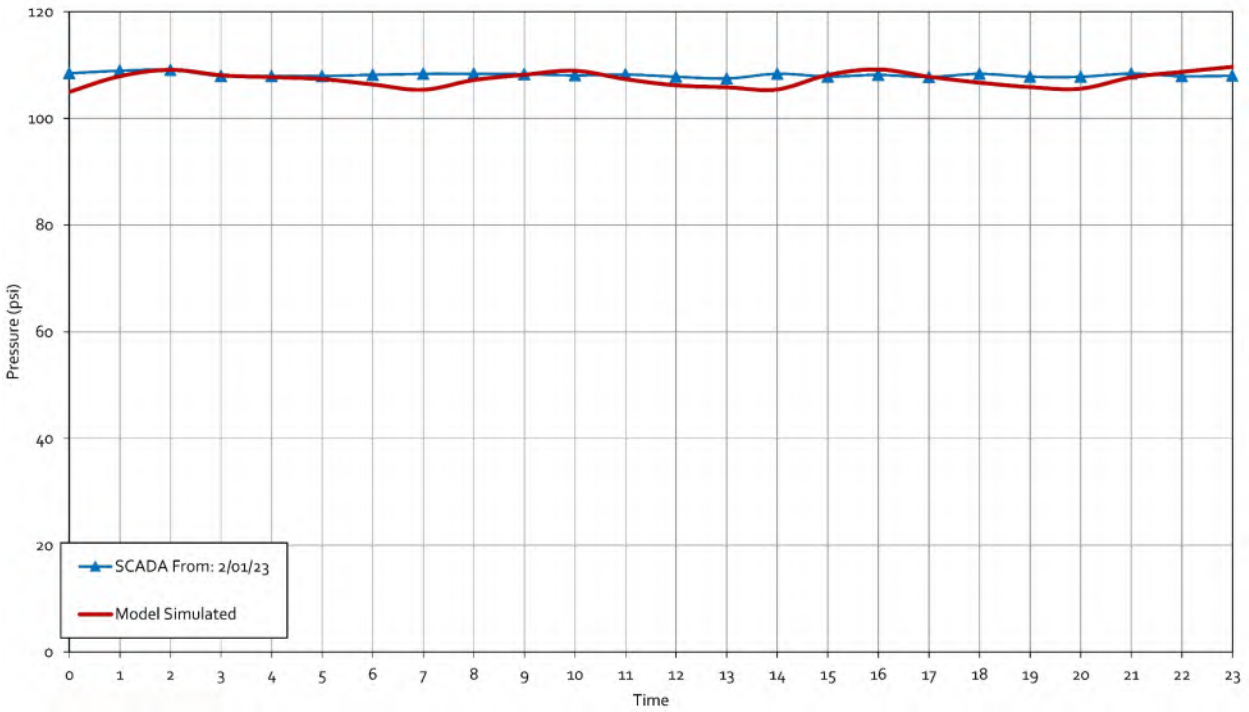


Figure 1C.52 Winter EPS Calibration – Otis Pressure

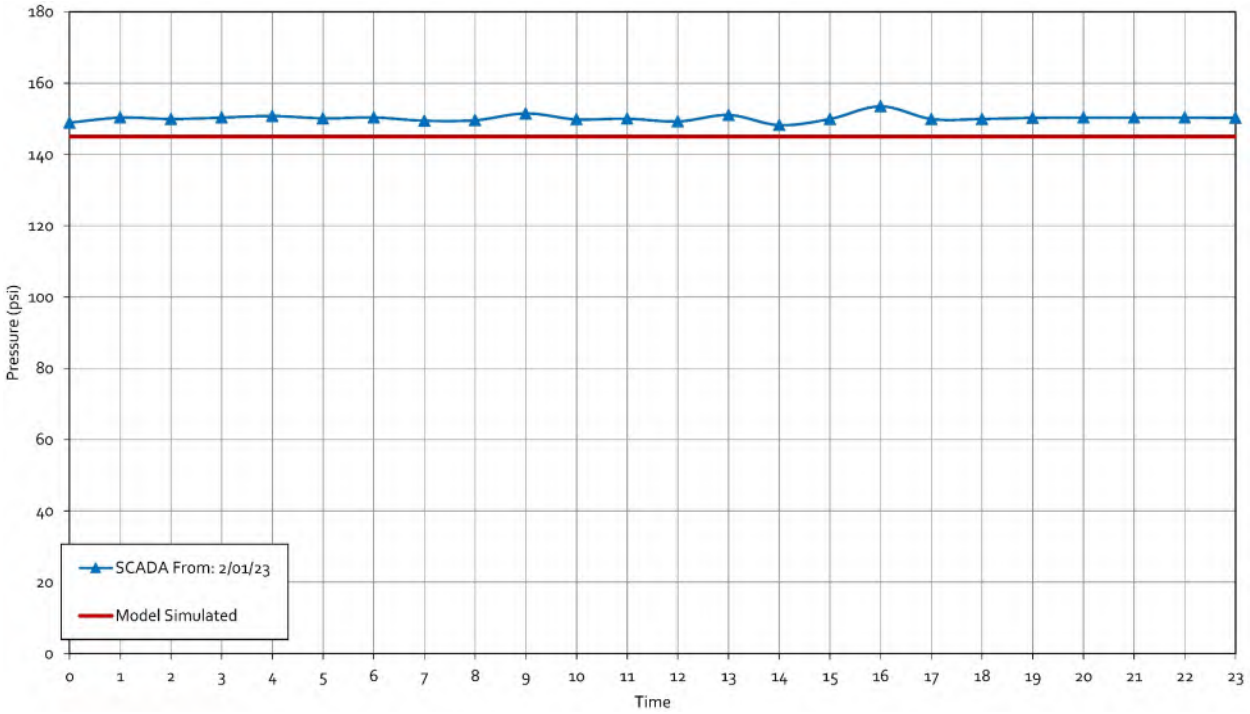


Figure 1C.53 Winter EPS Calibration – James St Pressure

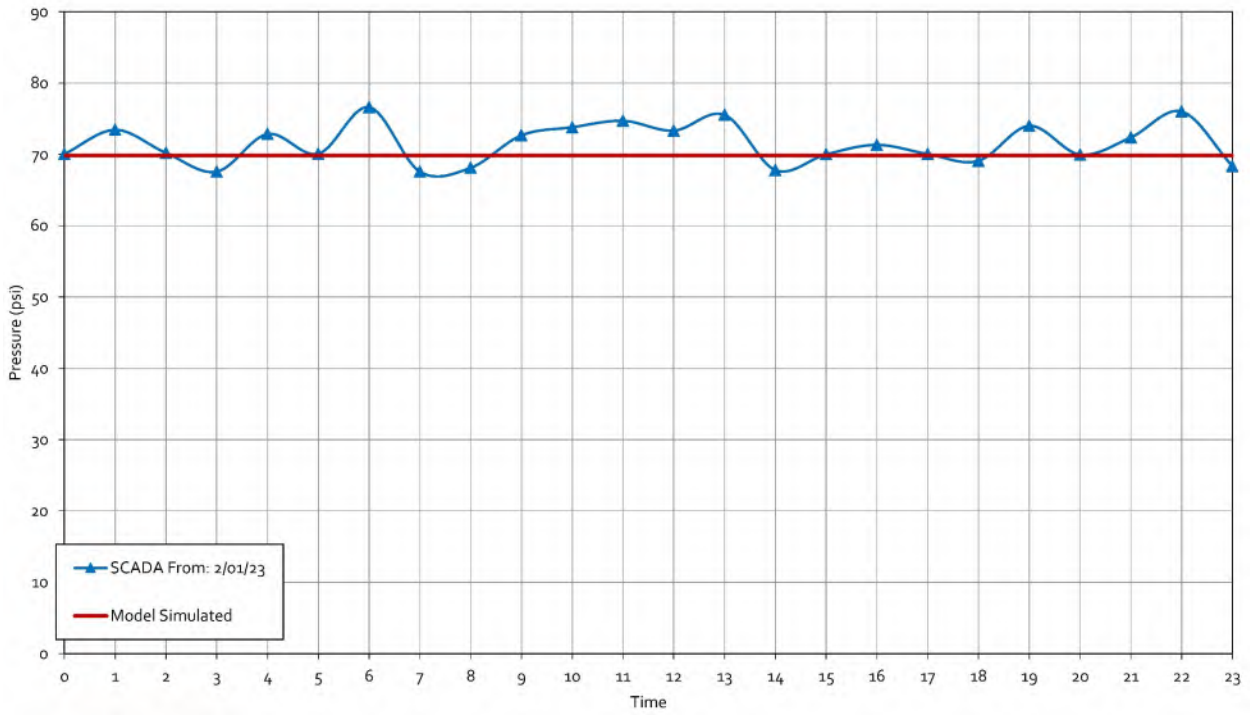


Figure 1C.54 Winter EPS Calibration – Huntington Pressure

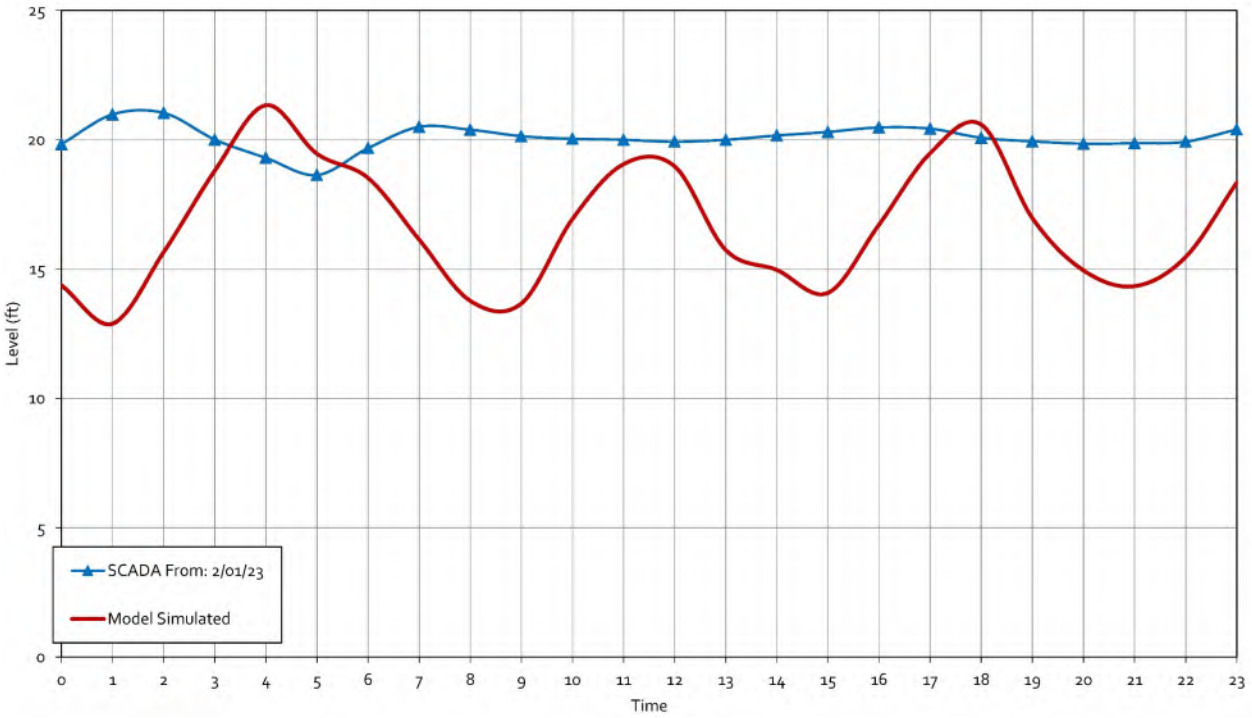


Figure 1C.55 Winter EPS Calibration – Padden Level

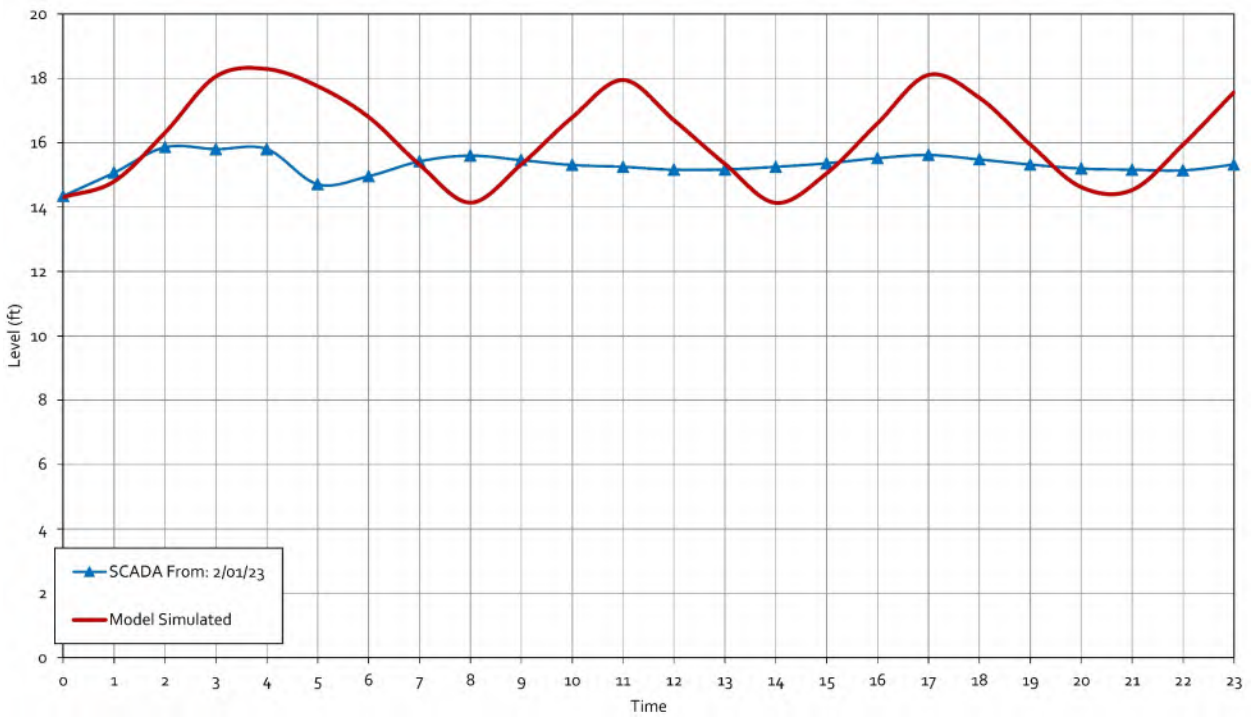


Figure 1C.56 Winter EPS Calibration – College Way Level

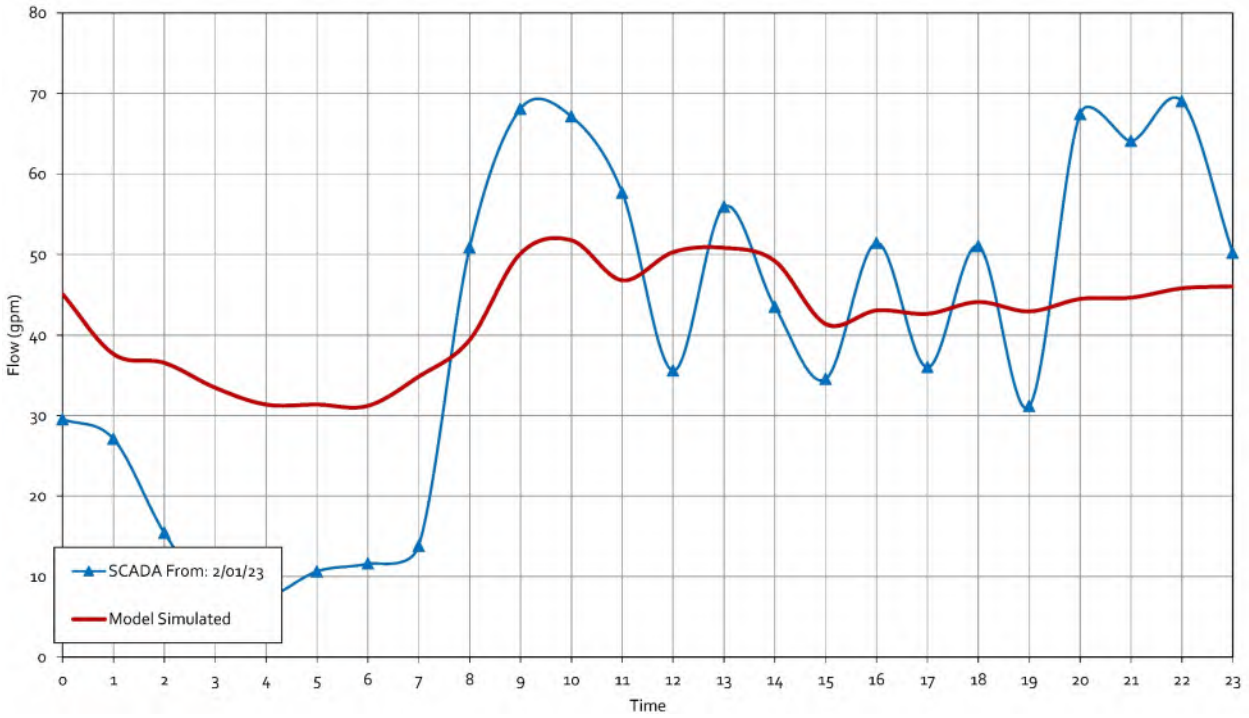


Figure 1C.57 Winter EPS Calibration – College Way Flow

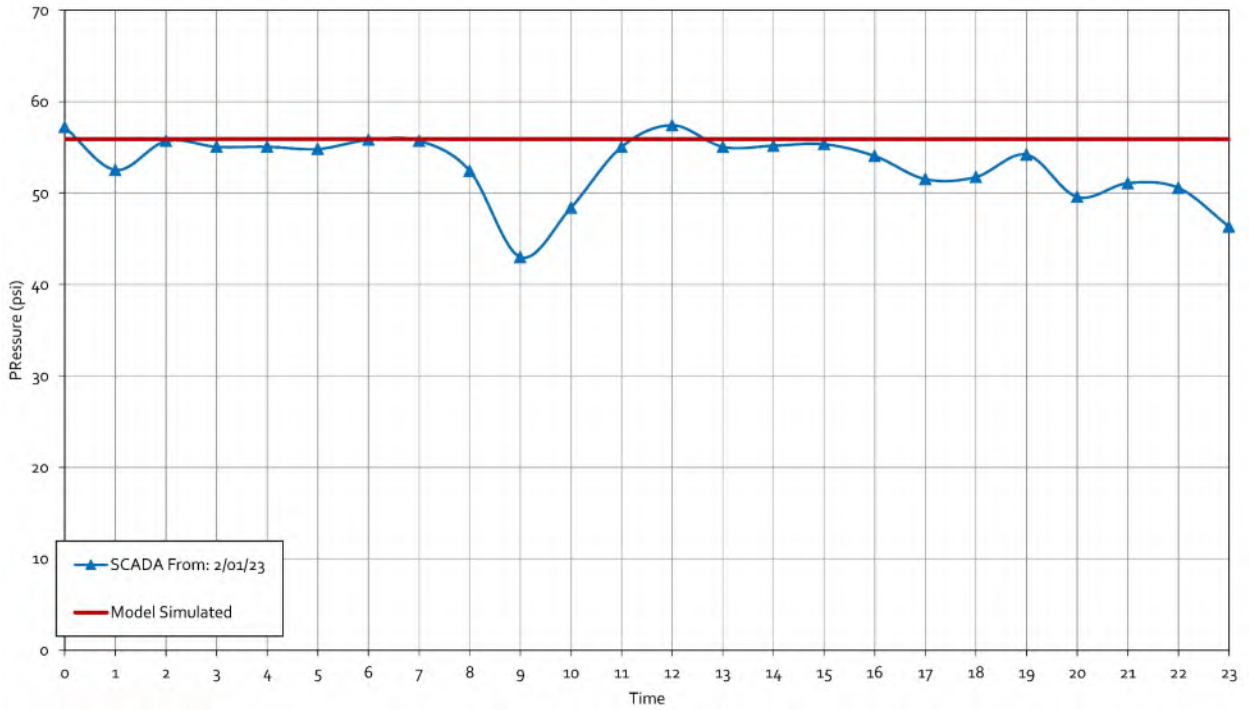


Figure 1C.58 Winter EPS Calibration – College Way Pressure

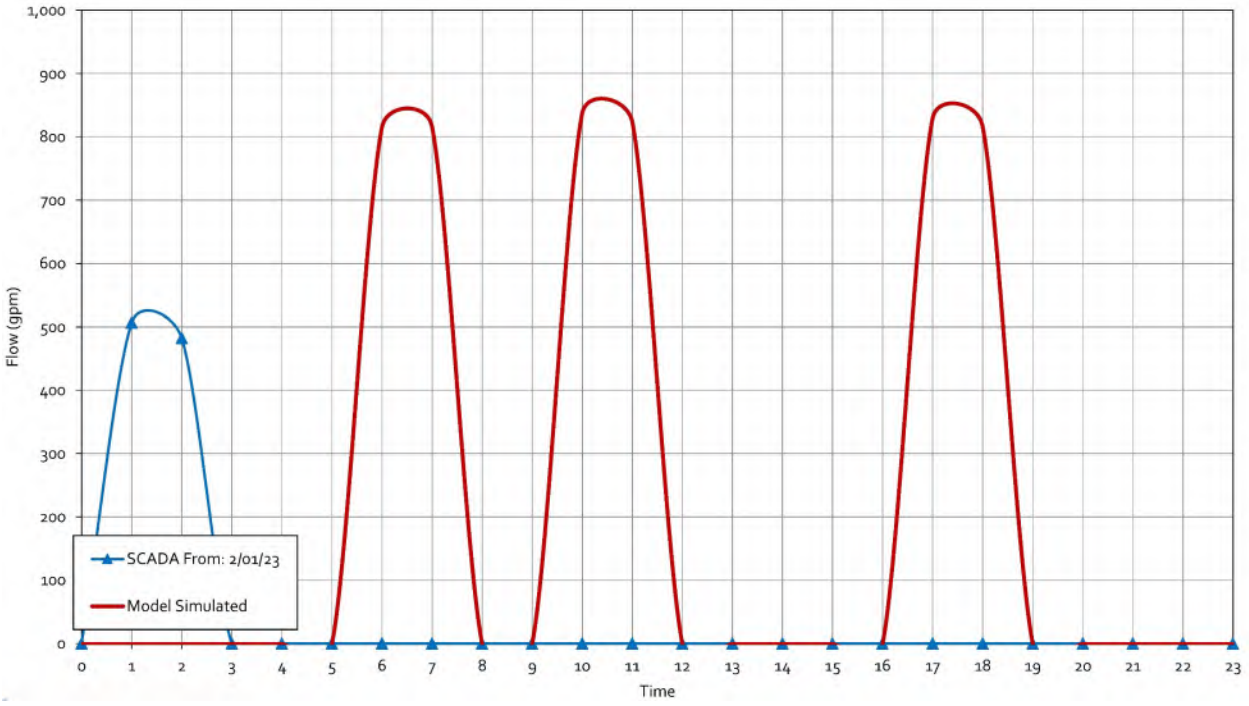


Figure 1C.59 Winter EPS Calibration – 38th St Flow

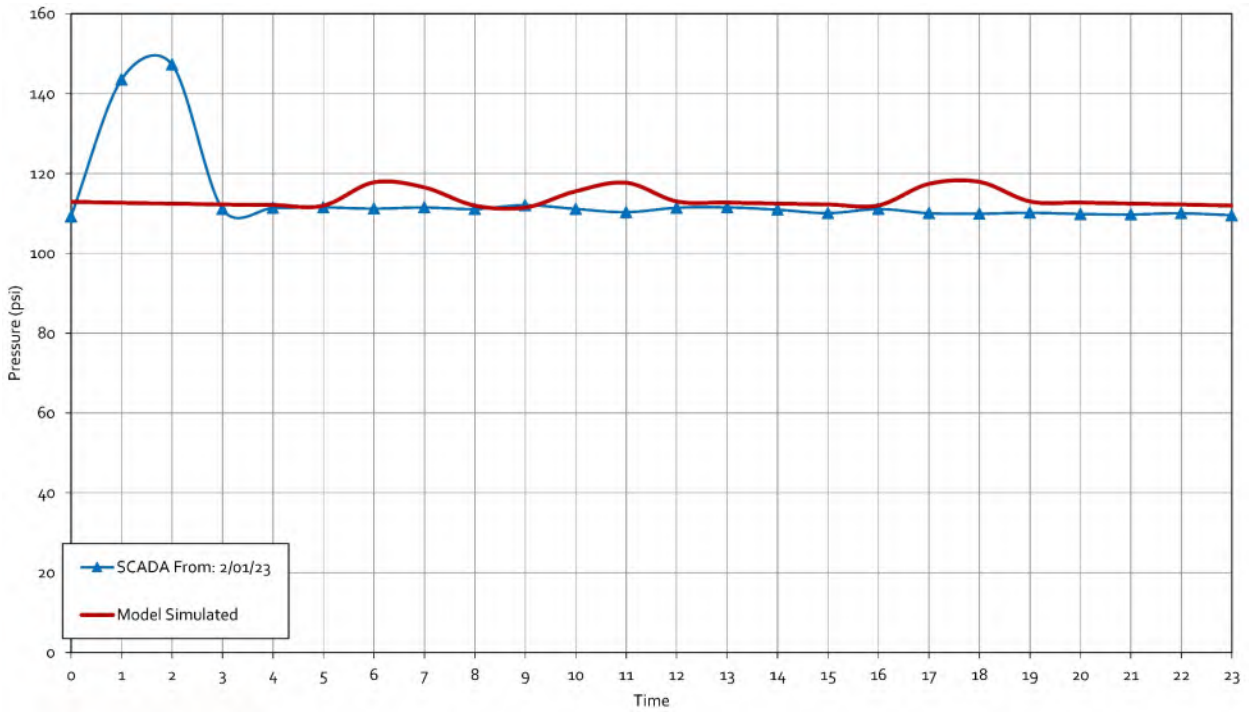


Figure 1C.60 Winter EPS Calibration - 38th St Pressure

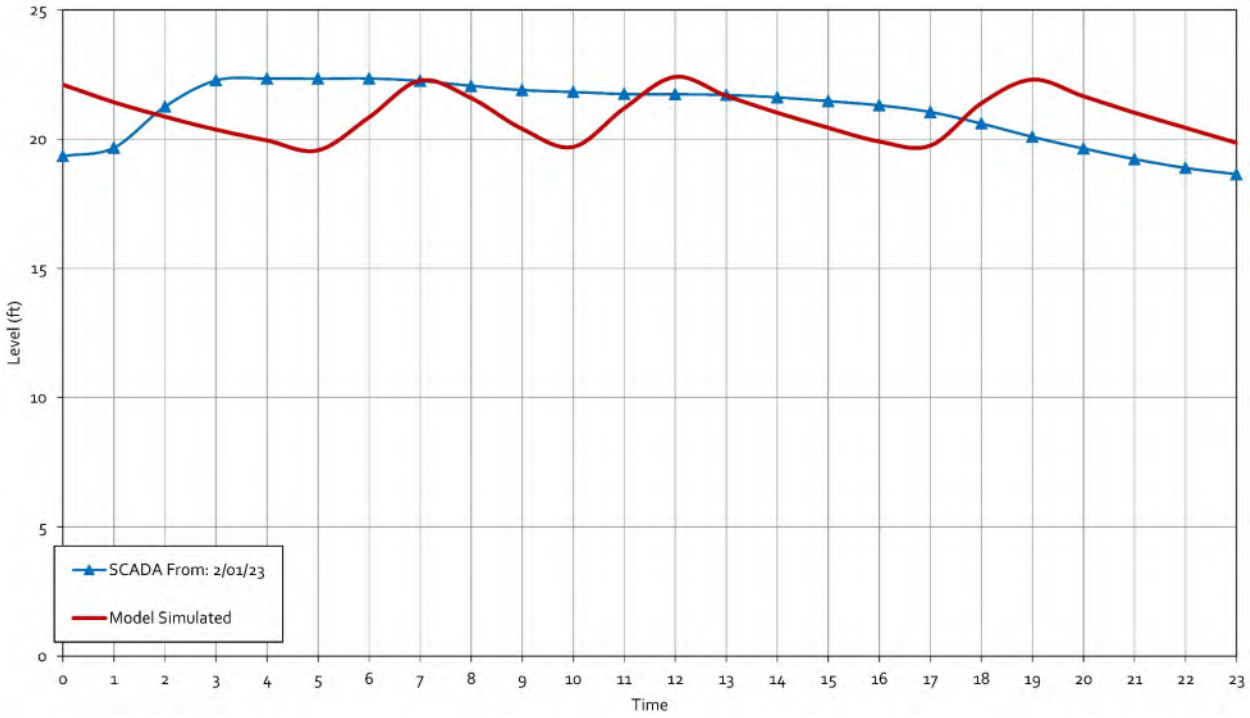


Figure 1C.61 Winter EPS Calibration – 40th Level

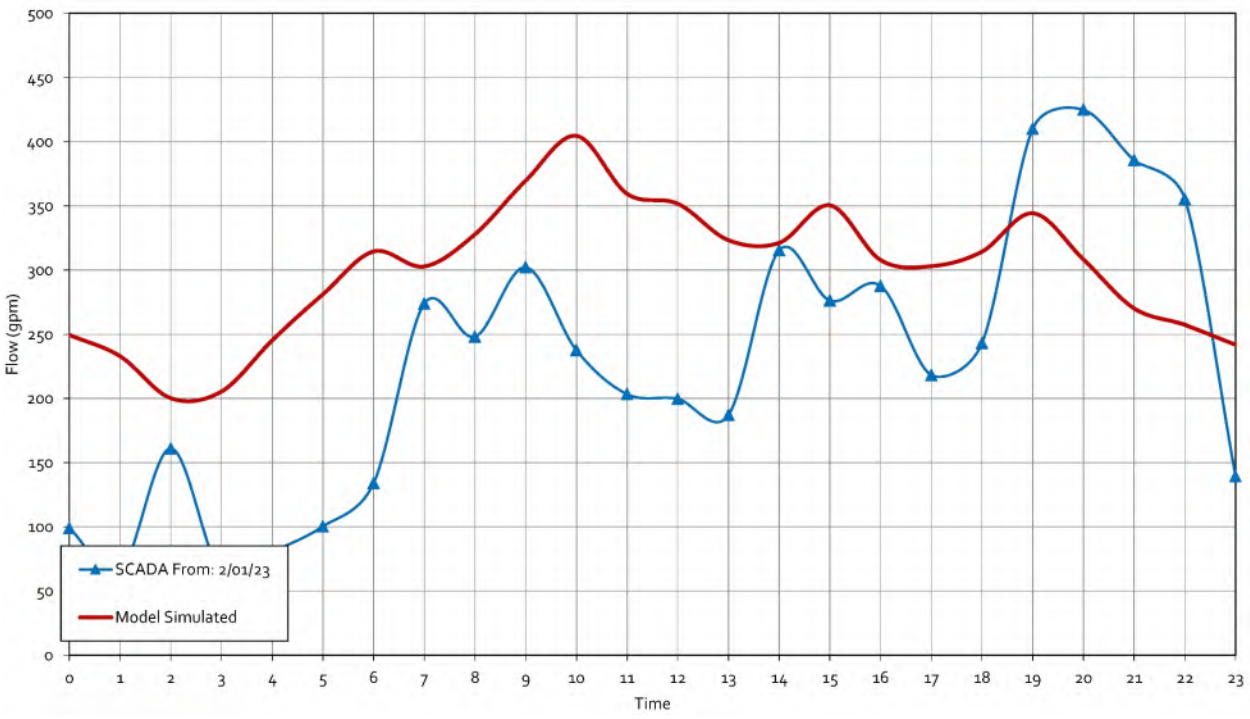


Figure 1C.62 Winter EPS Calibration – Balsam Flow

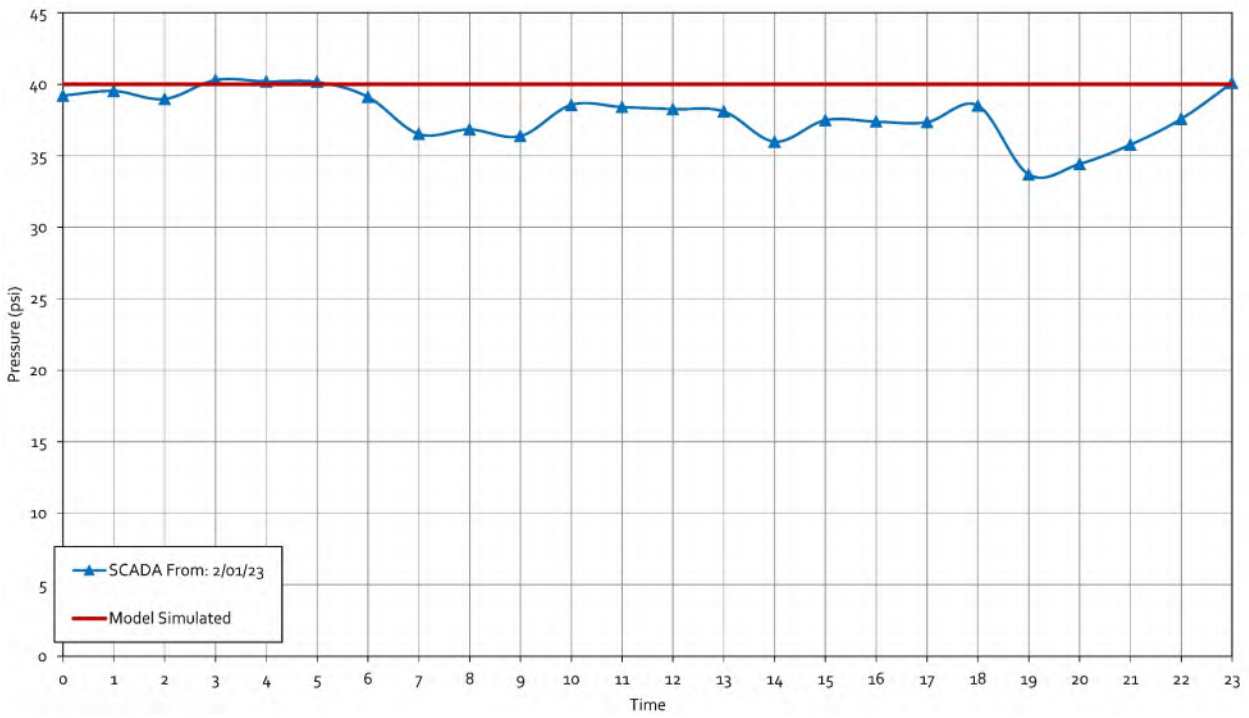


Figure 1C.63 Winter EPS Calibration – Balsam Pressure

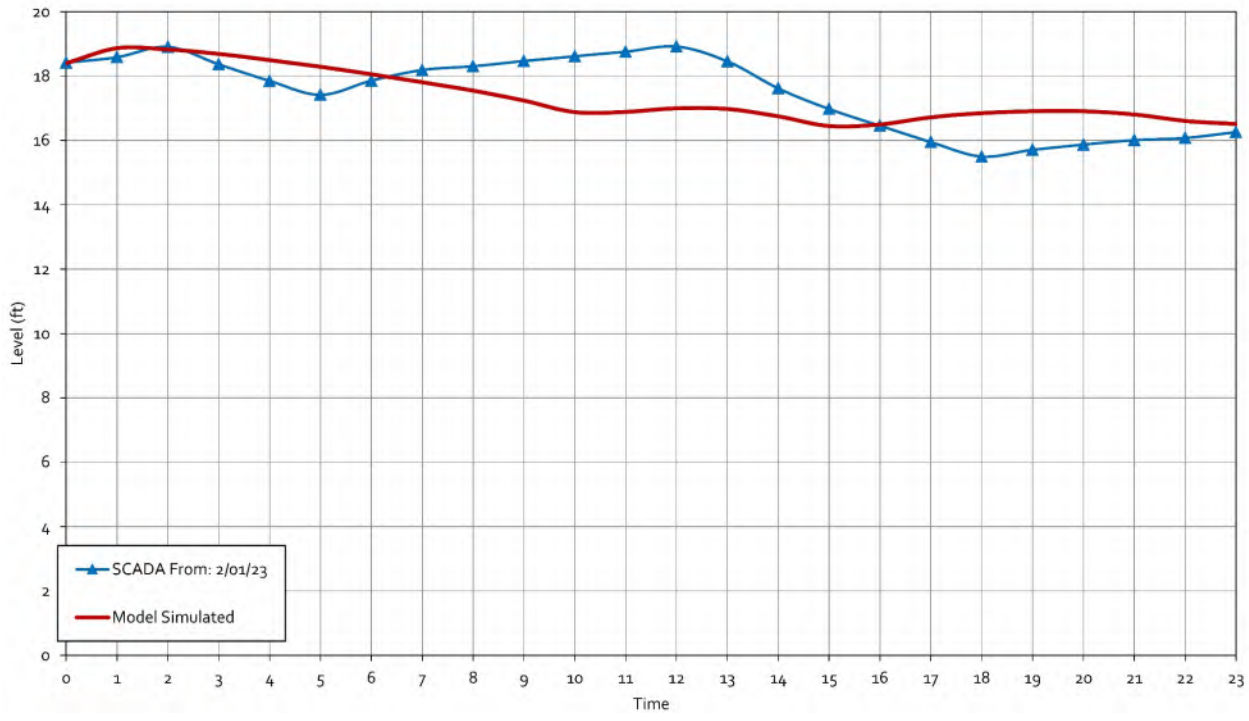


Figure 1C.64 Winter EPS Calibration – Reveille Level

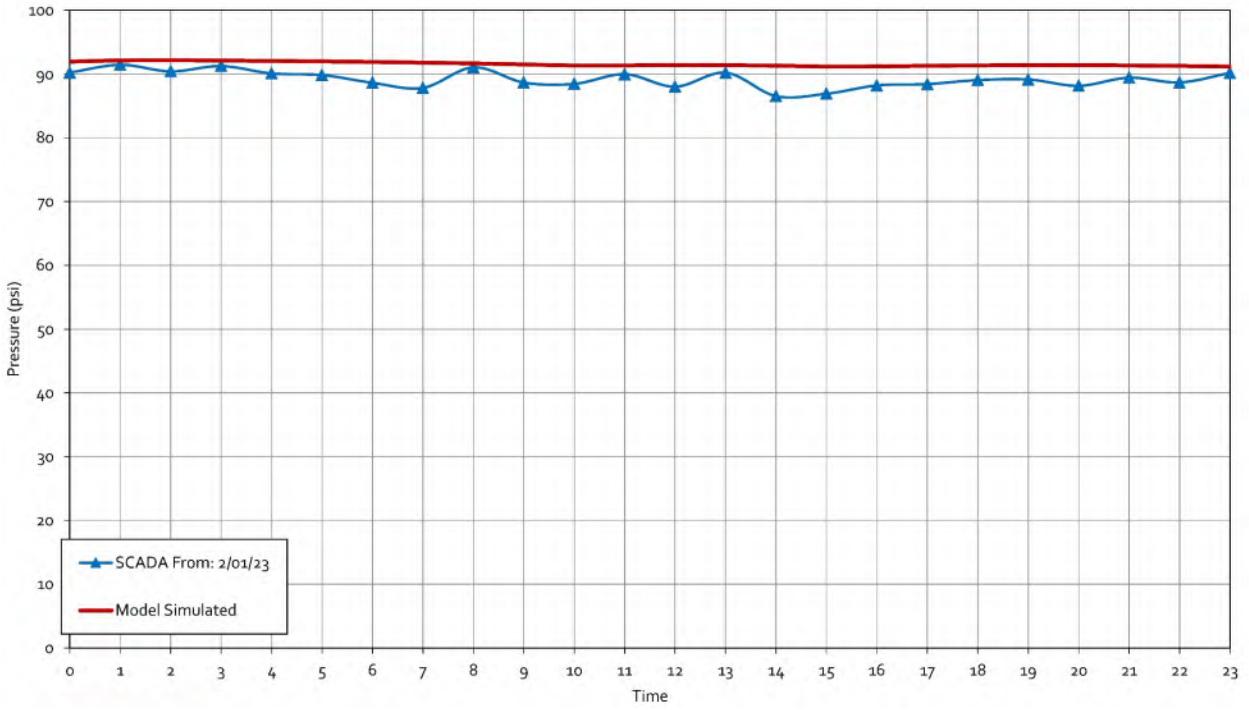


Figure 1C.65 Winter EPS Calibration – Reveille Pressure

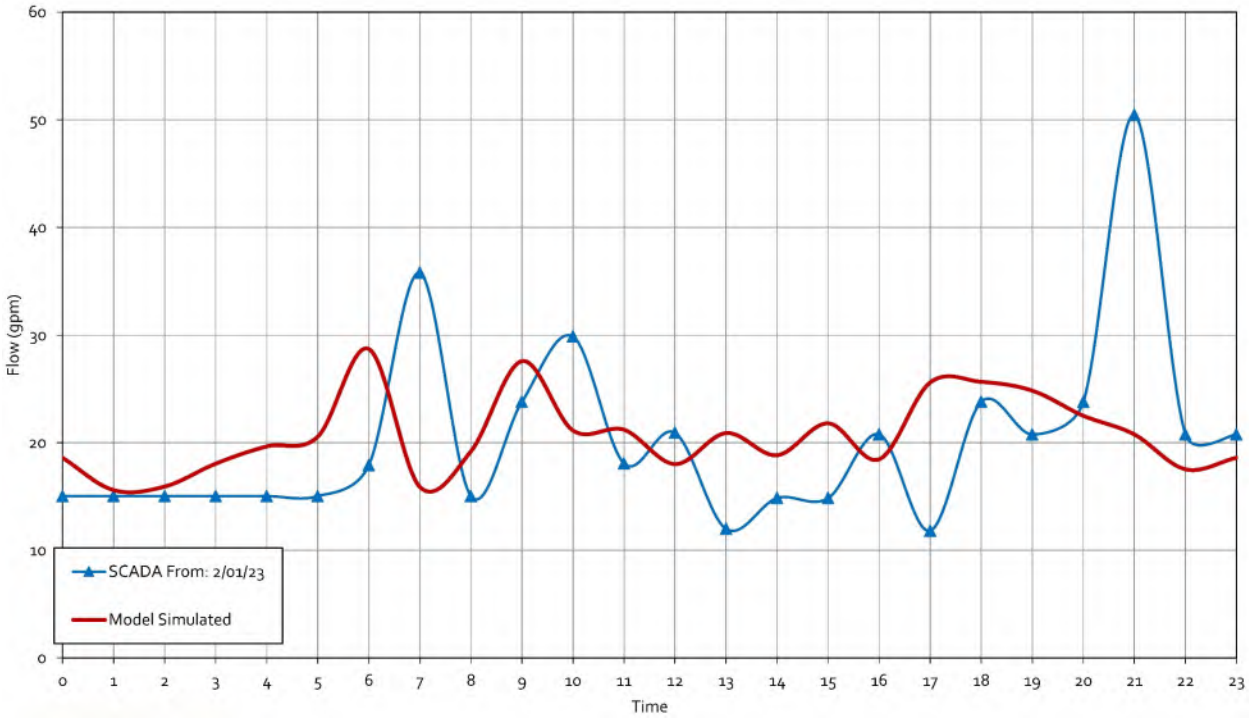


Figure 1C.66 Winter EPS Calibration – Birch Flow

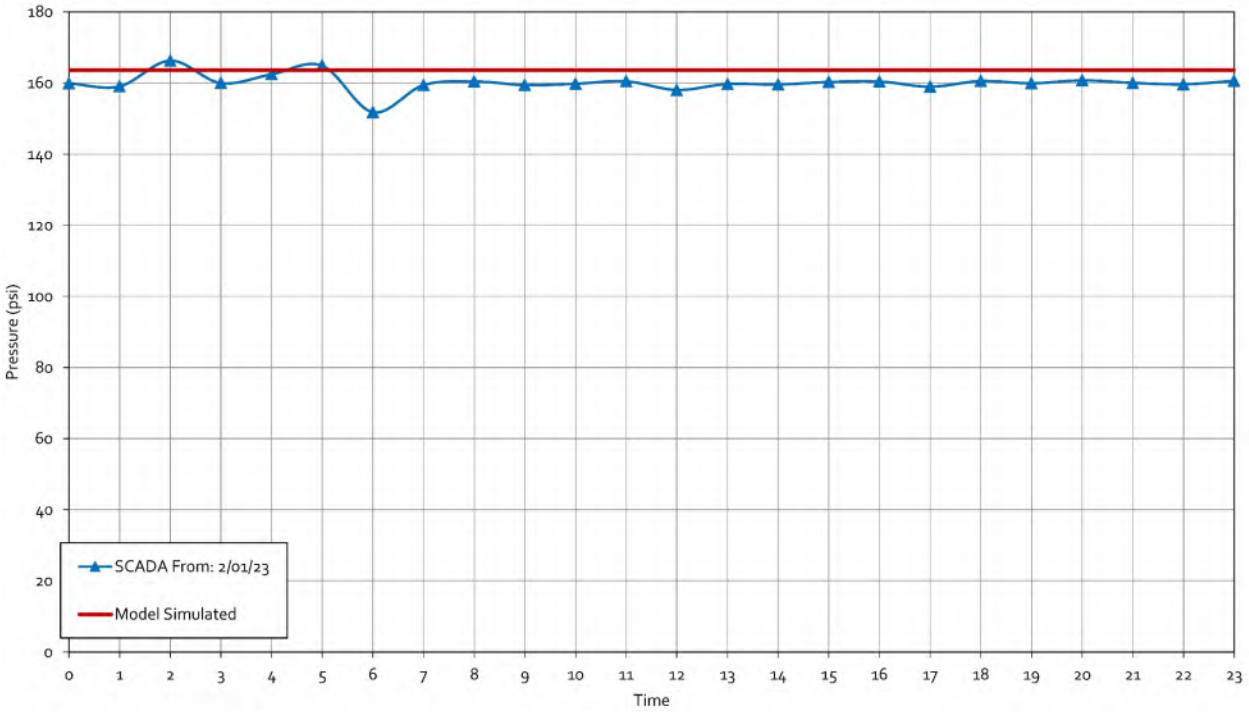


Figure 1C.67 Winter EPS Calibration – Birch Pressure

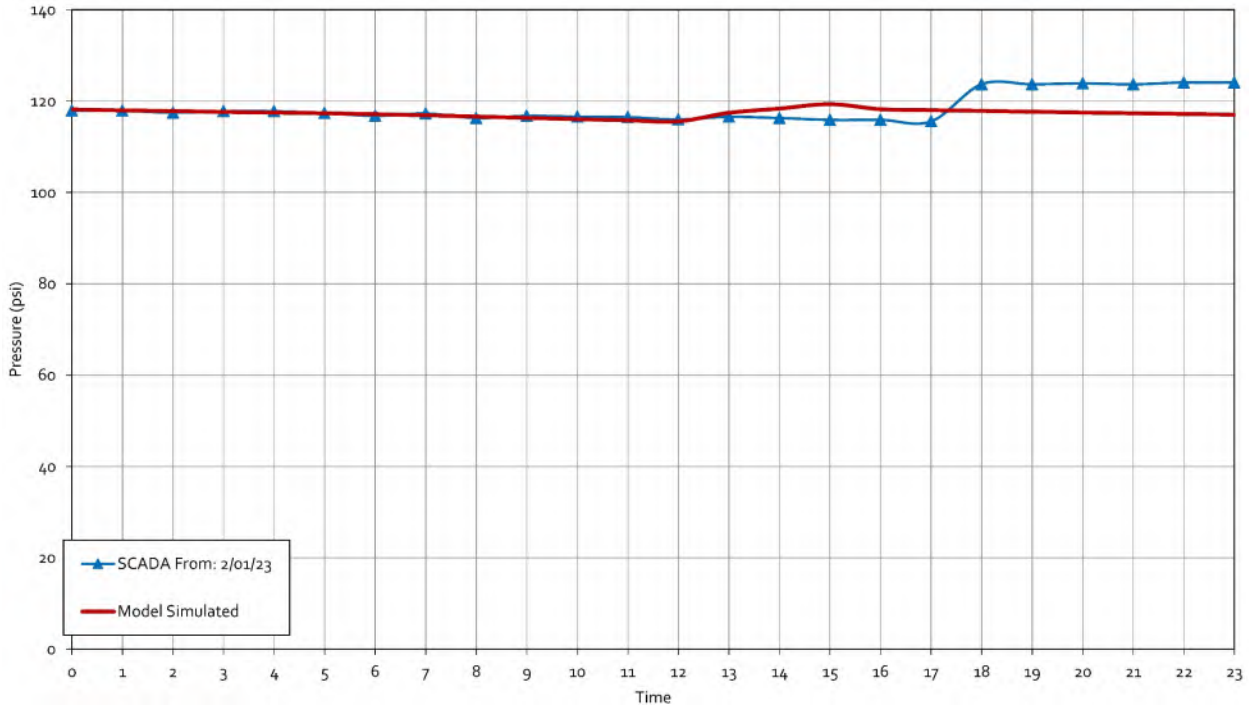


Figure 1C.68 Winter EPS Calibration – Governor Pressure

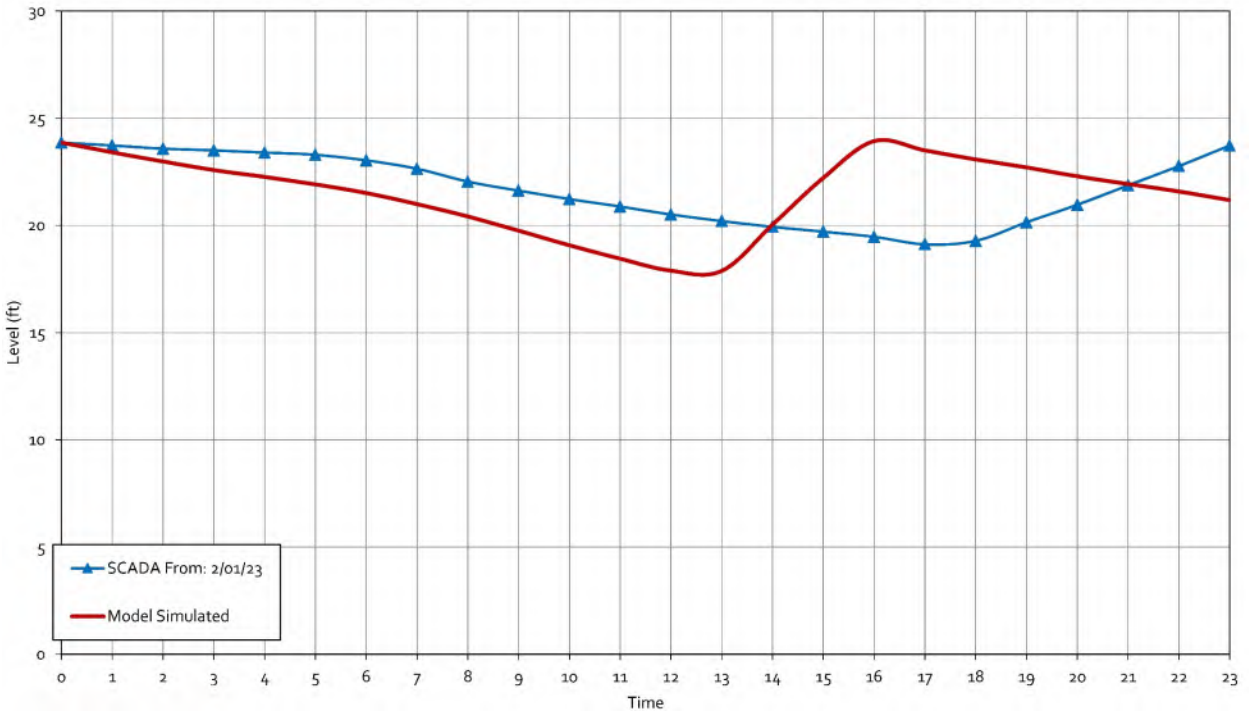


Figure 1C.69 Winter EPS Calibration – Parkhurst Level

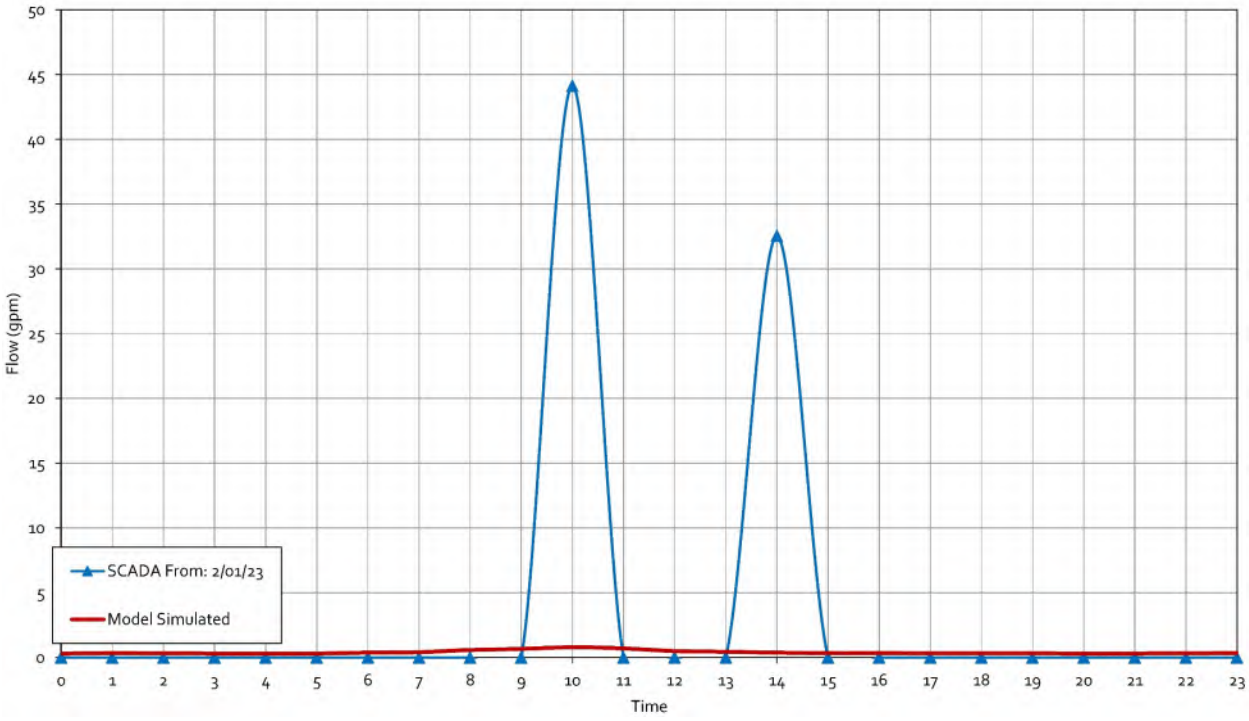


Figure 1C.70 Winter EPS Calibration – Samish Highlands Flow

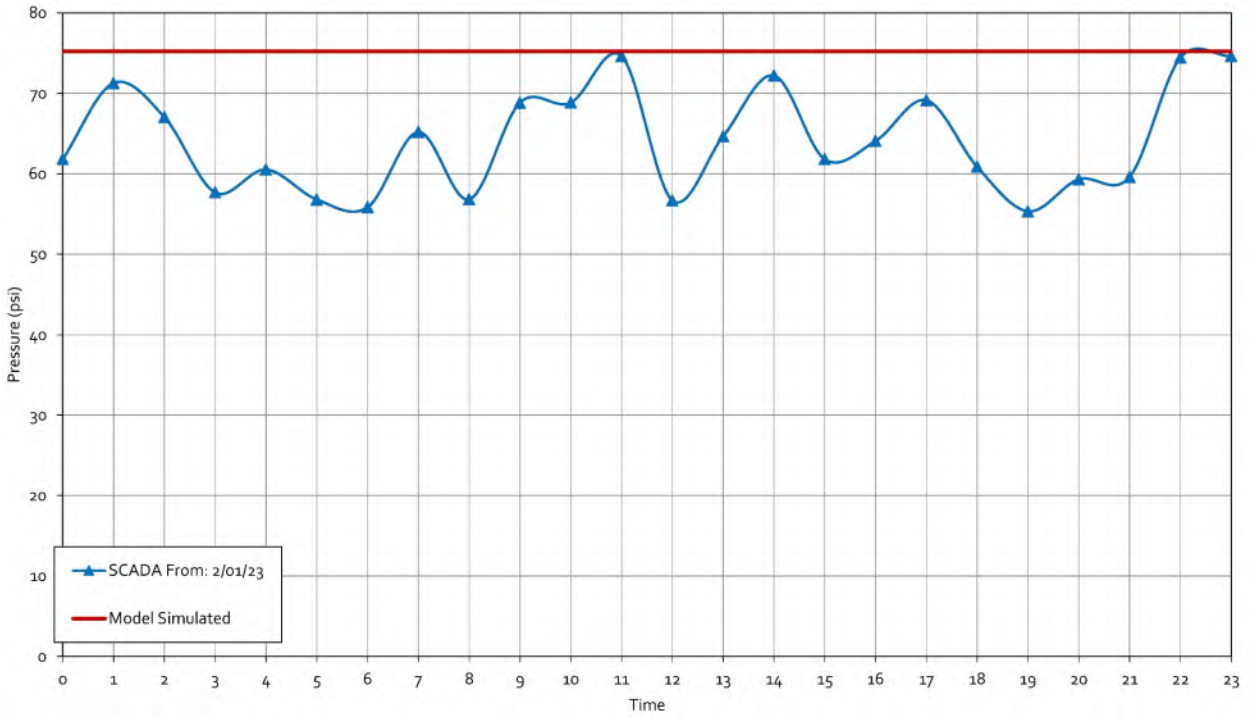


Figure 1C.71 Winter EPS Calibration – Samish Pressure

APPENDIX Q

WATER QUALITY SAMPLING PROCEDURES AND PROGRAM

1.1 BACTERIA SAMPLING PROCEDURE

REFERENCE

Standard Methods for the Examination of Water and Wastewater, 23rd edition, 2017. American Public Health Association, American Water Works Association, and the Water Environment Federation, Method 9060.

Manual for the Certification of Laboratories Analyzing Drinking Water, 5th edition, 2005. U.S. Environmental Protection Agency publication #815-R-05-004.

SAFETY

Sampling in unknown areas and neighborhoods can be dangerous. Communicate with the laboratory supervisor or other designated laboratory staff when leaving and returning from sample collection activities. When collecting environmental samples use appropriate personal protection equipment. Refer to the laboratory water work safety protocol (Attachment A). When collecting samples near roadways, wear a reflective vest or jacket, turn on vehicle strobe or flashers, use traffic cones when additional visibility is warranted, and position your vehicle in such a manner as not to be hit by it if it is struck from behind (see Attachment B).

SUMMARY OF METHOD

The City of Bellingham performs a variety of bacterial sampling and analyses. The baseline monitoring program, total coliform monitoring program, new main disinfection, customer service requests (CSR), urban stream monitoring program, and source water monitoring are examples of the types of samples that may be sampled and analyzed in the City of Bellingham Water Filtration Plant Laboratory. Analyses includes total coliform (TC), fecal coliform (FC), *Escherichia coli*, and heterotrophic bacteria.

Sample collection is an integral part of bacteriological analysis. Without well documented, aseptic, and well-planned sampling technique the analytical results will be questionable. Samples are usually collected in an environment that is not under the direct control of the laboratory staff, thus, special care must be taken to follow aseptic techniques. General sample collection procedures for bacterial analysis of either treated (distribution system or customer complaint) or untreated (source or environmental sample) water are described below. All samples should be collected in appropriate sterile sample bottles such as polypropylene (PP) bottles that will withstand the rigors of repeated autoclaving. Never rinse sample bottles with sample. Always leave ample air space in the bottle for mixing. In the instance of treated distribution system samples, a minimum of a one-inch air gap is required in the container to facilitate proper mixing of the sample.

Routine distribution system sampling locations are maintained at least annually to reduce potential for sample contamination. Sample taps should be maintained by:

- Clearing foliage in the vicinity of the station,
- Inspecting for leaks and adequate flows,
- Carefully oiling hinges and padlock to assure ease of access,
- Clean tap with weak bleach solution and a clean rag. Flush well.

Immediate cleaning should be done on any sample tap that appears dirty in order to avoid sample contamination.

A. TREATED WATER:

EQUIPMENT AND REAGENTS

1. Sterile 125 milliliter (ml) PP sample bottles containing approximately 0.1 ml 3% sodium thiosulfate* (autoclave with sodium thiosulfate at 121°C for 15 minutes)
2. Chlorine field meter, Hach DR 850 (or equivalent)
3. DPD powder for free chlorine analysis
4. Applicable field data form
5. Keys: COB key card, 4E25, 3EO3, and AB1 (for many distribution system sites)
6. Cooler and ice
7. Propane torch with safety starter attachment
8. Clean rag
9. Weak bleach solution
10. Manual hand pump for draining taps
11. Dechlorination tablets in mesh bag.
12. Traffic cones and safety vest/coat (see Appendix B)
13. Wasp spray, as needed seasonally

*Per Standard Methods for the Examination of Water and Wastewater, a 3% sodium thiosulfate ($Na_2S_2O_3$) solution is considered sufficient strength to quench a water sample containing < 5 milligrams per liter (mg/L) free chlorine. Make 3% $Na_2S_2O_3$ using aseptic technique. Thoroughly dissolve 30 milligrams (mg) $Na_2S_2O_3$ + 5 H_2O in 1 (liter) L lab pure water and store in a clean stoppered container in media refrigerator.

PROCEDURE

Routine Distribution Sampling:

1. If sampling the distribution system for Total Coliform Rule compliance, use a sampling station designated for this purpose. The City has a minimum number of routine distribution samples it must collect each month as described in WAC 246-290-300.

   In some unusual circumstances (frozen tap, tap in disrepair) another site may be used to represent the distribution system, but only under consultation with the lab supervisor. The following criteria must be followed if a non-routine tap is used:

   - Tap is free of aerators, strainers, hose attachments, mixing type faucets and purification devices.
   - Only a designated cold-water line is used.
2. Immediate maintenance should be initiated on a sample tap if the sampler observes any of the following:
   - Evidence of insects, dirt, or other debris. Clean tap with weak bleach solution and clean rag, flush tap for a minimum of 5-minutes, then flame tap prior to sampling.
   - Leaks shall be reported the same day to the Water Supervisor with the request made for quick repair.
3. Prior to entry to any reservoir notify the operator on duty of your planned entry. This can either be done at the beginning of the day for all sites to be entered or via radio upon arrival at each site.

4. Ensure that any entry alarm is acknowledged upon entry to the facility and reset upon leaving the facility. Consult the site alarm list maintained in the distribution system sampling tap location manual.
5. When sampling water reservoirs; make every attempt to sample while the tank is in a drain cycle (vs. filling).
6. Flame sample tap with a propane torch if there is any potential for tap contamination. Use best professional judgment to determine if flaming is needed and appropriate.
7. Allow the tap to run for 3 minutes prior to sampling. Adequate flushing is necessary to ensure that water representing the water main is sampled. Be sure this water runs directly through the dechlorination tablets in mesh bag.
8. Adjust the flow rate from the tap so that the jet of water breaks sharply away without lapping the outside lip of the tap or splashing.
9. Determine the free chlorine residual of the water using a chlorine field meter (Chlorine Residual, Free and Total Measurement with a Field Meter Procedure) and record on the field sheet. If value is ≤0.02 mg/L free chorine, also analyze for total chlorine and collect an HPC sample.
10. Ensure bottle is labeled with sample ID. Note date and time collected on field sheet.
11. Keep sample bottle closed until it is to be filled.
12. Clean hands with alcohol hand sanitizer and/or use disposable gloves, which should be cleaned with alcohol hand sanitizer as well.
13. Collect the sample:
    a. Hold the sample bottle at or near the bottom and loosen the cap.
    b. Carefully remove the lid and hold the bottle under the flow. Be careful not to touch the neck or inside of the bottle or cap.
    c. Hold the cap in hand during sampling to avoid contamination.
    d. Ensure that a minimum of 100 mls of sample is collected.
    e. Fill the bottle to within 1 inch of the top to maintain adequate space for mixing. DO NOT OVERFILL THE BOTTLE.
    f. Replace the lid and make sure the labeling is still legible.
15. Be alert for any unusual conditions surrounding the sampling event. Examples of such conditions could include unusual smells, the presence of turbidity, a level of free chlorine residual which is unusual for the area, or the presence of air in the lines. These conditions may indicate a problem with the water main or an intentional contamination event. As such, observation of any of the following should be communicated immediately to the lab supervisor.
16. During winter months, ensure that the tap is fully drained by intentional purging with the manual hand pump. This practice will prevent frozen water lines.
17. Store the bottle on ice in the dark during transport to the laboratory. Hold samples at $< 10^{\circ}$ C during transport to the laboratory. NOTE: It is important to avoid freezing the sample. Avoid direct contact between ice packs and samples for prolonged periods of time, which may cause freezing. Insulate ice with bubble wrap or thick paper to avoid direct contact with sample bottles as needed.
18. Complete the sampling forms including date, time, initials of sampler, sample location, lab number, the sample type including the residual chlorine value, and any comments.
19. Follow the guidelines for sample holding times described in the Storage section of the pertinent bacterial analysis standard operating procedures (SOP).

20. Upon return to the lab note the date, time, and initials of the person receiving sample(s) on the applicable lab benchsheet or Washington State Department of Health Coliform Bacteria Analysis Form.
21. Ensure the sample is analyzed the day it is received in the lab. Analysis can only be performed the following day if the time between sample collection and placement of sample in incubator does not exceed 30 hours.

Customer Complaint Sampling (CSR):

1. If sampling for a CSR or special project, select a representative sample site that is located in as clean an environment as possible. Use best professional judgment when selecting the sampling location and follow the guidelines below:
    - Remove any hoses, aerators, or strainers.
    - Ideally the tap should have a cold-water handle separate from the hot water handle. Sample from the cold-water tap, unless a sample is needed to confirm that the problem originates from the hot water tank.
    - Verify that no point-of-use water purification system is on the tap and confirm with the homeowner that no device such as an in-home filter is present on the supply line. Such devices may cause contamination of the sample.
    - Refuse to sample from an outside hose-bib even if the homeowner suggests this location.
2. DO NOT FLAME TAPS IN A HOME.
3. If the complaint is not related to premise plumbing, allow the tap to run for 3 minutes to flush the tap prior to collecting a sample. Adequate flushing is necessary to ensure that water representing the water main is sampled. A change in temperature and/or free chlorine residual from the cold-water tap is often a good indication that the water is coming from the water main.
4. In some instances, it may be of diagnostic benefit to sample both the stagnant water line and the line after it has been flushed as described above. Similarly, it may be of benefit to sample both the hot and cold line to assess conditions in the home. Best professional judgment should be used to determine the appropriate bacterial sampling protocol based on the complaint.
5. Follow the sampling procedures detailed in Routine Sampling items 7 – 21 (with the exception of item 16) above for proper documentation and transport to the laboratory.
6. Upon return to the lab note the date, time, and initials of the person receiving sample(s) on the applicable lab benchsheet or Washington State Department of Health Coliform Bacteria Analysis Form. DO NOT ASSIGN A DOH NUMBER FOR CSR'S. These samples are not considered routine samples.

B. SOURCE WATER AND ENVIRONMENTAL SAMPLING:

EQUIPMENT AND REAGENTS

1. Sterile 250/500 ml PP sample bottles without sodium thiosulfate (autoclave at 121°C for 15 minutes)
2. Weighted sampler (dedicated)
3. Long-handled dipper (as needed)
4. Field sampling form
5. Cooler and ice
6. AB1 Key
7. Disposable gloves (optional)
8. Traffic cones and safety vest/coat (see Appendix B)

PROCEDURE

Source Water Sampling:

1. Every week source water samples at the gatehouse and screenhouse are collected for bacterial analysis. A minimum of ten individual samples for fecal coliform analysis and four individual samples (collected the first two weeks of the month) for total coliform analysis are collected each month. Samples may also be collected from bulk water entering the Water Filtration Plant as long as it has not been chlorinated.
2. Prior to collecting a source water sample notify the operator that you will be entering the gatehouse and/or screenhouse.
3. Use the AB1 key to enter the gatehouse/screenhouse building.
4. Acknowledge the entry alarm immediately upon entering the building. If the alarm is not acknowledged an intruder alert will be sent to the operator. The alarm is located in the main entry room of the gatehouse and in the room to the right in the screenhouse.
5. The gatehouse site has a sample hatch and dedicated weighted sampler for sampling. Use the AB1 key to unlock the inner gate. The sample hatch and sampler are located to the left of the entrance and then to the right of the inner gate the hatch is at floor level. The sampler is located next to the hatch. The screenhouse is sampled upstairs southwest of the traveling barscreens and the weighted sample holder is secured with a rope next to the sampling hatch.
6. If possible, pre-label bottles with sample identification. Note date and time collected on field sheet.
7. Keep sample bottle closed until it is to be filled.
8. Clean hands with alcohol hand sanitizer and/or use disposable gloves, which should be cleaned with alcohol hand sanitizer as well.
9. Collect the sample:
    a. Place a 250ml PP bottle in the weighted sample holder that is retained at each site.
    b. Carefully remove the lid to the sample bottle. Be careful not to touch the neck or inside of the bottle or cap and avoid knocking the sides of the sample hatch opening with any part of the sampling apparatus. Keep the sampler rope clean and do not allow it to touch the floor or sides of the sample hatch.
    c. Hold the cap in hand during sampling to avoid contamination.
    d. Plunge the sampler with bottle into the water below the surface. Try to fill the bottle to within 1 inch of the top to maintain adequate space for mixing. If the

bottle does not have enough headspace immediately pour off some of the water to leave at least 1 inch of headspace.

e. Replace the lid and make sure the labeling is still legible.
f. Return the weighted sampler to its designated storage place.

10. Be alert for any unusual conditions surrounding the sampling event. Examples of such conditions could include unusual smells or the presence of turbidity. These conditions may indicate an intentional contamination event. As such, any observation of unusual conditions should be communicated immediately to the lab supervisor.
11. Make sure door is dead bolted upon leaving the facility and that the alarm is reset. When closing the door, the gatehouse and screenhouse doors will lock, but you will need to use your AB1 key to ensure the doors are dead bolted.
12. Store the samples on ice at < 10° C in the dark during transport to the laboratory. NOTE: It is important to avoid freezing the sample. Avoid direct contact between ice packs and samples for prolonged periods of time, which may cause freezing. Insulate ice with bubble wrap or thick paper to avoid direct contact with sample bottles as needed.
13. Complete the sampling forms including date, time, initials of sampler, sample location, lab number, the sample type, and any comments. Be sure to check the Raw Water Source Sample box on the Washington State Department of Health Coliform Bacteria Analysis Form.
14. When entering the lab, check the temperature of raw water samples utilizing the infrared (IR) digital sensing thermometer and record this value on the DOH slip. Check the IR thermometer against the NIST corrected thermometer in the media fridge and record the difference between the two thermometers on the temperature benchsheet on the media fridge. If the comparison varies by > 0.5 C, calibrate the IR thermometer.
15. Follow the guidelines for sample holding times described above in Routine Sampling items 19- 21. Environmental samples need to be analyzed within 8 hours of collection.

Environmental Sampling:

1. When collecting samples directly from a river, stream, storm drain, or lake, obtain samples representative of the water that is sampled.
    - It is undesirable to take samples too near the bank. Take special precaution to avoid stagnant or backwater areas if these do not represent the reach being sampled.
    - Establish sampling locations at critical sites and scale the sampling frequency as needed. For example, if sampling recreational water to determine bacterial densities, use a grid-based locational selection with multiple sampling sites. If sampling the same system at more than one location, take precautions not to disrupt the conditions leading to your next sample (i.e. always sample downstream to upstream).
    - Use best professional judgment to safely obtain the most representative sample.
2. If possible, pre-label bottles with sample identification. Note date and time collected on field sheet.
3. Keep sample bottle closed until it is to be filled.
4. Clean hands with alcohol hand sanitizer and/or use disposable gloves, which should be cleaned with alcohol hand sanitizer as well.
5. Collect the sample:
    a. Hold the sample bottle at or near the bottom and loosen the cap.

b. Carefully remove the lid and plunge the bottle, neck downward, below the water surface.
c. Turn the bottle until neck points slightly upward and mouth is directed toward the current. If there is no current, create a current artificially by pushing bottle forward horizontally in a direction away from the hand.
d. Be careful not to touch the neck or inside of the bottle or cap.
e. Hold the cap in hand during sampling to avoid contamination.
f. Fill the bottle to within 1 inch of the top to maintain adequate space for mixing. DO NOT OVERFILL THE BOTTLE.
g. Replace the lid and make sure the labeling is still legible.

6. Store the bottle on ice at < 10° C in the dark during transport to the laboratory, do not freeze. NOTE: It is important to avoid freezing the sample. Avoid direct contact between ice packs and samples for prolonged periods of time, which may cause freezing. Insulate ice with bubble wrap or thick paper to avoid direct contact with sample bottles as needed.
7. Complete project sampling forms including information such as date, time, initials of sampler, sample location, lab identifier, the sample type, and any comments.
8. Environmental samples need to be received in the lab within 6 hours of collection and the lab must analyze samples within 2 hours of receipt.
9. If it is not possible to collect a representative sample by hand, select one of the following alternatives:
    - Use a weighted line attached to a sample bottle and lower apparatus into the water to be sampled.
    - Use a long-handled sample pole with the sample bottle firmly attached to reach out into a representative portion of the water to be sampled.

QUALITY CONTROL PROCEDURES

Follow quality control procedures described in the applicable bacterial analysis SOP.

Laboratory staff should note on the sample benchsheet if a sample comes into the lab at >10° C.

Samples should be rejected if they show evidence of any of the following:

- freezing,
- presence of free chlorine,
- turbidity,
- any other condition deemed sufficient to interfere with analysis.

ATTACHMENT A

WATER WORK SAFETY PROTOCOLS

OVERVIEW

Collection of water-quality samples or data can be as simple as hand dipping water from a slow-moving stream or placing a probe in the water to as complex as using heavy power equipment while working from a cableway. Know the safety steps needed for any sampling method used.

The types of water work conducted by City of Bellingham Public Works Operations Division laboratory personnel include, but are not limited to, water temperature and discharge monitoring, and Urban Stream water quality monitoring using a Quanta hydrolab probe and hand dipping water samples from the stream. Employees are encouraged to obtain representative samples and measurements of each system, which frequently requires the employee to enter the water to obtain them. This document provides safety guidelines associated with work conducted near or in water. These guidelines were adapted from United States Geological Survey (USGS) National Field Manual for the Collection of Water-Quality Data (Lane and Fay, 1997).

NEAR WATER WORK

Personal flotation devises (PFD) are strongly recommended when employees are working near water. There are certain circumstances when the use of PFDs is mandatory. These conditions include water work in remote locations, work in large or potentially hazardous systems such as the Middle Fork of the Nooksack River, and any work where the employee will be entering the water for more than several seconds.

The employee must use their best professional judgment on the use of PFDs at all times as stream conditions change and what constitutes safe entry at certain times of year does not apply to others. In the non-mandatory conditions, the decision to use PFD will rest on the best judgment of the employee entering the water as to whether a potentially hazardous condition exists.

WADING

When surface-water work requires that an employee enter the water to obtain samples or measurements under conditions considered potentially hazardous as mentioned in the preceding section it is advisable that another employee accompany them to assist from shore.

When assessing stream wadability, examine the section of a stream or river you plan to wade. Check the field folder for information relating to safety, including maximum depths in relation to stage, wading-section anomalies such as slippery conditions and drop-offs or holes (a wading rod can be used to help assess streambed conditions), and velocity curves for determining wadable stages. **Do not attempt to wade a stream for which values of depth multiplied by velocity equal or exceed 10 ft^2/s.** For example, a stream only 2 ft deep but with velocities of 5 ft/s or more can be dangerous to wade.
The guidelines below are part of the City of Bellingham laboratory water work requirements:

- Wear a personal flotation device (PFD) during wading activities.

    - Approved PFDs for wading include the standard jacket type and the suspender type. The PFD must fit properly, be rated for your weight, and be in good condition.
    - The PFD should be dried and kept indoors between trips.
- Wear hip boots or chest waders. Boots and waders provide protection from cold and pollutants, as well as from underwater objects (Joseph, 1957).
    - Be aware of the possibility of slipping and going underwater while wearing hip boots or chest waders.
    - Hip boots with a strap at the top are better than boots that are open. The strap should be pulled closed. This allows air to be trapped in the boot in case you are submerged. The air cushion can be used as a partial mechanism for flotation until you reach shore or are rescued.
    - Avoid hip boots with tight ankles. These are difficult to remove in an emergency situation. **Whenever hip boots are worn, a PFD also must be worn.**
    - Avoid chest waders that are tight fitting at the top. Like tight-ankled hip boots, they are difficult to remove in an emergency situation. **Whenever chest waders are worn, a PFD also must be worn.**
- Be aware of surrounding conditions.
    - Watch for debris floating downstream, i.e. logs or aquatic vegetation.
    - Watch for sand channels that can shift under foot and become quicksand.
    - Watch the stream stage, especially when it could rise rapidly.
    - When wading downstream and within the influence of a dam or control structure, contact the gate operator before entering the stream.
- A harness and safety line can be used as an added safety measure.

WORKING ON BRIDGES

For every bridge site, develop and diagram a detailed procedure that pertains to the specific conditions of the site and reference any applicable state and federal regulations. Keep this procedure and diagram in the field folder. The bridge procedure includes plans for safety cones and signs, lane blockage, and traffic control.

Equipment used for sampling from a bridge can be heavy and unwieldy. Practice assembling and using the equipment before starting field activities, and make sure the equipment is operational before leaving the lab. When using a bridge crane, keep a pair of heavy-duty wire cutters readily available for cutting the cable in case debris snags the sounding line.

Be aware of boat traffic. The bridge crane cable should have strips of bright plastic flagging attached in intervals to make it easily visible to all boat traffic.

A PFD must be worn when working on bridges. The suspender type PFD is approved for bridge work.

Workers involved in peripheral activities should wear high-visibility vests with reflective tape.

ATTACHMENT B

OVERVIEW

Collection of water samples from roadways can present a safety risk. Try never to have your back to oncoming traffic and follow the safety steps below for any sampling method used.

1. Park next to the curb or as far off the roadway as possible.
2. When possible, park in such a manner that backing up will not be necessary to leave the site.
3. If there is not enough room or if there is heavy traffic, find a safer place to park and walk to the sample stations.
4. Once parked, turn on the 4-way flashers or strobe light.
5. If the vehicle is positioned before the sample station and on fairly level ground, turn the wheel away from the sample location in case the city vehicle is stuck from behind -- that way the city vehicle will be pushed away from the sampler.
6. A reflective safety vest or jacket will always be worn while working on or next to a roadway.
7. Exit the vehicle safely, always aware of oncoming traffic. Never leave the vehicle in idle upon departure per the City's anti-idling policy.
8. Place 3 traffic cones 3-paces apart behind your vehicle, where room is available. Note: parking in a designated parking spot may not allow for cones because of lack of space.
9. Angle the cones towards the curb/edge of the roadway, starting from the vehicle's rear bumper (driver's side) even if you are pulled off the street.
10. When the task is completed, pick up the cones being aware of traffic, carefully enter the vehicle, turn off the strobe light and proceed to the next location.





REFERENCES

Joseph, Jack, 1957, Don't die with your boots on: Outdoor Life, v. 119, no. 4, p. 70.

Lane, S.L., and Fay, R.G., October 1997, Safety in field activities: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A9, accessed November 21, 2005 at http://pubs.water.usgs.gov/twri9A9/

8. Regulatory/Certified Lab Sampling and Chain of Custody Procedures

8.1 MPA and Giardia/Cryptosporidium by cartridge filtration.

Frequency: Quarterly, refer to schedule
Sample Location: Treated line #9 in WTP Poly Room & Screenhouse basement near the chlorine injection line.

This sample procedure for Microscopic Particulate Analysis (MPA), *Giardia* and *Cryptosporidium* are taken from the EPA "Consensus Method for Determining Groundwater under the Direct Influence of Surface Water Using MPA " and the ASTM D-19 P229 "Proposed Test Method for Giardia Cysts and Cryptosporidium oocysts in Low Turbidity Water by a Fluorescent Antibody Procedure"

Testing Laboratory: Environmental Associates, Ltd.
24 Oakbrook Drive
Ithaca, NY 14850
Phone (607) 272-8902 Fax: (607) 256-7092

Equipment:
1. 10" 1 um polypropylene, yarn wound, nominal porosity filter (supplied by EA LTD)
2. 10" cartridge filter housing and holder
3. Water meter, flow control valve, inlet and discharge hoses
4. Stop watch, gallon jug
5. Cubitainers
6. Sodium Thiosulfate de-chlorinating agent (10%)
7. Large zip lock bags
8. Cooler and ice packs
9. Labels
10. Chain of custody forms

Sample Collection:
Sample volumes filtered depend upon water quality. Treated water of good quality requires a filter run of 18-24 hr. (1080-1440 gal), where raw water samples take shorter sample runs (500-900 gal). Due to the difficulty of detecting the relatively fragile microorganisms the samples must be shipped via overnight delivery on ice and received at the testing lab for immediate analysis no later in the week than Thursday. The treated sample should be set up to begin filtration in the morning and the raw sample set up in the late afternoon. Check the flow meters the first thing the following morning to determine gallons filtered, and then discontinue filtering accordingly. The samples must be at the warehouse for shipping before 1 PM. All required chain of custody forms are in the WTP Lab file drawer labeled "FORMS" filed under "MR's" the filters are kept in the large sample bottle cabinet.

Sample Procedure:

1. Attach the inlet hose of the sampling apparatus into the source water sampling point and screw the filter housing into the filter holder, check all connections for leaks while the unit is flushed for 3 minutes with the source water to be sampled.
2. Turn off the water, using aseptic technique install the filter cartridge within the holder.
3. Turn water on slowly with the unit in an upright position, if necessary invert the unit to make sure all the air is purged from the system. Using the valve on the supply side adjust the flow rate to 1 gallon per minute (gpm), record the initial meter reading. Place the filtration apparatus in such a way that it will remain upright for the duration of the filtration. Allow the unit to filter throughout the night. Depending upon the sample source the flow may need to be adjusted as the cartridge ripens.
4. First thing the following morning read the water meter and determine the sample volume filtered. Check the filtration rate and adjust if necessary, if the volume sampled is too low continue sampling for a few additional hours.
5. Turn off the water and disconnect the filter housing. Pour the water from the filtration housing and the woven cartridge filter into a zip lock bag, de-chlorinate chlorinated samples with a few mls of 10% sodium thiosulfate. Seal and label the bag and place inside a second zip lock bag, seal the second bag.
6. Between sample runs keep the sampling units clean and free of dirt, if necessary take the units to the lab and wash, otherwise store the units with the filter holder tightly screwed to the housing near the sampling points.
7. For each sample requiring MPA aseptically fill one cubitainer with sample water and label accordingly, de-chlorinate chlorinated samples.
8. Pack the filters in zip lock bags and cubitainers in cooler with ice packs wrapped in paper and ship overnight, be sure to include the completed chain of custody form sealed a zip lock bag.
9. To alert the testing lab of upcoming samples, fax a copy of each chain of custody form to the testing lab prior to shipment. There is a fax machine in the warehouse. Photocopy the chain of custody sample submittal forms and file in the WTP Lab three ring binder labeled Outside Lab Chain of Custody Forms. Do not ship these samples later in the week than Wednesday.
10. For additional sampling and equipment information refer to the Giardia/Crypto file in the WTP lab. Previous completed chain of custody forms are available in the binder for reference.
11. Maintain a supply of clean filters, cubitainers, coolers, ice packs, zip lock bags and chain of custody forms at all times.

Ensure any results received have been reviewed by Lab Supervisor prior to being filed.

8.2 THM/HAA – Stage 2 Disinfection and Disinfection by Products Rule

Run via EPA Method 524.2 (THM) and 552.2 (HAA)

Frequency: Quarterly, refer to schedule

Sample ID and Location:

(1) 19th & McKenzie
(2) Marietta Reservoir or Horton Road if reservoir is off line
(3) Alabama & Woburn
(4) Pacific Highway
(5) Kearney Reservoir
(6) Ava Lane
(7) Elwood & Ridgeway
(8) KGMI at Yew Street

Testing Laboratory:

Edge Analytical Laboratories
1620 S. Walnut Street
Burlington, WA 98233
1-(800) 755-9295
FAX: (360) 757-1402

Sample Kit Contents:

1. Ice packs, cooler and bubble pack.
2. Sixteen 40 ml septum top vials for each site to be sampled, each containing 25 mg of ascorbic acid. that must not be rinsed out during sample collection. Two vials are used for each site. It is a good ideas to bring some spare sampling vials in the event of accidental overfill or breakage.
3. One 40 ml vial labeled "Field Blank" and dated. The Field Blank serves as a quality control sample and must not be opened at any time and must travel with all samples.
4. Sixteen 2 ml red capped vials with 1:1 HCl (CAUTION this acid is hazardous and corrosive see safety response in the event of body contact at the bottom of the following page).
5. Eight 250 ml bottles for haloacetic acids (HALOAC).
6. Chain of custody submittal form for Edge Analytical.
7. Disposable gloves and safety glasses.
8. DPD Chlorine colorimeter.

Clean Sampling Note:

Bottles must NOT be filled near gasoline cans, gasoline powered motors, paint cans, lighter fluid, paint strippers, pesticide bottles or exhaust fumes from running engines. Do not fuel up vehicles prior to sampling. Fumes and vapors may contaminate the samples. Wash hands before sampling and be careful not to touch or otherwise contaminate the inside of the lid of the bottle during sampling. Do not allow the lip of the bottle to touch the sample tap during sampling. All samples need to be kept cold.

8.2 Trihalomethane (THM) and Haloacetic Acid (HAA) Sampling Init:

Sample Collection:

1. Freeze ice packs before collecting samples.
2. Fill out pertinent sections of the chain of custody (C-O-C) submittal form and sample containers. Most C-O-C forms have check-off boxes to indicate compliance sampling or requested turn around time. Both THM and HAA5 are required to be sampled quarterly for compliance monitoring. If bottles are prelabeled with the requested analysis, input this information from the labeled sample bottles unto the C-O-C to be sure the correct tests are performed. In the comments section, indicate that Edge should submit results for all samples on the State of Washington Volatile Organic Chemicals Analysis Report form and submit to the WA DOH for us. Our Utility ID is #WA 056003.
   After samples are collected, the time sampled will need to be input on this form.
3. When at the sampling site, ensure the sample tap has been allowed to run for at least three minutes prior to sample collection. Reduce the flow to a thin steady stream less than the thickness of a pencil. Use this time to write the time sampled onto each container and to collect a free chlorine residual value. Put on gloves and safety goggles prior to THM sampling.

Sampling 40 ml vials for THM:

4. Carefully fill 2-40 ml THM vials. Do not overfill and wash out the ascetic acid, but fill each vial completely. After filling, open the 2 ml red capped vial and carefully empty the entire contents (inc. smaller glass vial) into the filled 40 ml vial. Use caution not to allow HCl to make contact with anything other than the sample. If HCl gets on skin or surfaces follow directions at the bottom of this page.
5. Invert the vial and look for air bubbles, if any bubbles are present carefully add more water and cap the vial. *The lab will reject samples if they have air bubbles*. Once it is clear there are no air bubbles in the sample, shake the capped vial vigorously.

Sampling 250 ml bottle for HAA:

6. Fill one 250 glass bottle at each site for HAA. Do not rinse or overfill. Avoid agitation of the sample while filling. Be sure to transfer the time sampled information onto the C-O-C.

7. Label all sampling vials/bottles completely with sample location, time and date then pack in bubble pack. Ensure all bottles are prelabeled with the required analysis and all site information.
8. Load ice packs and vials in cooler with enough packing material to make closing the lid difficult. Assume the courier will throw the cooler into their car.
9. Make a copy of the chain of custody form and file for our records in the lab three ring binder labeled "Outside Lab Chain of Custody Forms". Place the original C-O-C in a ziplock in the cooler.
10. Instruct Edge that samples are available for pick up, or drop the samples of at the West Orchard Street location.
11. Maintain a supply of sample bottles, coolers, ice packs, ziplock bags and chain of custody forms at all times.

Hydrochloric Acid (HCl) Safety:

Eye contact: Immediately flush the eye with plenty of water. Continue for at least ten minutes and call for immediate medical help.

Skin contact: Wash off with plenty of water. Remove any contaminated clothing. If the skin reddens or appears damaged, call for medical aid.

8.2 Trihalomethane (THM) and Haloacetic Acid (HAA) Sampling Init:

EDGE ANALYTICAL LABORATORIES

Burlington WA	1620 S Walnut St. -98233
Corporate Office	800.755.9295 * 360.757.1400 * 360.757.1402 fax
Bellingham WA	805 Orchard Dr. Suite 4 - 98225

Sample Collection Procedure for

Haloacetic Acids (HAA_5) & Total Trihalomethane (TTHM)

(IRC Approved Method EPA 552.2/524.2)

READ ALL INSTRUCTIONS BEFORE COLLECTION

COLLECTION POINT:

*Samples should be collected in accordance with 40 CFR 141.132 (b) (1)
*Samples need to be taken from distribution, not at the source or the treatment plant



HAA5/TTHM **SAMPLE KIT CONTENTS:**

* 1 - 40mL vial labeled: 'Field Blank' and dated. The Field Blank serves as an indicator of contamination, which may occur during sample transport or storage. Therefore, this vial **must not be opened** and must always travel with the samples.
* 2 - 40mL vials for each source to be sampled. These vials each contain 25 mg of ascorbic acid that **must not** be rinsed out during sample collection.
* 2 - 2mL Red Capped vials containing inserts filled with 2 drops of 1:1 HCl **(CAUTION: HCl is Corrosive.)**
* 1- 250ml bottle
* Water Sample Information Form for each collection point.

SAMPLE COLLECTION: (TTHM)

1. Remove any potentially contaminating devices such as filters, screens, aerators, hoses, etc. from sampling points.
2. Open the tap and allow water to run, at least 3 minutes, until it reaches a constant temperature.
3. Reduce flow to a thin steady stream about the thickness of a pencil.

*** DO NOT LET THE VIALS TOUCH THE FAUCET OR SPIGOT AS THE SAMPLE MAY BECOME CONTAMINATED***

4. Fill the 2 - 40mL vials from each collection point at the same time under the same conditions. Avoid agitation of the sample while filling.
5. Allow the stream of water to gently flow into the vial just to overflowing, do not rinse out the ascorbic acid. (a.)
6. After filling, transfer complete contents, including insert, of one red-capped 2mL vial into each 40 mL vial. (b.)

*** DO NOT put red capped vial into the TTHM vial. Your sample should look like the field blank.**

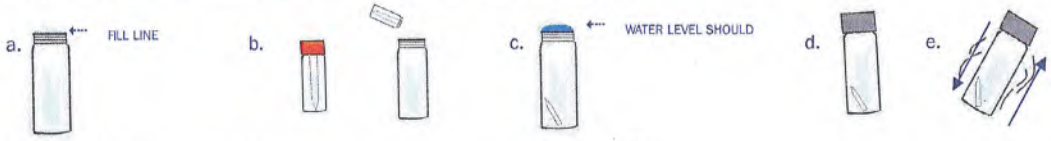
7. If necessary gently add more water so that sample vial looks like illustration (c.)

*** DO NOT TOUCH or otherwise contaminate the inside lid or the lip of the vials/bottles during sampling.**

8. Carefully place the cap onto the 40mL vial. The shiny side of the Teflon cap liner should be face down in contact with the water sample. Tighten down the cap securely. (d.)

*** IMPORTANT: Check for trapped air by inverting the vial and looking to see if any air bubbles are present. If air bubbles are present, gently add more water and repeat step 8. The lab will REJECT TTHM samples if there are air bubbles in the TTHM Container. This will result in resampling.**

9. When you are sure vial is properly filled, shake vigorously. (e)
10. Label each 40mL vial with DOH source number and your name for that collection point.



SAMPLE COLLECTION: (HAA_5)

1. Fill 250 ml bottle from same collection point at same time. (f.)
2. Tighten lid securely.
3. Label the bottle with DOH source number and your name for that collection point.



IMPORTANT: SAMPLES MUST BE KEPT COLD. If the samples are to be held for a day or longer prior to shipment, place the bottles in a refrigerator. **Once samples are ready to be shipped add a bag of ice to the cooler. Samples must be received at EDGE within 4 days of sampling.**

ALL SAMPLES MUST BE RECEIVED AT THE LABORATORY PRIOR TO 4PM ON FRIDAY OF THE WEEK IN WHICH YOU SAMPLED.

Place the completed Water Sample Information (WSI) form into a plastic bag and place in the cooler with the samples. Additional copies of the WSI are available online at www.EdgeAnalytical.com under forms. Please call Cindy O'Toole at (360) 757-1400 or 800-755-9295 if you have any questions.

8.3 Synthetic Organic Compounds (SOC's) -- Compliance testing for Phase II / V Rules

EPA Methods 515.4, 525.2, 531.2, 547
Herbicides, Pesticides, Adipate, PAH's, Carbamates, Glyphosate

Safety: Always use good industrial hygiene and safety practices as described in the Lab Chemical Hygiene Plan. Wash hands before breaks and at the end of the workday. Take care to avoid contact with acid preservatives.

Frequency: Yearly, refer to schedule**. Concurrent sampling with 504.1 EDB/DBCP** soil fumigants (Bellingham Method 8.5).

Sample Location: Entry point to distribution system (EPTDS) - Treated sample tap in poly room.

Testing Laboratory: Edge Analytical, Inc.
1620 S. Walnut Street
Burlington, WA 98233 Tel: 1-800-755-9295

Sample Kit Cooler Contents:

1. Ice packs, which must be frozen before scheduled sampling.
2. The following glass sample bottles wrapped in bubble pack.
    a. Two 1 L bottles at each collection point for method 525.2
    b. One 500 ml bottle at each collection point for method 515.4
    c. One 250 ml bottle at each collection point for method 547
    d. One 40 ml vial at each collection point for method 531.2
3. Water Sample Information (WSI) form and sample collection instructions in plastic bags.

Generic Clean Sampling Note:

Bottles must NOT be filled near gasoline cans, gasoline powered motors, paint cans, lighter fluid, paint strippers, pesticide bottles or exhaust fumes from running engines. Do not fuel up vehicles prior to sampling. Fumes and vapors may contaminate the samples. Wash hands and do not handle coins prior to sampling, be careful not to touch or otherwise contaminate the inside of the lid of the bottle during sampling. Do not allow the lip of the bottle to touch the sample tap during sampling. All samples need to be kept cold, ≤ 4°C.

Sample Collection:

1. Freeze ice packs before collecting samples.
2. Obtain a Water Sample Information (WSI) form from *M:\PW\Data\Plants\Lab\Lab WTP\WTP_REG\IOC VOC SOC*.
    - ✓ Use last year's WSI form as a reference when filling out new forms.
    - ✓ Confirm that **Compliance** is selected in the SAMPLING INFORMATION REQUIRED section so that the results will be forwarded to WSDOH regional office, this is required for compliance.
    - ✓ Complete items 2 and 3 in the SAMPLING INFORMATION REQUIRED section.
    - ✓ In the PUBLIC WATER SYSTEM (ONLY) section, confirm our system ID, DOH source number: S01, and source type: Surface.
    - ✓ Under "Other Analysis" confirm 547-glyphosate is added.

- ✓ Refer to the back side for step-by-step detailed instructions on proper sampling methods.

3. Read all sampling procedures and guidance.
4. Label each bottle completely.
5. Fill sample bottles being careful not to introduce air bubbles, fill the bottles so that little or no air space will remain after the cap is secured. Do not rinse or overfill the bottles.
6. Load bottles wrapped in bubble pack and frozen ice packs in the cooler with enough packing material to make closing the lid difficult. Assume the shipping people throw all coolers into their trucks.
7. Print copies of page 1 and page 2 the Chain-of-Custody-Analysis-Request from *M:\PW\Data\Plants\Lab\Lab WTP\WTP_REG\IOC VOC SOC*. Fill in the date and time that the samples were collected.
8. Sign the WSI and Chain-of-Custody forms to relinquish custody of the samples, and then make a copies of the forms for our records. Place the originals into a sealed ziplock bag and then place them in the cooler.
9. Transport the samples to the City of Bellingham warehouse. Instruct the warehouse to ship the cooler overnight delivery. All overnight deliveries must be at the warehouse no later than 1 PM.
10. Save a copy of the WSI and Chain-of-Custody in the lab three ring binder labeled “Outside Lab Chain of Custody Forms”.
11. Be sure a new sample kit arrives before the next scheduled sampling period, if not call Edge Analytical, 1-800-755-9295 to request a sample kit.

Ensure any results received have been reviewed by Lab Supervisor prior to being filed.

8.4 Volatile Organic Compounds (VOC's) -- Compliance testing for Phase II / V Rules

EPA Method 524.2

Safety: Always use good industrial hygiene and safety practices as described in the Lab Chemical Hygiene Plan. Wash hands before breaks and at the end of the workday. Read and understand all applicable MSDS's. Take care to avoid contact with HCl acid preservative.

Frequency: Yearly, refer to schedule.

Sample Location: Entry point to distribution system (EPTDS) - Treated sample tap in poly room.

Testing Laboratory: Edge Analytical, Inc.
1620 S. Walnut Street
Burlington, WA 98233 Tel: 1-800-755-9295

Sample Kit Cooler Contents:

1. Ice packs, which must be frozen before scheduled sampling.
2. The following glass sample bottles wrapped in bubble pack.
    a. One 40 ml vial labeled "Field Blank" (The field blank serves as an indicator of contamination which may occur during sample transport and storage. Therefore, this vial must not be opened and must always travel with the samples.)
    b. Two 40 ml vials for each source to be sampled containing 25 mg ascorbic acid that **must not** be rinsed out during sample collection.
    c. Two red-capped 2 ml vials for each source containing inserts filled with 2 drops of 1:1 HCl (Caution: HCl is corrosive. Handle with care and wash hands when finished collecting samples.)
3. Water Sample Information (WSI) form, for each source being collected and sample collection instructions in plastic bags.

Generic Clean Sampling Note:

Bottles must NOT be filled near gasoline cans, gasoline powered motors, paint cans, lighter fluid, paint strippers, pesticide bottles or exhaust fumes from running engines. Do not fuel up vehicles prior to sampling. Fumes and vapors may contaminate the samples. Wash hands and do not handle coins prior to sampling, be careful not to touch or otherwise contaminate the inside of the lid of the bottle during sampling. Do not allow the lip of the bottle to touch the sample tap during sampling. All samples need to be kept cold, ≤ 4°C.

Sample Collection:

1. Freeze ice packs before collecting samples.
2. Obtain a Water Sample Information (WSI) form from *M:\PW\Data\Plants\Lab\Lab WTP\WTP_REG\IOC VOC SOC*.

- ✓ Use last year's WSI form as a reference when filling out new forms.
- ✓ Confirm that **Compliance** is selected in the SAMPLING INFORMATION REQUIRED section so that the results will be forwarded to WSDOH regional office, this is required for compliance.
- ✓ Complete items 2 and 3 in the SAMPLING INFORMATION REQUIRED section.
- ✓ In the PUBLIC WATER SYSTEM (ONLY) section, confirm our system ID: 056003, DOH source number: S01, and source type: Surface. Confirm items 5 to 13 in this section are filled out correctly.
- ✓

Refer to back side of form for step-by-step detailed instructions on proper sampling methods.

3. Read all sampling procedures and guidance.
4. Label each bottle completely.
5. Fill two vials from each source at the same time and under the same conditions. Avoid agitation and entrainment of air in the sample while filling. Allow the stream of water to gently flow into the vial to just overflowing (Figure 1). Do not rinse or overfill the bottles.



Figure 1: Water level in VOC vial to just overflowing.

6. After filling, **transfer complete contents, including insert,** of one of the red-capped 2 ml vials into each 40 ml vial. There should be a bubble of water extending above the lip of the sample vial (Figure 2). Place the red-capped container back into the shipping cooler.
7. Carefully place the cap onto the vial. The shiny side of the Teflon cap liner should be face down in contact with the water sample. Tighten down the cap securely.
8. Check for trapped air by inverting the vial and looking to see if any air bubbles are present. If air bubbles are present, gently add more water per Figure 2 and cap per step 7. When the vials are properly filled, shake vigorously.

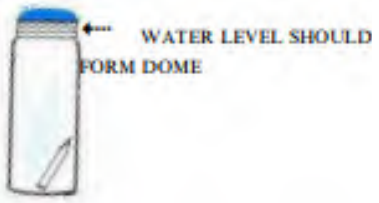


Figure 2: Water level in VOC vial after HCl preservative is added.

9. Load bottles wrapped in bubble pack and frozen ice packs in the cooler with enough packing material to make closing the lid difficult. Assume the shipping people toss sample coolers into their trucks.
10. Print copies of page 1 and page 2 the Chain-of-Custody-Analysis-Request from *M:\PW\Data\Plants\Lab\Lab WTP\WTP_REG\IOC VOC SOC*. Fill in the date and time that the samples were collected.
11. Sign the WSI and Chain-of-custody forms to relinquish custody of the samples, and then make copies of the forms for our records. Place the originals into a sealed ziplock bag and them place them in the cooler.
12. Transport the samples to the City of Bellingham warehouse. Instruct the warehouse to ship the cooler overnight delivery. All overnight deliveries must be at the warehouse no later than 1 PM.

13. Save a copy of the WSI in the lab three ring binder labeled "Outside Lab Chain of Custody Forms".
14. Be sure a new sample kit arrives before the next scheduled sampling period, if not call Edge Analytical, 1-800-755-9295 to request a sample kit.

Ensure any results received have been reviewed by Lab Supervisor prior to being filed.

8.5 EDB/DBCP -- Compliance testing for Phase II / V Rules

EPA Method 504.1

Frequency: Yearly, refer to schedule, you will need to **request this method specifically** when ordering sampling containers as it will not come automatically with the Phase II and V sampling kit.

Sample Location: (2) Treated Pipe #9 in poly room, and Gatehouse

Testing Laboratory: Edge Analytical Testing
1151 Knudson Road
Burlington, WA 98233
Tel: 1-800-755-9295

Sample Kit Contents:

1. Ice packs, cooler, plastic bags and bubble pack
2. One 40 ml vial labeled "Field Blank" (The field blank serves as an indicator of contamination which may occur during sample transport and storage. Therefore, this vial must not be opened and must always travel with the samples.)
3. Two 40 ml vials for each source to be sampled.
4. Water Sample Information form, for each source being collected and sample collection instructions.

Generic Clean Sampling Note:

Bottles must NOT be filled near gasoline cans, gasoline powered motors, paint cans, lighter fluid, paint strippers, pesticide bottles or exhaust fumes from running engines. Do not fuel up vehicles prior to sampling. Fumes and vapors may contaminate the samples. Wash hands and do not handle coins prior to sampling, be careful not to touch or otherwise contaminate the inside of the lid of the bottle during sampling. Do not allow the lip of the bottle to touch the sample tap during sampling. All samples need to be kept cold. When sampling from the Gatehouse using the Van Dorn sampler, remember to pour out the first grab then re-sample.

Sample Collection:

1. Freeze ice packs before collecting samples.
2. Fill out Water Sample Information (WSI) form provided with the sample kit. Remember to initial the form in the space provided to have the results forwarded to WSDOH regional office, this is required for compliance. Refer to the back side of form for step by step detailed instructions on proper sampling methods. Last year's WSI form can also serve as a reference when filling out new forms; it should show our system ID, class, source type and DOH source number.
3. Fill two vials from each source at the same time and under the same conditions. Avoid agitation of the sample while filling. Allow the stream of water to gently flow into the vial to just overflowing.
4. After filling, carefully place the cap onto the vial. The shiny side of the Teflon cap liner should be face down in contact with the water sample. Tighten down the cap securely. Label each bottle completely and pack in bubble pack.
5. Check for trapped air by inverting the vial and looking to see if any air bubbles are present If air bubbles are present, gently add more water and repeat step 5. When the vials are properly filled, shake vigorously.
6. Load ice packs and bottles in cooler with enough packing material to make closing the lid difficult. Assume the shipping people toss sample coolers into their trucks.
7. At warehouse sign the WSI form to relinquish chain of custody. Make a copy of the WSI form for our records and place the original in cooler inside a zip lock bag.

8. Instruct the warehouse to ship the cooler overnight delivery. All overnight deliveries must be at warehouse no later than 1 PM.
9. Be sure a new sample kit arrives before the next scheduled sampling period, if not call the lab.
10. Save a copy of the WSI in the lab three ring binder labeled "Outside Lab Chain of Custody Forms".

Ensure any results received have been reviewed by Lab Supervisor prior to being filed.

8.6 Inorganic Compounds -- Compliance testing for Phase II / V Rules

EPA Methods: 200.8, 300.0, 245.1
Metals, Cyanide, Nitrate and Nitrite, Sulfate, Total Al, Mercury

Safety: Always use good industrial hygiene and safety practices as described in the Lab Chemical Hygiene Plan. Wash hands before breaks and at the end of the workday. Take care to avoid contact with acid preservatives.
Frequency: Yearly, refer to schedule.

Sample Location: Entry point to distribution system (EPTDS) - Treated sample tap in poly room.

Testing Laboratory: Edge Analytical Testing
1620 S. Walnut Street
Burlington, WA 98233 Tel: 1-800-755-9295

Sample Kit Cooler Contents:

1. Ice packs, which must be frozen before scheduled sampling.
2. The following sample bottles.
    a. One or more plastic bottles with acid preservative for each collection point to be sampled for metals.
    b. One dark plastic bottle for each collection point to be sample for cyanide.
    c. One or more plastic bottles, no acid preservative, for each collection point to be sampled for nutrients and sulfate.
3. Water Sample Information (WSI) form, for each source being collected and sample collection instructions in plastic bags.

Generic Clean Sampling Note:
Bottles must NOT be filled near gasoline cans, gasoline powered motors, paint cans, lighter fluid, paint strippers, pesticide bottles or exhaust fumes from running engines. Do not fuel up vehicles prior to sampling. Fumes and vapors may contaminate the samples. Wash hands and do not handle coins prior to sampling, be careful not to touch or otherwise contaminate the inside of the lid of the bottle during sampling. Do not allow the lip of the bottle to touch the sample tap during sampling. All samples need to be kept cold, ≤ 4°C.

Sample Collection:

1. Freeze ice packs before collecting samples.
2. Obtain a Water Sample Information (WSI) form from *M:\PW\Data\Plants\Lab\Lab WTP\WTP_REG\IOC VOC SOC*.
    - ✓ Use last year's WSI form as a reference when filling out new forms.
    - ✓ Confirm that **Compliance** is selected in the SAMPLING INFORMATION REQUIRED section so that the results will be forwarded to WSDOH regional office, this is required for compliance.
    - ✓ Complete items 2 and 3 in the SAMPLING INFORMATION REQUIRED section.
    - ✓ In the PUBLIC WATER SYSTEM (ONLY) section, confirm our system ID, DOH source number: S01, and source type: Surface.

- ✓ Under "Other Analysis" confirm the following compounds are added: Al (Total), nitrite and nitrate, sulfate.
- ✓ Refer to the back side for step-by-step detailed instructions on proper sampling methods.

3. Read all sampling procedures and guidance.
4. Label each bottle completely.
5. Fill sample bottles full but not overfull. Allow the stream of water to gently flow into the bottle to the shoulder. Do not rinse or overfill the bottles.
6. Load bottles and frozen ice packs in the cooler with enough packing material to make closing the lid difficult. Assume the shipping people toss sample coolers into their trucks.
7. Print copies of page 1 and page 2 the Chain-of-Custody-Analysis-Request from *M:\PW\Data\Plants\Lab\Lab WTP\WTP_REG\IOC VOC SOC*. Fill in the date and time that the samples were collected.
8. Sign the WSI and chain-of-custody forms to relinquish custody of samples, and then make copies of the forms for our records. Place the originals into a sealed ziplock bag and then place them in the cooler.
9. Transport the samples to the City of Bellingham warehouse. Instruct the warehouse to ship the cooler overnight delivery. All overnight deliveries must be at the warehouse no later than 1 PM.
10. Save a copy of the WSI in the lab three ring binder labeled "Outside Lab Chain of Custody Forms".
11. Be sure a new sample kit arrives before the next scheduled sampling period, if not call Edge Analytical, 1-800-755-9295 to request a sample kit.

Ensure any results received have been reviewed by Lab Supervisor prior to being filed.

Procedure Manual Section **8.8 Total Organic Carbon (TOC) Sampling**
Method: SM 5310C
Frequency: Quarterly timed to occur at or near time of THM/HAA sampling

Sample Locations: (1) Gatehouse and (2) Treated Pipe #9 in polymer room

Testing Laboratory:

Montgomery Watson Harza Laboratories
750 Royal Oaks Drive #100
Monrovia, California 91016
Tel: 1 (626) 386-1100
Fax: (626) 386-1101

Sample Kit Contents:

1. Ice packs, cooler and bubble pack.
2. Two 250 ml amber glass bottles with teflon septum cap for each site to be sampled, the TOC bottle should contain 2 mls concentrated sulfuric acid as a preservative. Do not rinse out the acid during sampling. It is a good idea to bring at least one spare sample vial if needed.
3. Disposable gloves and safety glasses.
4. Chain of custody submittal form.

Sample Collection:

1. Freeze ice packs before collecting samples.
2. Fill out pertinent information on the chain of custody (C-O-C) submittal form. Check the box to indicate compliance sampling. Total Organic Carbon samples should also have a paired alkalinity sample taken/analyzed at the same time. Ensure Method SM5310C is indicated on the sample vial and written in to the C-O-C so the correct tests are performed. Most information can be written on the sampling vials ahead of time with the exception of the time sampled.
3. At the Gatehouse use a well rinsed Van Dorn sampler to collect the sample. Use the Treated Pipe #9 at the Water Plant to collect the "Treated" sample. Put on gloves and safety glasses.
4. Carefully fill the sample vials, do not rinse or overfill, be sure the water level is slightly above the top of the vial prior to capping. Once the bottle is capped, invert the bottle and look for air bubbles. If any bubbles are present carefully add more water and cap the vial. The lab will reject any sample that has air bubbles so it may be necessary to use a new (spare) vial if attempts to remove air may have displaced the H_2SO_4.
5. Ensure each vial is labeled completely and pack in bubble pack. Transfer time sampled information onto the C-O-C.
6. Load ice packs and bottles with plenty of packing material, assume shippers throw the cooler into the trucks.
7. At the Warehouse sign to relinquish the chain of custody form, make a copy the chain of custody form for our records, and place the original C-O-C in a ziplock in the cooler.
8. Instruct the warehouse to ship the cooler overnight delivery. All overnight deliveries must be at Warehouse no later than 1pm.
9. Maintain a supply of sample bottles, coolers, ice packs, zip lock bags and chain of custody forms at all times.
10. Save a copy of the chain of custody in the lab three ring binder labeled "Outside Lab Chain of Custody Forms".

Ensure any results received have been reviewed by Lab Supervisor prior to being filed.

8.9 Inorganic Compounds -- Asbestos

EPA Methods: 100.1/100.2
Frequency: every nine years, refer to schedule

Sample Location: " at a tap served by asbestos-cement pipe and under conditions where asbestos contamination is most likely to occur", CFR Title 40, Section 141.23 (b) (5).
Since the City of Bellingham is continually removing the few remaining asbestos-cement pipes that exist in the system, the identity of the sample tap will change over time. Prior to sampling, the location of the tap will be determined by the Water Distribution System Supervisor and the Laboratory Supervisor.

Testing Laboratory: Lab/Cor, Inc
7619 6th Ave NW
Seattle WA 98117
Phone: (206) 781-0155

Sample Kit Contents:

1. Ice packs, cooler, plastic bags and bubble pack
2. Two 1-liter plastic bottles for each source to be sampled.
3. Water Sample Information form, for each source being collected and sample collection instructions.

Generic Clean Sampling Note:

Bottles must NOT be filled near gasoline cans, gasoline powered motors, paint cans, lighter fluid, paint strippers, pesticide bottles or exhaust fumes from running engines. Do not fuel up vehicles prior to sampling. Fumes and vapors may contaminate the samples. Wash hands and do not handle coins prior to sampling, be careful not to touch or otherwise contaminate the inside of the lid of the bottle during sampling. Do not allow the lip of the bottle to touch the sample tap during sampling. All samples need to be kept cold. When sampling from the Gatehouse using the Van Dorn sampler, remember to pour out the first grab then re-sample.

Sample Collection:

1. Freeze ice packs before collecting samples.
2. Fill out the Chain of Custody form provided with the sample kit. Remember to include System ID and Source numbers. In the comments section, ask to have results forwarded to WSDOH regional office, this is required for compliance.
3. Collect the samples under similar conditions to Total Coliform Rule samples (i.e don't flush lines any more than one would under TCR sampling). Fill both plastic bottles to the predetermined mark from each source, avoid agitation of the sample while filling. Allow the stream of water to gently flow into the bottle to approximately 800 or 900 mls (marked on the bottle). Label each bottle completely and pack in bubble pack.
4. Load ice packs and bottles in cooler with enough packing material to make closing the lid difficult. Assume the shipping people toss sample coolers into their trucks.
5. At warehouse sign the WSI form to show that the samples have been relinquished. Copy the WSI form for our records and place the original in cooler inside a zip lock bag.
6. Instruct the warehouse to ship the cooler overnight delivery. All overnight deliveries must be at warehouse no later than 1 PM.
7. Be sure a new sample kit arrives before the next scheduled sampling period, if not call the lab.
8. Save a copy of the Chain of Custody in the lab three ring binder labeled "Outside Lab Chain of Custody Forms".

Ensure any results received have been reviewed by Lab Supervisor prior to being filed.

CITY OF BELLINGHAM

DEPARTMENT OF PUBLIC WORKS OPERATIONS DIVISION

TOTAL COLIFORM RULE MONITORING PLAN

10/27/2021 rev. 7











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TOTAL COLIFORM RULE MONITORING PLAN
City of Bellingham Department of Public Works Operations Division

1. INTRODUCTION

The City of Bellingham provides approximately 89,902 in-city and 7,481 adjacent-county residents with direct potable water service. Total water produced by the City of Bellingham (City) in 2020 was 2.97 billion gallons. The City water utility is managed by the Department of Public Works Operations Division (PWOps). The PWOps Division is responsible for planning, design, construction, operation, maintenance, sampling, and compliance reporting for this water system.

The State of Washington Department of Health (DOH) through Washington Administrative Code 246-290-300, and the Federal Total Coliform Rule (TCR) (Title 40 CFR Parts 141.21 & 141.63) requires public water systems to implement a Coliform Monitoring Plan, and to collect potable water samples for total coliform and *E. coli* analysis from their distribution system based upon this written plan. For Group A systems like the City of Bellingham, the plan consists of such elements as: a description of the distribution system; system maps depicting sample collection sites placed to reflect the distribution system in its various pressure zones, sampling information; and actions to take in the event of a positive coliform sample.

The City's water distribution system consists of over 427 miles of water lines ranging in size from 66 inches down to 2 inches. The distribution system is divided into thirteen pressure zones that currently contain 101 utilized sampling stations. Routine sample sites are selected to represent each of the pressure zones and reservoirs, major distribution branches, pump stations, feed lines to consecutive systems, and areas of concern, such as ends of distribution system zones. The rationale of sample site per zone is included as Appendix 1.0. Those designated as "dead end" stations are within several connections of the end of the zone or at a distribution line that terminates. These sites are generally expected to have less favorable water quality conditions and lower disinfectant residuals. Some of these stations will be redistributed to "representative" stations as water main extensions are made to accommodate growth.

Samples are collected throughout the month at a minimum of 100 of these routine sampling stations. City of Bellingham laboratory staff are responsible for collecting, analyzing and reporting all coliform compliance samples. The Coliform Monitoring Plan is an important part of this effort.

The City last updated its Coliform Monitoring Plan in 2015 in response to revisions to the Total Coliform Rule which required different responses to the presence of coliform in the distribution system. This current Plan has been updated to reflect an estimated service population of >96,001 and the need to include 10 additional sampling stations per WAC 246-290-300.

This Plan details the specifics of the City distribution system as it pertains to the Total Coliform Rule. It also outlines an appropriate response to a potential violation of the Total Coliform Rule. This way, there is assurance of prompt and proper notification, sufficiency in the information collected, and ultimately, integrity of treated water all the way to the customer's tap.

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2. SYSTEM DESCRIPTION

This section gives pertinent system information as specified in DOH publication #331-036 (revised). *Preparation of a Coliform Monitoring Plan* (April 2013).

Table 2-1 City of Bellingham System Information

Water System Information:		Additional Information
Water System name:	**City of Bellingham**	**Department of Public Works**
System ID Number:	WA 056003	
County:	Whatcom	
Source:	DOH Source Number – S01	
Source Name(s):	Lake Whatcom	
	Middle Fork Nooksack	Diversion of water from the Middle Fork of the Nooksack River supplements Lake Whatcom water
Source Category:	Surface	Lake Whatcom
Source Location:	Sec: 28 Twn: 38N Range: 03E	Lat: 48.765 Long: 122.415
Treatment Plant Location:	3201 Arbor Court Bellingham, WA	
Process Utilized:	Particulate removal by dissolved air floatation, coagulation, and mixed bed in-line filtration. Corrosion control by addition of soda ash. Disinfection and oxidation by self-generated sodium hypochlorite.	
Total population served:	**97,383**	
Inside City limits:	89,902	
Outside of City limits:	7,481	
Number of Housing Units	46,085	
Total pressure zones:	13	

Water System Information:		Additional Information
Minimum Number of routine monthly samples:	100	10 sampling taps added in 2021 to accommodate 96,001 customers
Reservoirs:	14	
Total Reservoir Capacity	27,750,000 gallons	
Pump/Booster Stations:	15	Currently in use
Zone:	**Population Served in Each Pressure Zone (04/2021)[1]:**	**% of Total Service Population in Each Pressure Zone:**
Alabama Hill	3,661	3.8%
Birch Street	253	0.3%
College Way	1,844	1.9%
Cordata	12,111	12.4%
Dakin and Yew	13,993	14.4%
Governor Road	864	0.9%
Huntington	110	0.1%
King Mountain	156	0.4%
North (gravity)	35,721	36.7%
Padden Yew	3,654	3.8%
Reveille	411	0.4%
Samish Hill	32	0.0%
South	24,359	25.0%
TOTAL:	**97,383**	
Zone:	**Routine Sampling Stations**	**% of Sampling Taps in Each Pressure Zone:**
Alabama Hill	4	4.0%
Birch Street	1	1.0%
College Way	3	3.0%
Cordata	12	11.9%
Dakin and Yew	18	17.8%
Governor Road	1	1.0%
Huntington	1	1.0%
King Mountain	2	2.0%
North (gravity)	30	29.7%
Padden Yew	7	6.9%
Reveille (aka Upper Yew)	1	1.0%
Samish Hill	1	1.0%
South	20	19.8%
TOTAL:	**101**	

1. City of Bellingham GIS layer of water pressure zones as of 04/14/2021. Includes student population from dormitories at WWU.

Water System Information:		Additional Information
Distribution reservoirs:	**Continue here: Zone Served:**	**Tank Capacity (gal):**
Clearwell	Gravity/Dakin-Yew	1,000,000
College Way	College Way	500,000
Contact –Time Res (CT)	North (gravity)	16,000,000
Consolidation	Padden-Yew	500,000
Dakin 1	Dakin-Yew	500,000
Dakin 2	Dakin-Yew	500,000
Reveille	Padden-Yew	300,000
40th Street	Padden-Yew	500,000
Kearney	Cordata	2,500,000
Marietta*	Cordata (off-line)	(3,000,000)
Padden (38th St)	Padden-Yew	450,000
Parkhurst	Samish Hill	185,000
Sehome	South	750,000
Whatcom Falls	North (gravity)	3,800,000
	Total Reservoir Capacity:	**27,485,000**
Distribution pump stations:	**Zone Served:**	**Number of pumps:**
Balsam Lane	Alabama Hill	4
Birch Street	Dakin-Yew	3
College Way	College Way	6
Consolidation	Padden-Yew (feeds Reveille Reservoir)	1
Dakin/Consolidation	Dakin-Yew (feeds Consolidation and Dakin #1 and #2 Reservoirs)	5
Governor	Upper-Yew (out of 40th Reservoir into Parkhurst Reservoir)	3
James Street	North/King	2
Huntington	Dakin-Yew	2
Otis Street	South	4
Raymond	Serves one home in Padden-Yew	1
Reveille	Upper Yew	2
Short Street	Cordata	7
38th Street	Padden-Yew	3
Woburn Street	Dakin-Yew. Station to maintain fire flows but can be used to fill Dakin #1 and #2 Reservoirs if necessary.	4
Samish Highlands	Reveille	2

*North gravity zone does not need the 3 million gallons of storage, so this reservoir is currently offline.

Table 2-2 City of Bellingham Water Pump Stations.

Pump Station	Service Zone	Location	Location Zone*
James St. Reservoir	North	James St, across from 4188 James	
Otis	South	Otis St, Lot 19, Block 22	
Birch Street	Dakin-Yew	Birch St. at Birch Falls Drive	
Samish Highlands	Reveille	4300 Samish Crest Lane	Samish Hill
Dakin-Yew	Dakin-Yew	At WTP	
Woburn	Dakin-Yew	2838 Woburn	North
Huntington	Dakin-Yew	End of 900 block, Huntington St	
Short	Cordata	Short St, behind 4165 Meridian Way	
Consolidation Reservoir	Padden-Yew	Consolidation, S of 801 Yew St	
Reveille Res.	Padden-Yew	2400 Reveille St	
38th St.- Padden Res.	Padden-Yew	38th St, Behind 3800 Broad St	
Raymond	Padden-Yew	Serves one single-family residence	
Balsam Lane/Dakin Res.	Alabama Hill	End of Balsam Lane	
Governor	Upper-Yew	1895 Governor	Padden-Yew
College Way	College Way	Highland & W. College Way	

*Pump stations are not always located within the boundaries of the zone they serve

Table 2-3 City of Bellingham Water Reservoirs.

Reservoir Name	Service Zone (for stored water)	Location	Volume (gallons)	Location Zone*
Clearwell	Dakin-Yew	Inside WTP	1,000,000	
CT- Reservoir	North	WTP & Whatcom Falls Park	16,000,000	
		Total Capacity Before Full Contact Time:	**17,000,000**	
Kearney	Cordata	James St. near Springcreek Ln	2,500,000	
Marietta	Cordata	Behind 1402 Marietta Drive	(3,000,000)	(Offline)
Whatcom Falls	North	WTP & Whatcom Falls Park	3,800,000	
Padden	Padden-Yew	38th St, Behind 3800 Broad St	450,000	
Sehome	South	Jersey St, Sehome Hill Park	750,000	
College Way	College Way	Highland & W. College Way	500,000	
Consolidation	Padden-Yew	Consolidation, S of 801 Yew St	500,000	
Dakin 1	Dakin-Yew	End of Balsam Lane	500,000	Alabama Hill
Dakin 2	Dakin-Yew	End of Balsam Lane	500,000	Alabama Hill
40th St.	Padden-Yew	South of Mill & 40th	500,000	Upper Yew
Reveille	Padden-Yew	2400 Reveille St	300,000	
Parkhurst	Samish Hill	Off of Parkhurst Road	185,000	
		Total Capacity at Full Contact:	**10,485,000**	

Before Contact Time
After Contact Time

*Reservoirs are not always located in the boundaries of the zone they serve

Table 2-4 City of Bellingham Water Average Daily Demand (ADD) by pressure zone (gpm). Taken from the 2013 update to City of Bellingham Water System Plan Update.

Pressure Zone	2012	2018	2022
North[1] - elevation 276	**2,917**	**3,152**	**3,172**
Cordata[2] - elevation 350	**804**	**869**	**1,107**
South[3] - elevation 457	**1,335**	**1,443**	**1,442**
King Mountain - elevation 519	**9**	**10**	**41**
Dakin & Consolidation[4] - elevation 519	**826**	**896**	**905**
Birch Street - elevation 780	**10**	**11**	**16**
College Way - elevation 541	**52**	**56**	**56**
Padden Yew - elevation 696	**282**	**305**	**336**
Alabama Hill - elevation 730	**221**	**239**	**276**
Reveille[5] - elevation 830	**17**	**19**	**63**
Governor Road[5] - elevation 873	**53**	**57**	**106**

1. Includes Montgomery Rd. Water Assoc. and Water Dist. #2
2. Includes Deer Creek Water Assoc.
3. Includes California St. Water Assoc.
4. Includes the elevation 660 Huntington pressure zone, LWWSD (east side of lake), Water Dist #7, and Glen Cove Water
5. In the 20-year planning horizon Reveille and Governor will be combined into Samish Hill Zone (elev. 870)

Table 2-5 City of Bellingham Water Main Sizes.

Water Main Diameter (inches)	Length (feet)	Miles
Unknown	2,308	0.4
1	703	0.1
2	2,973	0.6
4	116,569	22.1
6	510,943	96.8
8	804,490	152.4
10	153,570	29.1
12	314,416	59.5
14	4,724	0.9
16	138,405	26.2
20	61,819	11.7
24	46,635	8.8
30	7,526	1.4
36	10,959	2.1
42	101	0.0
48	18,078	3.4
60	972	0.2
66	1,541	0.3
72	59,884	11.3
Grand Total	**2,256,616**	**427.4**

All laboratory analysis for the Total Coliform Rule is performed in the City of Bellingham Ecology accredited laboratory at the Water Filtration Plant. Methods for which the laboratory currently maintains accreditation include: SM 92223 B (Colilert), SM 9222 D (FC plate), SM 9222 B (TC plate), EPA 1603$_{mod}$ (EC plate), and SM 9215 B (HPC via R2a agar).

Table 2-6 City of Bellingham Laboratory Information.

Lab and Plant Information:		Additional Information
Laboratory Name	City of Bellingham Water Plant Lab	Lab ID WA 00116
Address:	3201 Arbor Ct. Bellingham, WA 98229	(note no mail service)
Hours of Operation	Monday-Friday 06:30 to 17:00	After hours by request
Lab Contact Name:	Peg Wendling, Technical Supervisor	(360) 778-7870
Water Plant Contact:	Nick Leininger, Chief Operator	(360) 778-7890
Address to contact:	2221 Pacific Street Bellingham, WA 98229	

3. SYSTEM MAPS

The figures on the following pages illustrate the different pressure zones in the City of Bellingham's water distribution system, along with their corresponding routine sampling locations. Table 3-1 below details where to find each of the maps included here. Figure 3-1 shows all of the City of Bellingham pressure zones while Figures 3-2 through 3-14 show each pressure zone individually including water distribution reservoirs, sampled pump stations and sample taps in their correct physical locations, starting with the North Zone which is the City's largest zone by population, and ending with the Samish Hill zone, the City's smallest. In Figures 3-2 to 3-14 the locations of all sampling stations are shown as they are physically located, most of which are in the zone the water represents. Note, the 40th Street and Dakin 1 Reservoirs and Padden-Yew and Woburn pump stations are not located in the zone these facilities serve. A spreadsheet is included in Appendix 1.0 which lists each sampling station and the actual zone it feeds or represents.

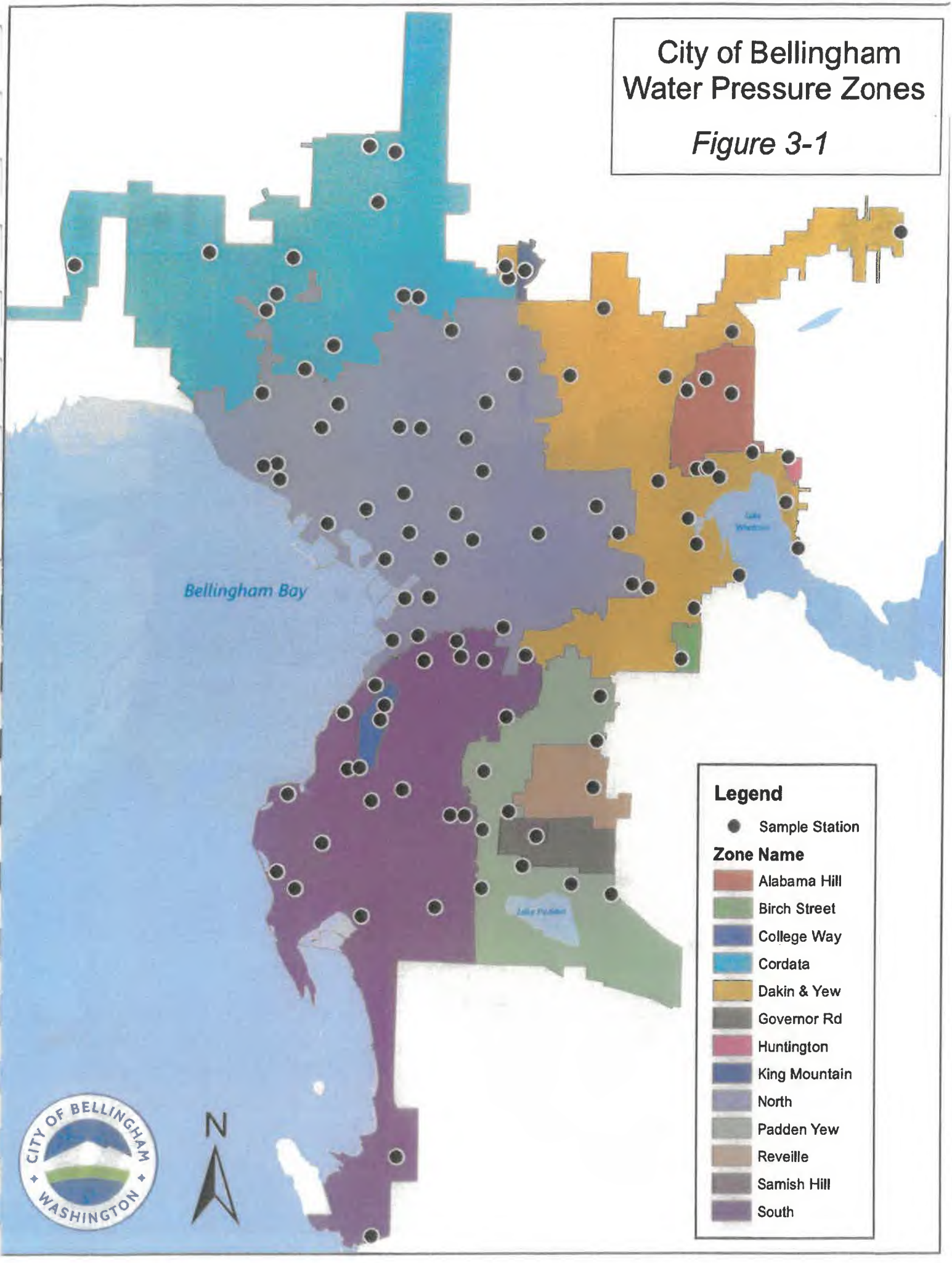
Table 3-1 Diagram with the pages and figure numbers for relevant distribution system maps.

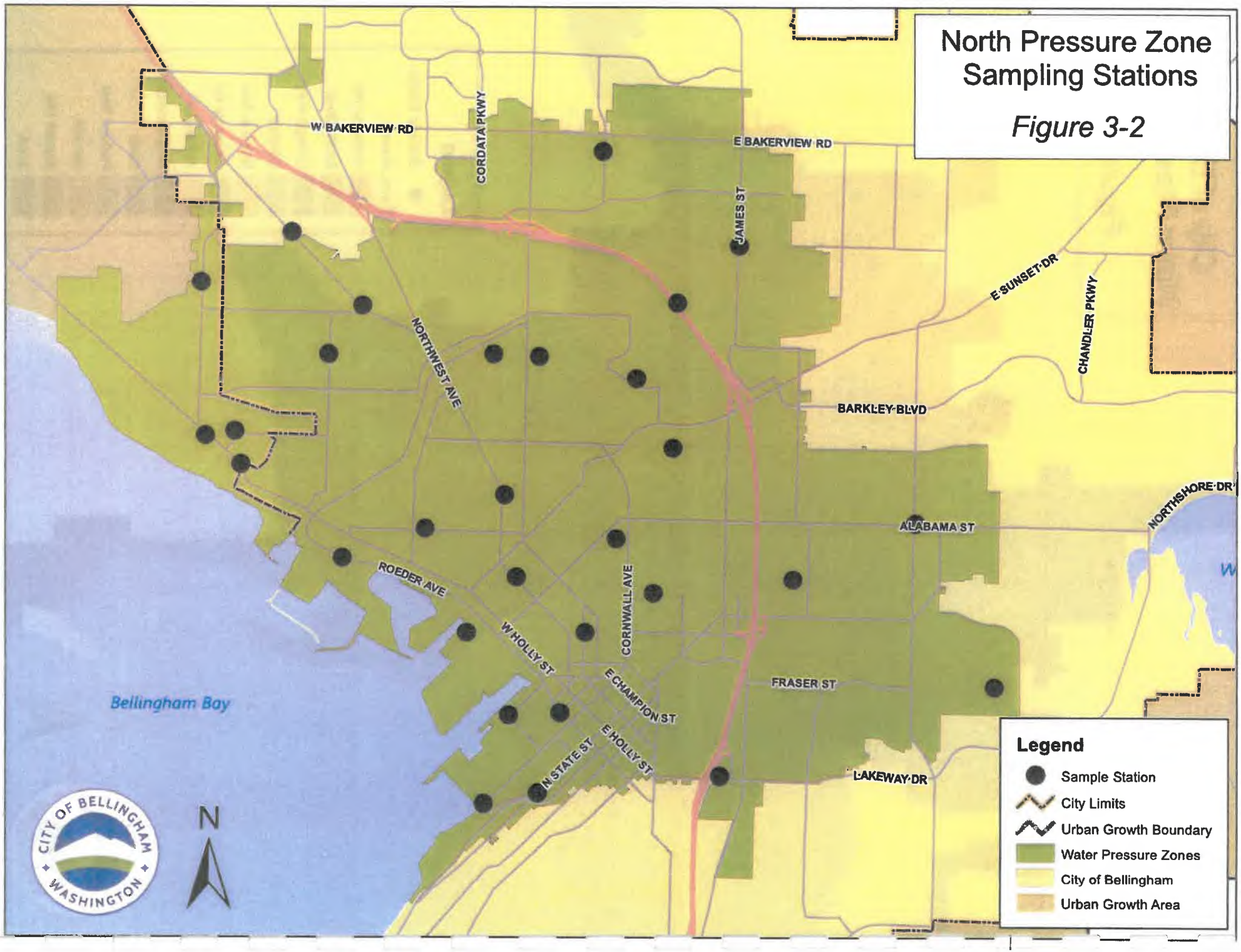
Page in Report	Figure #	Description
Page 11	Figure 3-1	City of Bellingham Water Pressure Zones
Page 12	Figure 3-2	North Pressure Zone Sampling Stations
Page 13	Figure 3-3	South Pressure Zone Sampling Stations
Page 14	Figure 3-4	Dakin -Yew Pressure Zone Sampling Stations
Page 15	Figure 3-5	Cordata Pressure Zone Sampling Stations
Page 16	Figure 3-6	Alabama Hill Pressure Zone Sampling Stations
Page 17	Figure 3-7	Padden-Yew Pressure Zone Sampling Stations
Page 18	Figure 3-8	College Way Pressure Zone Sampling Stations
Page 19	Figure 3-9	Governor Pressure Zone Sampling Stations
Page 20	Figure 3-10	Reveille Pressure Zone Sampling Stations
Page 21	Figure 3-11	King Mountain Pressure Zone Sampling Stations
Page 22	Figure 3-12	Birch St. Pressure Zone Sampling Stations
Page 23	Figure 3-13	Huntington Zone Sampling Stations
Page 24	Figure 3-14	Samish Hill Zone Sampling Stations

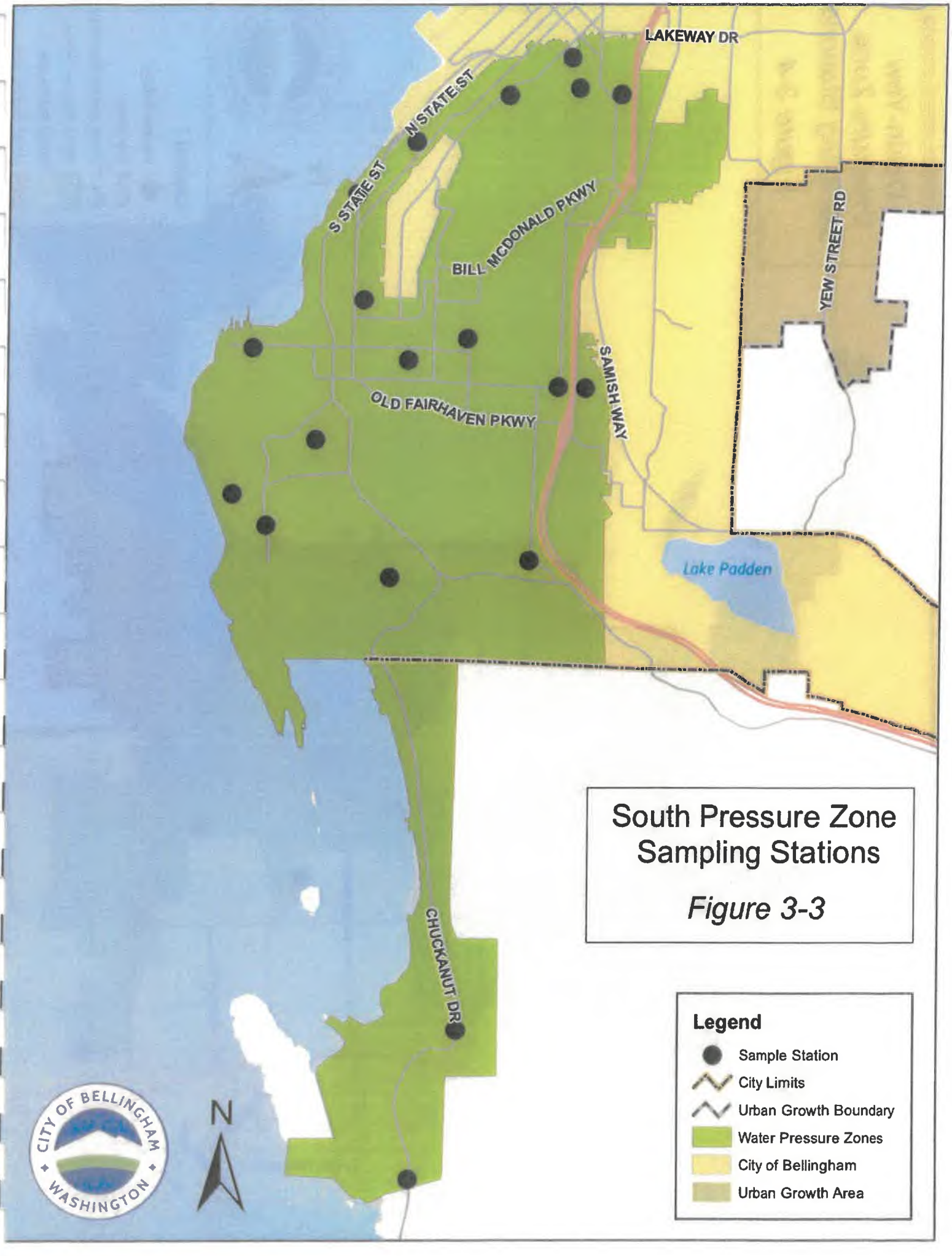
Routine sample taps used for TCR compliance are displayed on the figures with a black dot. There are a total of 101 routine stations sampled per month. Ten sample taps were added with this 2021 revised TCR Monitoring Plan to maintain compliance with WAC 246-290-300, when it was determined that the population served by the City of Bellingham had exceeded 96,001. These ten sites were selected to best represent the conditions and growth in the City's distribution network and are presented in Table 3-2 on the following page.

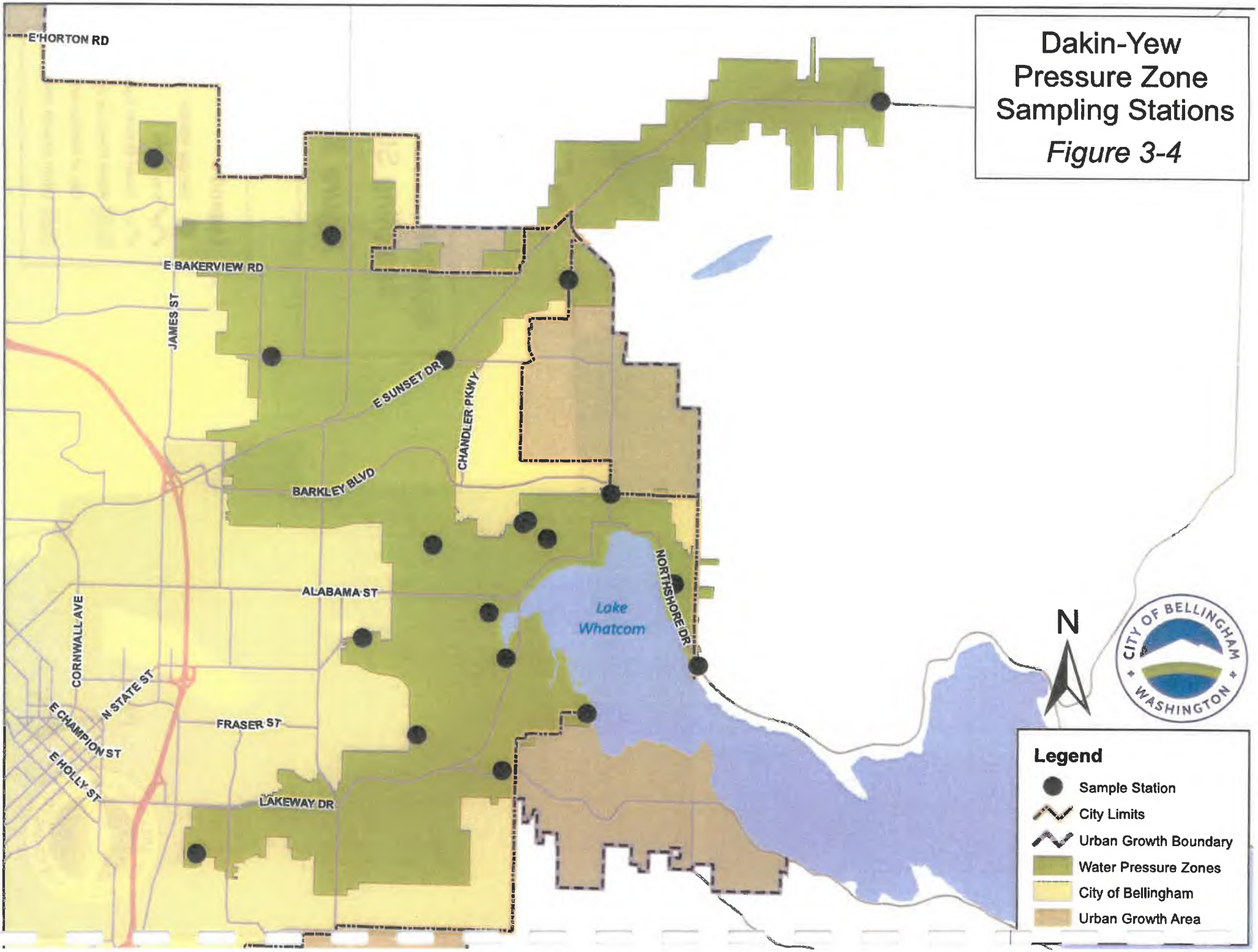
Table 3-2 Stations added to Bellingham's Total Coliform Rule sampling inventory in 2021

Sample Tap	Pressure Zone	Description
Granary & Laurel	North (gravity)	Highest zone by population
1314 E Maplewood	North	Largest zone
Birchwood Ave. & I-5	North	Largest zone
Hilton	North	Largest zone – food processors
34th & Donovan	South	Second largest zone by population
30th & Church	South	Second largest zone
Mahogany & Ambrosia	Cordata	Area experiencing high growth
Kline Road & Spring Vista	Cordata	Area experiencing high growth
E Oregon & Huntington	Huntington	First and only tap in this zone
Birch Falls	Birch Street	First and only tap in this zone


City of Bellingham
Water Pressure Zones
Figure 3-1
Bellingham Bay
Legend
Sample Station
Zone Name
Alabama Hill
Birch Street
College Way
Cordata
Dakin & Yew
Governor Rd
Huntington
King Mountain
North
Padden Yew
Reveille
Samish Hill
South
N
CITY OF BELLINGHAM
WASHINGTON

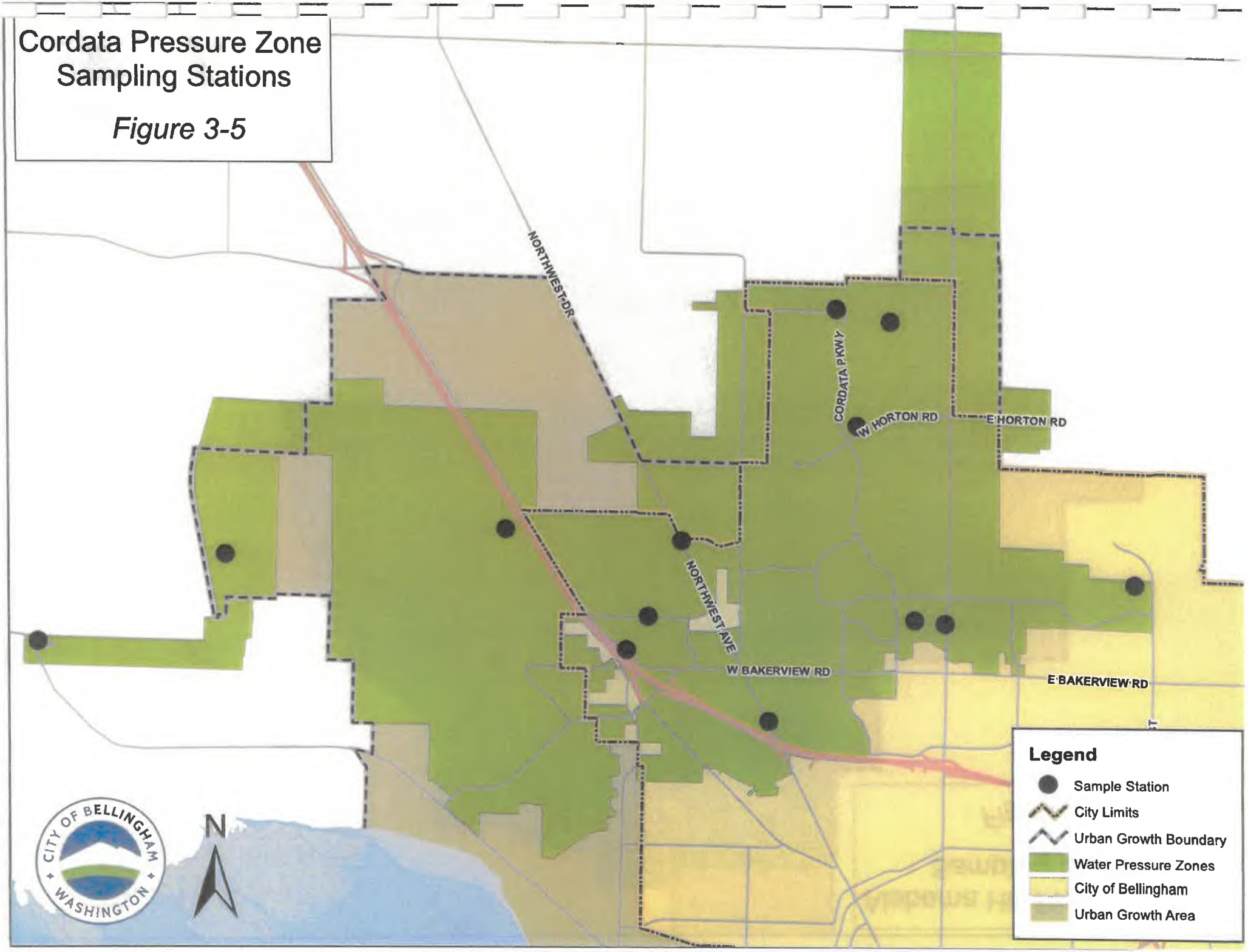

North Pressure Zone Sampling Stations
Figure 3-2
W BAKERVIEW RD
E BAKERVIEW RD
CORDATA PKWY
JAMES ST
E SUNSET DR
CHANDLER PKWY
NORTHWEST AVE
BARKLEY BLVD
NORTHSHORE DR
ALABAMA ST
ROEDER AVE
CORNWALL AVE
W HOLLY ST
E CHAMPION ST
FRASER ST
E HOLLY ST
N STATE ST
LAKEWAY DR
Bellingham Bay
CITY OF BELLINGHAM WASHINGTON
N
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area

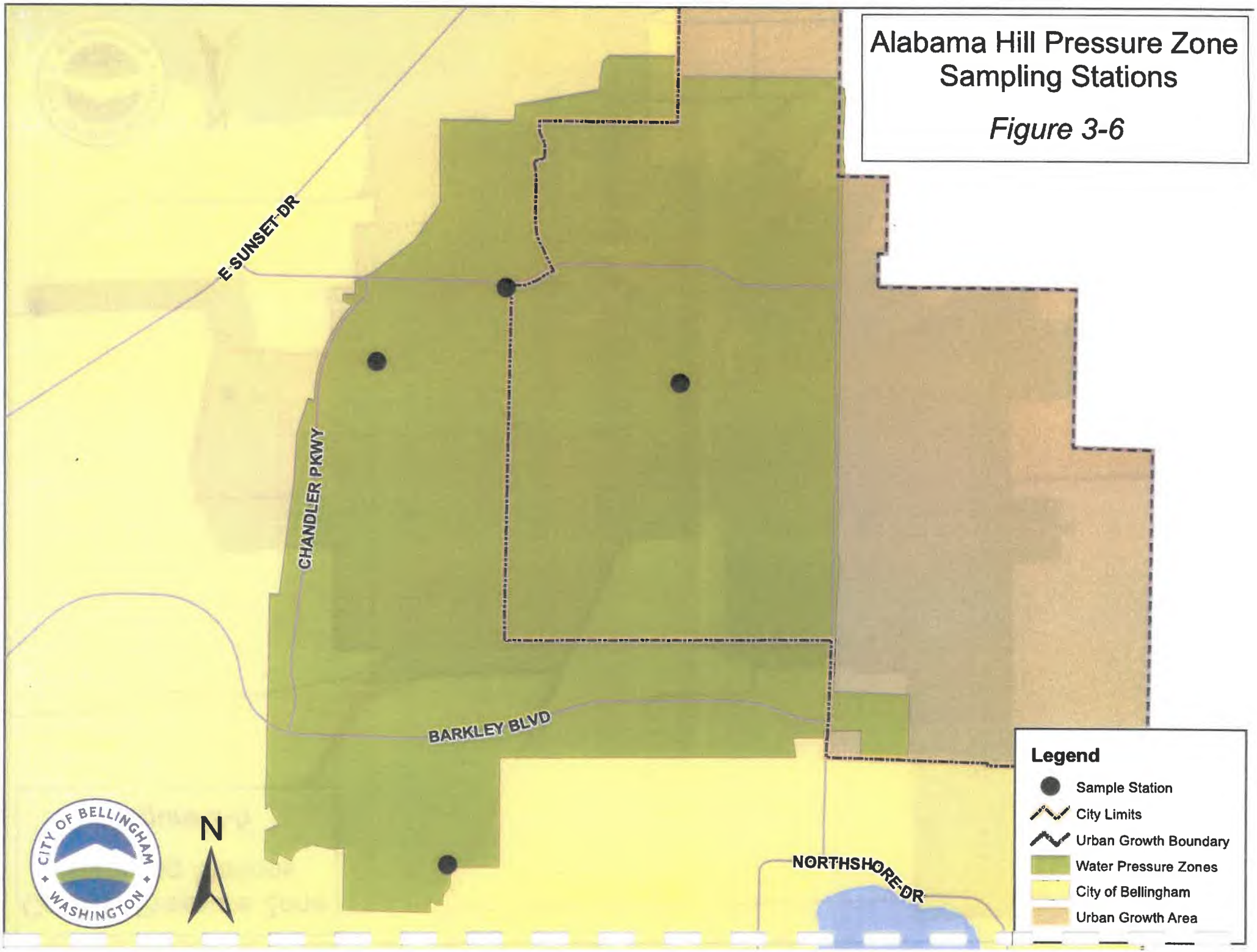

LAKEWAY DR
N STATE ST
S STATE ST
BILL MCDONALD PKWY
YEW STREET RD
SAMISH WAY
OLD FAIRHAVEN PKWY
Lake Padden
CHUCKANUT DR
South Pressure Zone
Sampling Stations
Figure 3-3
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area
CITY OF BELLINGHAM
WASHINGTON
N

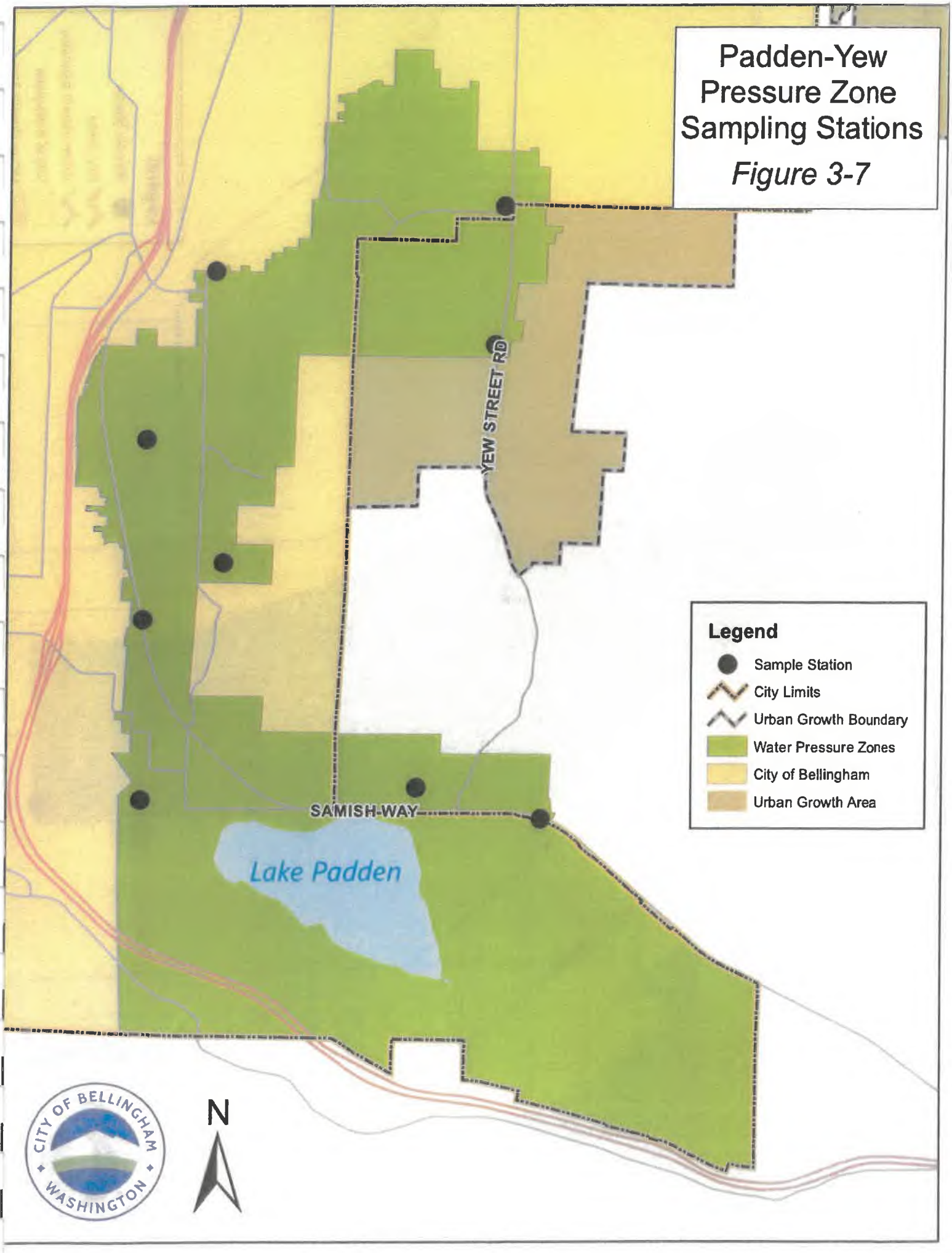

Dakin-Yew
Pressure Zone
Sampling Stations
Figure 3-4
E HORTON RD
E BAKERVIEW RD
JAMES ST
E SUNSET DR
CHANDLER PKWY
BARKLEY BLVD
ALABAMA ST
CORNWALL AVE
N STATE ST
E CHAMPION ST
E HOLLY ST
FRASER ST
LAKEWAY DR
NORTHSHORE DR
Lake
Whatcom
N
CITY OF BELLINGHAM
WASHINGTON
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area

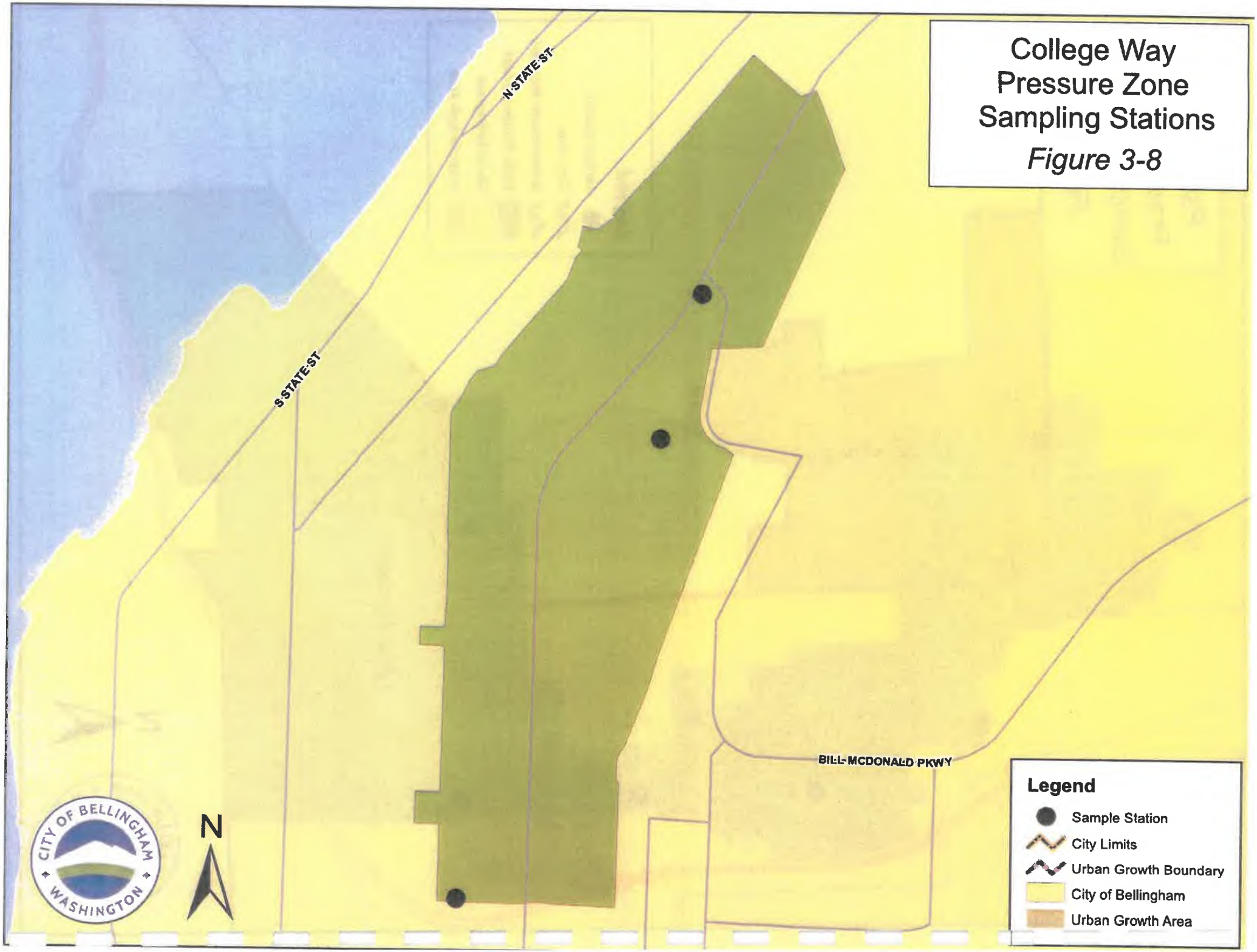
Cordata Pressure Zone Sampling Stations

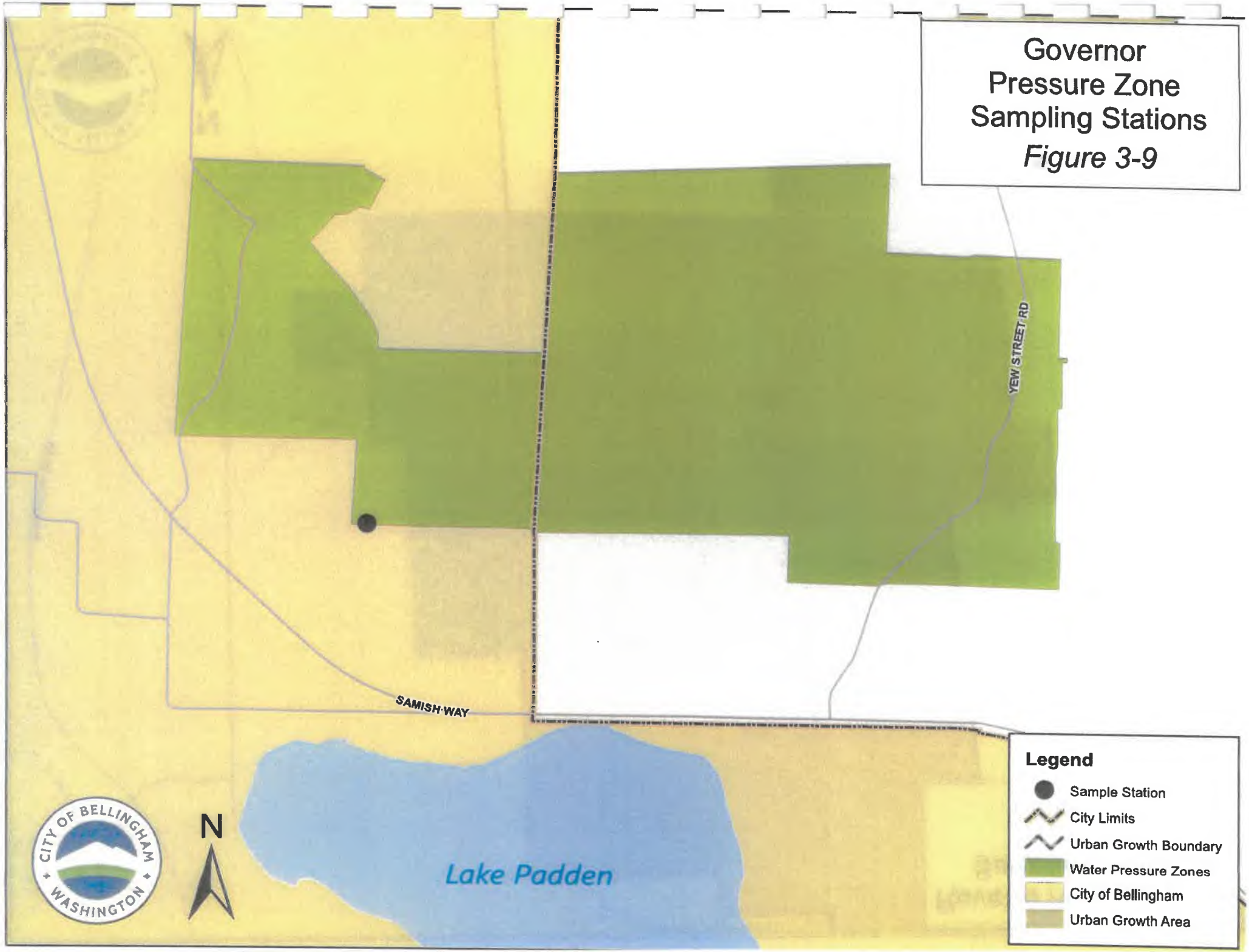
Figure 3-5

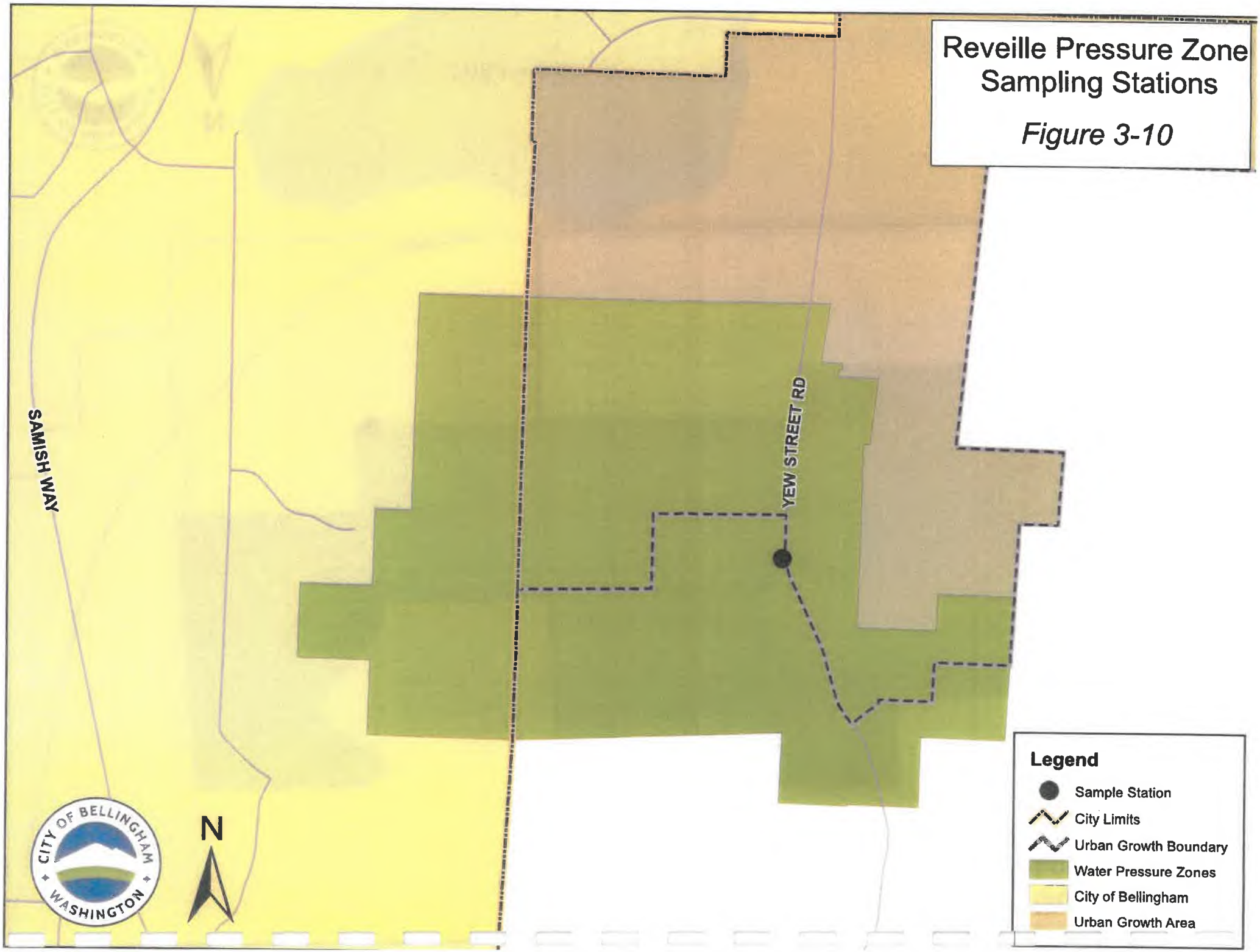


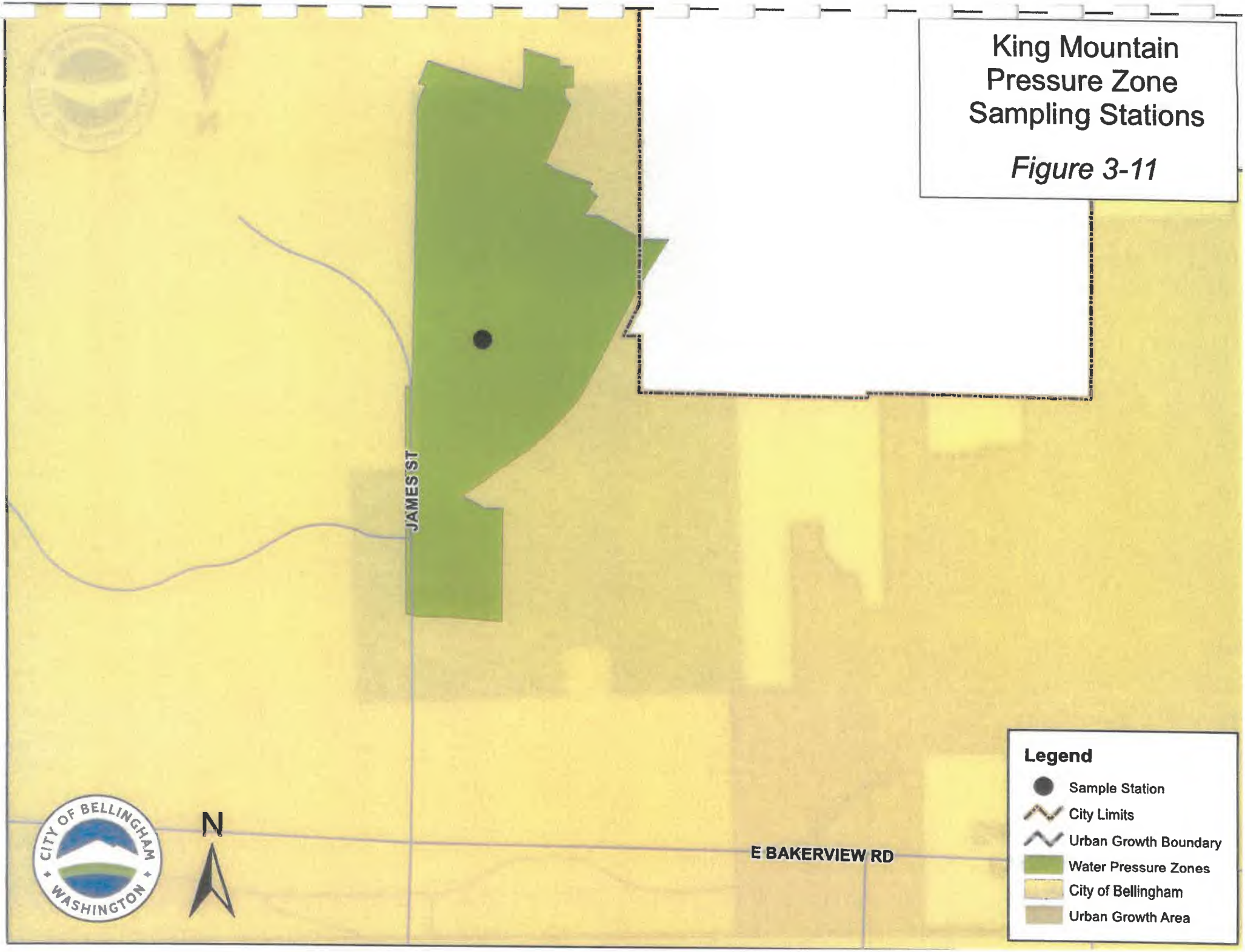

Alabama Hill Pressure Zone
Sampling Stations
Figure 3-6
E SUNSET DR
CHANDLER PKWY
BARKLEY BLVD
NORTHSHORE DR
N
CITY OF BELLINGHAM
WASHINGTON
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area

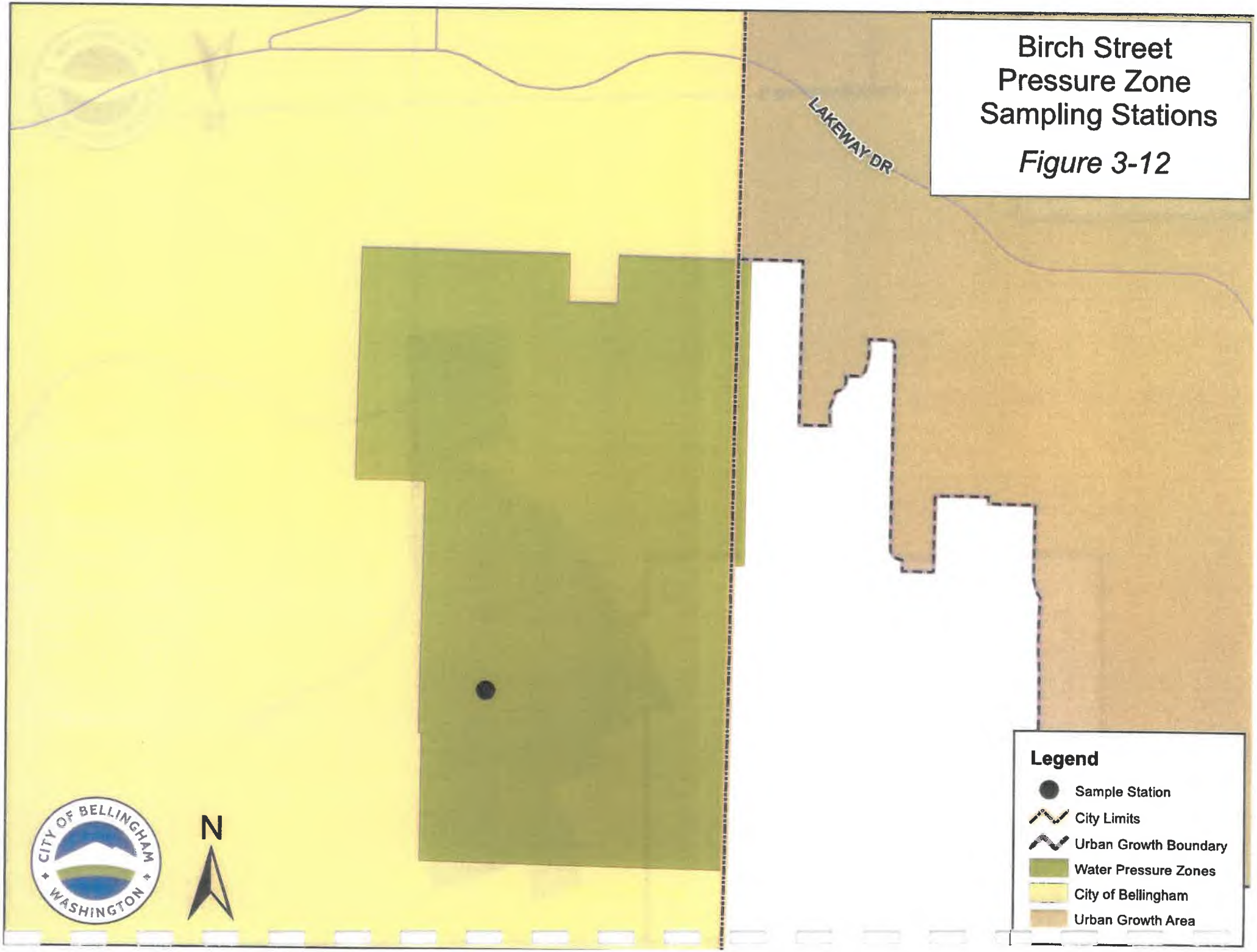

Padden-Yew
Pressure Zone
Sampling Stations
Figure 3-7
YEW STREET RD
SAMISH WAY
Lake Padden
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area
N
CITY OF BELLINGHAM
WASHINGTON

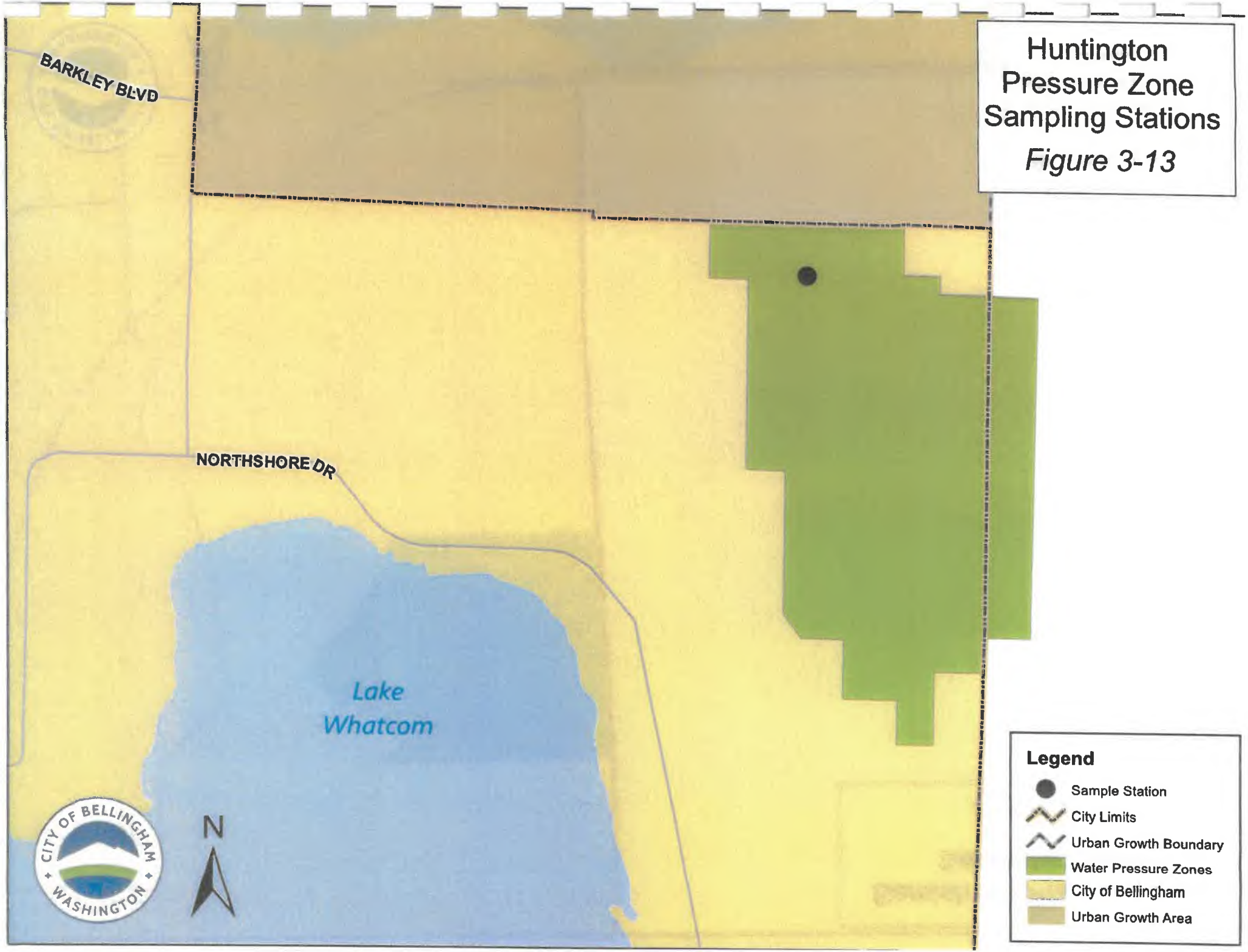

College Way
Pressure Zone
Sampling Stations
Figure 3-8
N STATE ST
S STATE ST
BILL MCDONALD PKWY
N
CITY OF BELLINGHAM
WASHINGTON
Legend
Sample Station
City Limits
Urban Growth Boundary
City of Bellingham
Urban Growth Area

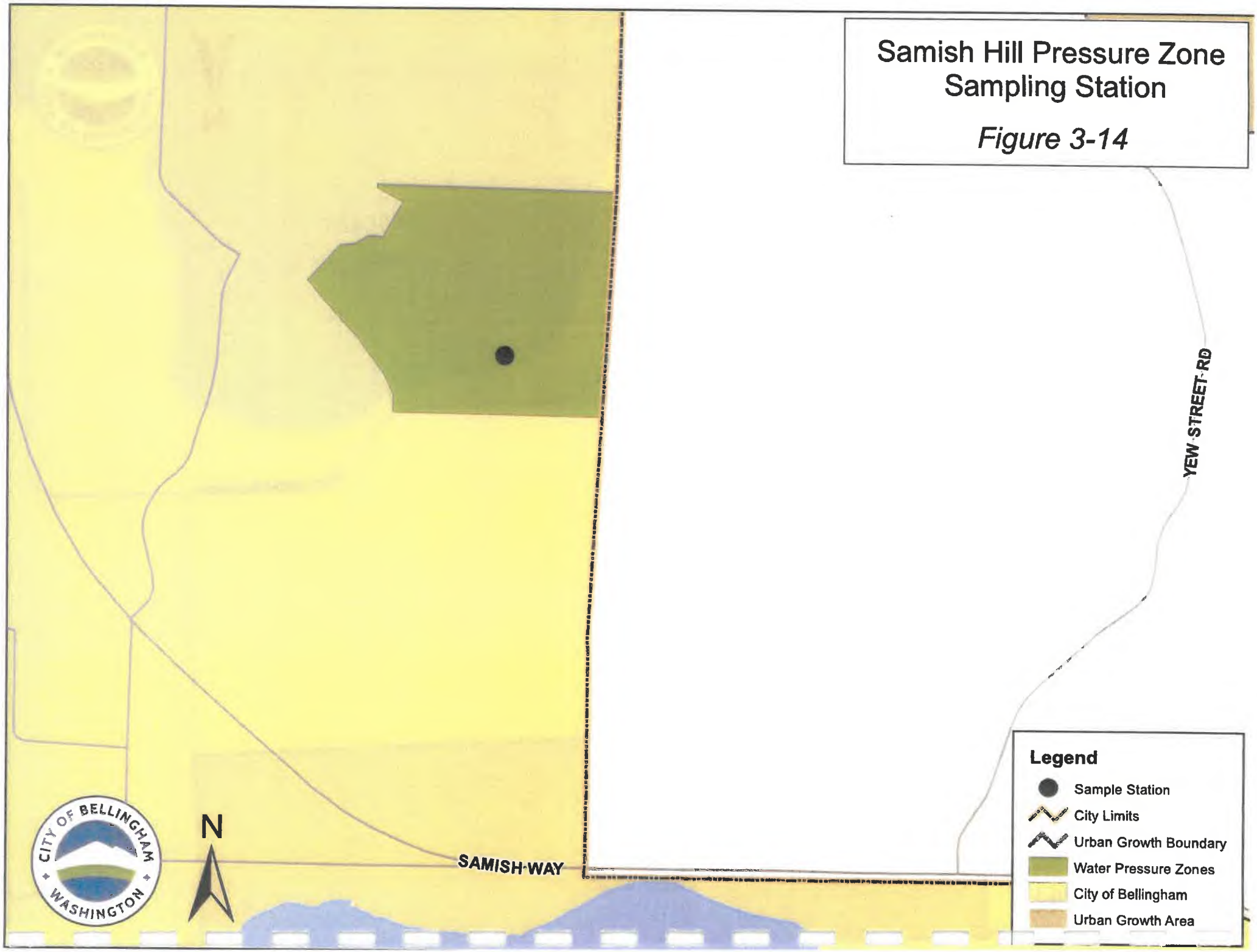

Governor
Pressure Zone
Sampling Stations
Figure 3-9
YEW STREET RD
SAMISH WAY
Lake Padden
N
CITY OF BELLINGHAM
WASHINGTON
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area


Reveille Pressure Zone
Sampling Stations
Figure 3-10
SAMISH WAY
YEW STREET RD
N
CITY OF BELLINGHAM
WASHINGTON
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area


King Mountain
Pressure Zone
Sampling Stations
Figure 3-11
JAMES ST
E BAKERVIEW RD
N
CITY OF BELLINGHAM
WASHINGTON
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area


Birch Street
Pressure Zone
Sampling Stations
Figure 3-12
LAKEWAY DR
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area
N
CITY OF BELLINGHAM
WASHINGTON


Huntington
Pressure Zone
Sampling Stations
Figure 3-13
BARKLEY BLVD
NORTHSHORE DR
Lake
Whatcom
N
CITY OF BELLINGHAM
WASHINGTON
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area


Samish Hill Pressure Zone
Sampling Station
Figure 3-14
YEW STREET RD
SAMISH WAY
N
CITY OF BELLINGHAM
WASHINGTON
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area

4. OVERVIEW OF RESPONSE TO COLIFORM POSITIVE SAMPLE

The following is a section to assist the Laboratory Analyst with responding correctly to a coliform positive sample. It is based on the Revised Total Coliform Rule, effective April, 1 2016.

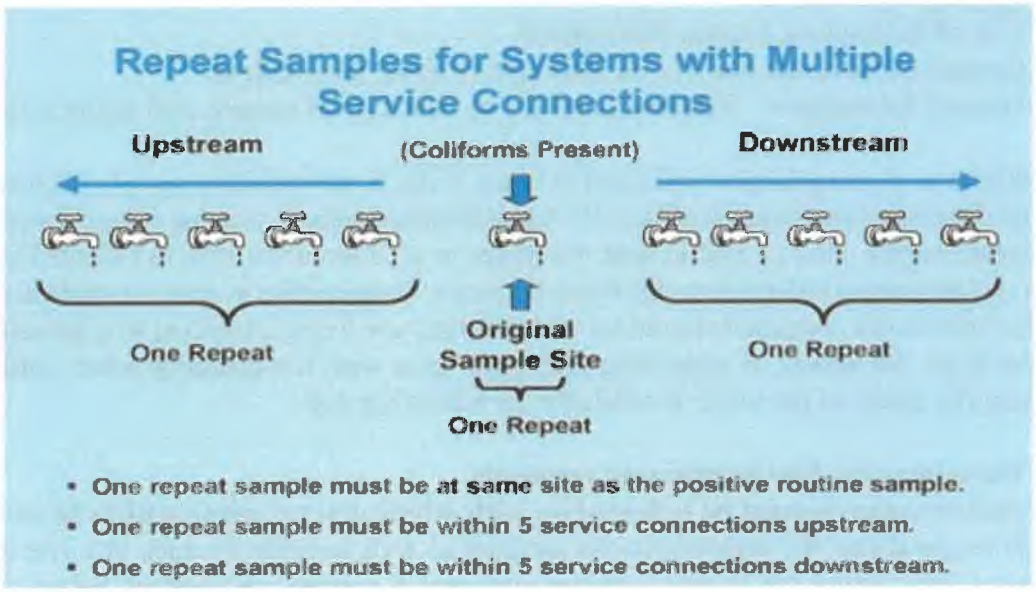
If a routine coliform sample is positive:

STEP 1 CRITICAL! **Check for florescence.** Verify if the sample is E coli positive.

STEP 2 Notify Supervisor. Tell Lab Supervisor or Water Quality Specialist about any positive total coliform or E. coli sample.

1) For an E. coli positive sample refer to Procedure 4.1 on next page
2) For a total coliform positive sample refer to Procedure 4.2 on page 22

STEP 3 Resample Within 24 Hours.. Follow the directions on the appropriate Procedure based on the type of coliform positive you have observed. **Take two samples per site**, one for Colilert and one for mEndo membrane filtration for enumeration. Run a free residual chlorine at each site. If Cl2 is less than 0.02 mg/L run also R2A HPC method.



Procedures

4.1	Detection of an *E. coli* Positive Routine Sample	page 26
4.2	Detection of a Total Coliform Positive Routine Sample	page 30

4.1 Procedure for the Detection of an *E. coli* Positive in a Routine Sample

1. Contact one of the following people:

Laboratory Supervisor: (360) 303-3300, (360) 778-7872 (Peg)
Water Quality Specialist: (360) 961-9454 (Michelle), (360) 815-9843 (Rich)

If none of the above are available, contact:
Public Works Superintendent: (360) 778-7892, (360) 299-4864 (Steve)
Responsible Person in Charge- in Steve's absence: As assigned

If you are the person communicating with the Superintendent of Plants, fill the Superintendent in on the situation and our planned response. Let them know that with an E.coli positive sample the Department of Health will also need to be notified within 24-hours at the phone numbers below.

Ask the individual contacted if they would like to contact the state Dept. of Health (DOH) since it is a requirement. If you cannot reach one these people, leave messages for them, and proceed with the rest of the steps and wait an appropriate amount of time. If no response occurs, you will need to contact the DOH with information about the positive E coli sample.



The Dept. of Health phone numbers: **(253) 395-6775** during business hours or
(877) 481-4901 after business hours.
The Office of Drinking Water staff person on call will return the call within 30 minutes.

If you need to leave a message on the Department of Health answering machine, give them the following information:

- City of Bellingham System ID# 056003
- Contact name/phone number for information about the incident
- General Information: Bacteria found *E. coli,* location of sample, and utility actions since

Additional communication will need to occur if the E. coli positive sample occurred in an area of the water distribution system with sensitive populations (school, nursing home, hospital, dialysis center, daycare center, etc.) or if it is near the meter to a consecutive system (Water District, mobile park, etc.). Get contact information for these facilities. Consecutive system contacts are listed on page 26. The individuals contacted should be told that they are being contacted as a precautionary measure to give them the option of exercising additional care with the drinking water until more information about the safety of the water is available the following day.

2. Determine the best locations to resample.
A positive sample must be followed up with additional sampling within 24-hours.
It is required that the original site be sampled as well one sample each at a site within 5 service connections above the original routine site, and 5 service connections below the routine site. Section 5.0 of this Plan can help you identify where to take these samples. Jim Bergner is also a helpful resource to help determine the current direction of water flow in the distribution system. He has access to the City's hydraulic model and can confirm sites are appropriate to characterize upstream and downstream locations.

It is assumed that prior to collecting the follow up sample you have contacted your Supervisor for consultation. This individual will work with you to initiate an investigation as to the source of

contamination. The types of information helpful to this investigation include: the free chlorine residual at the time the sample was taken, the condition of sample tap (i.e. cleanliness, presence of insects), any unusual activity around sample tap (i.e. construction, firefighting), a main break or repair in the area, approximate flushing time before sample was taken, transport conditions of sample, and condition of sample (i.e. turbid, excessive debris).

3. Resample as soon as possible.
In all cases, resample within 2 hours after notification of the positive E coli result. Do not wait any longer than 2 hours for additional information as the second set of samples are time critical. If better information becomes available later in the day, you can always resample once more.

Perform 3 repeat samples for each *E. coli* positive sample **on the same day as initial test results are read.** For each of the three samples you will get a chlorine value, and collect at least 200 mls of sample per site. At sites with free chlorine < 0.02 mg/L run a total Cl_2 and HPC.

The three repeat samples (minimum 200 ml each site) should be:
1) Original site where *E.coli* positive occurred
2) One site "upstream" of this tap and within 5 services (refer to Section 5.0 of this Plan)
3) One site "downstream" of this tap and within 5 services

Ensure that the samples are taken using clean sampling technique and take special care that the sample tap is clean. Always flame the tap and flush 3 minutes prior to sampling. Do NOT institute water main flushing or system chlorination prior to collecting this second sample.

4. Analyze repeat samples.
Conduct both the Colilert test and the mEndo total membrane filtration test on each of the three repeat samples. Perform verification on any colonies that grow on the total membrane test by picking them into LTB and EC. Because it is possible to count the number of viable bacteria colonies in the membrane method, the mEndo test better helps to identify the severity of contamination.

5. Investigate sources and possible explanations for positive sample.
Determine if the coliform sample is valid. Possible reasons the sample may not be valid:
- There was excess debris in the sample tap (flame tap and flush longer),
- The sample was colored prior to the addition of Colilert (if the sample is very yellow, it is best to run membrane filtration),
- Colilert media contamination
- The sampler touched inside of the bottle or the test was read after 28 hours
- The sample was not representative of normal conditions (firefighting, etc.)

Even if the sample is suspected to not be valid, perform repeat sampling immediately at the same site, having corrected the issue identified as invalidating the sample.

6. Verify that notification to the state DOH has occurred if needed. Specific instructions for notification is provided in the procedure specific to the type of coliform that is positive, detailed below.

7. Complete all paperwork.
Carefully fill out the DOH form for each sample to indicate that these are repeat samples. Be sure to include the DOH number for the original routine sample that failed. The appropriate section of the form to include this information is below:

2. Repeat Sample (after unsat. routine)

☐ Distribution System ⟸ **Check this box for all 3 repeat samples**

☐ Source Groundwater Rule (GWR)

Unsatisfactory routine lab number:

__ __ __ - __ __ __ __ __ ⟸ **Put the positive original (routine) sample DOH number here**

Unsatisfactory routine collect date:

_____/_____/_____ ⟸ **Date original (routine) sample collected that went positive**

Chlorinated: Yes_____ No_____

Chlorine Residual: Total_____ Free_____

8. Communicate to Lab Group.
Inform the Lab Group at Grp.pw.ops.plants.lab that a repeat E.coli coliform test is in progress and when it can be read. Be sure to prioritize getting the results from these samples and communicate who to notify when the results are available.

9. Repeat sample result notification.
If any of the repeat samples are coliform positive, check for the presence of *E. coli*.
If total coliform or E. *coli* is present in this second sample, an acute violation has occurred. An acute violation means Tier 1 public notice must occur. Prompt public notification must occur following the steps in the Public Notification Rule Plan. Also a full system investigation and possible system sanitization will need to be conducted. Ensure that you have notified a City employee from step 1 above to begin these processes. Section 7.0 of this Plan gives a summary of the notification requirements that will need to occur.

Acute Coliform MCL Violation:
An acute violation constitutes a situation that poses a serious health threat as a result of short term exposure. Due to the public health implications, 24-hour notification is a requirement. A combination of two samples- routine and repeat- must have at least one E.coli coliform and one other coliform. Results will look like one of the following combinations.

Figure 4-1 TRIGGERS REQUIRING A LEVEL 2 ASSESSMENT & PUBLIC NOTICE

Routine Sample	Repeat Sample
E. coli +	Total Coliform +
E. coli +	Any missing sample
E. coli +	E. coli +
Total Coliform +	E. coli +
Total Coliform +	Total Coliform + (without E coli analysis)

A Level 2 may also be required if there have been multiple coliform positives in rolling 12-month period.

IMPORTANT NOTIFICATION:
Notification of the DOH by telephone of violation of the Total Coliform Rule (WAC 246-290-480) must also occur for an acute coliform MCL violation within 24 hours of determination. DOH consultation, full system investigation, Level 2 Assessment, and likely intensive flushing of the system and cleaning. The DOH should be instrumental in determining appropriate follow-up actions.

10. Consecutive System Contact Information

Glenn-Cove Water Assoc
J William Freudenberger
Phone: 360.**734.5283**

Lummi Water and Sewer
Chip Anderson District Manager
Phone: 360.**758.7167**

Whatcom County Water Dist #2/#7
Lori Whitfield (Administration)
Phone: 360.**733.5770**
Dave Olson (Operations)
Phone: 360.**201.3333**

Lake Whatcom Water & Sewer
Justin Cleary, Manager
Phone: 360.**734.9224**

Montgomery Road Water Assoc
Richard and Jane Campbell
Phone: 360.**223-9934**

California Street Water Assoc
George Dodge/Douglas W Gallagher
Phone: 360. **756.8710**

Deer Creek Water Association
Douglas Wittinger
Phone: 360.**820.4314**

4.2 Detection of a Total Coliform Positive Routine Sample

It is assumed here the Lab Analyst has checked for florescence to verify if the sample is E coli negative.

1. Contact one of the following people:

Laboratory Supervisor: (360) 778-7872, (360) 733-9178, (360) 303-3300 (Peg)
Water Quality Specialist: (360) 961-9454 (Michelle), (360) 815-9842 (Rich)

The individual you contact will work with you to initiate an investigation as to the source of contamination and help you coordinate the repeat sampling.

2. Determine the best locations to resample.
A positive sample must be followed up with additional sampling within 24-hours.
It is required that the original site be sampled as well one sample each at a site within 5 service connections above the original routine site, and 5 service connections below the routine site. Section 5.0 of this Plan can help you identify where to take these samples. Jim Bergner is also a helpful resource to help determine the current direction of water flow in the distribution system. He has access to the City's hydraulic model and can confirm sites are appropriate to characterize upstream and downstream locations.

3. Resample as soon as possible.
Perform 3 repeat samples for each total coliform positive sample **on the same day as initial test results are read.** For each of the three samples you will get a free residual chlorine value, and collect 200 mls of sample. Run HPC and total chlorine at sites <0.02 mg/L chlorine. Section 5.0 of this Plan can help you identify where to take these repeat samples.
The three repeat samples should be:

1) Original site where coliform positive occurred
2) One site "upstream" of this tap and within 5 services (refer to Section 5.0 of this Plan)
3) One site "downstream" of this tap and within 5 services

Ensure that the samples are taken using clean sampling techniques and take special care to make certain that the sample tap is clean. Always flame the tap well and flush 3-5 minutes prior to sampling. Do NOT institute water main flushing or distribution system chlorination prior to sample collection.

4. Analyze repeat samples.
Conduct both the Colilert test and the mEndo total membrane filtration test on each of the three repeat samples. Perform verification on any colonies that grow on the total membrane test by picking them into LTB and EC. The mEndo test helps identify the severity of contamination.

5. Carefully fill out the DOH form for each sample to indicate these are repeat samples. Be sure to include the DOH number for the original routine sample that failed. The appropriate section of the form to include this information is below:

2.☐ Repeat Sample (follow-up to an unsatisfactory sample) ⟸ **Check this box for all 3 repeat samples**

Provide information below.

Unsatisfactory routine lab number:

___ ___ ___ ___ ___ ___ ___ ___ ⟸ **Put original (routine) sample DOH number here**

Unsatisfactory routine collect date:

_____/_____/_____ ⟸ **Date original (routine) sample collected**

Chlorinated: Yes_____ No_____

Chlorine Residual: Total_____ Free_____

6. Communicate to Lab Group.
Inform the Lab Group at Grp.pw.ops.plants.lab that a repeat coliform test is in progress and when it can be read. Be sure to prioritize getting the results from these samples and communicate who to notify when the results are available.

7. If the repeat sample is E coli positive
If any of the repeat samples are coliform positive, check for the presence of *E. coli*.
If E. *coli* is present in this second sample, an acute violation has occurred. An acute violation means Tier 1 public notice and Level 2 Assessment must occur. Prompt public notification must occur following the steps in the Public Notification Rule Plan. Ensure that you have notified a City employee from step 1 above to begin these processes. In all cases notify the Department of Health about the situation. Section 7 of this Plan gives a summary of the notification requirements that will need to occur.



The Dept. of Health phone numbers: **(253) 395-6775** during business hours or **(877) 481-4901** after business hours.

The Office of Drinking Water staff person on call will return the call within 30 minutes.

A full system investigation and possible system sanitization will need to be conducted. Ensure that you have notified a City employee from step 1 above to begin this process. Document all conditions regarding sampling and sample observations well as these will be part of the report.

8. If the repeat sample is total coliform positive.
If there are two days of total coliform positive samples, then public notification will not need to occur and an MCL violation did not occur, assuming less than 5% of samples for the month were total coliform positive. A Level 1 Assessment as described here in Section 6 will need to occur if > 5% of sites (including repeats) are positive for total coliform.

5.0 Repeat Coliform Sampling Locations

In all cases, use your best professional judgment when determining the best locations to sample following a positive coliform occurrence in a routine sample. The following table is meant to assist you in determining site verified to be within 5-service connections from our routine sampling locations. System dynamics change so verify direction of water flow prior to sampling. **Up = water before tap "upstream", Down = water after the tap "downstream".**

NORTH ZONE (Gravity Zone)

Type	Location	Tap # / Notes
Routine	Whatcom Falls Reservoir	Entry point to the North (gravity) Zone
Up	Treated (WTP pump #9)	
Down	Water Treatment Plant Lab sink	
Routine	Alabama & Woburn	
Up	2503 Alabama	
Down	2115 Alabama	
Routine	Alderwood & Bennett	
Up	3236 Alderwood Ave.	
Down	3325 Alderwood Ave.	
Routine	Commercial & Chestnut	
Up	1205 Commercial	
Down	121 W Chestnut	End of line so this is a vicinity "upstream" site
Routine	Cornwall & Pine	aka Cornwall and Wharf
Up	Port Maintenance Office (619 Cornwall)	
Down	Dry Docks (100 E Pine St.)	
Routine	City Hall	
Up	210 Lottie	
Down	316 Lottie	
Routine	Deemer at Firestation	
Up	4060 Deemer	
Down	495 East Bakerview	
Routine	Dupont & I Street	
Up	1706 I Street	
Down	1609 I Street	
Routine	E & Logan St.	
Up	2500 Cornwall Ave.	
Down	2422 E Street	
Routine	Eldridge & Lindberg	
Up	3133 Eldridge Ave	
Down	660 Marine Drive	
Routine	Franklin & Illinois	
Up	403 Illinois	
Down	2834 Franklin	

NORTH ZONE (continued)

Type	Location	Notes
Routine	Henry & Monroe	
Up	2406 Henry	
Down	2330 Henry	
Routine	Kentucky & Ellis	
Up	401 Kentucky St.	
Down	309 Kentucky St.	
Routine	Lakeway & James	
Up	819 James	
Down	709 James	
Routine	Hilton Ave.	
Up	1010 Hilton	
Down	1001 Hilton	
Routine	Granary and Laurel	
Up	1015 Granary	
Down	301 W Laurel St.	(update when Granary Ave. gets extended)
Routine	W Maplewood & Cottonwood	
Up	2800 W Maplewood	
Down	2815 W Maplewood	
Routine	W Maplewood & McLeod	On border of North and Cordata zones.
Up	2945 W Maplewood	
Down	3001 W Maplewood	
Routine	1314 E Maplewood	
Up	1310 E Maplewood	
Down	1400 E Maplewood	
Routine	McLeod & James	
Up	3700 James St	
Down	3865 James St.	
Routine	Birchwood Ave. & I-5	New connector road.
Up	3600 James Street	Site will need to be updated once platted.
Down	340 Birchwood Ave.	
Routine	W. North & Elm	
Up	1210 W North St.	
Down	2603 Elm St.	
Routine	Squalicum and Roeder	
Up	2694 Roeder	
Down	2700 Roeder	Also sample in Bellingham Cold Storage. Site Manager Gary White phone: 360.733.1640

NORTH ZONE (continued)

Type	Location	Notes
Routine	Northwest and Larrabee	
Up	4337 Northwest	
Down	4366 Northwest	
Routine	Oeser Cedar	
Up	710 Marine Drive	
Down	2938 Seaview Circle	
Routine	Virginia Street	
Up	2221 Pacific Street	South side of campus along Virginia
Down	2200 Nevada Street	
Routine	Peabody & Victor	
Up	3228 Peabody	
Down	905 Victor	
Routine	Pinewood & Birchwood	
Up	2826 Birchwood	
Down	2905 Birchwood	
Routine	St. Joseph's Hospital	
Up	2940 Squalicum Parkway	
Down	Maternity Ward St. Joe's	
Routine	State & Berry	
Up	833 N. State	
Down	820 N. State	
Routine	Seaview Circle	Tap is not used at present time.
Routine	James St pump station	Tap inside station, not used

REVEILLE ZONE (aka UPPER-YEW)

Type	Location	Notes
Routine	KGMI (2219 Yew St.)	
Up	2224 Yew St. Rd.	
Down	2218 Yew St. Rd.	

HUNTINGTON ZONE

Type	Location	Notes
Routine	E Oregon & Huntington	
Up	4914 E Oregon	
Down	5010 E Oregon	

PADDEN YEW ZONE

Type	Location	Notes
Routine	Ashley & Dumas	
Up	4113 Dumas Ave.	
Down	300 40th St.	On edge of South Zone (3996 Byron in South Zone)
	Consolidation Reservoir	
Up	818 Yew St.	12" CI fill line
Down	801 Spieden Place	
Routine	40th St. Reservoir	Serves Padden-Yew Zone, although it is
Up	1412 40th St.	Physically located in the Upper-Yew Zone
Down	1400 40th St.	
Routine	Reveille Reservoir	
Up	2418 Yew St.	
Down	2402 Yew St.	870 Reveille is tapped off of reservoir – it is the
Down	870 Reveille	only house tapped on the third line.
Routine	Ridgemont (near 915 36th St.)	
Up	923 36th St.	
Down	919 36th St.	
Routine	Padden Estates (near 4921 Samish Way)	
Up	4907 Samish Way	Trailer park manages water internally, not a place to
Down	4929 Samish Way	Sample for repeats.
Routine	Timberlake Drive	
Up	819 Timberlake Court	
Down	1841 Timberlake Court	
Routine	Cowgill & Samish	Retired in 2021 – too many taps in Padden Yew Zone

GOVERNOR ZONE

Type	Location	Notes
Routine	Harrison	(end of zone)
Up	2316 Hawk Way	
Down	4411 Harrison	Tap located at this address

SAMISH HILL ZONE

Type	Location	Notes
Routine	Parkhurst Reservoir	Up/Down depend on reservoir fill cycle
Up	4333 Samish Crest Dr	
Down	4501 Merlin Court	

DAKIN-YEW ZONE

Type	Location	Notes
Routine	Academy & Pullman	Replaced Dakin Res. #2 when sampling line under
Up	4101 Academy (Silver Beach School)	Reservoir split in 2008. Dakin #2 is physically
Down	4036 Academy	located in Alabama Hill Zone but serves the
D2	or 4103 Academy (newer section of school)	Dakin-Yew Zone.
Routine	Ava Lane	Update after development gets built
Up	4003 Ava Lane	
Down	3936 Ruston Way	
Routine	Britton Road	The DOH doesn't usually want a downstream site
Up	4502 E Oregon St	taken from a consecutive system. Take one as a
Down	1405 Britton	"courtesy sample" and get an additional upstream.
D2	Or 1404 E 36th Ln (alternate site in WD #7)	WD #7 phone 360.752.9208.
Routine	Control Dam	
Up	1935 Electric	
Down	2109 Electric	
Routine	Dakin #1 Reservoir (faucet at reservoir)	Serves Dakin-Yew Zone though physically located
Up	2906 Sylvan	in the Alabama Hill Zone.
Down	2918 Sylvan St (Big Rock Condominium)	
Routine	Division Street	
Up	1997 Division St.	
Down	3735 Irongate	
Routine	Everson Goshen Road	
Up	2084 Mt. Baker Highway	
Down	2098 Mt. Baker Highway (end of system)	
Routine	Fir (S of Alabama)	
Up	2405 Fir	
Down	End of system	COB asset 0500250, Fir St. lift station
Routine	Lakeside	The Glenn Cove Water Dist. phone 360.734.5283
Up	1802 Lakeside Ave	Has a first connection at 1718 Euclid Ave. Take
Down	1724 Euclid Ave	"courtesy sample" and communicate results to them.
Routine	Lakeway & Bonanza	
Up	3717 Lakeway	
Down	1330 Bonanza	
Routine	Dakin #2 Reservoir (tap outside reservoir)	Not used (Academy replaced due to low flow)

DAKIN-YEW ZONE (continued)

Type	Location	Notes
Routine	Michigan St.	
Up	2132 Michigan St.	
Down	2204 Michigan St.	
Routine	Mt. Baker Highway	
Up	2945 E Sunset Sunset Drive	
Down	3635 E McLeod Rd.	
Routine	Nevada & Edwards	
Up	1106 Nevada	
Down	1062 Nevada	
Routine	E North & Huntington	
Up	1612 Northshore Dr.	
Down	2616 Huntington St.	
Routine	Northshore Drive	Take one "courtesy sample" in Eagleridge as this in
Up	2124 Northshore Drive	LWWSD service area phone 360.734-9224, and
Down	2130 Northshore Drive	communicate results to them.
Routine	Strider Loop	
Up	4122 Strider Loop	
Down	4175 Strider Loop	
Routine	Treated (WTP pump #9)	Entry point to the distribution system.
Up	CT-out (WTP pump #8)	
Down	Whatcom Falls Reservoir	
Routine	Vining Street Park	
Up	2801 Vining Street	
Down	2815 Vining Street	
Routine	Britton Loop	Tap is not used presently. No services off long line.

KING MOUNTAIN ZONE

Type	Location	Notes
Routine	Frances Ave (King Mountain)	
Up	4310 Frances Ave	
Down	4328 Frances Ave	
Routine	Winslow Court	
Up	4341 Winslow Court	
Down	4356 Winslow Court	Tap at end of the water main. 4356 is technically Up.

ALABAMA HILL ZONE

Type	Location	Notes
Routine	Balsam Lane pump station (Sylvan)	
Up	Dakin 1 Reservoir	
Down	3704 Sylvan Place	

Routine	Holly Court	
Up	1408 Holly Court	
Down	1411 Holly Court	End of line. 1411 technically Up.

Routine	McLeod & Magrath	
Up	3886 Magrath Rd.	
Down	3801 E. McLeod	

Routine	3724 Woodside Way	
Up	3720 Woodside Way	
Down	3728 Woodside Way	

COLLEGE WAY ZONE

Type	Location	Notes
Routine	Elwood & Ridgeway	
Up	317 Hillcrest Way	
Down	312 Ridgeway Dr.	

Routine	17th & Douglas	Can be South Zone based on valving.
Up	920 17th St.	
Down	937 Highland Dr.	End of line/zone w/ valve close on Douglas/Highland

Routine	College Way Reservoir (formerly Sunset Res)	Pump station at site serves the College Way Zone.
Up	102 Highland Drive	
Down	222 Highland Drive	

BIRCH FALLS ZONE

Type	Location	Notes
Routine	1113 Birch Falls	
Up	1116 Birch Falls	
Down	1009 Birch Falls	(as of this writing unbuilt)

SOUTH ZONE

Type	Location	Notes
Routine	Bayside & Willow	
Up	426 Bayside	
Down	500 Bayside	
Routine	Chuckanut Drive & Soundview	
Up	709 Chuckanut Drive	
Down	694 Chuckanut Drive	
Routine	E Oak Street	Replaced Sehome Reservoir 12/11 due to very
Up	Sehome Reservoir	low pressure at installed Sehome Reservoir tap.
Down	700 N Garden St.	
Routine	18th & Fairhaven Ave	
Up	1820 Fairhaven Ave.	
Down	3310 18th St.	
Routine	15th & Douglas	
Up	1001 15th St.	
Down	1003 14th St.	
Routine	4th & Harris	
Up	401 Harris Ave.	
Down	300 Harris Ave.	
Routine	14th & State	
Up	341 S. State	401-423 State St originate on 6" CI in alley
Down	444 14th St.	
Routine	Larrabee State Park	
Up	467 Cove Road	or 508 E Dolphin (hooks directly into Chuckanut)
Down	None (end of line)	
Routine	Laurel & Liberty	
Up	930 Liberty	
Down	1004 Liberty	
Routine	Linden & Fieldston	
Up	410 Linden	
Down	602 Fieldston	
Routine	19th & McKenzie	
Up	1403 19th St.	
Down	1817 McKenzie	
Routine	Otis Street Pump Station	Faucet inside station
Up	1734 Valencia	24" CCP to 30" CCP to 36" CCP w/ no service connections, terminates near 1734 Valencia
Down	1015 Otis Street	
Routine	Padden Reservoir	Serves South Zone although physically located in the
Up	2414 36th St.	Padden-Yew Zone
Down	3800 Broad St.	

SOUTH ZONE (continued)

Type	Location	Notes
Routine	32nd & Donovan	
Up	1519 32nd Street	
Down	1520 Bonnie Lane	
Routine	24th & Mill	
Up	1122 24th St.	
Down	1120 24th Street.	
Routine	Forest & Palm	
Up	101 S Forest Street	
Down	310 Palm Street	
Routine	Underhill	
Up	115 Underhill	
Down	120 Underhill	
Routine	E Maple & Jersey	
Up	1023 Jersey Street	
Down	712 E Maple Street	
Routine	34th & Donovan	
Up	3409 Donovan Ave.	
Down	3213 Donovan Ave.	
Routine	30th & Church	
Up	3114 30th St.	
Down	3204 30th St.	
Routine	Sehome Reservoir (replace by E Oak St)	Not in use. Pressure issues replaced by E Oak
Routine	Cowgill and Samish	Not in use. Spare tap.

CORDATA ZONE

Type	Location	Notes
Routine	Bellingham Athletic Club	
Up	4192 Meridian	
Down	4176 Meridian	Assume water flow toward North Zone - verify
Routine	Grady Way	
Up	344 Grady Way	
Down	336 Grady Way	
Routine	Horton Road	
Up	477 W Horton	
Down	485 W Horton	
Routine	Mitchell Way	At Fed Ex Building
Up	4330 Mitchell	
Down	4373 Mitchell	(end of line)
Routine	Northwest & Sterling	
Up	733 Sterling Dr.	
Down	4018 Northwest Ave.	Address of complex, 4000 1st on service lateral
Routine	Pacific Highway	
Up	4100 Pacific Highway	
Down	4146 Pacific highway	
Routine	Short St. pump station	Inside station
Up	4170 Cordata Prkwy (DQ)	
Down	204 Olivine Lane	(note Short St. name change to Olivine)
Routine	Curtis Road	The DOH doesn't usually want a downstream site
Up	4405 Curtis	taken from a consecutive system. Take one as a
Down	WD. #2 (360)733-5770, Lummi (360)758-7167	"courtesy sample" and get an additional upstream.
Routine	Kearney Reservoir	
Up	4281 James St.	Reservoir fill line 1": DI
Down	4266 Springcreek Lane	
Routine	Mahogany & Ambrosia	
Up	4201 Spire Drive	As area builds out check for closer "up"
Down	4203 Ambrosia Lane	
Routine	Lummi – Marine Drive (out of City)	The DOH doesn't usually want a downstream site
Up	Curtis Road (tap #55)	taken from a consecutive system. Take one as a
Down	Lummi Water & Sewer Dist (360) 758-7167	"courtesy sample" and get an additional upstream.
Routine	Kline Rd. & Spring Vista	
Up	4728 Cordata Parkway	Will need to be updated when buildout occurs
Down	613 Spring Vista Way	Will need to be updated when buildout occurs
Routine	Marietta Reservoir	Currently offline, no need for storage in this zone
Routine	4805 Aldrich	Tap is not used at this time.

5.1 Special Considerations for End of Distribution System Sample

Per the requirements in WAC 246-290-300 3(v):

If a total coliform-positive sample is at the end of the distribution system, or one service connection away from the end of the distribution system, the system shall still take all required repeat samples. The department may allow an alternative sampling location in lieu of the requirement to collect at least one repeat sample upstream or downstream of the original sampling site. Systems may propose repeat monitoring locations to the department that the system believes to be representative of a pathway for contamination of the distribution system. A system may elect to specify either alternative fixed locations or criteria for selecting repeat sampling sites on a situational basis in a standard operating procedure (SOP) in its plan. The system shall design its SOP to focus the repeat samples at locations that best verify and determine the extent of potential contamination of the distribution system area based on specific situations. The department may modify the SOP or require alternative monitoring locations as needed.

6. Level 1 and Level 2 Assessments

An investigation should occur any time coliform bacteria is observed in a routine and a repeat sample. In the case of total coliform, an investigation is not a regulatory requirement until the number of total coliform positives exceed 5% of the samples collected for the month, but it is a prudent practice to investigate regardless. The presence of coliform bacteria is an unusual occurrence in the City of Bellingham water distribution system, and time should be spent following any positive sample to assure that sampling and distribution system controls are effectively in place to assure sanitary conditions.

Below is a discussion of the Assessments that are required as part of 40 CFR 141.859 and WAC 246-290-320 (2)(b).

6.1 Level 1 Assessment

Systems must submit a Level 1 Assessment to their state within 30 days after learning that they have exceeded a total coliform trigger. A Level 1 Assessment is required (40 CFR 141.859(a)(1) & WAC 246-290-320 (2)(b)) to be conducted by the water system operator/owner to assure the safety of the potable water supply following either of the following scenarios:

a. The number of total coliform positive samples exceeds 5% of the total coliform samples collected for the month (includes routine and repeat samples), or
b. The City fails to take every required repeat sample after any single routine total coliform positive sample.

A Level 1 Assessment is defined in the code as "An evaluation to identify the possible presence of sanitary defects, defects in distribution system coliform monitoring practices, and the likely reason that the system triggered the assessment. It is conducted by the system operator. Minimum elements include:

a. Review and identification of atypical events that could affect distributed water quality or indicate that distributed water quality was impaired
b. Changes in distribution system maintenance and operation that could affect distributed water quality (including water storage)
c. Source and treatment considerations that bear on distributed water quality, where appropriate
d. Existing water quality monitoring data
e. Inadequacies in sampling sites, sampling protocol, and sample processing

The system must conduct the assessment consistent with any State directives that tailor assessment elements with respect to the size and type of the system and the size, type, and characteristics of the distribution system."

It is important to also note that with the revised Total Coliform Rule (2016 implementation), an MCL violation has not occurred if total coliform positives exceed 5% of the total samples collected for the month as long as a Level 1 Assessment occurred. With this in mind, communication with the service population no longer needs to occur if there are sufficient total coliform samples to trigger a 5% exceedance.

The number of positive samples will determine whether the utility has a non-acute MCL violation per the following:

(A/B) x 100

A = Total number of total coliform positive samples (routine coliform positive + repeat coliform positive)

B = Total number of samples (routine + repeat samples) taken that month



(positives / total compliance samples for month including repeats) * 100 = x %

if x is greater than 5% (5 positives), there is a non-acute violation.

In all cases the state Department of Health should be contacted to inform them that a Level 1 Assessment is going to be conducted. The DOH may have instructions for the completion of this Assessment that will supersede what is written in this plan.

To conduct a sufficiently robust Level 1 Assessment the reader is advised to refer to the contents of the EPA publication 815-R-14-006 (September 2014):
http://water.epa.gov/lawsregs/rulesregs/sdwa/tcr/upload/epa815r14006.pdf
Refer to Appendix B in the above publication to meet minimum investigatory components via the example developed by the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee. This example is included here on the following two pages.

For clarification, descriptions of a Level 1 vs. Level 2 Assessment are shown below:

Table 6-1 Level 1 and Level 2 Assessment criteria

Level 1	Level 2
Confirmed Total Coliform contamination or failure to collect all required repeat samples	An E. coli MCL violation or a second Level 1 Assessment in rolling 12 month period
Performed by Water Utility staff -basic inspection.	Performed by personnel approved by DOH - more detailed than the Level 1 Assessment.
State provides template.guide for conducting Assessment.	State provides template.guide for conducting Assessment.
Submit to DOH within 30 days of trigger.	Submit to DOH within 30 days of trigger.
Look for sanitary defects or concerns with operations and maintenance.	Look for sanitary defects or concerns with operations and maintenance.
No public notification requirement.	Public notification requirement.

Per WAC 246-290-480 all documentation of any Level 1 Assessment and corrective action shall be maintained for a period of not less than 5 years and be available for DOH review at any time.

CONCEPT EXAMPLE
Level 1 Assessment Form
(Developed by the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee)

System Name:	Source Water:	PWSID #
System Type:	Population Served:	PWS Address:
Operator in Responsible Charge (ORC):	Phone:	
City, State:		
County:		
Person that collected TC samples if different than ORC:	Phone:	
Address, City, State, Zip:		
Date Assessment Completed:		

Questions	Reviewed? (check if completed or type N/A)	Issue(s) Found? (Y/N)	Issue Description	Corrective Action Taken (Including Date)
1. Evaluate sample site. -condition or location of tap -regular use of connection				
2. Sample protocol followed and reviewed. -flush tap -remove aerator -no swivel -fresh sample bottles -sample storage acceptable				
3. Have any of the following occurred at relevant facilities prior to the collection of TC samples? -any interruptions in the treatment process -any reported loss of pressure events (5 psi) -operation and maintenance activities that could have introduced total coliform -reported vandalism and/or unauthorized access to facilities -visible indicators of unsanitary conditions reported -Has there been a fire fighting event, flushing operation, sheared hydrant, etc.				
4. Have there been any recent operational changes to the system? -sources introduced -treatment or operational changes -potential sources of contamination				
5. Distribution System -system pressure -cross connection -pump station -air relief valves -fire hydrants or blow off -breaks -repairs				
6. Storage Tank -screens -security -access opening -condition of tank -vent -drain overflow -pressure tank -O&M				

EXAMPLE

CONCEPT EXAMPLE
Level 1 Assessment Form
(Developed by the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee)

Questions	Reviewed? (check if completed or type N/A)	Issue(s) Found? (Y/N)	Issue Description	Corrective Action Taken (Including Date)
7. Treatment Process -interruptions -POE/POU -softeners -O&M				
8. Source – Well -sanitary seal -vent screened -air gap -cross connection -security -pump to waste line				
9. Source – Spring -condition of spring development -condition of spring box -security				
10. Source - Surface Water Supply -heavy rainfall -rapid snowmelt				

EXAMPLE

Note: Form to be completed based on data and documents available to the PWS operator in charge, maintained on file and returned to the Primacy Agency within 30 days of triggering the assessment.

Additional Comments:

Print name of person completing form: Date:
Signature:

Reserved for State

1. Assessment has been successfully completed.
2. Likely reason for total coliform-positives occurrence is established.
3. System has corrected the problem.
4. Was a reset requested and / or granted? – Rationale
5. Name of State reviewer:

6.2 Level 2 Assessment

A Level 2 Assessment is a more detailed examination of the system, its operational practices and its monitoring program and results. The elements of a Level 2 Assessment may be the same as that of a Level 1 Assessment, but each element is investigated in greater detail. The party conducting the Level 2 Assessment is determined by the State of Washington Department of Health.

1. A Level 2 Assessment

A Level 2 Assessment is required to be conducted as soon as practical after the conditions that trigger this assessment. A Level 2 Assessment is required (40 CFR 141.859(a)(2)) to be conducted by a DOH approved entity to assure the safety of the potable water supply following either of the following scenarios:

a. An E coli maximum contaminant level (MCL) violation, or

b. The City has a second Level 1 Assessment within a rolling 12-month period unless the state has determined a likely cause for the situation that resulted in the initial Level 1 treatment technique trigger and establishes that the system has fully corrected the problem.

A Level 2 Assessment is defined in the code as "an evaluation to identify the possible presence of sanitary defects, defects in distribution system coliform monitoring practices, and (when possible) the likely reason that the system triggered the assessment. A Level 2 Assessment provides a more detailed examination of the system (including the system's monitoring and operational practices) than does a Level 12 Assessment through the use of more comprehensive investigation and review of available information, additional internal and external resources, and other relevant practices. Minimum elements include review and identification of atypical events that could affect distributed water quality or indicate that distributed water quality was impaired, changes in distribution system maintenance and operation that could affect the distributed water quality (included storage), source and treatment considerations that bear on distributed water quality, where appropriate existing water quality monitoring data, and inadequacies in sample sites, sampling protocol, and sample processing."

In all cases the state Department of Health should be aware that a Level 2 Assessment needs to be conducted. The DOH may have instructions for the completion of this Assessment that will supersede what is written in this plan. WAC 246-290-320 (2)(b) details state requirements.

To conduct a sufficiently robust Level 2 Assessment the reader is advised to work closely with the DOH to determine the appropriate personnel to conduct this review. For guidance, refer to the contents of the EPA publication 815-R-14-006 (September 2014):
http://water.epa.gov/lawsregs/rulesregs/sdwa/tcr/upload/epa815r14006.pdf
Refer to Appendix B in the above publication to meet minimum investigatory components via the example developed by the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee. This example is included here on the following five pages.

Per WAC 246-290-480 all documentation of any Level 2 Assessment and corrective action shall be maintained for a period of not less than 5 years and be available for DOH review at any time.

CONCEPT EXAMPLE
Level 2 Assessment Form
(Developed by EPA and the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee)

System Name:	Source Water:	PWSID #
System Type:	Population Served:	PWS Address:
Operator in Responsible Charge (ORC):	Phone:	
City, State:		
County:		
Person that collected TC samples if different than ORC:	Phone:	
Address, City, State, Zip:		
Date Assessment Completed:		

	Questions	Reviewed? (check if completed or type N/A)	Issue(s) Found? (Y/N)	Issue Description	Corrective Action Taken (Including Date)
1.	**Evaluate sample site**				
a.	What is the condition of the tap? **(Provide comments)**				
b.	What is the location of the tap? **(Provide comments)**				
c.	What is the regular use of the connection? **(Provide comments)**				
d.	Have there been any plumbing changes or construction? If yes, when and what was the repair or change?				
e.	Have there been any plumbing breaks or failure? If yes, when?				
f.	List any identified cross connections after the service connection or in premise plumbing. **(Provide comments)**				
g.	Were all of the backflow prevention devices present, operational and maintained?				
h.	Were there any low pressure events or changes in water pressure after the service connection or in the premise plumbing? If yes, when?				
i.	Are there any treatment devices after the service connection or in premise? **(Circle response, if applicable)**	Point of Entry (POE)	Point of Use (POU)		
j.	Other comments on sample site?				

EXAMPLE

CONCEPT EXAMPLE
Level 2 Assessment Form
(Developed by EPA and the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee)

	Questions	Reviewed? (check if completed or type N/A)	Issue(s) Found? (Y/N)	Issue Description	Corrective Action Taken (Including Date)
2.	**Sample protocol followed and reviewed**				
2.	Sample protocol followed and reviewed				
a.	Flush tap, remove acrator, no swivel, fresh sample bottles, sample storage acceptable				
3.	**Have any of the following occurred at relevant facilities prior to the collection of TC samples?**				
a.	Were there any operation and maintenance activities that could have introduced total coliforms?				
b.	Have there been any interruptions in the treatment process?				
c.	Has the system lost pressure to less than 5 psi?				
d.	Have there been any vandalism and/or unauthorized access to facilities?				
e.	Are there any visible indicators of unsanitary conditions observed?				
f.	Have there been any analytical results or any additional samples collected, including source samples which were positive (not for compliance)?				
g.	Have there been any community illness suspected of being waterborne (e.g., Does the community public health official indicate that an outbreak has occurred.)				
h.	Did the water system receive any TCR monitoring violations in the past 12 months? If yes, when.				
i.	What was the most recent date on which satisfactory total coliform samples were taken?	Date: _____			
j.	Have there been a fire fighting event, flushing operation, sheared hydrant, etc.				
k.	Other comments on records and maintenance?				
4.	**Have there been any recent treatment or operational changes?**				
a.	Have any inactive sources recently been introduced into the system (e.g., auxiliary systems)?				
b.	Have there been any new sources introduced into the system?				
c.	Is there evidence of any potential sources of contamination (main breaks, low pressure, high				

SAMPLE

CONCEPT EXAMPLE
Level 2 Assessment Form
(Developed by EPA and the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee)

	Questions	Reviewed? (check if completed or type N/A)	Issue(s) Found? (Y/N)	Issue Description	Corrective Action Taken (Including Date)
	turbidity, loss of disinfection, etc.)?				
5.	**Distribution System**				
a.	System pressure: Is there evidence that the system experienced low or negative pressure? If yes, when?				
b.	List any identified cross connections.				
c.	Pump station: Are there any sanitary defects in the pump station? Are pump(s) operable?				
d.	Last pump maintenance/service date. **(Respond if applicable)**	Date: _____		Maintenance Performed?	
e.	Air relief valves: Is the valve vault subject to flooding or does the vent terminate below grade?				
f.	Fire hydrant/blow off: Are any located in an area with a high water table or pits?				
g.	Is the distribution system secured to prevent unauthorized access?				
h.	Are the backflow prevention devices at high risk sites present, operational and maintained?				
i.	Have there been any water main repairs / additions? If yes when, and what was the repair or addition?				
j.	Have there been any water main breaks? If yes, when?				
k.	Was there any scheduled flushing of the distribution system? If yes, when?				
l.	Is there any evidence of intentional contamination in the distribution system?				
m.	Other comments on the distribution information.				
6.	**Storage Facilities**				
a.	Are the overflow and vents properly screened?				
b.	Is the facility secured to prevent unauthorized access?				
c.	Does the Access opening have the proper gasket and seal tightly?				
d.	Could the physical condition of tank be a source of contamination?				

EXAMPLE

CONCEPT EXAMPLE
Level 2 Assessment Form
(Developed by EPA and the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee)

	Questions	Reviewed? (check if completed or type N/A)	Issue(s) Found? (Y/N)	Issue Description	Corrective Action Taken (Including Date)
e.	Is the Vent turned down and maintain an approved air gap at the termination point?				
f.	Does the Drain/overflow line terminate a minimum of 12" air gap?				
g.	If present, Is the Pressure tank maintaining an appropriate minimum pressure?				
h.	Is proper O&M being performed?				
i.	Was there any observed physical deterioration of the tank?				
j.	Were there any observed leaks?				
k.	Is there any evidence of intentional contamination at the storage tank?				
l.	Have there been any facility maintenance? (i.e. painting/coating) If yes, when?				
m.	Is facility maintenance occurring per appropriate schedule?				
n.	Does the tank "float" on the distribution system or are there separate inlet and outlet lines?				
o.	What is the measured chlorine residual (total/free) of the water exiting the storage tank today?	Residual _____			
p.	Are there any unsealed openings in the storage facility such as access doors, vents or joints?				
q.	Other comments on the storage system				
7.	**Treatment Process. (If applicable)**				
a.	Treatment devices operational and maintained?				
b.	Is there any recent installation or repair of treatment equipment?				
c.	Were there any recent changes in the treatment process? If yes, when, what was the change?				
d.	Were there any interruptions of treatment (lapses in chemical feed, turbidity excursions, disinfection)? If yes which part, when and for how long?				
e.	What is the free chlorine residual measured immediately downstream from the point of application?	**Residual: ____**			

EXAMPLE

CONCEPT EXAMPLE
Level 2 Assessment Form
(Developed by EPA and the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee)

	Questions	Reviewed? (check if completed or type N/A)	Issue(s) Found? (Y/N)	Issue Description	Corrective Action Taken (Including Date)
f.	Did a review of the filter turbidity profiles reveal any anomalies?				
g.	Were there any failures to meet the CxT calculations?				
h.	Were the flow rates above the rated capacity?				
i.	Were there any anomalies on the settled water turbidities?				
j.	Other comments on the treatment system.				
8.	**Source – Well**				
a.	Is the sanitary seal intact?				
b.	Is the vent screened?				
c.	Does the vent and pump to waste terminate in an approved air gap?				
d.	Are there any unprotected cross connections at the wellhead?				
e.	How is the well used? **(Circle if applicable)**	Primary	Backup	Emergency	Not a PWS / Not Drinking Water
f.	How far does the casing extend above grade?	Height _____		Comments:	
g.	Is the well cap vented?				
h.	Is there evidence of standing water near the wellhead?				
i.	Is the wellhead secured to prevent unauthorized access?				
j.	Have there been any sewer spills, source water spills or other disturbances?				
k.	Other comments on the well system. (Are there aspects of well construction and operation that would bear on observed positives?)				
9.	**Source – Spring**				
a.	What is the condition of the spring development?				
b.	What is the condition of the spring box?				
c.	Is the spring secured to prevent unauthorized access?				

EXAMPLE

7.0 Public Notification and Compliance

This section will help to better explain violations associated with bacteriological sampling and required public notification. As with any public notification requirement, it is recommended that you contact the state Department of Health for any further notification and compliance issues immediately upon detection a total coliform-positive routine sample followed by an *E. coli* positive repeat sample (or an *E. coli*-positive routine sample followed by a total coliform-positive repeat sample), this is a serious potential health risk. This creates an acute, or short-term, violation that may have a more immediate health effect.

Table 7-1 Summary of public notification requirements of the revised TCR

Public Notification Requirements
E. coli MCL violation - Issued within 24 hours (Tier 1 violation)
• Routine total coliform + and repeat E. coli +
• Routine E. coli + and total coliform +
• Routine E coli + and system fails to take all repeat samples
• Repeat total coliform + and Analyst forgot to check for E coli presence
Treatment Technique violation - Issued within 30 days (Tier 2)
• System fails to conduct a required assessment within 30 days of the treatment technique trigger
• System fails to correct a sanitary defect within the required timeframe
Monitoring Violation - Issued within one year (Tier 3)
• System fails to collect all required routine samples
• Routine total coliform + sample not checked for presence of E. coli
Reporting Violation - Issued within one year (Tier 3)
• System fails to submit a monitoring report or completed assessment form in time
• System fails to notify DOH of an E coli + sample in a timely manner

A total coliform-positive routine sample followed by an *E. coli* positive repeat sample or an E coli positive routine sample followed by a total coliform-positive repeat sample is an Acute (Tier 1) violation. Two E coli positive samples constitute a clear Tier 1 acute violation and requires public notice within 24 hours.

Procedures for ACUTE (Tier 1) Violations
1. Notify the state Dept. of Health at by the end of the day you are notified by calling **(253) 395-6775** during business hours or **(877) 481-4901** after business hours. The Office of Drinking Water staff person on call will return the call within 30 minutes. 2. Notify the public within 24 hours by posting or hand delivery. You may also elect to notify the public by television, radio, or other methods approved by the DOH. *Note: Consider providing consumers with bottled water until the problem has been solved.*

A system that has failed to comply with a TCR requirement (for example, the sample siting plan requirement, or failure to take a routine or repeat sample) has committed a monitoring violation. Federal regulations detail how, when, and at what frequency notices for violations should be provided. Because different violations have different requirements, you should contact your state primacy agency for assistance when and how public notice is required.

Total Coliform positives > 5% of samples

A less serious but still significant potential health risk exists if more than 5% of routine samples (routine and/or repeat) in a month are total coliform-positive. At 90 routine samples, this means 4.5 monthly samples would be positive for total coliform. With the revision to the Total Coliform Rule (2016 implementation) an exceedance of the 5% positive is no longer an MCL violation. This means that public notification no longer needs to occur, BUT a Level 1 Assessment must occur within 30 days of being notified of the 5% exceedance. Refer to Section 6.1 of this Plan for information on a Level 1 Assessment.

8.0 Distribution of Routine Sampling Stations

Water samples are collected for bacteria analysis following the City laboratory's standard operating procedure: 1.1 Bacteria Sampling Procedure, which is included in Appendix 2.0 of this report. At the time of collection, a free chlorine residual sample is also taken utilizing a field colorimeter. If no free chlorine is detected, a HPC is analyzed for the site. Samples are transported at <6° C to the Water Treatment Plant shortly after their collection. These samples are analyzed by trained Lab Analyst at the state accredited laboratory at the City of Bellingham's Water Treatment Plant. Coliforms are analyzed by the Chromogenic Substrate Coliform Test, (SM 9223B), per the 23rd edition of Standard Methods for the Examination of Water and Wastewater, and in the laboratory procedure 1.2 Enzyme Substrate Coliform Test, which is included here in Appendix 3.0.

Routine sampling tap locations in the water distribution system are selected to proportionately represent the population consuming water in each of the City's eleven distinct pressure zones. Figure 8.0 breaks down the distribution of routine taps by zone.

Figure 8-1. Routine sampling stations by pressure zone (April 2021 population estimate)

		% POP*	TAPS :	% of Total	DIFF
North (Gravity)	35,721	36.7	30	29.7	**-7.0**
South	24,359	25.0	20	19.8	**-5.2**
Dakin Yew	13,993	14.4	18	17.8	**3.5**
Cordata	12,111	12.4	12	11.9	**-0.6**
Alabama Hill	3,661	3.8	4	4.0	**0.2**
Padden-Yew	3,654	3.8	7	6.9	**3.2**
College Way	1844	1.9	3	3.0	**1.1**
Governor Road	864	0.9	1	1.0	**0.1**
Reveille	411	0.4	1	1.0	**0.6**
King Mountain	370	0.4	2	2.0	**1.6**
Birch Street	253	0.3	1	1.0	**0.7**
Huntington	110	0.1	1	1.0	**0.9**
Samish Hill	32	0.0	1	1.0	**1.0**
	97,383	100.0	**101**	100.0	

*Working to get more North and South Zone taps for the next TCRP update. Wanted to get unrepresented zones this update.

Also important in assessing water quality is the evaluation of dead end and/or low-pressure areas, reservoirs, and consecutive system feed lines. In an effort to adequately represent all water delivered by the City, routine stations are selected to also represent these specific water characteristics. It is important to note that current population estimates put the actual service population inside the Bellingham city limits at 89,902 with the remaining 7,481 residing in areas outside of the incorporated urban boundary.

Prioritization will be on ensuring sampling station distribution closely represents the service population per zone. Focus was made with this update on getting taps in unrepresented zones Birch and Huntington. Despite the fact that 4 new taps were added to the North Zone and 2 to the South Zone, to maintain representation based on customer base, additional taps in these zones will be an area to focus for future sampling station installations.

9.0 Total Coliform Plan Maintenance Program

Some of the possible changes that should be reflected in the next update to the Coliform Monitoring Plan would be any of the following: an addition or deletion of pump stations, reservoirs, or pressure zones; a hydraulic re-routing that would impact pressure zones; an expansion of a distribution area; or, the addition of sampling sites.

The Public Works Superintendent will inform the Laboratory Technical Supervisor, should the service population near the next trigger value of 130,001 customers. At this time, ten additional sampling stations will be added. This Plan will also be updated to ensure proper State notification.

Public Works Laboratory staff receive full training on the Total Coliform Rule Plan with each update. Staff enact potential scenarios where the Plan would need to be activated. Training has also occurred at intervals greater than the revision cycles.

The City has set up the protocol of preemptively adding sampling stations to parts of its distribution network that require new city infrastructure. This includes areas recently incorporated into the City urban growth or service area, such as Cordata north and the Bellingham waterfront redevelopment at the former Georgia Pacific Mill site.

APPENDIX 1.0

Appendix 1.0: Sample Tap by Pressure Zone and System Status

Pressure Zone	Taps	Representative	Dead end	Reservoir	Pump Station	Consecutive System
North	Hilton Avenue*		1			
	Alabama & Woburn	1				
	North & Elm	1				
	Franklin & E. Illinois	1				
	Lakeway & James	1				
	Eldridge & Lindbergh	1				
	W Maplewood & McLeod	1				
	McLeod & James	1				
	Oeser Cedar		1			yes
	Virginia		1			
	Pinewood & Birchwood	1				
	State & Berry		1			
	Squalicum & Roeder*	1				
	Alderwood & Bennett	1				
	Dupont & I	1				
	City Hall	1				
	Commercial & Chestnut		1			
	Peabody & Victor	1				
	Henry & Monroe	1				
	Granary & Laurel	1				
	E and Logan	1				
	Cornwall & Pine		1			
	St. Jopseph Hospital*	1				
	Orchard St	1				
	Deemer @ Firestation	1				
	Kentucky & Ellis		1			
	W Maplewood & Cottonwood	1				
	Whatcom Falls Res	1		yes		
	1314 E Maplewood	1				
	2021 Totals	22	7			

*Heavey food/fish processing or medical facilities

Pressure Zone	Taps	Representative	Dead end	Reservoir	Pump Station	Consecutive System
College Way	Elwood & Ridgeway		1			
	17th & Douglas		1			
	College Way	1		yes		
	2021 Totals	1	2			

Pressure Zone	Taps	Representative	Dead end	Reservoir	Pump Station	Consecutive System
South	4th & Harris	1				
	14th & State	1				
	15th & Douglas	1				
	18th & Fairhaven		1			
	19th & McKenzie	1				
	24th & Mill	1				
	30th and Church		1			
	32nd & Donovan	1				
	34th and Donovan	1				
	Bayside & Willow		1			
	Linden & Fieldston	1				
	Forest & Palm	1				
	E Oak (Sehome Res.)	1		yes		
	Otis St. Pump Station	1			yes	
	E Maple and Jersey	1				
	Laurel & Liberty	1				
	College Way	1		yes		
	Chuckanut Drive	1				
	Larrabee State Park		1			
	Underhill		1			
	2021 Totals	15	5			

Pressure Zone	Taps	Representative	Dead end	Reservoir	Pump Station	Consecutive System
Cordata	Northwest & Sterling	1				
	Horton Rd.		1			
	Mahogany and Ambrosia		1			
	B.A.C.	1				
	Kline Rd. & Spring Vista		1			
	Pacific Hwy	1				
	Mitchell Way		1			
	Larson/Grady Way		1			
	Short Street P/S	1			yes	
	Kearney Reservoir	1		yes		
	Curtis Road	1				yes
	Northwest & Larrabee	1				
	Lummi-Marine Dr.		1			yes
	2021 Totals	7	6			

Pressure Zone	Taps	Representative	Dead end	Reservoir	Pump Station	Consecutive System
Dakin-Yew	Treated	1		yes		
	Nevada and Edwards		1			
	Dakin 1 Res.	1		yes		
	Academy (Dakin 2 Res.)	1		yes		
	Mt Baker Hwy	1				formerly
	Britton Rd.		1			yes
	Northshore Dr.		1			yes
	Control Dam	1				
	Lakeside		1			yes
	Strider Loop	1				
	Division St.	1				
	Michigan St.	1				
	Huntington & E. North		1			
	Everson Goshen Rd.		1			
	Lakeway & Bonanza	1				formerly
	Fir St.		1			
	Vining St. Park	1				
	Ava Lane	1				
	2021 Totals	11	7			

Pressure Zone	Taps	Representative	Dead end	Reservoir	Pump Station	Consecutive System
Padden-Yew	Reveille Res.	1		yes		
	Consolidation Res.	1		yes		
	40th St. Reservoir	1		yes		
	Padden Res.	1		yes		
	Ashley & Dumas	1				
	Ridgemont		1			
	Timberlake Way		1			
	Padden Estates		1			yes
	2021 Totals	5	3			

Pressure Zone	Taps	Representative	Dead end	Reservoir	Pump Station	Consecutive System
Reveille	KGMI		1			
	2021 Totals		1			

Pressure Zone	Taps	Representative	Dead end	Reservoir	Pump Station	Consecutive System
Alabama Hill	Northern Heights*	1				
	Woodside Way	1				
	Holly Court		1			
	Balsam Lane (Sylvan)	1			yes	
	2021 Totals	3	1			

*McCleod & Magrath

Pressure Zone	Taps	Representative	Dead end	Reservoir	Pump Station	Consecutive System
King Mountain	Winslow Court		1			
	Frances Ave	1				formerly
	2021 Totals	1	1			

Pressure Zone	Taps	Representative	Dead end	Reservoir	Pump Station	Consecutive System
Governor	Harrison		1			
	2021 Totals		1			

Pressure Zone	Taps	Representative	Dead end	Reservoir	Pump Station	Consecutive System
Huntington	E Oregon & Huntington		1			
	2021 Totals		1			

Pressure Zone	Taps	Representative	Dead end	Reservoir	Pump Station	Consecutive System
Birch	Birch Falls		1			
	2021 Totals		1			

Pressure Zone	Taps	Representative	Dead end	Reservoir	Pump Station	Consecutive System
Samish Hill	Parkhurst Res.	1		yes		
	2021 Totals	1				

APPENDIX 2.0

1.1 BACTERIA SAMPLING PROCEDURE

REFERENCE

Standard Methods for the Examination of Water and Wastewater, 23rd edition, 2017. American Public Health Association, American Water Works Association, and the Water Environment Federation, Method 9060.

Manual for the Certification of Laboratories Analyzing Drinking Water, 5th edition, 2005. U.S. Environmental Protection Agency publication #815-R-05-004.

SAFETY

Sampling in unknown areas and neighborhoods can be dangerous. Communicate with the laboratory supervisor or other designated laboratory staff when leaving and returning from sample collection activities. When collecting environmental samples use appropriate personal protection equipment. Refer to the laboratory water work safety protocol (Attachment A). When collecting samples near roadways, wear a reflective vest or jacket, turn on vehicle strobe or flashers, use traffic cones when additional visibility is warranted, and position your vehicle in such a manner as not to be hit by it if it is struck from behind (see Attachment B).

SUMMARY OF METHOD

The City of Bellingham performs a variety of bacterial sampling and analyses. The baseline monitoring program, total coliform monitoring program, new main disinfection, customer service requests (CSR), urban stream monitoring program, and source water monitoring are examples of the types of samples that may be sampled and analyzed in the City of Bellingham Water Filtration Plant Laboratory. Analyses includes total coliform (TC), fecal coliform (FC), *Escherichia coli*, and heterotrophic bacteria.

Sample collection is an integral part of bacteriological analysis. Without well documented, aseptic, and well-planned sampling technique the analytical results will be questionable. Samples are usually collected in an environment that is not under the direct control of the laboratory staff, thus, special care must be taken to follow aseptic techniques. General sample collection procedures for bacterial analysis of either treated (distribution system or customer complaint) or untreated (source or environmental sample) water are described below. All samples should be collected in appropriate sterile sample bottles such as polypropylene (PP) bottles that will withstand the rigors of repeated autoclaving. Never rinse sample bottles with sample. Always leave ample air space in the bottle for mixing. In the instance of treated distribution system samples, a minimum of a one-inch air gap is required in the container to facilitate proper mixing of the sample.

Routine distribution system sampling locations are maintained at least annually to reduce potential for sample contamination. Sample taps should be maintained by:

- Clearing foliage in the vicinity of the station,
- Inspecting for leaks and adequate flows,
- Carefully oiling hinges and padlock to assure ease of access,
- Clean tap with weak bleach solution and a clean rag. Flush well.

Immediate cleaning should be done on any sample tap that appears dirty in order to avoid sample contamination.

A. TREATED WATER:

EQUIPMENT AND REAGENTS

1. Sterile 125 milliliter (ml) PP sample bottles containing approximately 0.1 ml 3% sodium thiosulfate* (autoclave with sodium thiosulfate at 121°C for 15 minutes)
2. Chlorine field meter, Hach DR 850 (or equivalent)
3. DPD powder for free chlorine analysis
4. Applicable field data form
5. Keys: COB key card, 4E25, 3EO3, and AB1 (for many distribution system sites)
6. Cooler and ice
7. Propane torch with safety starter attachment
8. Clean rag
9. Weak bleach solution
10. Manual hand pump for draining taps
11. Dechlorination tablets in mesh bag.
12. Traffic cones and safety vest/coat (see Appendix B)
13. Wasp spray, as needed seasonally

*Per Standard Methods for the Examination of Water and Wastewater, a 3% sodium thiosulfate ($Na_2S_2O_3$) solution is considered sufficient strength to quench a water sample containing < 5 milligrams per liter (mg/L) free chlorine. Make 3% $Na_2S_2O_3$ using aseptic technique. Thoroughly dissolve 30 milligrams (mg) $Na_2S_2O_3$ + 5 H_2O in 1 (liter) L lab pure water and store in a clean stoppered container in media refrigerator.

PROCEDURE

Routine Distribution Sampling:

1. If sampling the distribution system for Total Coliform Rule compliance, use a sampling station designated for this purpose. The City has a minimum number of routine distribution samples it must collect each month as described in WAC 246-290-300.
   In some unusual circumstances (frozen tap, tap in disrepair) another site may be used to represent the distribution system, but only under consultation with the lab supervisor. The following criteria must be followed if a non-routine tap is used:
   - Tap is free of aerators, strainers, hose attachments, mixing type faucets and purification devices.
   - Only a designated cold-water line is used.
2. Immediate maintenance should be initiated on a sample tap if the sampler observes any of the following:
   - Evidence of insects, dirt, or other debris. Clean tap with weak bleach solution and clean rag, flush tap for a minimum of 5-minutes, then flame tap prior to sampling.
   - Leaks shall be reported the same day to the Water Supervisor with the request made for quick repair.
3. Prior to entry to any reservoir notify the operator on duty of your planned entry. This can either be done at the beginning of the day for all sites to be entered or via radio upon arrival at each site.

4. Ensure that any entry alarm is acknowledged upon entry to the facility and reset upon leaving the facility. Consult the site alarm list maintained in the distribution system sampling tap location manual.
5. When sampling water reservoirs; make every attempt to sample while the tank is in a drain cycle (vs. filling).
6. Flame sample tap with a propane torch if there is any potential for tap contamination. Use best professional judgment to determine if flaming is needed and appropriate.
7. Allow the tap to run for 3 minutes prior to sampling. Adequate flushing is necessary to ensure that water representing the water main is sampled. Be sure this water runs directly through the dechlorination tablets in mesh bag.
8. Adjust the flow rate from the tap so that the jet of water breaks sharply away without lapping the outside lip of the tap or splashing.
9. Determine the free chlorine residual of the water using a chlorine field meter (Chlorine Residual, Free and Total Measurement with a Field Meter Procedure) and record on the field sheet. If value is $\leq$0.02 mg/L free chorine, also analyze for total chlorine and collect an HPC sample.
10. Ensure bottle is labeled with sample ID. Note date and time collected on field sheet.
11. Keep sample bottle closed until it is to be filled.
12. Clean hands with alcohol hand sanitizer and/or use disposable gloves, which should be cleaned with alcohol hand sanitizer as well.
13. Collect the sample:
    a. Hold the sample bottle at or near the bottom and loosen the cap.
    b. Carefully remove the lid and hold the bottle under the flow. Be careful not to touch the neck or inside of the bottle or cap.
    c. Hold the cap in hand during sampling to avoid contamination.
    d. Ensure that a minimum of 100 mls of sample is collected.
    e. Fill the bottle to within 1 inch of the top to maintain adequate space for mixing. DO NOT OVERFILL THE BOTTLE.
    f. Replace the lid and make sure the labeling is still legible.
15. Be alert for any unusual conditions surrounding the sampling event. Examples of such conditions could include unusual smells, the presence of turbidity, a level of free chlorine residual which is unusual for the area, or the presence of air in the lines. These conditions may indicate a problem with the water main or an intentional contamination event. As such, observation of any of the following should be communicated immediately to the lab supervisor.
16. During winter months, ensure that the tap is fully drained by intentional purging with the manual hand pump. This practice will prevent frozen water lines.
17. Store the bottle on ice in the dark during transport to the laboratory. Hold samples at $< 10^{\circ}$ C during transport to the laboratory. NOTE: It is important to avoid freezing the sample. Avoid direct contact between ice packs and samples for prolonged periods of time, which may cause freezing. Insulate ice with bubble wrap or thick paper to avoid direct contact with sample bottles as needed.
18. Complete the sampling forms including date, time, initials of sampler, sample location, lab number, the sample type including the residual chlorine value, and any comments.
19. Follow the guidelines for sample holding times described in the Storage section of the pertinent bacterial analysis standard operating procedures (SOP).

20. Upon return to the lab note the date, time, and initials of the person receiving sample(s) on the applicable lab benchsheet or Washington State Department of Health Coliform Bacteria Analysis Form.
21. Ensure the sample is analyzed the day it is received in the lab. Analysis can only be performed the following day if the time between sample collection and placement of sample in incubator does not exceed 30 hours.

Customer Complaint Sampling (CSR):

1. If sampling for a CSR or special project, select a representative sample site that is located in as clean an environment as possible. Use best professional judgment when selecting the sampling location and follow the guidelines below:
    - Remove any hoses, aerators, or strainers.
    - Ideally the tap should have a cold-water handle separate from the hot water handle. Sample from the cold-water tap, unless a sample is needed to confirm that the problem originates from the hot water tank.
    - Verify that no point-of-use water purification system is on the tap and confirm with the homeowner that no device such as an in-home filter is present on the supply line. Such devices may cause contamination of the sample.
    - Refuse to sample from an outside hose-bib even if the homeowner suggests this location.
2. DO NOT FLAME TAPS IN A HOME.
3. If the complaint is not related to premise plumbing, allow the tap to run for 3 minutes to flush the tap prior to collecting a sample. Adequate flushing is necessary to ensure that water representing the water main is sampled. A change in temperature and/or free chlorine residual from the cold-water tap is often a good indication that the water is coming from the water main.
4. In some instances, it may be of diagnostic benefit to sample both the stagnant water line and the line after it has been flushed as described above. Similarly, it may be of benefit to sample both the hot and cold line to assess conditions in the home. Best professional judgment should be used to determine the appropriate bacterial sampling protocol based on the complaint.
5. Follow the sampling procedures detailed in Routine Sampling items 7 – 21 (with the exception of item 16) above for proper documentation and transport to the laboratory.
6. Upon return to the lab note the date, time, and initials of the person receiving sample(s) on the applicable lab benchsheet or Washington State Department of Health Coliform Bacteria Analysis Form. DO NOT ASSIGN A DOH NUMBER FOR CSR'S. These samples are not considered routine samples.

B. SOURCE WATER AND ENVIRONMENTAL SAMPLING:

EQUIPMENT AND REAGENTS

1. Sterile 250/500 ml PP sample bottles without sodium thiosulfate (autoclave at 121°C for 15 minutes)
2. Weighted sampler (dedicated)
3. Long-handled dipper (as needed)
4. Field sampling form
5. Cooler and ice
6. AB1 Key
7. Disposable gloves (optional)
8. Traffic cones and safety vest/coat (see Appendix B)

PROCEDURE

Source Water Sampling:

1. Every week source water samples at the gatehouse and screenhouse are collected for bacterial analysis. A minimum of ~~nine~~ ten individual samples for fecal coliform analysis and four individual samples (collected the first two weeks of the month) for total coliform analysis are collected each month. Samples may also be collected from bulk water entering the Water Filtration Plant as long as it has not been chlorinated.
2. Prior to collecting a source water sample notify the operator that you will be entering the gatehouse and/or screenhouse.
3. Use the AB1 key to enter the gatehouse/screenhouse building.
4. Acknowledge the entry alarm immediately upon entering the building. If the alarm is not acknowledged an intruder alert will be sent to the operator. The alarm is located in the main entry room of the gatehouse and in the room to the right in the screenhouse.
5. The gatehouse site has a sample hatch and dedicated weighted sampler for sampling. Use the AB1 key to unlock the inner gate. The sample hatch and sampler are located to the left of the entrance and then to the right of the inner gate the hatch is at floor level. The sampler is located next to the hatch. The screenhouse is sampled upstairs southwest of the traveling barscreens and the weighted sample holder is secured with a rope next to the sampling hatch.
6. If possible, pre-label bottles with sample identification. Note date and time collected on field sheet.
7. Keep sample bottle closed until it is to be filled.
8. Clean hands with alcohol hand sanitizer and/or use disposable gloves, which should be cleaned with alcohol hand sanitizer as well.
9. Collect the sample:
    a. Place a 250ml PP bottle in the weighted sample holder that is retained at each site.
    b. Carefully remove the lid to the sample bottle. Be careful not to touch the neck or inside of the bottle or cap and avoid knocking the sides of the sample hatch opening with any part of the sampling apparatus. Keep the sampler rope clean and do not allow it to touch the floor or sides of the sample hatch.
    c. Hold the cap in hand during sampling to avoid contamination.
    d. Plunge the sampler with bottle into the water below the surface. Try to fill the bottle to within 1 inch of the top to maintain adequate space for mixing. If the

bottle does not have enough headspace immediately pour off some of the water to leave at least 1 inch of headspace.

e. Replace the lid and make sure the labeling is still legible.
f. Return the weighted sampler to its designated storage place.

10. Be alert for any unusual conditions surrounding the sampling event. Examples of such conditions could include unusual smells or the presence of turbidity. These conditions may indicate an intentional contamination event. As such, any observation of unusual conditions should be communicated immediately to the lab supervisor.
11. Make sure door is dead bolted upon leaving the facility and that the alarm is reset. When closing the door, the gatehouse and screenhouse doors will lock, but you will need to use your AB1 key to ensure the doors are dead bolted.
12. Store the samples on ice at < 10° C in the dark during transport to the laboratory. NOTE: It is important to avoid freezing the sample. Avoid direct contact between ice packs and samples for prolonged periods of time, which may cause freezing. Insulate ice with bubble wrap or thick paper to avoid direct contact with sample bottles as needed.
13. Complete the sampling forms including date, time, initials of sampler, sample location, lab number, the sample type, and any comments. Be sure to check the Raw Water Source Sample box on the Washington State Department of Health Coliform Bacteria Analysis Form.
14. When entering the lab, check the temperature of raw water samples utilizing the infrared (IR) digital sensing thermometer and record this value on the DOH slip. Check the IR thermometer against the NIST corrected thermometer in the media fridge and record the difference between the two thermometers on the temperature benchsheet on the media fridge. If the comparison varies by > 0.5 C, calibrate the IR thermometer.
15. Follow the guidelines for sample holding times described above in Routine Sampling items 19- 21. Environmental samples need to be analyzed within 8 hours of collection.

Environmental Sampling:

1. When collecting samples directly from a river, stream, storm drain, or lake, obtain samples representative of the water that is sampled.
    - It is undesirable to take samples too near the bank. Take special precaution to avoid stagnant or backwater areas if these do not represent the reach being sampled.
    - Establish sampling locations at critical sites and scale the sampling frequency as needed. For example, if sampling recreational water to determine bacterial densities, use a grid-based locational selection with multiple sampling sites. If sampling the same system at more than one location, take precautions not to disrupt the conditions leading to your next sample (i.e. always sample downstream to upstream).
    - Use best professional judgment to safely obtain the most representative sample.
2. If possible, pre-label bottles with sample identification. Note date and time collected on field sheet.
3. Keep sample bottle closed until it is to be filled.
4. Clean hands with alcohol hand sanitizer and/or use disposable gloves, which should be cleaned with alcohol hand sanitizer as well.
5. Collect the sample:
    a. Hold the sample bottle at or near the bottom and loosen the cap.

b. Carefully remove the lid and plunge the bottle, neck downward, below the water surface.
c. Turn the bottle until neck points slightly upward and mouth is directed toward the current. If there is no current, create a current artificially by pushing bottle forward horizontally in a direction away from the hand.
d. Be careful not to touch the neck or inside of the bottle or cap.
e. Hold the cap in hand during sampling to avoid contamination.
f. Fill the bottle to within 1 inch of the top to maintain adequate space for mixing. DO NOT OVERFILL THE BOTTLE.
g. Replace the lid and make sure the labeling is still legible.

6. Store the bottle on ice at < 10° C in the dark during transport to the laboratory, do not freeze. NOTE: It is important to avoid freezing the sample. Avoid direct contact between ice packs and samples for prolonged periods of time, which may cause freezing. Insulate ice with bubble wrap or thick paper to avoid direct contact with sample bottles as needed.
7. Complete project sampling forms including information such as date, time, initials of sampler, sample location, lab identifier, the sample type, and any comments.
8. Environmental samples need to be received in the lab within 6 hours of collection and the lab must analyze samples within 2 hours of receipt.
9. If it is not possible to collect a representative sample by hand, select one of the following alternatives:
    - Use a weighted line attached to a sample bottle and lower apparatus into the water to be sampled.
    - Use a long-handled sample pole with the sample bottle firmly attached to reach out into a representative portion of the water to be sampled.

QUALITY CONTROL PROCEDURES

Follow quality control procedures described in the applicable bacterial analysis SOP.

Laboratory staff should note on the sample benchsheet if a sample comes into the lab at >10° C.

Samples should be rejected if they show evidence of any of the following:

- freezing,
- presence of free chlorine,
- turbidity,
- any other condition deemed sufficient to interfere with analysis.

ATTACHMENT A

WATER WORK SAFETY PROTOCOLS

OVERVIEW

Collection of water-quality samples or data can be as simple as hand dipping water from a slow-moving stream or placing a probe in the water to as complex as using heavy power equipment while working from a cableway. Know the safety steps needed for any sampling method used.

The types of water work conducted by City of Bellingham Public Works Operations Division laboratory personnel include, but are not limited to, water temperature and discharge monitoring, and Urban Stream water quality monitoring using a Quanta hydrolab probe and hand dipping water samples from the stream. Employees are encouraged to obtain representative samples and measurements of each system, which frequently requires the employee to enter the water to obtain them. This document provides safety guidelines associated with work conducted near or in water. These guidelines were adapted from United States Geological Survey (USGS) National Field Manual for the Collection of Water-Quality Data (Lane and Fay, 1997).

NEAR WATER WORK

Personal flotation devises (PFD) are strongly recommended when employees are working near water. There are certain circumstances when the use of PFDs is mandatory. These conditions include water work in remote locations, work in large or potentially hazardous systems such as the Middle Fork of the Nooksack River, and any work where the employee will be entering the water for more than several seconds.

The employee must use their best professional judgment on the use of PFDs at all times as stream conditions change and what constitutes safe entry at certain times of year does not apply to others. In the non-mandatory conditions, the decision to use PFD will rest on the best judgment of the employee entering the water as to whether a potentially hazardous condition exists.

WADING

When surface-water work requires that an employee enter the water to obtain samples or measurements under conditions considered potentially hazardous as mentioned in the preceding section it is advisable that another employee accompany them to assist from shore.

When assessing stream wadability, examine the section of a stream or river you plan to wade. Check the field folder for information relating to safety, including maximum depths in relation to stage, wading-section anomalies such as slippery conditions and drop-offs or holes (a wading rod can be used to help assess streambed conditions), and velocity curves for determining wadable stages. **Do not attempt to wade a stream for which values of depth multiplied by velocity equal or exceed 10 ft^2/s.** For example, a stream only 2 ft deep but with velocities of 5 ft/s or more can be dangerous to wade.
The guidelines below are part of the City of Bellingham laboratory water work requirements:

- Wear a personal flotation device (PFD) during wading activities.

    - Approved PFDs for wading include the standard jacket type and the suspender type. The PFD must fit properly, be rated for your weight, and be in good condition.
    - The PFD should be dried and kept indoors between trips.
- Wear hip boots or chest waders. Boots and waders provide protection from cold and pollutants, as well as from underwater objects (Joseph, 1957).
    - Be aware of the possibility of slipping and going underwater while wearing hip boots or chest waders.
    - Hip boots with a strap at the top are better than boots that are open. The strap should be pulled closed. This allows air to be trapped in the boot in case you are submerged. The air cushion can be used as a partial mechanism for flotation until you reach shore or are rescued.
    - Avoid hip boots with tight ankles. These are difficult to remove in an emergency situation. **Whenever hip boots are worn, a PFD also must be worn.**
    - Avoid chest waders that are tight fitting at the top. Like tight-ankled hip boots, they are difficult to remove in an emergency situation. **Whenever chest waders are worn, a PFD also must be worn.**
- Be aware of surrounding conditions.
    - Watch for debris floating downstream, i.e. logs or aquatic vegetation.
    - Watch for sand channels that can shift under foot and become quicksand.
    - Watch the stream stage, especially when it could rise rapidly.
    - When wading downstream and within the influence of a dam or control structure, contact the gate operator before entering the stream.
- A harness and safety line can be used as an added safety measure.

WORKING ON BRIDGES

For every bridge site, develop and diagram a detailed procedure that pertains to the specific conditions of the site and reference any applicable state and federal regulations. Keep this procedure and diagram in the field folder. The bridge procedure includes plans for safety cones and signs, lane blockage, and traffic control.

Equipment used for sampling from a bridge can be heavy and unwieldy. Practice assembling and using the equipment before starting field activities, and make sure the equipment is operational before leaving the lab. When using a bridge crane, keep a pair of heavy-duty wire cutters readily available for cutting the cable in case debris snags the sounding line.

Be aware of boat traffic. The bridge crane cable should have strips of bright plastic flagging attached in intervals to make it easily visible to all boat traffic.

A PFD must be worn when working on bridges. The suspender type PFD is approved for bridge work.

Workers involved in peripheral activities should wear high-visibility vests with reflective tape.

ATTACHMENT B

OVERVIEW

Collection of water samples from roadways can present a safety risk. Try never to have your back to oncoming traffic and follow the safety steps below for any sampling method used.

1. Park next to the curb or as far off the roadway as possible.
2. When possible, park in such a manner that backing up will not be necessary to leave the site.
3. If there is not enough room or if there is heavy traffic, find a safer place to park and walk to the sample stations.
4. Once parked, turn on the 4-way flashers or strobe light.
5. If the vehicle is positioned before the sample station and on fairly level ground, turn the wheel away from the sample location in case the city vehicle is stuck from behind -- that way the city vehicle will be pushed away from the sampler.
6. A reflective safety vest or jacket will always be worn while working on or next to a roadway.
7. Exit the vehicle safely, always aware of oncoming traffic. Never leave the vehicle in idle upon departure per the City's anti-idling policy.
8. Place 3 traffic cones 3-paces apart behind your vehicle, where room is available. Note: parking in a designated parking spot may not allow for cones because of lack of space.
9. Angle the cones towards the curb/edge of the roadway, starting from the vehicle's rear bumper (driver's side) even if you are pulled off the street.
10. When the task is completed, pick up the cones being aware of traffic, carefully enter the vehicle, turn off the strobe light and proceed to the next location.





REFERENCES

Joseph, Jack, 1957, Don't die with your boots on: Outdoor Life, v. 119, no. 4, p. 70.

Lane, S.L., and Fay, R.G., October 1997, Safety in field activities: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A9, accessed November 21, 2005 at http://pubs.water.usgs.gov/twri9A9/

APPENDIX 3.0

1.8 ENZYME SUBSTRATE COLIFORM AND *E.COLI* TEST - COLITAG®

REFERENCE

Standard Methods for the Examination of Water and Wastewater, 22nd edition, 2012. American Public Health Association, American Water Works Association, and the Water Environment Federation, Method 9223 B.

CPI International Colitag® product information sheets.

SAFETY

Although the medium used in this analysis is not considered hazardous, it is still advisable to follow prudent laboratory practices for avoiding contact, (i.e., breathing, touching) of a laboratory reagent or material. Take all safety precautions as required by the Lab Chemical Hygiene Plan. Read and understand all applicable material safety data sheets (MSDS).

SUMMARY OF METHOD

Colitag®, an enzyme substrate (aka chromogenic/fluorogenic substrate) test medium, is used for the simultaneous detection, specific identification, and confirmation of total coliforms and *Escherichia coli* in water. As the target organisms metabolize the nutrients and specific indicators in Colitag a yellow color is produced, which confirms the presence of total coliforms. A fluorogenic substrate is used to detect the enzyme β-D-glucuronide, which is produced by *E.coli*. Non-coliform bacteria are suppressed and cannot metabolize the indicator nutrients. Therefore, they do not interfere with the specific identification of the target microbes during the test incubation period.

The City of Bellingham directly supplies over 86,300 residents of Bellingham and some adjacent county lands with potable water. The City's distribution system is divided into eight major pressure zones and currently contains a minimum of 90 routine monthly sampling sites. Samples are collected throughout the month at designated sampling stations. Sample sites were selected to represent each of the pressure zones and reservoirs, major distribution branches, feed lines to consecutive systems and areas of concern, such as ends of distribution system zones.

City of Bellingham drinking water distribution system samples are collected by trained laboratory staff, transported on ice to the Water Treatment Plant (WTP) shortly after collection, and analyzed using the enzyme substrate (aka chromogenic/fluorogenic substrate) test in the City's State accredited laboratory located within the WTP. In addition, the laboratory also maintains accreditation in the total coliform membrane filtration method. If coliform presence is detected, laboratory staff shall take action as summarized in Section 4 of the City of Bellingham Total Coliform Rule Monitoring Plan.

EQUIPMENT AND REAGENTS

1. CPI Colitag snap-packs (CPI PN: 4600-0012)
2. Sterile, calibrated 100 milliliter (ml) non-fluorescent borosilicate glass bottle
3. Colitag color and fluorescence comparator (CPI PN: 4600-0040)
4. Long Wavelength (6 watt, 365-366nm) ultraviolet lamp
5. 44.5°C water bath
6. Timer
7. Wire basket
8. Coated lead doughnuts
9. 35°C incubator
10. Drinking water sample (100 ml)

STORAGE

Maintain samples at < 10°C during transport to the lab. It is best to analyze samples the same day of receipt, but if this is not possible do not exceed 30 hours holding time.

Protect Colitag snap-pack media from direct sunlight because the indicator compounds may be hydrolyzed, creating a false-positive (yellow) result. Store the media in a cool, dry location and discard caked or discolored media. Also discard any media that has passed the manufacturer's expiration date.

PROCEDURE

1. Collect sample as per SOP #1.1 in a sterile sample bottle with 0.1 ml of 3% sodium thiosulfate to quench any chlorine residual.
2. Shake sample vigorously (approximately 25 times) and pour 100 ml into a sterile glass bottle.
3. Carefully separate one Colitag snap-pack from the strip taking care not to accidentally open the next pack.
4. Tap the Colitag reagent snap-pack to ensure that all the powder is in the bottom part of the pack.
5. Aseptically open one pack by snapping back at the score line. **Caution: Do not touch the opening of pack**.
6. Add the contents of the pack to the water sample.
7. Mix thoroughly by inverting bottle several times to achieve even distribution of media throughout the sample. Some particles may remain undissolved. Dissolution continues during incubation.
8. Incubate sample at 44.5 ± 0.2°C for 7 to 10 minutes in the "plates" waterbath. Set the lab timer and keep it with you. Place bottles in a wire basket on top of the lead doughnuts or other spacer to keep the sample bottle caps above the water level. The water level should be above the upper level of the sample in the bottle.
9. After initial 44.5 °C incubation, transfer the bottles to the 35 ± 0.5°C incubator for 16 to 22 hours.
10. Once the samples are in the incubator, record the sample information pertinent to this analysis on the Washington State Department of Health Coliform Bacteria Analysis Form.

11. After at least 16 hours or before 22 hours, compare each sample against the color comparator. Color should be uniform throughout the vessel. If not, mix by inversion before reading. Read and interpret results per Table 1.

Table 1: Sample interpretation for Colitag.

Sample Appearance	Result
Less yellow than the Colitag Comparator	Negative for total coliforms and *E.coli*
Yellow equal to or greater than the Colitag Comparator	Positive for total coliforms IMMEDIATELY CHECK FOR FLUORESCENCE
Under longwave UV lamp (365 nm) fluorescence equal to or greater than the Colitag Comparator	Positive for *E.coli* Consult City of Bellingham Total Coliform Rule Monitoring Plan Section 4.0 Overview of Response to Coliform Positive Sample.

11. On the Washington State Department of Health Coliform Bacteria Analysis Form (SOP 1.7: DOH form SOP.doc) fill out the Drinking Water Results section.

QUALITY CONTROL PROCEDURES

Perform Colitag media quality control procedures (SOP # 2.15 Colitag QC) to test for sterility, performance with positive and negative controls, and pH verification for each new lot of media received and every quarter that the lot is in use.

TROUBLESHOOTING

- Non-coliform bacteria, such as *Aeromonas* and *Pseudomonas* species, may produce small amounts of the enzyme β-d-Galactosidase, but are suppressed and generally will not produce a positive response within the incubation time unless more than 10^4 colony-forming units (CFU)/ml (i.e. 10^6 CFU/100ml) are present.
- Some strains of *Shigella* spp. may produce a positive fluorescence response. However, because *Shigella* spp. are human pathogens, this will give an indication that the water is not considered sanitary.
- If there is background color, compare inoculated tubes to a control tube containing only water sample.

CALCULATIONS

No calculations are necessary. Report results as total coliform and/or *E. coli* present or absent in 100-ml sample.

APPENDIX R

COLIFORM MONITORING PLAN

CITY OF BELLINGHAM

DEPARTMENT OF PUBLIC WORKS OPERATIONS DIVISION

TOTAL COLIFORM RULE MONITORING PLAN

10/27/2021 rev. 7











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TOTAL COLIFORM RULE MONITORING PLAN
City of Bellingham Department of Public Works Operations Division

1. INTRODUCTION

The City of Bellingham provides approximately 89,902 in-city and 7,481 adjacent-county residents with direct potable water service. Total water produced by the City of Bellingham (City) in 2020 was 2.97 billion gallons. The City water utility is managed by the Department of Public Works Operations Division (PWOps). The PWOps Division is responsible for planning, design, construction, operation, maintenance, sampling, and compliance reporting for this water system.

The State of Washington Department of Health (DOH) through Washington Administrative Code 246-290-300, and the Federal Total Coliform Rule (TCR) (Title 40 CFR Parts 141.21 & 141.63) requires public water systems to implement a Coliform Monitoring Plan, and to collect potable water samples for total coliform and *E. coli* analysis from their distribution system based upon this written plan. For Group A systems like the City of Bellingham, the plan consists of such elements as: a description of the distribution system; system maps depicting sample collection sites placed to reflect the distribution system in its various pressure zones, sampling information; and actions to take in the event of a positive coliform sample.

The City's water distribution system consists of over 427 miles of water lines ranging in size from 66 inches down to 2 inches. The distribution system is divided into thirteen pressure zones that currently contain 101 utilized sampling stations. Routine sample sites are selected to represent each of the pressure zones and reservoirs, major distribution branches, pump stations, feed lines to consecutive systems, and areas of concern, such as ends of distribution system zones. The rationale of sample site per zone is included as Appendix 1.0. Those designated as "dead end" stations are within several connections of the end of the zone or at a distribution line that terminates. These sites are generally expected to have less favorable water quality conditions and lower disinfectant residuals. Some of these stations will be redistributed to "representative" stations as water main extensions are made to accommodate growth.

Samples are collected throughout the month at a minimum of 100 of these routine sampling stations. City of Bellingham laboratory staff are responsible for collecting, analyzing and reporting all coliform compliance samples. The Coliform Monitoring Plan is an important part of this effort.

The City last updated its Coliform Monitoring Plan in 2015 in response to revisions to the Total Coliform Rule which required different responses to the presence of coliform in the distribution system. This current Plan has been updated to reflect an estimated service population of >96,001 and the need to include 10 additional sampling stations per WAC 246-290-300.

This Plan details the specifics of the City distribution system as it pertains to the Total Coliform Rule. It also outlines an appropriate response to a potential violation of the Total Coliform Rule. This way, there is assurance of prompt and proper notification, sufficiency in the information collected, and ultimately, integrity of treated water all the way to the customer's tap.

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2. SYSTEM DESCRIPTION

This section gives pertinent system information as specified in DOH publication #331-036 (revised). *Preparation of a Coliform Monitoring Plan* (April 2013).

Table 2-1 City of Bellingham System Information

Water System Information:		Additional Information
Water System name:	**City of Bellingham**	**Department of Public Works**
System ID Number:	WA 056003	
County:	Whatcom	
Source:	DOH Source Number – S01	
Source Name(s):	Lake Whatcom	
	Middle Fork Nooksack	Diversion of water from the Middle Fork of the Nooksack River supplements Lake Whatcom water
Source Category:	Surface	Lake Whatcom
Source Location:	Sec: 28 Twn: 38N Range: 03E	Lat: 48.765 Long: 122.415
Treatment Plant Location:	3201 Arbor Court Bellingham, WA	
Process Utilized:	Particulate removal by dissolved air floatation, coagulation, and mixed bed in-line filtration. Corrosion control by addition of soda ash. Disinfection and oxidation by self-generated sodium hypochlorite.	
Total population served:	**97,383**	
Inside City limits:	89,902	
Outside of City limits:	7,481	
Number of Housing Units	46,085	
Total pressure zones:	13	

Water System Information:		Additional Information
Minimum Number of routine monthly samples:	100	10 sampling taps added in 2021 to accommodate 96,001 customers
Reservoirs:	14	
Total Reservoir Capacity	27,750,000 gallons	
Pump/Booster Stations:	15	Currently in use
Zone:	**Population Served in Each Pressure Zone (04/2021)[1]:**	**% of Total Service Population in Each Pressure Zone:**
Alabama Hill	3,661	3.8%
Birch Street	253	0.3%
College Way	1,844	1.9%
Cordata	12,111	12.4%
Dakin and Yew	13,993	14.4%
Governor Road	864	0.9%
Huntington	110	0.1%
King Mountain	156	0.4%
North (gravity)	35,721	36.7%
Padden Yew	3,654	3.8%
Reveille	411	0.4%
Samish Hill	32	0.0%
South	24,359	25.0%
TOTAL:	**97,383**	
Zone:	**Routine Sampling Stations**	**% of Sampling Taps in Each Pressure Zone:**
Alabama Hill	4	4.0%
Birch Street	1	1.0%
College Way	3	3.0%
Cordata	12	11.9%
Dakin and Yew	18	17.8%
Governor Road	1	1.0%
Huntington	1	1.0%
King Mountain	2	2.0%
North (gravity)	30	29.7%
Padden Yew	7	6.9%
Reveille (aka Upper Yew)	1	1.0%
Samish Hill	1	1.0%
South	20	19.8%
TOTAL:	**101**	

1. City of Bellingham GIS layer of water pressure zones as of 04/14/2021. Includes student population from dormitories at WWU.

Water System Information:		Additional Information
Distribution reservoirs:	**Continue here: Zone Served:**	**Tank Capacity (gal):**
Clearwell	Gravity/Dakin-Yew	1,000,000
College Way	College Way	500,000
Contact –Time Res (CT)	North (gravity)	16,000,000
Consolidation	Padden-Yew	500,000
Dakin 1	Dakin-Yew	500,000
Dakin 2	Dakin-Yew	500,000
Reveille	Padden-Yew	300,000
40th Street	Padden-Yew	500,000
Kearney	Cordata	2,500,000
Marietta*	Cordata (off-line)	(3,000,000)
Padden (38th St)	Padden-Yew	450,000
Parkhurst	Samish Hill	185,000
Sehome	South	750,000
Whatcom Falls	North (gravity)	3,800,000
	Total Reservoir Capacity:	**27,485,000**
Distribution pump stations:	**Zone Served:**	**Number of pumps:**
Balsam Lane	Alabama Hill	4
Birch Street	Dakin-Yew	3
College Way	College Way	6
Consolidation	Padden-Yew (feeds Reveille Reservoir)	1
Dakin/Consolidation	Dakin-Yew (feeds Consolidation and Dakin #1 and #2 Reservoirs)	5
Governor	Upper-Yew (out of 40th Reservoir into Parkhurst Reservoir)	3
James Street	North/King	2
Huntington	Dakin-Yew	2
Otis Street	South	4
Raymond	Serves one home in Padden-Yew	1
Reveille	Upper Yew	2
Short Street	Cordata	7
38th Street	Padden-Yew	3
Woburn Street	Dakin-Yew. Station to maintain fire flows but can be used to fill Dakin #1 and #2 Reservoirs if necessary.	4
Samish Highlands	Reveille	2

*North gravity zone does not need the 3 million gallons of storage, so this reservoir is currently offline.

Table 2-2 City of Bellingham Water Pump Stations.

Pump Station	Service Zone	Location	Location Zone*
James St. Reservoir	North	James St, across from 4188 James	
Otis	South	Otis St, Lot 19, Block 22	
Birch Street	Dakin-Yew	Birch St. at Birch Falls Drive	
Samish Highlands	Reveille	4300 Samish Crest Lane	Samish Hill
Dakin-Yew	Dakin-Yew	At WTP	
Woburn	Dakin-Yew	2838 Woburn	North
Huntington	Dakin-Yew	End of 900 block, Huntington St	
Short	Cordata	Short St, behind 4165 Meridian Way	
Consolidation Reservoir	Padden-Yew	Consolidation, S of 801 Yew St	
Reveille Res.	Padden-Yew	2400 Reveille St	
38th St.- Padden Res.	Padden-Yew	38th St, Behind 3800 Broad St	
Raymond	Padden-Yew	Serves one single-family residence	
Balsam Lane/Dakin Res.	Alabama Hill	End of Balsam Lane	
Governor	Upper-Yew	1895 Governor	Padden-Yew
College Way	College Way	Highland & W. College Way	

*Pump stations are not always located within the boundaries of the zone they serve

Table 2-3 City of Bellingham Water Reservoirs.

Reservoir Name	Service Zone (for stored water)	Location	Volume (gallons)	Location Zone*
Clearwell	Dakin-Yew	Inside WTP	1,000,000	
CT- Reservoir	North	WTP & Whatcom Falls Park	16,000,000	
		Total Capacity Before Full Contact Time:	**17,000,000**	
Kearney	Cordata	James St. near Springcreek Ln	2,500,000	
Marietta	Cordata	Behind 1402 Marietta Drive	(3,000,000)	(Offline)
Whatcom Falls	North	WTP & Whatcom Falls Park	3,800,000	
Padden	Padden-Yew	38th St, Behind 3800 Broad St	450,000	
Sehome	South	Jersey St, Sehome Hill Park	750,000	
College Way	College Way	Highland & W. College Way	500,000	
Consolidation	Padden-Yew	Consolidation, S of 801 Yew St	500,000	
Dakin 1	Dakin-Yew	End of Balsam Lane	500,000	Alabama Hill
Dakin 2	Dakin-Yew	End of Balsam Lane	500,000	Alabama Hill
40th St.	Padden-Yew	South of Mill & 40th	500,000	Upper Yew
Reveille	Padden-Yew	2400 Reveille St	300,000	
Parkhurst	Samish Hill	Off of Parkhurst Road	185,000	
		Total Capacity at Full Contact:	**10,485,000**	

Before Contact Time
After Contact Time

*Reservoirs are not always located in the boundaries of the zone they serve

Table 2-4 City of Bellingham Water Average Daily Demand (ADD) by pressure zone (gpm). Taken from the 2013 update to City of Bellingham Water System Plan Update.

Pressure Zone	2012	2018	2022
North[1] - elevation 276	**2,917**	**3,152**	**3,172**
Cordata[2] - elevation 350	**804**	**869**	**1,107**
South[3] - elevation 457	**1,335**	**1,443**	**1,442**
King Mountain - elevation 519	**9**	**10**	**41**
Dakin & Consolidation[4] - elevation 519	**826**	**896**	**905**
Birch Street - elevation 780	**10**	**11**	**16**
College Way - elevation 541	**52**	**56**	**56**
Padden Yew - elevation 696	**282**	**305**	**336**
Alabama Hill - elevation 730	**221**	**239**	**276**
Reveille[5] - elevation 830	**17**	**19**	**63**
Governor Road[5] - elevation 873	**53**	**57**	**106**

1. Includes Montgomery Rd. Water Assoc. and Water Dist. #2
2. Includes Deer Creek Water Assoc.
3. Includes California St. Water Assoc.
4. Includes the elevation 660 Huntington pressure zone, LWWSD (east side of lake), Water Dist #7, and Glen Cove Water
5. In the 20-year planning horizon Reveille and Governor will be combined into Samish Hill Zone (elev. 870)

Table 2-5 City of Bellingham Water Main Sizes.

Water Main Diameter (inches)	Length (feet)	Miles
Unknown	2,308	0.4
1	703	0.1
2	2,973	0.6
4	116,569	22.1
6	510,943	96.8
8	804,490	152.4
10	153,570	29.1
12	314,416	59.5
14	4,724	0.9
16	138,405	26.2
20	61,819	11.7
24	46,635	8.8
30	7,526	1.4
36	10,959	2.1
42	101	0.0
48	18,078	3.4
60	972	0.2
66	1,541	0.3
72	59,884	11.3
Grand Total	**2,256,616**	**427.4**

All laboratory analysis for the Total Coliform Rule is performed in the City of Bellingham Ecology accredited laboratory at the Water Filtration Plant. Methods for which the laboratory currently maintains accreditation include: SM 92223 B (Colilert), SM 9222 D (FC plate), SM 9222 B (TC plate), EPA 1603$_{mod}$ (EC plate), and SM 9215 B (HPC via R2a agar).

Table 2-6 City of Bellingham Laboratory Information.

Lab and Plant Information:		Additional Information
Laboratory Name	City of Bellingham Water Plant Lab	Lab ID WA 00116
Address:	3201 Arbor Ct. Bellingham, WA 98229	(note no mail service)
Hours of Operation	Monday-Friday 06:30 to 17:00	After hours by request
Lab Contact Name:	Peg Wendling, Technical Supervisor	(360) 778-7870
Water Plant Contact:	Nick Leininger, Chief Operator	(360) 778-7890
Address to contact:	2221 Pacific Street Bellingham, WA 98229	

3. SYSTEM MAPS

The figures on the following pages illustrate the different pressure zones in the City of Bellingham's water distribution system, along with their corresponding routine sampling locations. Table 3-1 below details where to find each of the maps included here. Figure 3-1 shows all of the City of Bellingham pressure zones while Figures 3-2 through 3-14 show each pressure zone individually including water distribution reservoirs, sampled pump stations and sample taps in their correct physical locations, starting with the North Zone which is the City's largest zone by population, and ending with the Samish Hill zone, the City's smallest. In Figures 3-2 to 3-14 the locations of all sampling stations are shown as they are physically located, most of which are in the zone the water represents. Note, the 40th Street and Dakin 1 Reservoirs and Padden-Yew and Woburn pump stations are not located in the zone these facilities serve. A spreadsheet is included in Appendix 1.0 which lists each sampling station and the actual zone it feeds or represents.

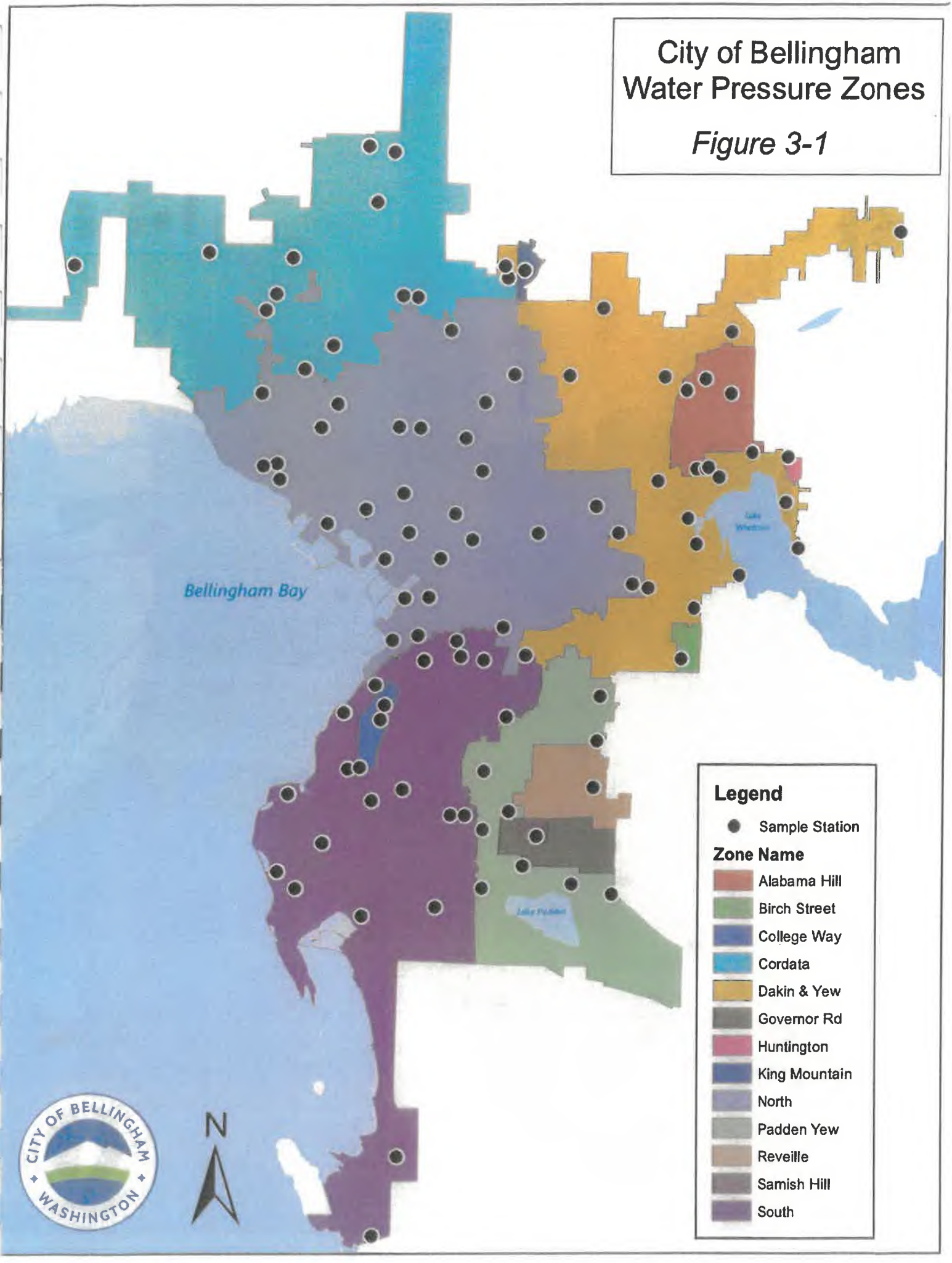
Table 3-1 Diagram with the pages and figure numbers for relevant distribution system maps.

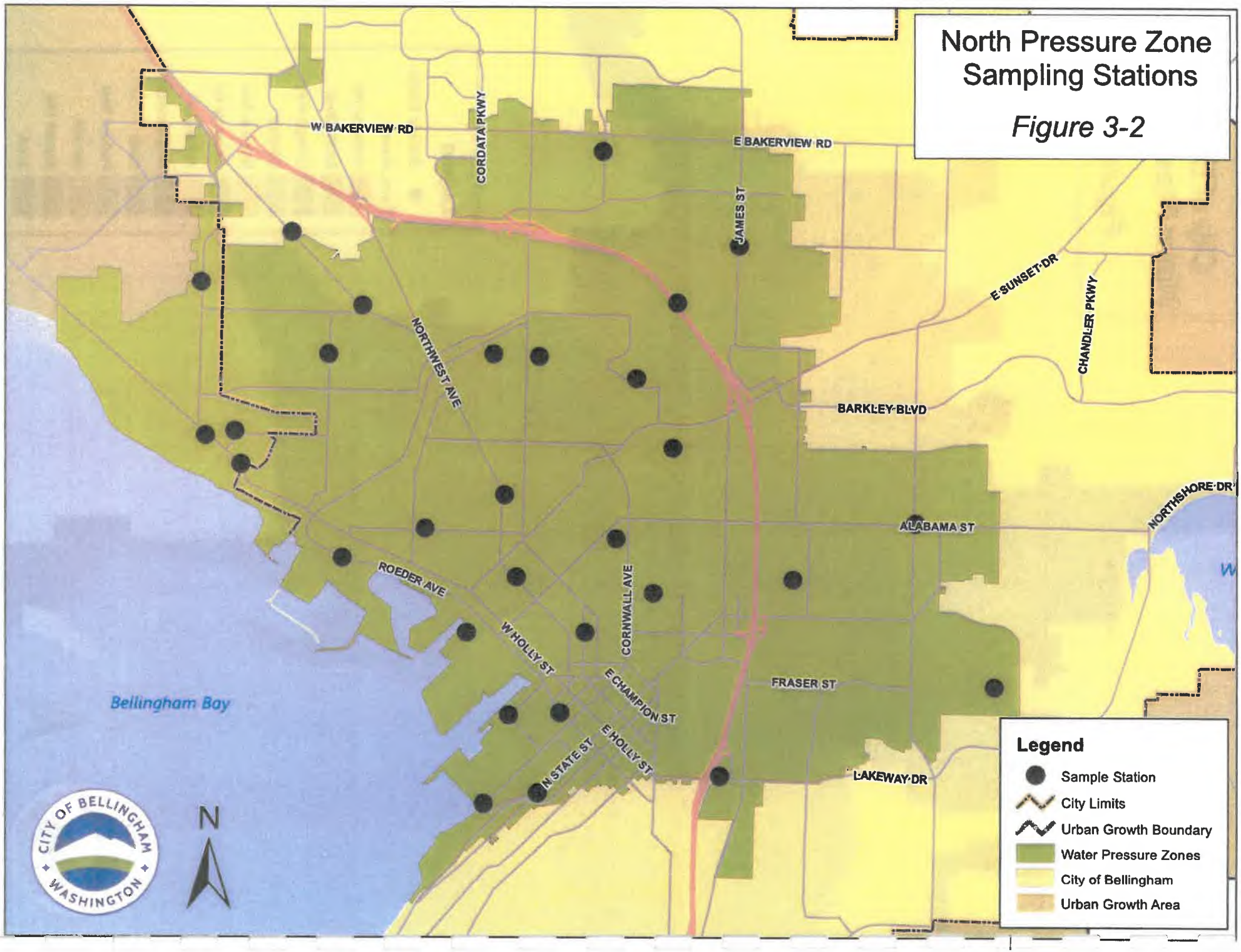
Page in Report	Figure #	Description
Page 11	Figure 3-1	City of Bellingham Water Pressure Zones
Page 12	Figure 3-2	North Pressure Zone Sampling Stations
Page 13	Figure 3-3	South Pressure Zone Sampling Stations
Page 14	Figure 3-4	Dakin -Yew Pressure Zone Sampling Stations
Page 15	Figure 3-5	Cordata Pressure Zone Sampling Stations
Page 16	Figure 3-6	Alabama Hill Pressure Zone Sampling Stations
Page 17	Figure 3-7	Padden-Yew Pressure Zone Sampling Stations
Page 18	Figure 3-8	College Way Pressure Zone Sampling Stations
Page 19	Figure 3-9	Governor Pressure Zone Sampling Stations
Page 20	Figure 3-10	Reveille Pressure Zone Sampling Stations
Page 21	Figure 3-11	King Mountain Pressure Zone Sampling Stations
Page 22	Figure 3-12	Birch St. Pressure Zone Sampling Stations
Page 23	Figure 3-13	Huntington Zone Sampling Stations
Page 24	Figure 3-14	Samish Hill Zone Sampling Stations

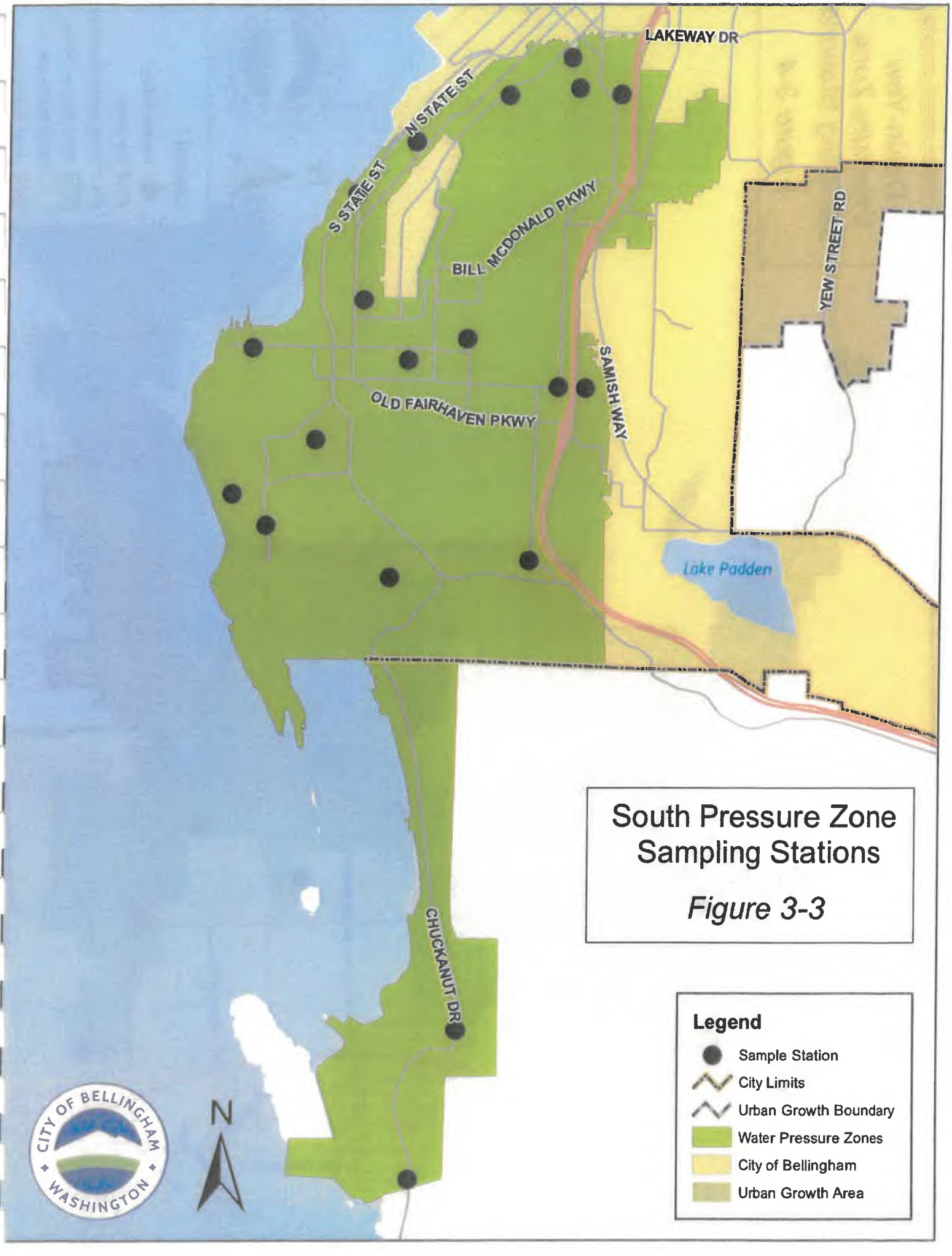
Routine sample taps used for TCR compliance are displayed on the figures with a black dot. There are a total of 101 routine stations sampled per month. Ten sample taps were added with this 2021 revised TCR Monitoring Plan to maintain compliance with WAC 246-290-300, when it was determined that the population served by the City of Bellingham had exceeded 96,001. These ten sites were selected to best represent the conditions and growth in the City's distribution network and are presented in Table 3-2 on the following page.

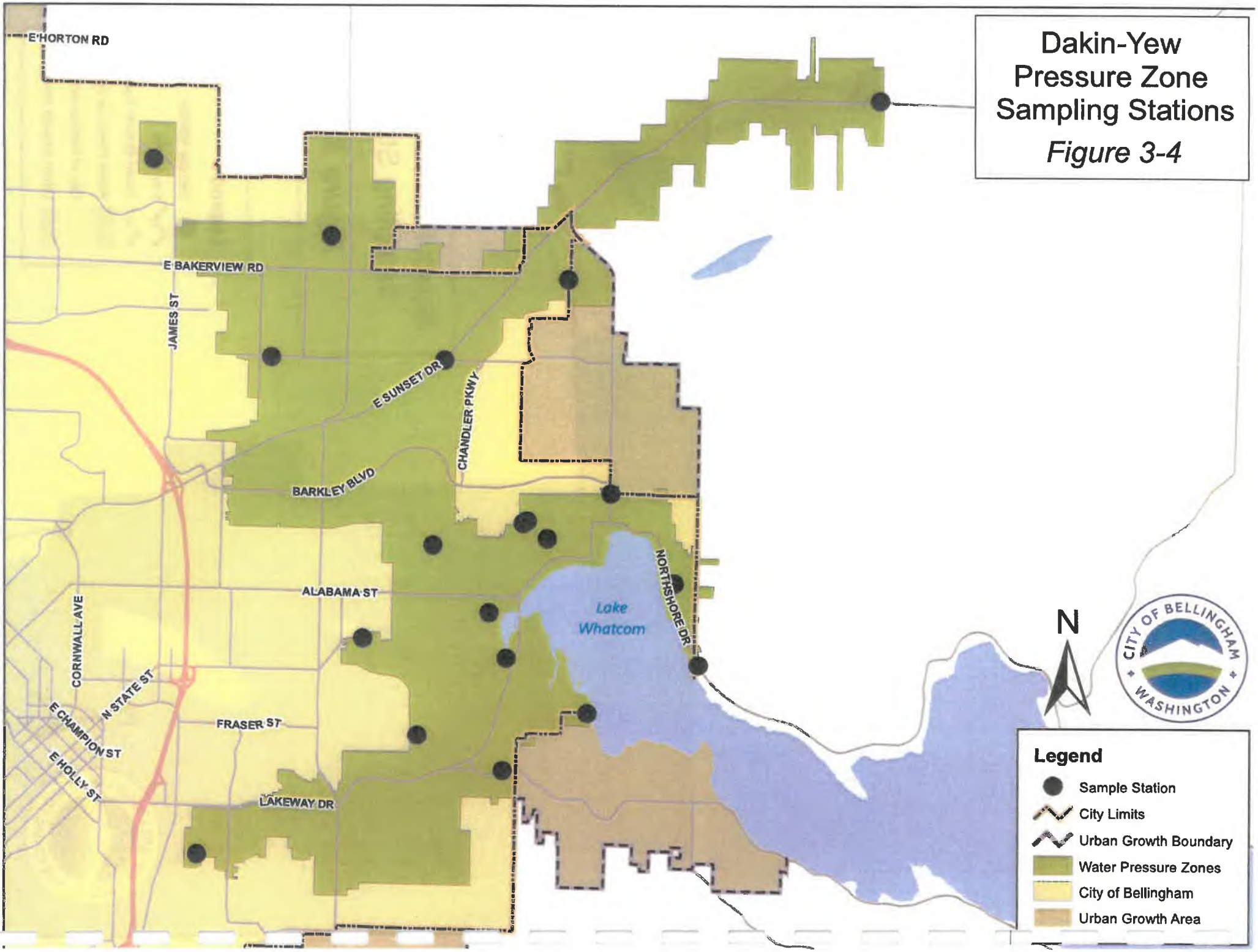
Table 3-2 Stations added to Bellingham's Total Coliform Rule sampling inventory in 2021

Sample Tap	Pressure Zone	Description
Granary & Laurel	North (gravity)	Highest zone by population
1314 E Maplewood	North	Largest zone
Birchwood Ave. & I-5	North	Largest zone
Hilton	North	Largest zone – food processors
34th & Donovan	South	Second largest zone by population
30th & Church	South	Second largest zone
Mahogany & Ambrosia	Cordata	Area experiencing high growth
Kline Road & Spring Vista	Cordata	Area experiencing high growth
E Oregon & Huntington	Huntington	First and only tap in this zone
Birch Falls	Birch Street	First and only tap in this zone


City of Bellingham
Water Pressure Zones
Figure 3-1
Bellingham Bay
Legend
Sample Station
Zone Name
Alabama Hill
Birch Street
College Way
Cordata
Dakin & Yew
Governor Rd
Huntington
King Mountain
North
Padden Yew
Reveille
Samish Hill
South
N
CITY OF BELLINGHAM
WASHINGTON

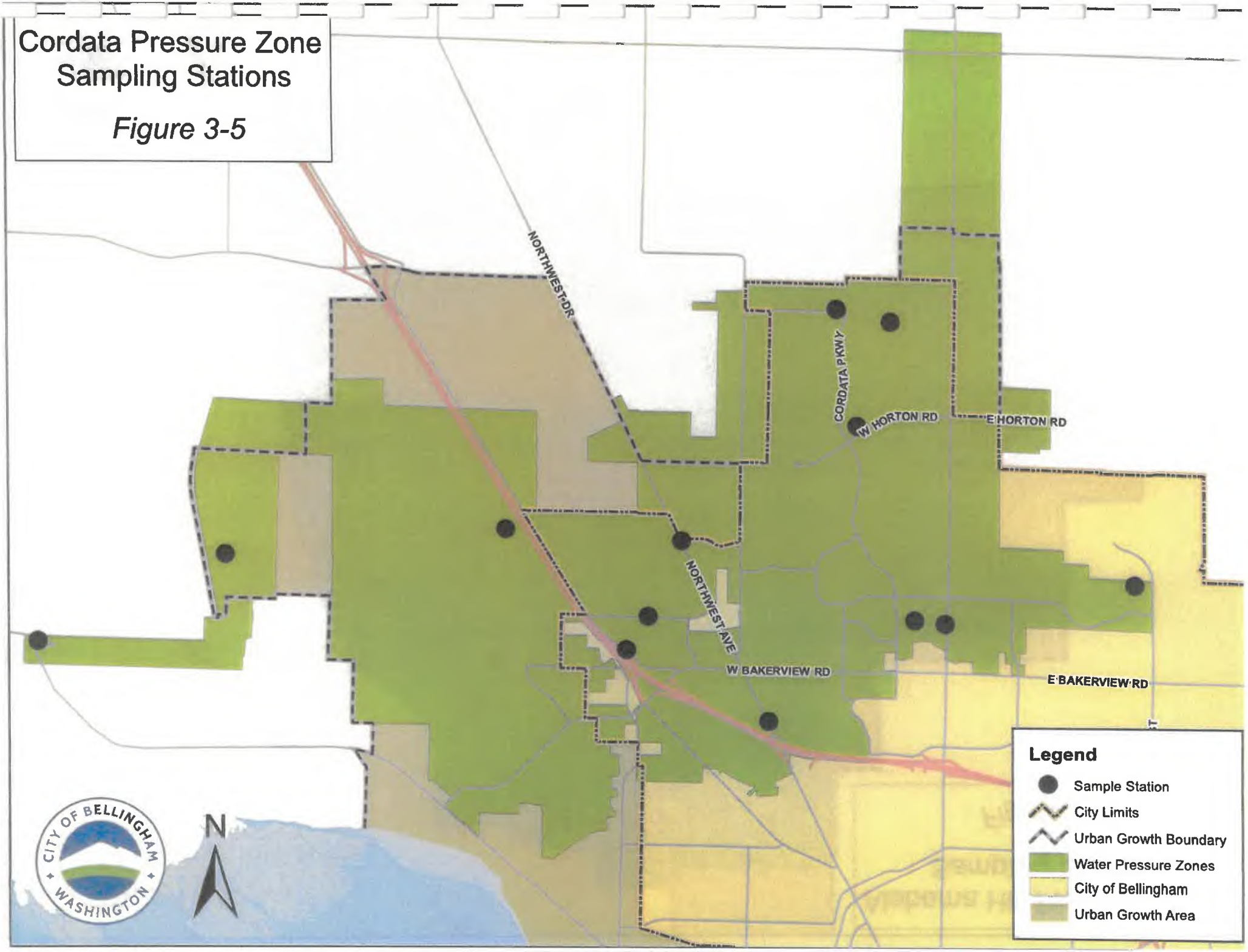

North Pressure Zone Sampling Stations
Figure 3-2
W BAKERVIEW RD
E BAKERVIEW RD
CORDATA PKWY
JAMES ST
E SUNSET DR
CHANDLER PKWY
NORTHWEST AVE
BARKLEY BLVD
NORTHSHORE DR
ALABAMA ST
ROEDER AVE
CORNWALL AVE
W HOLLY ST
E CHAMPION ST
FRASER ST
E HOLLY ST
N STATE ST
LAKEWAY DR
Bellingham Bay
CITY OF BELLINGHAM WASHINGTON
N
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area

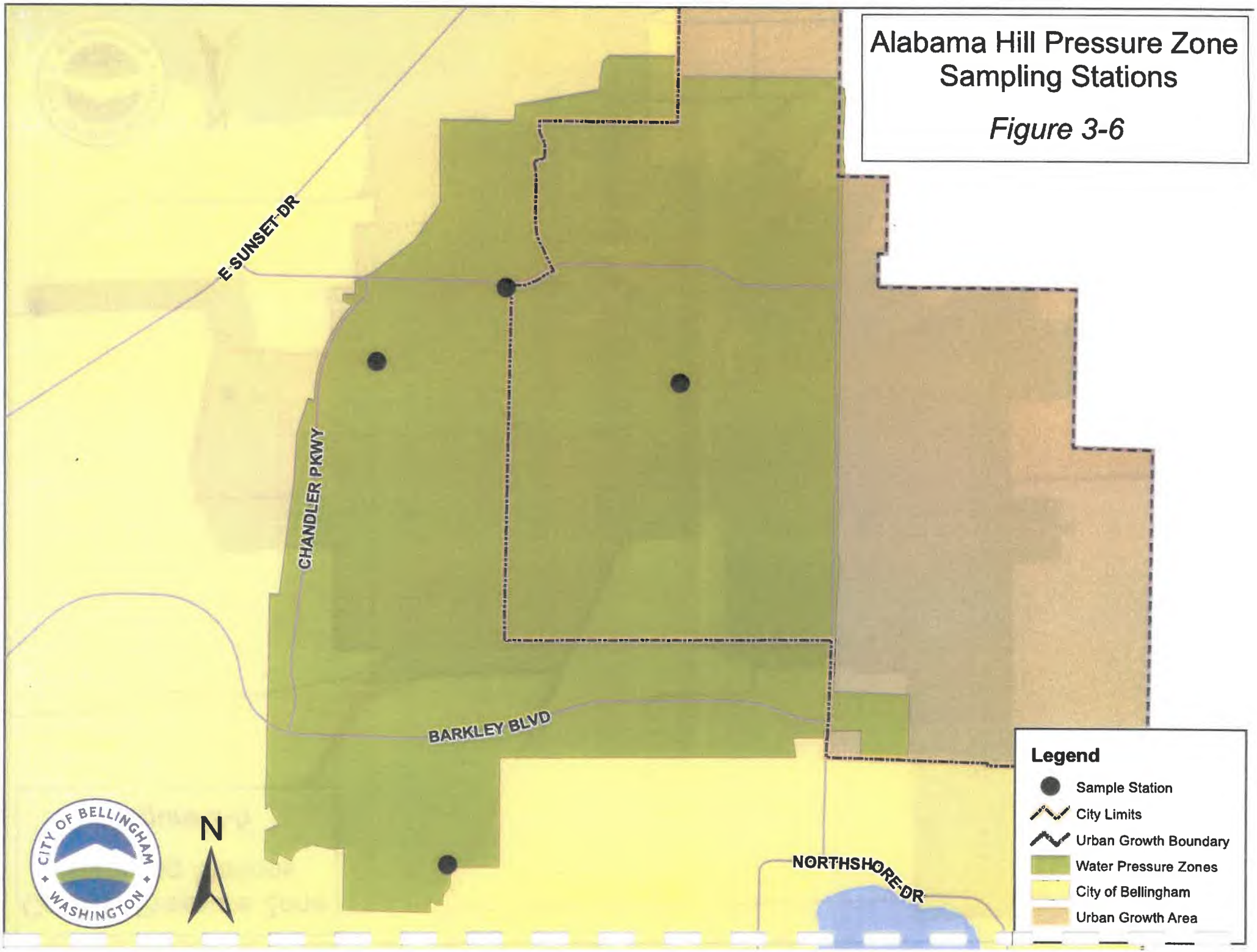

LAKEWAY DR
N STATE ST
S STATE ST
BILL MCDONALD PKWY
YEW STREET RD
SAMISH WAY
OLD FAIRHAVEN PKWY
Lake Padden
CHUCKANUT DR
South Pressure Zone
Sampling Stations
Figure 3-3
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area
CITY OF BELLINGHAM
WASHINGTON
N

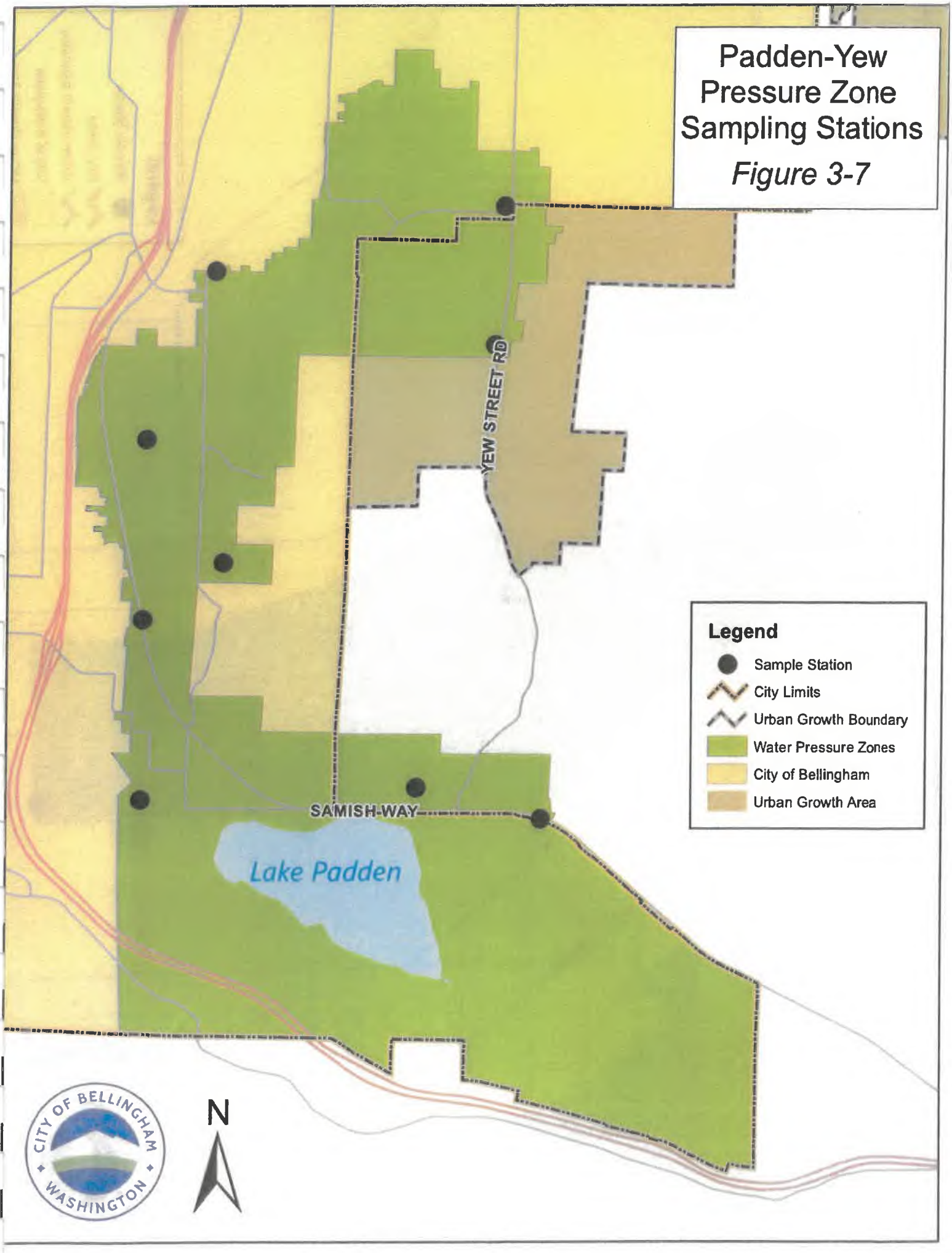

Dakin-Yew
Pressure Zone
Sampling Stations
Figure 3-4
E HORTON RD
E BAKERVIEW RD
JAMES ST
E SUNSET DR
CHANDLER PKWY
BARKLEY BLVD
ALABAMA ST
CORNWALL AVE
N STATE ST
E CHAMPION ST
E HOLLY ST
FRASER ST
LAKEWAY DR
NORTHSHORE DR
Lake
Whatcom
N
CITY OF BELLINGHAM
WASHINGTON
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area

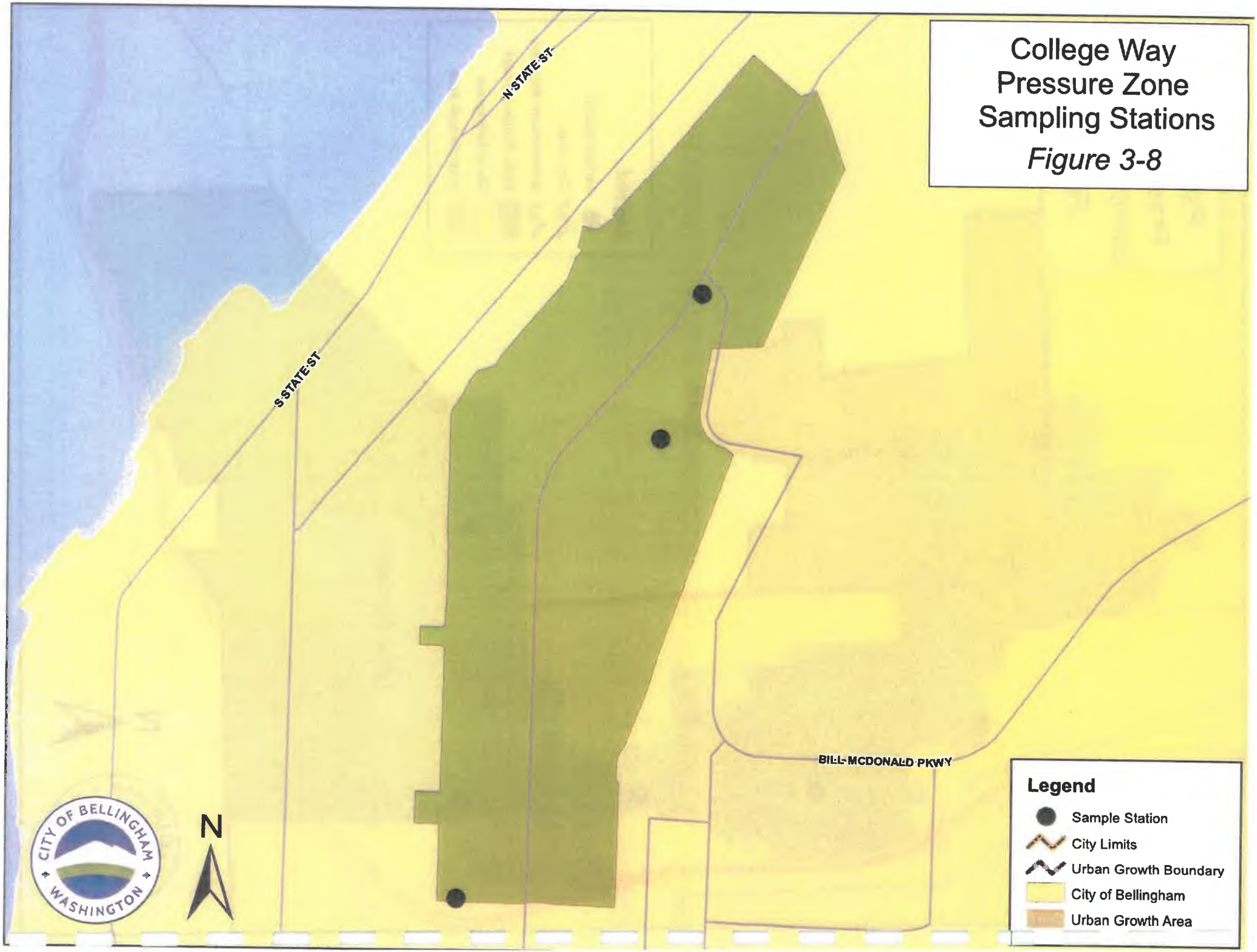
Cordata Pressure Zone Sampling Stations

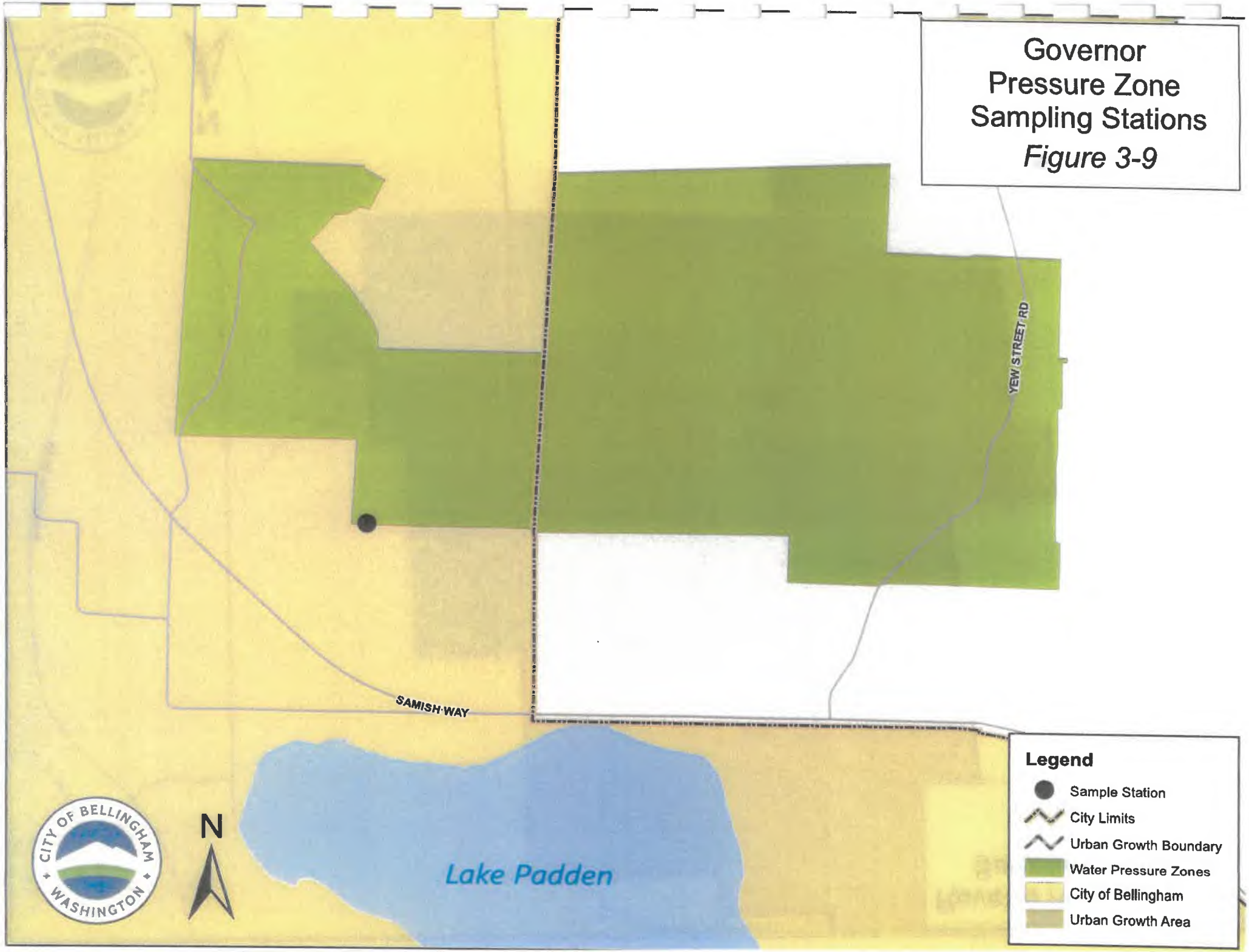
Figure 3-5

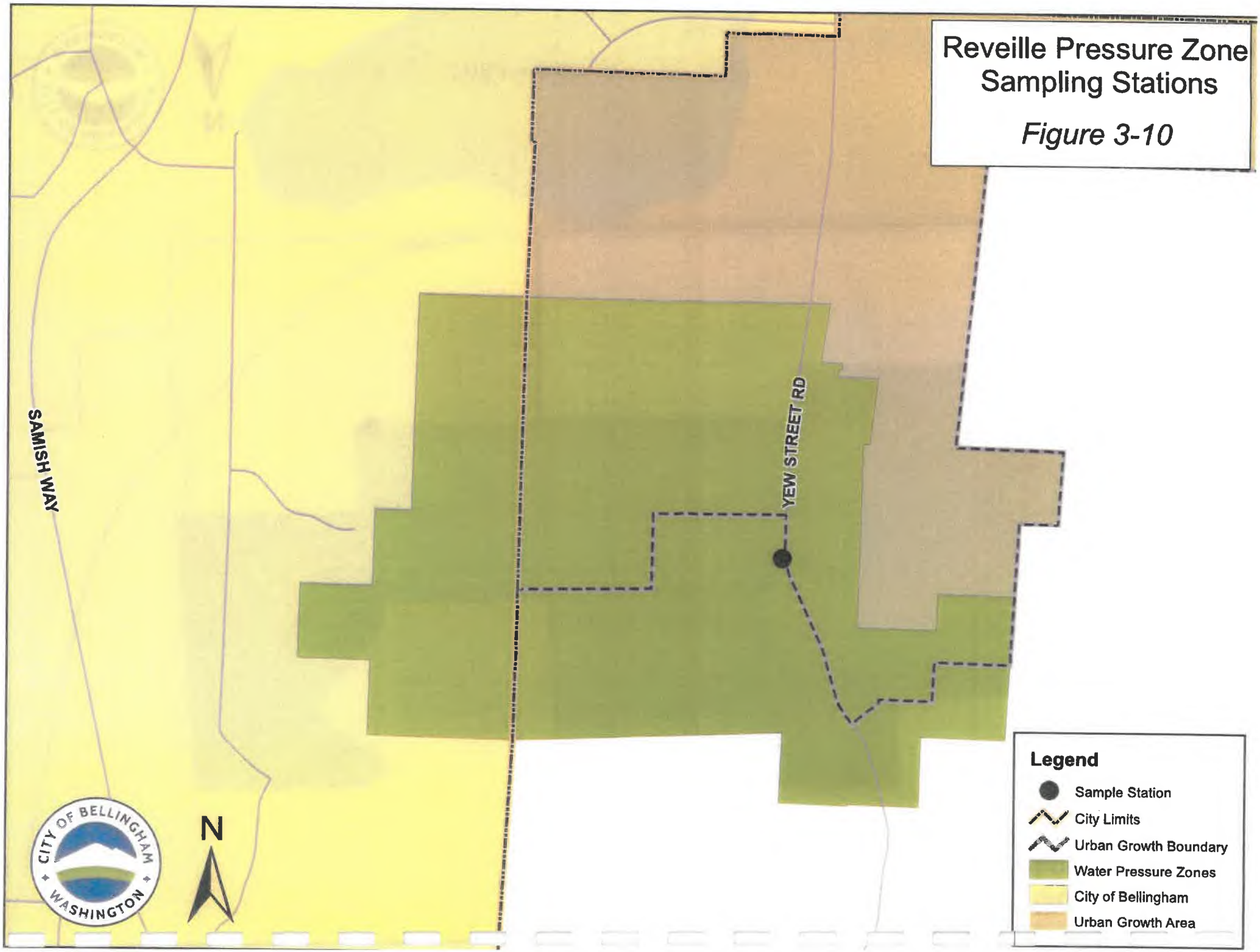


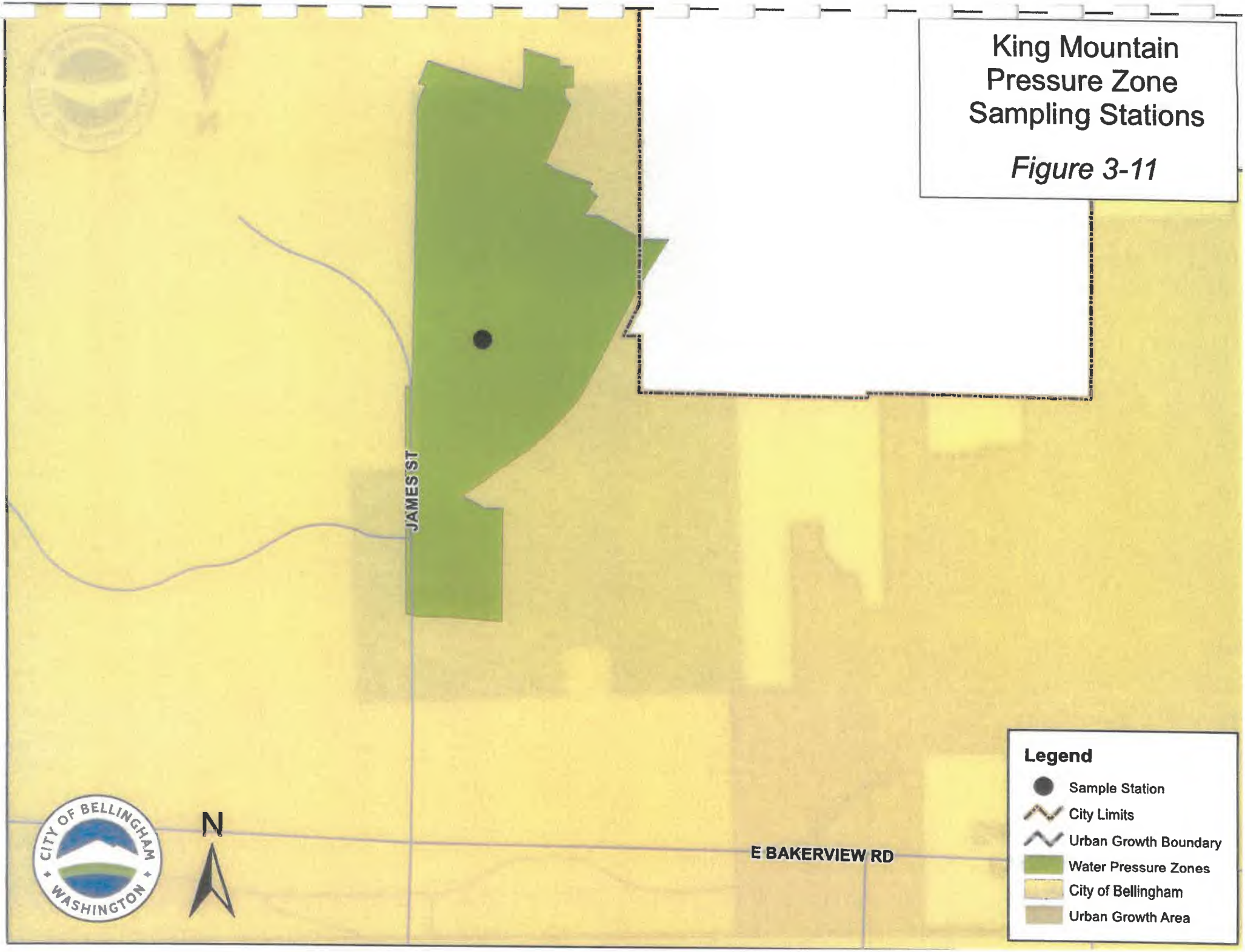

Alabama Hill Pressure Zone
Sampling Stations
Figure 3-6
E SUNSET DR
CHANDLER PKWY
BARKLEY BLVD
NORTHSHORE DR
N
CITY OF BELLINGHAM
WASHINGTON
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area

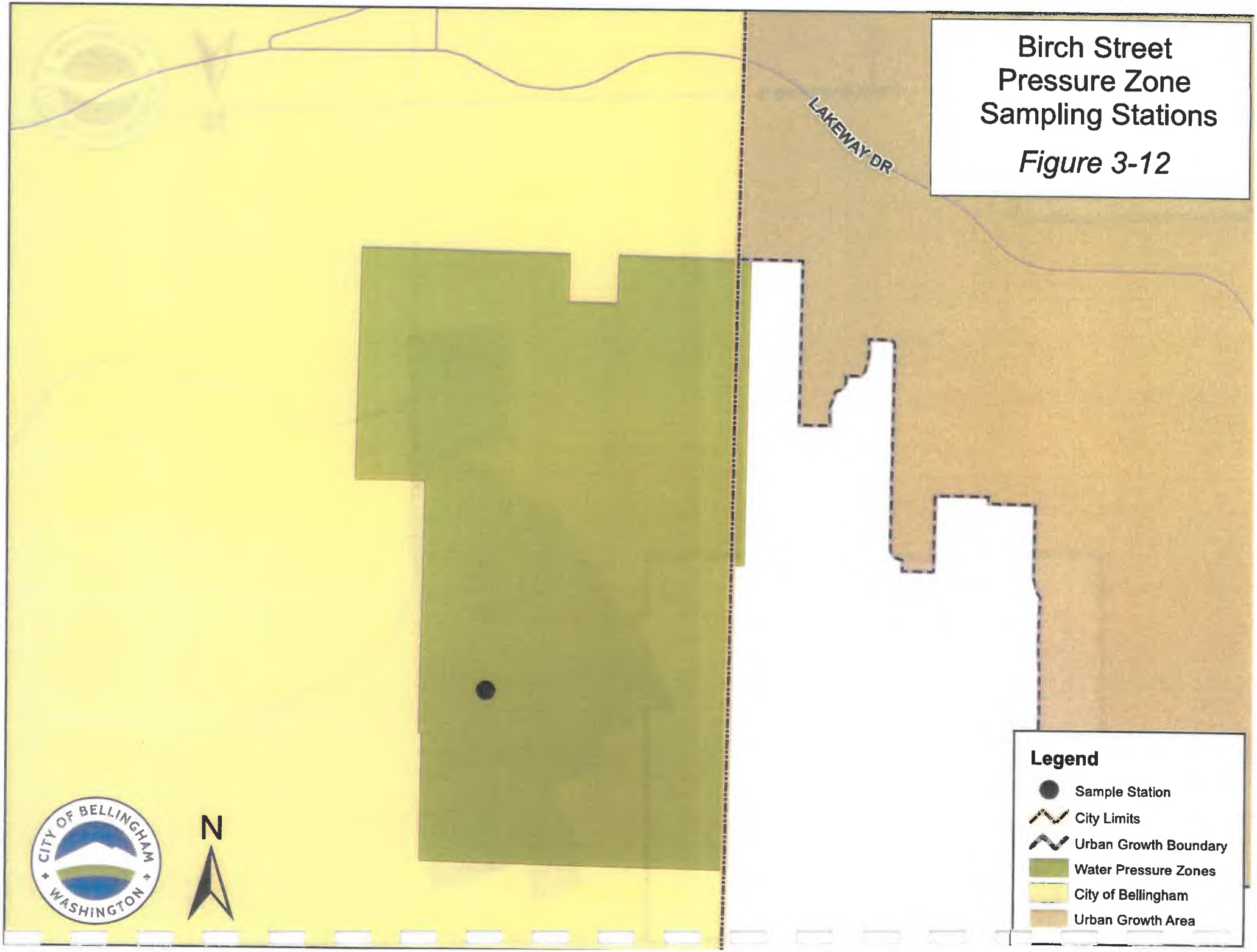

Padden-Yew
Pressure Zone
Sampling Stations
Figure 3-7
YEW STREET RD
SAMISH WAY
Lake Padden
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area
N
CITY OF BELLINGHAM
WASHINGTON

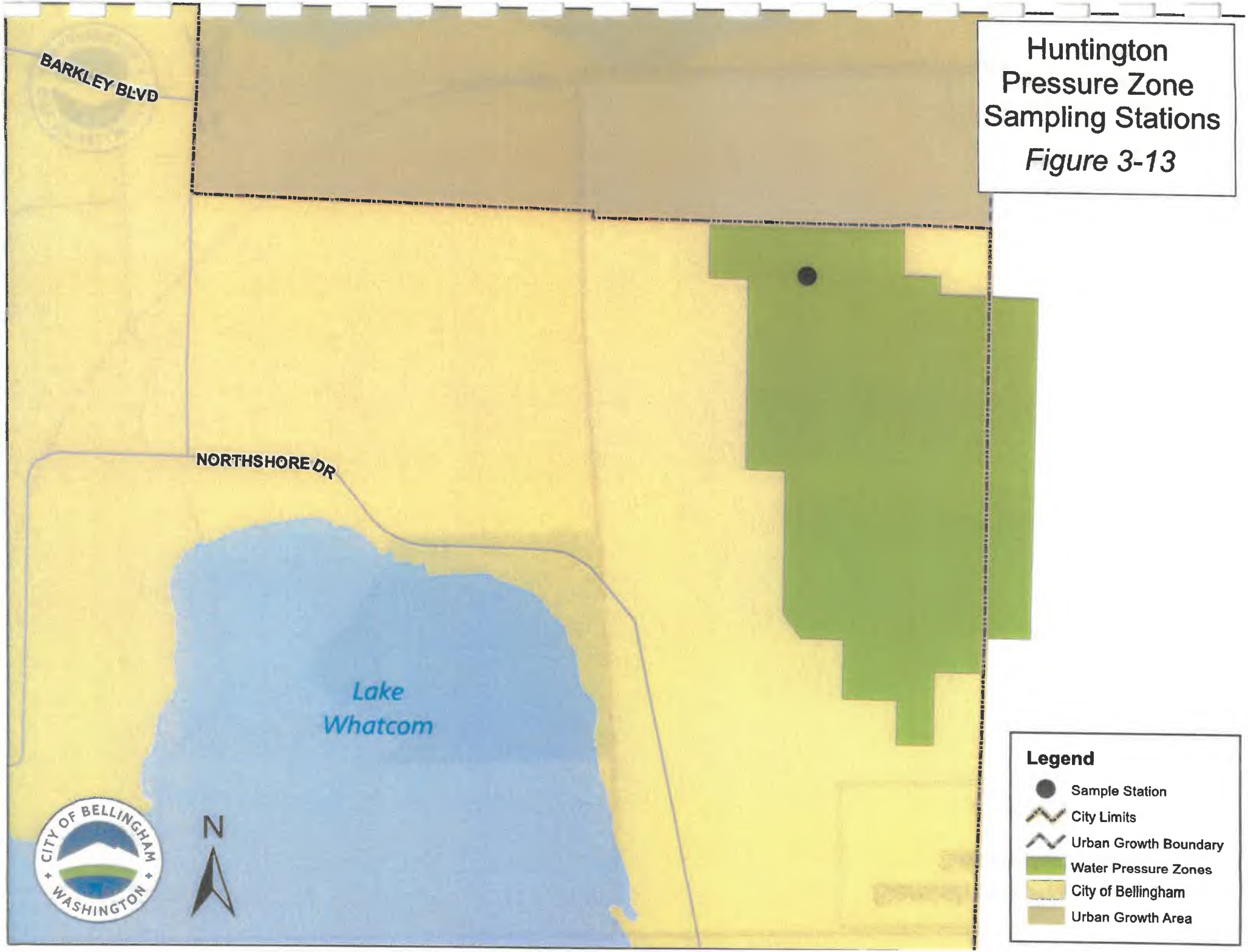

College Way
Pressure Zone
Sampling Stations
Figure 3-8
N STATE ST
S STATE ST
BILL MCDONALD PKWY
N
CITY OF BELLINGHAM
WASHINGTON
Legend
Sample Station
City Limits
Urban Growth Boundary
City of Bellingham
Urban Growth Area

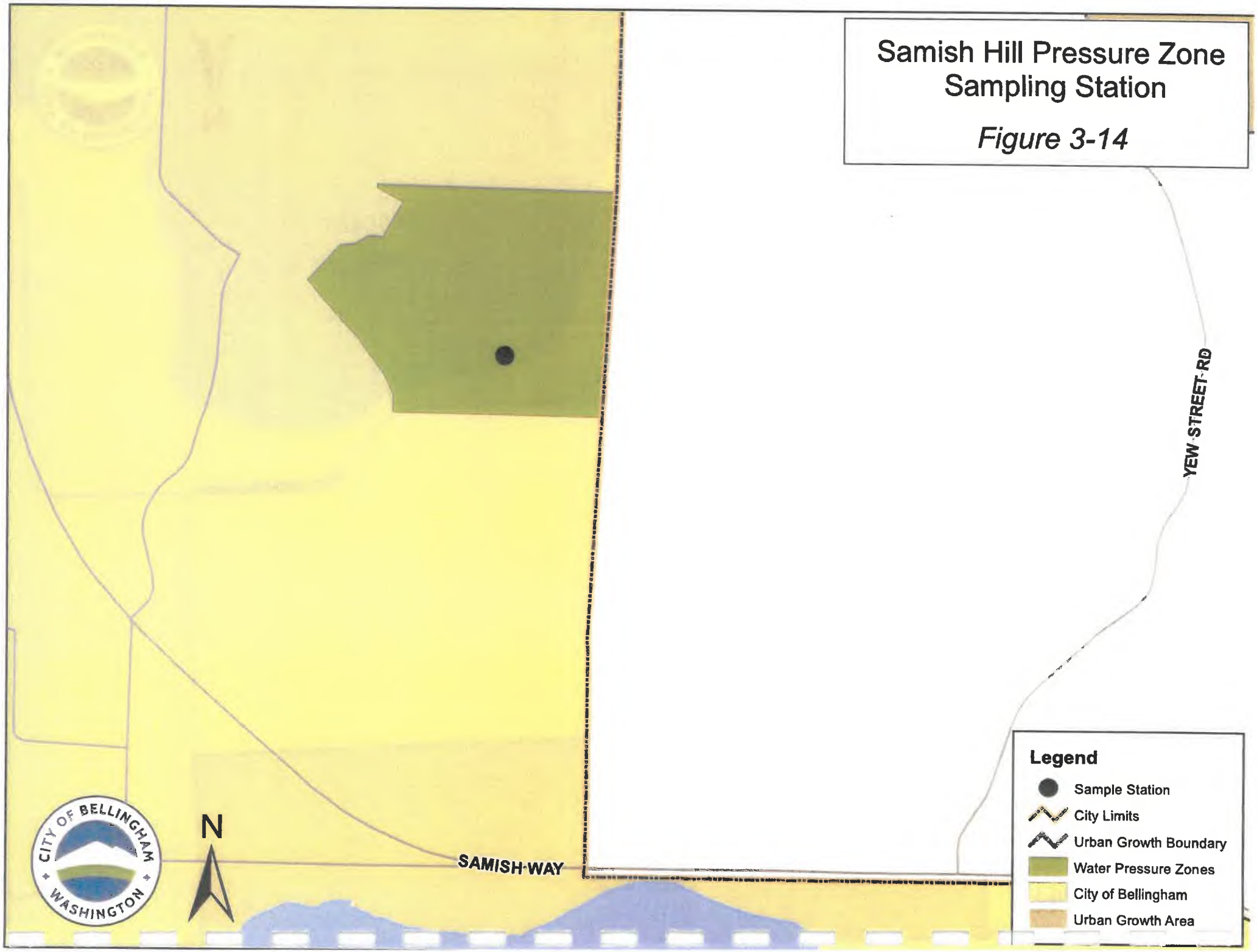

Governor
Pressure Zone
Sampling Stations
Figure 3-9
YEW STREET RD
SAMISH WAY
Lake Padden
N
CITY OF BELLINGHAM
WASHINGTON
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area


Reveille Pressure Zone
Sampling Stations
Figure 3-10
SAMISH WAY
YEW STREET RD
N
CITY OF BELLINGHAM
WASHINGTON
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area


King Mountain
Pressure Zone
Sampling Stations
Figure 3-11
JAMES ST
E BAKERVIEW RD
N
CITY OF BELLINGHAM
WASHINGTON
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area


Birch Street
Pressure Zone
Sampling Stations
Figure 3-12
LAKEWAY DR
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area
N
CITY OF BELLINGHAM
WASHINGTON


Huntington
Pressure Zone
Sampling Stations
Figure 3-13
BARKLEY BLVD
NORTHSHORE DR
Lake
Whatcom
N
CITY OF BELLINGHAM
WASHINGTON
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area


Samish Hill Pressure Zone
Sampling Station
Figure 3-14
YEW STREET RD
SAMISH WAY
N
CITY OF BELLINGHAM
WASHINGTON
Legend
Sample Station
City Limits
Urban Growth Boundary
Water Pressure Zones
City of Bellingham
Urban Growth Area

4. OVERVIEW OF RESPONSE TO COLIFORM POSITIVE SAMPLE

The following is a section to assist the Laboratory Analyst with responding correctly to a coliform positive sample. It is based on the Revised Total Coliform Rule, effective April, 1 2016.

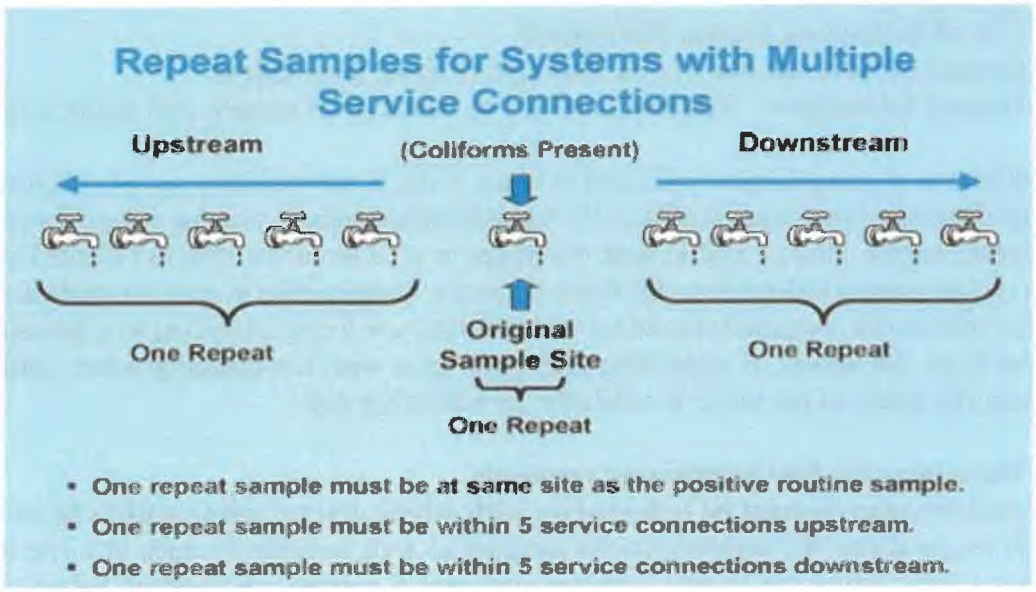
If a routine coliform sample is positive:

STEP 1 CRITICAL! **Check for florescence.** Verify if the sample is E coli positive.

STEP 2 Notify Supervisor. Tell Lab Supervisor or Water Quality Specialist about any positive total coliform or E. coli sample.

1) For an E. coli positive sample refer to Procedure 4.1 on next page
2) For a total coliform positive sample refer to Procedure 4.2 on page 22

STEP 3 Resample Within 24 Hours.. Follow the directions on the appropriate Procedure based on the type of coliform positive you have observed. **Take two samples per site**, one for Colilert and one for mEndo membrane filtration for enumeration. Run a free residual chlorine at each site. If Cl2 is less than 0.02 mg/L run also R2A HPC method.



Procedures

4.1	Detection of an *E. coli* Positive Routine Sample	page 26
4.2	Detection of a Total Coliform Positive Routine Sample	page 30

4.1 Procedure for the Detection of an *E. coli* Positive in a Routine Sample

1. Contact one of the following people:

Laboratory Supervisor: (360) 303-3300, (360) 778-7872 (Peg)
Water Quality Specialist: (360) 961-9454 (Michelle), (360) 815-9843 (Rich)

If none of the above are available, contact:
Public Works Superintendent: (360) 778-7892, (360) 299-4864 (Steve)
Responsible Person in Charge- in Steve's absence: As assigned

If you are the person communicating with the Superintendent of Plants, fill the Superintendent in on the situation and our planned response. Let them know that with an E.coli positive sample the Department of Health will also need to be notified within 24-hours at the phone numbers below.

Ask the individual contacted if they would like to contact the state Dept. of Health (DOH) since it is a requirement. If you cannot reach one these people, leave messages for them, and proceed with the rest of the steps and wait an appropriate amount of time. If no response occurs, you will need to contact the DOH with information about the positive E coli sample.



The Dept. of Health phone numbers: **(253) 395-6775** during business hours or
(877) 481-4901 after business hours.
The Office of Drinking Water staff person on call will return the call within 30 minutes.

If you need to leave a message on the Department of Health answering machine, give them the following information:

- City of Bellingham System ID# 056003
- Contact name/phone number for information about the incident
- General Information: Bacteria found *E. coli,* location of sample, and utility actions since

Additional communication will need to occur if the E. coli positive sample occurred in an area of the water distribution system with sensitive populations (school, nursing home, hospital, dialysis center, daycare center, etc.) or if it is near the meter to a consecutive system (Water District, mobile park, etc.). Get contact information for these facilities. Consecutive system contacts are listed on page 26. The individuals contacted should be told that they are being contacted as a precautionary measure to give them the option of exercising additional care with the drinking water until more information about the safety of the water is available the following day.

2. Determine the best locations to resample.
A positive sample must be followed up with additional sampling within 24-hours.
It is required that the original site be sampled as well one sample each at a site within 5 service connections above the original routine site, and 5 service connections below the routine site. Section 5.0 of this Plan can help you identify where to take these samples. Jim Bergner is also a helpful resource to help determine the current direction of water flow in the distribution system. He has access to the City's hydraulic model and can confirm sites are appropriate to characterize upstream and downstream locations.

It is assumed that prior to collecting the follow up sample you have contacted your Supervisor for consultation. This individual will work with you to initiate an investigation as to the source of

contamination. The types of information helpful to this investigation include: the free chlorine residual at the time the sample was taken, the condition of sample tap (i.e. cleanliness, presence of insects), any unusual activity around sample tap (i.e. construction, firefighting), a main break or repair in the area, approximate flushing time before sample was taken, transport conditions of sample, and condition of sample (i.e. turbid, excessive debris).

3. Resample as soon as possible.
In all cases, resample within 2 hours after notification of the positive E coli result. Do not wait any longer than 2 hours for additional information as the second set of samples are time critical. If better information becomes available later in the day, you can always resample once more.

Perform 3 repeat samples for each *E. coli* positive sample **on the same day as initial test results are read.** For each of the three samples you will get a chlorine value, and collect at least 200 mls of sample per site. At sites with free chlorine < 0.02 mg/L run a total Cl_2 and HPC.

The three repeat samples (minimum 200 ml each site) should be:
1) Original site where *E.coli* positive occurred
2) One site "upstream" of this tap and within 5 services (refer to Section 5.0 of this Plan)
3) One site "downstream" of this tap and within 5 services

Ensure that the samples are taken using clean sampling technique and take special care that the sample tap is clean. Always flame the tap and flush 3 minutes prior to sampling. Do NOT institute water main flushing or system chlorination prior to collecting this second sample.

4. Analyze repeat samples.
Conduct both the Colilert test and the mEndo total membrane filtration test on each of the three repeat samples. Perform verification on any colonies that grow on the total membrane test by picking them into LTB and EC. Because it is possible to count the number of viable bacteria colonies in the membrane method, the mEndo test better helps to identify the severity of contamination.

5. Investigate sources and possible explanations for positive sample.
Determine if the coliform sample is valid. Possible reasons the sample may not be valid:
- There was excess debris in the sample tap (flame tap and flush longer),
- The sample was colored prior to the addition of Colilert (if the sample is very yellow, it is best to run membrane filtration),
- Colilert media contamination
- The sampler touched inside of the bottle or the test was read after 28 hours
- The sample was not representative of normal conditions (firefighting, etc.)

Even if the sample is suspected to not be valid, perform repeat sampling immediately at the same site, having corrected the issue identified as invalidating the sample.

6. Verify that notification to the state DOH has occurred if needed. Specific instructions for notification is provided in the procedure specific to the type of coliform that is positive, detailed below.

7. Complete all paperwork.
Carefully fill out the DOH form for each sample to indicate that these are repeat samples. Be sure to include the DOH number for the original routine sample that failed. The appropriate section of the form to include this information is below:

2. Repeat Sample (after unsat. routine)

☐ Distribution System ⟸ **Check this box for all 3 repeat samples**

☐ Source Groundwater Rule (GWR)

Unsatisfactory routine lab number:

__ __ __ - __ __ __ __ __ ⟸ **Put the positive original (routine) sample DOH number here**

Unsatisfactory routine collect date:

_____/_____/_____ ⟸ **Date original (routine) sample collected that went positive**

Chlorinated: Yes_____ No_____

Chlorine Residual: Total_____ Free_____

8. Communicate to Lab Group.
Inform the Lab Group at Grp.pw.ops.plants.lab that a repeat E.coli coliform test is in progress and when it can be read. Be sure to prioritize getting the results from these samples and communicate who to notify when the results are available.

9. Repeat sample result notification.
If any of the repeat samples are coliform positive, check for the presence of *E. coli*.
If total coliform or E. *coli* is present in this second sample, an acute violation has occurred. An acute violation means Tier 1 public notice must occur. Prompt public notification must occur following the steps in the Public Notification Rule Plan. Also a full system investigation and possible system sanitization will need to be conducted. Ensure that you have notified a City employee from step 1 above to begin these processes. Section 7.0 of this Plan gives a summary of the notification requirements that will need to occur.

Acute Coliform MCL Violation:
An acute violation constitutes a situation that poses a serious health threat as a result of short term exposure. Due to the public health implications, 24-hour notification is a requirement. A combination of two samples- routine and repeat- must have at least one E.coli coliform and one other coliform. Results will look like one of the following combinations.

Figure 4-1 TRIGGERS REQUIRING A LEVEL 2 ASSESSMENT & PUBLIC NOTICE

Routine Sample	Repeat Sample
E. coli +	Total Coliform +
E. coli +	Any missing sample
E. coli +	E. coli +
Total Coliform +	E. coli +
Total Coliform +	Total Coliform + (without E coli analysis)

A Level 2 may also be required if there have been multiple coliform positives in rolling 12-month period.

IMPORTANT NOTIFICATION:
Notification of the DOH by telephone of violation of the Total Coliform Rule (WAC 246-290-480) must also occur for an acute coliform MCL violation within 24 hours of determination. DOH consultation, full system investigation, Level 2 Assessment, and likely intensive flushing of the system and cleaning. The DOH should be instrumental in determining appropriate follow-up actions.

10. Consecutive System Contact Information

Glenn-Cove Water Assoc
J William Freudenberger
Phone: 360.**734.5283**

Lummi Water and Sewer
Chip Anderson District Manager
Phone: 360.**758.7167**

Whatcom County Water Dist #2/#7
Lori Whitfield (Administration)
Phone: 360.**733.5770**
Dave Olson (Operations)
Phone: 360.**201.3333**

Lake Whatcom Water & Sewer
Justin Cleary, Manager
Phone: 360.**734.9224**

Montgomery Road Water Assoc
Richard and Jane Campbell
Phone: 360.**223-9934**

California Street Water Assoc
George Dodge/Douglas W Gallagher
Phone: 360. **756.8710**

Deer Creek Water Association
Douglas Wittinger
Phone: 360.**820.4314**

4.2 Detection of a Total Coliform Positive Routine Sample

It is assumed here the Lab Analyst has checked for florescence to verify if the sample is E coli negative.

1. Contact one of the following people:

Laboratory Supervisor: (360) 778-7872, (360) 733-9178, (360) 303-3300 (Peg)
Water Quality Specialist: (360) 961-9454 (Michelle), (360) 815-9842 (Rich)

The individual you contact will work with you to initiate an investigation as to the source of contamination and help you coordinate the repeat sampling.

2. Determine the best locations to resample.
A positive sample must be followed up with additional sampling within 24-hours.
It is required that the original site be sampled as well one sample each at a site within 5 service connections above the original routine site, and 5 service connections below the routine site. Section 5.0 of this Plan can help you identify where to take these samples. Jim Bergner is also a helpful resource to help determine the current direction of water flow in the distribution system. He has access to the City's hydraulic model and can confirm sites are appropriate to characterize upstream and downstream locations.

3. Resample as soon as possible.
Perform 3 repeat samples for each total coliform positive sample **on the same day as initial test results are read.** For each of the three samples you will get a free residual chlorine value, and collect 200 mls of sample. Run HPC and total chlorine at sites <0.02 mg/L chlorine. Section 5.0 of this Plan can help you identify where to take these repeat samples.
The three repeat samples should be:

1) Original site where coliform positive occurred
2) One site "upstream" of this tap and within 5 services (refer to Section 5.0 of this Plan)
3) One site "downstream" of this tap and within 5 services

Ensure that the samples are taken using clean sampling techniques and take special care to make certain that the sample tap is clean. Always flame the tap well and flush 3-5 minutes prior to sampling. Do NOT institute water main flushing or distribution system chlorination prior to sample collection.

4. Analyze repeat samples.
Conduct both the Colilert test and the mEndo total membrane filtration test on each of the three repeat samples. Perform verification on any colonies that grow on the total membrane test by picking them into LTB and EC. The mEndo test helps identify the severity of contamination.

5. Carefully fill out the DOH form for each sample to indicate these are repeat samples. Be sure to include the DOH number for the original routine sample that failed. The appropriate section of the form to include this information is below:

2.☐ Repeat Sample (follow-up to an unsatisfactory sample) ⟸ **Check this box for all 3 repeat samples**

Provide information below.

Unsatisfactory routine lab number:

___ ___ ___ ___ ___ ___ ___ ___ ⟸ **Put original (routine) sample DOH number here**

Unsatisfactory routine collect date:

_____/_____/_____ ⟸ **Date original (routine) sample collected**

Chlorinated: Yes_____ No_____

Chlorine Residual: Total_____ Free_____

6. Communicate to Lab Group.
Inform the Lab Group at Grp.pw.ops.plants.lab that a repeat coliform test is in progress and when it can be read. Be sure to prioritize getting the results from these samples and communicate who to notify when the results are available.

7. If the repeat sample is E coli positive
If any of the repeat samples are coliform positive, check for the presence of *E. coli*.
If E. *coli* is present in this second sample, an acute violation has occurred. An acute violation means Tier 1 public notice and Level 2 Assessment must occur. Prompt public notification must occur following the steps in the Public Notification Rule Plan. Ensure that you have notified a City employee from step 1 above to begin these processes. In all cases notify the Department of Health about the situation. Section 7 of this Plan gives a summary of the notification requirements that will need to occur.



The Dept. of Health phone numbers: **(253) 395-6775** during business hours or **(877) 481-4901** after business hours.

The Office of Drinking Water staff person on call will return the call within 30 minutes.

A full system investigation and possible system sanitization will need to be conducted. Ensure that you have notified a City employee from step 1 above to begin this process. Document all conditions regarding sampling and sample observations well as these will be part of the report.

8. If the repeat sample is total coliform positive.
If there are two days of total coliform positive samples, then public notification will not need to occur and an MCL violation did not occur, assuming less than 5% of samples for the month were total coliform positive. A Level 1 Assessment as described here in Section 6 will need to occur if > 5% of sites (including repeats) are positive for total coliform.

5.0 Repeat Coliform Sampling Locations

In all cases, use your best professional judgment when determining the best locations to sample following a positive coliform occurrence in a routine sample. The following table is meant to assist you in determining site verified to be within 5-service connections from our routine sampling locations. System dynamics change so verify direction of water flow prior to sampling. **Up = water before tap "upstream", Down = water after the tap "downstream".**

NORTH ZONE (Gravity Zone)

Type	Location	Tap # / Notes
Routine	Whatcom Falls Reservoir	Entry point to the North (gravity) Zone
Up	Treated (WTP pump #9)	
Down	Water Treatment Plant Lab sink	
Routine	Alabama & Woburn	
Up	2503 Alabama	
Down	2115 Alabama	
Routine	Alderwood & Bennett	
Up	3236 Alderwood Ave.	
Down	3325 Alderwood Ave.	
Routine	Commercial & Chestnut	
Up	1205 Commercial	
Down	121 W Chestnut	End of line so this is a vicinity "upstream" site
Routine	Cornwall & Pine	aka Cornwall and Wharf
Up	Port Maintenance Office (619 Cornwall)	
Down	Dry Docks (100 E Pine St.)	
Routine	City Hall	
Up	210 Lottie	
Down	316 Lottie	
Routine	Deemer at Firestation	
Up	4060 Deemer	
Down	495 East Bakerview	
Routine	Dupont & I Street	
Up	1706 I Street	
Down	1609 I Street	
Routine	E & Logan St.	
Up	2500 Cornwall Ave.	
Down	2422 E Street	
Routine	Eldridge & Lindberg	
Up	3133 Eldridge Ave	
Down	660 Marine Drive	
Routine	Franklin & Illinois	
Up	403 Illinois	
Down	2834 Franklin	

NORTH ZONE (continued)

Type	Location	Notes
Routine	Henry & Monroe	
Up	2406 Henry	
Down	2330 Henry	
Routine	Kentucky & Ellis	
Up	401 Kentucky St.	
Down	309 Kentucky St.	
Routine	Lakeway & James	
Up	819 James	
Down	709 James	
Routine	Hilton Ave.	
Up	1010 Hilton	
Down	1001 Hilton	
Routine	Granary and Laurel	
Up	1015 Granary	
Down	301 W Laurel St.	(update when Granary Ave. gets extended)
Routine	W Maplewood & Cottonwood	
Up	2800 W Maplewood	
Down	2815 W Maplewood	
Routine	W Maplewood & McLeod	On border of North and Cordata zones.
Up	2945 W Maplewood	
Down	3001 W Maplewood	
Routine	1314 E Maplewood	
Up	1310 E Maplewood	
Down	1400 E Maplewood	
Routine	McLeod & James	
Up	3700 James St	
Down	3865 James St.	
Routine	Birchwood Ave. & I-5	New connector road.
Up	3600 James Street	Site will need to be updated once platted.
Down	340 Birchwood Ave.	
Routine	W. North & Elm	
Up	1210 W North St.	
Down	2603 Elm St.	
Routine	Squalicum and Roeder	
Up	2694 Roeder	
Down	2700 Roeder	Also sample in Bellingham Cold Storage. Site Manager Gary White phone: 360.733.1640

NORTH ZONE (continued)

Type	Location	Notes
Routine	Northwest and Larrabee	
Up	4337 Northwest	
Down	4366 Northwest	
Routine	Oeser Cedar	
Up	710 Marine Drive	
Down	2938 Seaview Circle	
Routine	Virginia Street	
Up	2221 Pacific Street	South side of campus along Virginia
Down	2200 Nevada Street	
Routine	Peabody & Victor	
Up	3228 Peabody	
Down	905 Victor	
Routine	Pinewood & Birchwood	
Up	2826 Birchwood	
Down	2905 Birchwood	
Routine	St. Joseph's Hospital	
Up	2940 Squalicum Parkway	
Down	Maternity Ward St. Joe's	
Routine	State & Berry	
Up	833 N. State	
Down	820 N. State	
Routine	Seaview Circle	Tap is not used at present time.
Routine	James St pump station	Tap inside station, not used

REVEILLE ZONE (aka UPPER-YEW)

Type	Location	Notes
Routine	KGMI (2219 Yew St.)	
Up	2224 Yew St. Rd.	
Down	2218 Yew St. Rd.	

HUNTINGTON ZONE

Type	Location	Notes
Routine	E Oregon & Huntington	
Up	4914 E Oregon	
Down	5010 E Oregon	

PADDEN YEW ZONE

Type	Location	Notes
Routine	Ashley & Dumas	
Up	4113 Dumas Ave.	
Down	300 40th St.	On edge of South Zone (3996 Byron in South Zone)
	Consolidation Reservoir	
Up	818 Yew St.	12" CI fill line
Down	801 Spieden Place	
Routine	40th St. Reservoir	Serves Padden-Yew Zone, although it is
Up	1412 40th St.	Physically located in the Upper-Yew Zone
Down	1400 40th St.	
Routine	Reveille Reservoir	
Up	2418 Yew St.	
Down	2402 Yew St.	870 Reveille is tapped off of reservoir – it is the
Down	870 Reveille	only house tapped on the third line.
Routine	Ridgemont (near 915 36th St.)	
Up	923 36th St.	
Down	919 36th St.	
Routine	Padden Estates (near 4921 Samish Way)	
Up	4907 Samish Way	Trailer park manages water internally, not a place to
Down	4929 Samish Way	Sample for repeats.
Routine	Timberlake Drive	
Up	819 Timberlake Court	
Down	1841 Timberlake Court	
Routine	Cowgill & Samish	Retired in 2021 – too many taps in Padden Yew Zone

GOVERNOR ZONE

Type	Location	Notes
Routine	Harrison	(end of zone)
Up	2316 Hawk Way	
Down	4411 Harrison	Tap located at this address

SAMISH HILL ZONE

Type	Location	Notes
Routine	Parkhurst Reservoir	Up/Down depend on reservoir fill cycle
Up	4333 Samish Crest Dr	
Down	4501 Merlin Court	

DAKIN-YEW ZONE

Type	Location	Notes
Routine	Academy & Pullman	Replaced Dakin Res. #2 when sampling line under
Up	4101 Academy (Silver Beach School)	Reservoir split in 2008. Dakin #2 is physically
Down	4036 Academy	located in Alabama Hill Zone but serves the
D2	or 4103 Academy (newer section of school)	Dakin-Yew Zone.
Routine	Ava Lane	Update after development gets built
Up	4003 Ava Lane	
Down	3936 Ruston Way	
Routine	Britton Road	The DOH doesn't usually want a downstream site
Up	4502 E Oregon St	taken from a consecutive system. Take one as a
Down	1405 Britton	"courtesy sample" and get an additional upstream.
D2	Or 1404 E 36th Ln (alternate site in WD #7)	WD #7 phone 360.752.9208.
Routine	Control Dam	
Up	1935 Electric	
Down	2109 Electric	
Routine	Dakin #1 Reservoir (faucet at reservoir)	Serves Dakin-Yew Zone though physically located
Up	2906 Sylvan	in the Alabama Hill Zone.
Down	2918 Sylvan St (Big Rock Condominium)	
Routine	Division Street	
Up	1997 Division St.	
Down	3735 Irongate	
Routine	Everson Goshen Road	
Up	2084 Mt. Baker Highway	
Down	2098 Mt. Baker Highway (end of system)	
Routine	Fir (S of Alabama)	
Up	2405 Fir	
Down	End of system	COB asset 0500250, Fir St. lift station
Routine	Lakeside	The Glenn Cove Water Dist. phone 360.734.5283
Up	1802 Lakeside Ave	Has a first connection at 1718 Euclid Ave. Take
Down	1724 Euclid Ave	"courtesy sample" and communicate results to them.
Routine	Lakeway & Bonanza	
Up	3717 Lakeway	
Down	1330 Bonanza	
Routine	Dakin #2 Reservoir (tap outside reservoir)	Not used (Academy replaced due to low flow)

DAKIN-YEW ZONE (continued)

Type	Location	Notes
Routine	Michigan St.	
Up	2132 Michigan St.	
Down	2204 Michigan St.	
Routine	Mt. Baker Highway	
Up	2945 E Sunset Sunset Drive	
Down	3635 E McLeod Rd.	
Routine	Nevada & Edwards	
Up	1106 Nevada	
Down	1062 Nevada	
Routine	E North & Huntington	
Up	1612 Northshore Dr.	
Down	2616 Huntington St.	
Routine	Northshore Drive	Take one "courtesy sample" in Eagleridge as this in
Up	2124 Northshore Drive	LWWSD service area phone 360.734-9224, and
Down	2130 Northshore Drive	communicate results to them.
Routine	Strider Loop	
Up	4122 Strider Loop	
Down	4175 Strider Loop	
Routine	Treated (WTP pump #9)	Entry point to the distribution system.
Up	CT-out (WTP pump #8)	
Down	Whatcom Falls Reservoir	
Routine	Vining Street Park	
Up	2801 Vining Street	
Down	2815 Vining Street	
Routine	Britton Loop	Tap is not used presently. No services off long line.

KING MOUNTAIN ZONE

Type	Location	Notes
Routine	Frances Ave (King Mountain)	
Up	4310 Frances Ave	
Down	4328 Frances Ave	
Routine	Winslow Court	
Up	4341 Winslow Court	
Down	4356 Winslow Court	Tap at end of the water main. 4356 is technically Up.

ALABAMA HILL ZONE

Type	Location	Notes
Routine	Balsam Lane pump station (Sylvan)	
Up	Dakin 1 Reservoir	
Down	3704 Sylvan Place	

Routine	Holly Court	
Up	1408 Holly Court	
Down	1411 Holly Court	End of line. 1411 technically Up.

Routine	McLeod & Magrath	
Up	3886 Magrath Rd.	
Down	3801 E. McLeod	

Routine	3724 Woodside Way	
Up	3720 Woodside Way	
Down	3728 Woodside Way	

COLLEGE WAY ZONE

Type	Location	Notes
Routine	Elwood & Ridgeway	
Up	317 Hillcrest Way	
Down	312 Ridgeway Dr.	

Routine	17th & Douglas	Can be South Zone based on valving.
Up	920 17th St.	
Down	937 Highland Dr.	End of line/zone w/ valve close on Douglas/Highland

Routine	College Way Reservoir (formerly Sunset Res)	Pump station at site serves the College Way Zone.
Up	102 Highland Drive	
Down	222 Highland Drive	

BIRCH FALLS ZONE

Type	Location	Notes
Routine	1113 Birch Falls	
Up	1116 Birch Falls	
Down	1009 Birch Falls	(as of this writing unbuilt)

SOUTH ZONE

Type	Location	Notes
Routine	Bayside & Willow	
Up	426 Bayside	
Down	500 Bayside	
Routine	Chuckanut Drive & Soundview	
Up	709 Chuckanut Drive	
Down	694 Chuckanut Drive	
Routine	E Oak Street	Replaced Sehome Reservoir 12/11 due to very
Up	Sehome Reservoir	low pressure at installed Sehome Reservoir tap.
Down	700 N Garden St.	
Routine	18th & Fairhaven Ave	
Up	1820 Fairhaven Ave.	
Down	3310 18th St.	
Routine	15th & Douglas	
Up	1001 15th St.	
Down	1003 14th St.	
Routine	4th & Harris	
Up	401 Harris Ave.	
Down	300 Harris Ave.	
Routine	14th & State	
Up	341 S. State	401-423 State St originate on 6" CI in alley
Down	444 14th St.	
Routine	Larrabee State Park	
Up	467 Cove Road	or 508 E Dolphin (hooks directly into Chuckanut)
Down	None (end of line)	
Routine	Laurel & Liberty	
Up	930 Liberty	
Down	1004 Liberty	
Routine	Linden & Fieldston	
Up	410 Linden	
Down	602 Fieldston	
Routine	19th & McKenzie	
Up	1403 19th St.	
Down	1817 McKenzie	
Routine	Otis Street Pump Station	Faucet inside station
Up	1734 Valencia	24" CCP to 30" CCP to 36" CCP w/ no service connections, terminates near 1734 Valencia
Down	1015 Otis Street	
Routine	Padden Reservoir	Serves South Zone although physically located in the
Up	2414 36th St.	Padden-Yew Zone
Down	3800 Broad St.	

SOUTH ZONE (continued)

Type	Location	Notes
Routine	32nd & Donovan	
Up	1519 32nd Street	
Down	1520 Bonnie Lane	
Routine	24th & Mill	
Up	1122 24th St.	
Down	1120 24th Street.	
Routine	Forest & Palm	
Up	101 S Forest Street	
Down	310 Palm Street	
Routine	Underhill	
Up	115 Underhill	
Down	120 Underhill	
Routine	E Maple & Jersey	
Up	1023 Jersey Street	
Down	712 E Maple Street	
Routine	34th & Donovan	
Up	3409 Donovan Ave.	
Down	3213 Donovan Ave.	
Routine	30th & Church	
Up	3114 30th St.	
Down	3204 30th St.	
Routine	Sehome Reservoir (replace by E Oak St)	Not in use. Pressure issues replaced by E Oak
Routine	Cowgill and Samish	Not in use. Spare tap.

CORDATA ZONE

Type	Location	Notes
Routine	Bellingham Athletic Club	
Up	4192 Meridian	
Down	4176 Meridian	Assume water flow toward North Zone - verify
Routine	Grady Way	
Up	344 Grady Way	
Down	336 Grady Way	
Routine	Horton Road	
Up	477 W Horton	
Down	485 W Horton	
Routine	Mitchell Way	At Fed Ex Building
Up	4330 Mitchell	
Down	4373 Mitchell	(end of line)
Routine	Northwest & Sterling	
Up	733 Sterling Dr.	
Down	4018 Northwest Ave.	Address of complex, 4000 1st on service lateral
Routine	Pacific Highway	
Up	4100 Pacific Highway	
Down	4146 Pacific highway	
Routine	Short St. pump station	Inside station
Up	4170 Cordata Prkwy (DQ)	
Down	204 Olivine Lane	(note Short St. name change to Olivine)
Routine	Curtis Road	The DOH doesn't usually want a downstream site
Up	4405 Curtis	taken from a consecutive system. Take one as a
Down	WD. #2 (360)733-5770, Lummi (360)758-7167	"courtesy sample" and get an additional upstream.
Routine	Kearney Reservoir	
Up	4281 James St.	Reservoir fill line 1": DI
Down	4266 Springcreek Lane	
Routine	Mahogany & Ambrosia	
Up	4201 Spire Drive	As area builds out check for closer "up"
Down	4203 Ambrosia Lane	
Routine	Lummi – Marine Drive (out of City)	The DOH doesn't usually want a downstream site
Up	Curtis Road (tap #55)	taken from a consecutive system. Take one as a
Down	Lummi Water & Sewer Dist (360) 758-7167	"courtesy sample" and get an additional upstream.
Routine	Kline Rd. & Spring Vista	
Up	4728 Cordata Parkway	Will need to be updated when buildout occurs
Down	613 Spring Vista Way	Will need to be updated when buildout occurs
Routine	Marietta Reservoir	Currently offline, no need for storage in this zone
Routine	4805 Aldrich	Tap is not used at this time.

5.1 Special Considerations for End of Distribution System Sample

Per the requirements in WAC 246-290-300 3(v):

If a total coliform-positive sample is at the end of the distribution system, or one service connection away from the end of the distribution system, the system shall still take all required repeat samples. The department may allow an alternative sampling location in lieu of the requirement to collect at least one repeat sample upstream or downstream of the original sampling site. Systems may propose repeat monitoring locations to the department that the system believes to be representative of a pathway for contamination of the distribution system. A system may elect to specify either alternative fixed locations or criteria for selecting repeat sampling sites on a situational basis in a standard operating procedure (SOP) in its plan. The system shall design its SOP to focus the repeat samples at locations that best verify and determine the extent of potential contamination of the distribution system area based on specific situations. The department may modify the SOP or require alternative monitoring locations as needed.

6. Level 1 and Level 2 Assessments

An investigation should occur any time coliform bacteria is observed in a routine and a repeat sample. In the case of total coliform, an investigation is not a regulatory requirement until the number of total coliform positives exceed 5% of the samples collected for the month, but it is a prudent practice to investigate regardless. The presence of coliform bacteria is an unusual occurrence in the City of Bellingham water distribution system, and time should be spent following any positive sample to assure that sampling and distribution system controls are effectively in place to assure sanitary conditions.

Below is a discussion of the Assessments that are required as part of 40 CFR 141.859 and WAC 246-290-320 (2)(b).

6.1 Level 1 Assessment

Systems must submit a Level 1 Assessment to their state within 30 days after learning that they have exceeded a total coliform trigger. A Level 1 Assessment is required (40 CFR 141.859(a)(1) & WAC 246-290-320 (2)(b)) to be conducted by the water system operator/owner to assure the safety of the potable water supply following either of the following scenarios:

a. The number of total coliform positive samples exceeds 5% of the total coliform samples collected for the month (includes routine and repeat samples), or
b. The City fails to take every required repeat sample after any single routine total coliform positive sample.

A Level 1 Assessment is defined in the code as "An evaluation to identify the possible presence of sanitary defects, defects in distribution system coliform monitoring practices, and the likely reason that the system triggered the assessment. It is conducted by the system operator. Minimum elements include:

a. Review and identification of atypical events that could affect distributed water quality or indicate that distributed water quality was impaired
b. Changes in distribution system maintenance and operation that could affect distributed water quality (including water storage)
c. Source and treatment considerations that bear on distributed water quality, where appropriate
d. Existing water quality monitoring data
e. Inadequacies in sampling sites, sampling protocol, and sample processing

The system must conduct the assessment consistent with any State directives that tailor assessment elements with respect to the size and type of the system and the size, type, and characteristics of the distribution system."

It is important to also note that with the revised Total Coliform Rule (2016 implementation), an MCL violation has not occurred if total coliform positives exceed 5% of the total samples collected for the month as long as a Level 1 Assessment occurred. With this in mind, communication with the service population no longer needs to occur if there are sufficient total coliform samples to trigger a 5% exceedance.

The number of positive samples will determine whether the utility has a non-acute MCL violation per the following:

(A/B) x 100

A = Total number of total coliform positive samples (routine coliform positive + repeat coliform positive)

B = Total number of samples (routine + repeat samples) taken that month



(positives / total compliance samples for month including repeats) * 100 = x %

if x is greater than 5% (5 positives), there is a non-acute violation.

In all cases the state Department of Health should be contacted to inform them that a Level 1 Assessment is going to be conducted. The DOH may have instructions for the completion of this Assessment that will supersede what is written in this plan.

To conduct a sufficiently robust Level 1 Assessment the reader is advised to refer to the contents of the EPA publication 815-R-14-006 (September 2014):
http://water.epa.gov/lawsregs/rulesregs/sdwa/tcr/upload/epa815r14006.pdf
Refer to Appendix B in the above publication to meet minimum investigatory components via the example developed by the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee. This example is included here on the following two pages.

For clarification, descriptions of a Level 1 vs. Level 2 Assessment are shown below:

Table 6-1 Level 1 and Level 2 Assessment criteria

Level 1	Level 2
Confirmed Total Coliform contamination or failure to collect all required repeat samples	An E. coli MCL violation or a second Level 1 Assessment in rolling 12 month period
Performed by Water Utility staff -basic inspection.	Performed by personnel approved by DOH - more detailed than the Level 1 Assessment.
State provides template.guide for conducting Assessment.	State provides template.guide for conducting Assessment.
Submit to DOH within 30 days of trigger.	Submit to DOH within 30 days of trigger.
Look for sanitary defects or concerns with operations and maintenance.	Look for sanitary defects or concerns with operations and maintenance.
No public notification requirement.	Public notification requirement.

Per WAC 246-290-480 all documentation of any Level 1 Assessment and corrective action shall be maintained for a period of not less than 5 years and be available for DOH review at any time.

CONCEPT EXAMPLE
Level 1 Assessment Form
(Developed by the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee)

System Name:	Source Water:	PWSID #
System Type:	Population Served:	PWS Address:
Operator in Responsible Charge (ORC):	Phone:	
City, State:		
County:		
Person that collected TC samples if different than ORC:	Phone:	
Address, City, State, Zip:		
Date Assessment Completed:		

Questions	Reviewed? (check if completed or type N/A)	Issue(s) Found? (Y/N)	Issue Description	Corrective Action Taken (Including Date)
1. Evaluate sample site. -condition or location of tap -regular use of connection				
2. Sample protocol followed and reviewed. -flush tap -remove aerator -no swivel -fresh sample bottles -sample storage acceptable				
3. Have any of the following occurred at relevant facilities prior to the collection of TC samples? -any interruptions in the treatment process -any reported loss of pressure events (5 psi) -operation and maintenance activities that could have introduced total coliform -reported vandalism and/or unauthorized access to facilities -visible indicators of unsanitary conditions reported -Has there been a fire fighting event, flushing operation, sheared hydrant, etc.				
4. Have there been any recent operational changes to the system? -sources introduced -treatment or operational changes -potential sources of contamination				
5. Distribution System -system pressure -cross connection -pump station -air relief valves -fire hydrants or blow off -breaks -repairs				
6. Storage Tank -screens -security -access opening -condition of tank -vent -drain overflow -pressure tank -O&M				

EXAMPLE

CONCEPT EXAMPLE
Level 1 Assessment Form
(Developed by the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee)

Questions	Reviewed? (check if completed or type N/A)	Issue(s) Found? (Y/N)	Issue Description	Corrective Action Taken (Including Date)
7. Treatment Process -interruptions -POE/POU -softeners -O&M				
8. Source – Well -sanitary seal -vent screened -air gap -cross connection -security -pump to waste line				
9. Source – Spring -condition of spring development -condition of spring box -security				
10. Source - Surface Water Supply -heavy rainfall -rapid snowmelt				

EXAMPLE

Note: Form to be completed based on data and documents available to the PWS operator in charge, maintained on file and returned to the Primacy Agency within 30 days of triggering the assessment.

Additional Comments:

Print name of person completing form: Date:
Signature:

Reserved for State

1. Assessment has been successfully completed.
2. Likely reason for total coliform-positives occurrence is established.
3. System has corrected the problem.
4. Was a reset requested and / or granted? – Rationale
5. Name of State reviewer:

6.2 Level 2 Assessment

A Level 2 Assessment is a more detailed examination of the system, its operational practices and its monitoring program and results. The elements of a Level 2 Assessment may be the same as that of a Level 1 Assessment, but each element is investigated in greater detail. The party conducting the Level 2 Assessment is determined by the State of Washington Department of Health.

1. A Level 2 Assessment

A Level 2 Assessment is required to be conducted as soon as practical after the conditions that trigger this assessment. A Level 2 Assessment is required (40 CFR 141.859(a)(2)) to be conducted by a DOH approved entity to assure the safety of the potable water supply following either of the following scenarios:

a. An E coli maximum contaminant level (MCL) violation, or

b. The City has a second Level 1 Assessment within a rolling 12-month period unless the state has determined a likely cause for the situation that resulted in the initial Level 1 treatment technique trigger and establishes that the system has fully corrected the problem.

A Level 2 Assessment is defined in the code as "an evaluation to identify the possible presence of sanitary defects, defects in distribution system coliform monitoring practices, and (when possible) the likely reason that the system triggered the assessment. A Level 2 Assessment provides a more detailed examination of the system (including the system's monitoring and operational practices) than does a Level 12 Assessment through the use of more comprehensive investigation and review of available information, additional internal and external resources, and other relevant practices. Minimum elements include review and identification of atypical events that could affect distributed water quality or indicate that distributed water quality was impaired, changes in distribution system maintenance and operation that could affect the distributed water quality (included storage), source and treatment considerations that bear on distributed water quality, where appropriate existing water quality monitoring data, and inadequacies in sample sites, sampling protocol, and sample processing."

In all cases the state Department of Health should be aware that a Level 2 Assessment needs to be conducted. The DOH may have instructions for the completion of this Assessment that will supersede what is written in this plan. WAC 246-290-320 (2)(b) details state requirements.

To conduct a sufficiently robust Level 2 Assessment the reader is advised to work closely with the DOH to determine the appropriate personnel to conduct this review. For guidance, refer to the contents of the EPA publication 815-R-14-006 (September 2014):
http://water.epa.gov/lawsregs/rulesregs/sdwa/tcr/upload/epa815r14006.pdf
Refer to Appendix B in the above publication to meet minimum investigatory components via the example developed by the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee. This example is included here on the following five pages.

Per WAC 246-290-480 all documentation of any Level 2 Assessment and corrective action shall be maintained for a period of not less than 5 years and be available for DOH review at any time.

CONCEPT EXAMPLE
Level 2 Assessment Form
(Developed by EPA and the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee)

System Name:	Source Water:	PWSID #
System Type:	Population Served:	PWS Address:
Operator in Responsible Charge (ORC):	Phone:	
City, State:		
County:		
Person that collected TC samples if different than ORC:	Phone:	
Address, City, State, Zip:		
Date Assessment Completed:		

	Questions	Reviewed? (check if completed or type N/A)	Issue(s) Found? (Y/N)	Issue Description	Corrective Action Taken (Including Date)
1.	**Evaluate sample site**				
a.	What is the condition of the tap? **(Provide comments)**				
b.	What is the location of the tap? **(Provide comments)**				
c.	What is the regular use of the connection? **(Provide comments)**				
d.	Have there been any plumbing changes or construction? If yes, when and what was the repair or change?				
e.	Have there been any plumbing breaks or failure? If yes, when?				
f.	List any identified cross connections after the service connection or in premise plumbing. **(Provide comments)**				
g.	Were all of the backflow prevention devices present, operational and maintained?				
h.	Were there any low pressure events or changes in water pressure after the service connection or in the premise plumbing? If yes, when?				
i.	Are there any treatment devices after the service connection or in premise? **(Circle response, if applicable)**	Point of Entry (POE)	Point of Use (POU)		
j.	Other comments on sample site?				

EXAMPLE

CONCEPT EXAMPLE
Level 2 Assessment Form
(Developed by EPA and the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee)

	Questions	Reviewed? (check if completed or type N/A)	Issue(s) Found? (Y/N)	Issue Description	Corrective Action Taken (Including Date)
2.	**Sample protocol followed and reviewed**				
2.	Sample protocol followed and reviewed				
a.	Flush tap, remove acrator, no swivel, fresh sample bottles, sample storage acceptable				
3.	**Have any of the following occurred at relevant facilities prior to the collection of TC samples?**				
a.	Were there any operation and maintenance activities that could have introduced total coliforms?				
b.	Have there been any interruptions in the treatment process?				
c.	Has the system lost pressure to less than 5 psi?				
d.	Have there been any vandalism and/or unauthorized access to facilities?				
e.	Are there any visible indicators of unsanitary conditions observed?				
f.	Have there been any analytical results or any additional samples collected, including source samples which were positive (not for compliance)?				
g.	Have there been any community illness suspected of being waterborne (e.g., Does the community public health official indicate that an outbreak has occurred.)				
h.	Did the water system receive any TCR monitoring violations in the past 12 months? If yes, when.				
i.	What was the most recent date on which satisfactory total coliform samples were taken?	Date: _____			
j.	Have there been a fire fighting event, flushing operation, sheared hydrant, etc.				
k.	Other comments on records and maintenance?				
4.	**Have there been any recent treatment or operational changes?**				
a.	Have any inactive sources recently been introduced into the system (e.g., auxiliary systems)?				
b.	Have there been any new sources introduced into the system?				
c.	Is there evidence of any potential sources of contamination (main breaks, low pressure, high				

SAMPLE

CONCEPT EXAMPLE
Level 2 Assessment Form
(Developed by EPA and the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee)

	Questions	Reviewed? (check if completed or type N/A)	Issue(s) Found? (Y/N)	Issue Description	Corrective Action Taken (Including Date)
	turbidity, loss of disinfection, etc.)?				
5.	**Distribution System**				
a.	System pressure: Is there evidence that the system experienced low or negative pressure? If yes, when?				
b.	List any identified cross connections.				
c.	Pump station: Are there any sanitary defects in the pump station? Are pump(s) operable?				
d.	Last pump maintenance/service date. **(Respond if applicable)**	Date: _____		Maintenance Performed?	
e.	Air relief valves: Is the valve vault subject to flooding or does the vent terminate below grade?				
f.	Fire hydrant/blow off: Are any located in an area with a high water table or pits?				
g.	Is the distribution system secured to prevent unauthorized access?				
h.	Are the backflow prevention devices at high risk sites present, operational and maintained?				
i.	Have there been any water main repairs / additions? If yes when, and what was the repair or addition?				
j.	Have there been any water main breaks? If yes, when?				
k.	Was there any scheduled flushing of the distribution system? If yes, when?				
l.	Is there any evidence of intentional contamination in the distribution system?				
m.	Other comments on the distribution information.				
6.	**Storage Facilities**				
a.	Are the overflow and vents properly screened?				
b.	Is the facility secured to prevent unauthorized access?				
c.	Does the Access opening have the proper gasket and seal tightly?				
d.	Could the physical condition of tank be a source of contamination?				

EXAMPLE

CONCEPT EXAMPLE
Level 2 Assessment Form
(Developed by EPA and the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee)

	Questions	Reviewed? (check if completed or type N/A)	Issue(s) Found? (Y/N)	Issue Description	Corrective Action Taken (Including Date)
e.	Is the Vent turned down and maintain an approved air gap at the termination point?				
f.	Does the Drain/overflow line terminate a minimum of 12" air gap?				
g.	If present, Is the Pressure tank maintaining an appropriate minimum pressure?				
h.	Is proper O&M being performed?				
i.	Was there any observed physical deterioration of the tank?				
j.	Were there any observed leaks?				
k.	Is there any evidence of intentional contamination at the storage tank?				
l.	Have there been any facility maintenance? (i.e. painting/coating) If yes, when?				
m.	Is facility maintenance occurring per appropriate schedule?				
n.	Does the tank "float" on the distribution system or are there separate inlet and outlet lines?				
o.	What is the measured chlorine residual (total/free) of the water exiting the storage tank today?	Residual _____			
p.	Are there any unsealed openings in the storage facility such as access doors, vents or joints?				
q.	Other comments on the storage system				
7.	**Treatment Process. (If applicable)**				
a.	Treatment devices operational and maintained?				
b.	Is there any recent installation or repair of treatment equipment?				
c.	Were there any recent changes in the treatment process? If yes, when, what was the change?				
d.	Were there any interruptions of treatment (lapses in chemical feed, turbidity excursions, disinfection)? If yes which part, when and for how long?				
e.	What is the free chlorine residual measured immediately downstream from the point of application?	**Residual: ____**			

EXAMPLE

CONCEPT EXAMPLE
Level 2 Assessment Form
(Developed by EPA and the Technical Workgroup Supporting the Total Coliform Rule Distribution System Advisory Committee)

	Questions	Reviewed? (check if completed or type N/A)	Issue(s) Found? (Y/N)	Issue Description	Corrective Action Taken (Including Date)
f.	Did a review of the filter turbidity profiles reveal any anomalies?				
g.	Were there any failures to meet the CxT calculations?				
h.	Were the flow rates above the rated capacity?				
i.	Were there any anomalies on the settled water turbidities?				
j.	Other comments on the treatment system.				
8.	**Source – Well**				
a.	Is the sanitary seal intact?				
b.	Is the vent screened?				
c.	Does the vent and pump to waste terminate in an approved air gap?				
d.	Are there any unprotected cross connections at the wellhead?				
e.	How is the well used? **(Circle if applicable)**	Primary	Backup	Emergency	Not a PWS / Not Drinking Water
f.	How far does the casing extend above grade?	Height _____		Comments:	
g.	Is the well cap vented?				
h.	Is there evidence of standing water near the wellhead?				
i.	Is the wellhead secured to prevent unauthorized access?				
j.	Have there been any sewer spills, source water spills or other disturbances?				
k.	Other comments on the well system. (Are there aspects of well construction and operation that would bear on observed positives?)				
9.	**Source – Spring**				
a.	What is the condition of the spring development?				
b.	What is the condition of the spring box?				
c.	Is the spring secured to prevent unauthorized access?				

EXAMPLE

7.0 Public Notification and Compliance

This section will help to better explain violations associated with bacteriological sampling and required public notification. As with any public notification requirement, it is recommended that you contact the state Department of Health for any further notification and compliance issues immediately upon detection a total coliform-positive routine sample followed by an *E. coli* positive repeat sample (or an *E. coli*-positive routine sample followed by a total coliform-positive repeat sample), this is a serious potential health risk. This creates an acute, or short-term, violation that may have a more immediate health effect.

Table 7-1 Summary of public notification requirements of the revised TCR

Public Notification Requirements
E. coli MCL violation - Issued within 24 hours (Tier 1 violation)
• Routine total coliform + and repeat E. coli +
• Routine E. coli + and total coliform +
• Routine E coli + and system fails to take all repeat samples
• Repeat total coliform + and Analyst forgot to check for E coli presence
Treatment Technique violation - Issued within 30 days (Tier 2)
• System fails to conduct a required assessment within 30 days of the treatment technique trigger
• System fails to correct a sanitary defect within the required timeframe
Monitoring Violation - Issued within one year (Tier 3)
• System fails to collect all required routine samples
• Routine total coliform + sample not checked for presence of E. coli
Reporting Violation - Issued within one year (Tier 3)
• System fails to submit a monitoring report or completed assessment form in time
• System fails to notify DOH of an E coli + sample in a timely manner

A total coliform-positive routine sample followed by an *E. coli* positive repeat sample or an E coli positive routine sample followed by a total coliform-positive repeat sample is an Acute (Tier 1) violation. Two E coli positive samples constitute a clear Tier 1 acute violation and requires public notice within 24 hours.

Procedures for ACUTE (Tier 1) Violations
1. Notify the state Dept. of Health at by the end of the day you are notified by calling **(253) 395-6775** during business hours or **(877) 481-4901** after business hours. The Office of Drinking Water staff person on call will return the call within 30 minutes. 2. Notify the public within 24 hours by posting or hand delivery. You may also elect to notify the public by television, radio, or other methods approved by the DOH. *Note: Consider providing consumers with bottled water until the problem has been solved.*

A system that has failed to comply with a TCR requirement (for example, the sample siting plan requirement, or failure to take a routine or repeat sample) has committed a monitoring violation. Federal regulations detail how, when, and at what frequency notices for violations should be provided. Because different violations have different requirements, you should contact your state primacy agency for assistance when and how public notice is required.

Total Coliform positives > 5% of samples

A less serious but still significant potential health risk exists if more than 5% of routine samples (routine and/or repeat) in a month are total coliform-positive. At 90 routine samples, this means 4.5 monthly samples would be positive for total coliform. With the revision to the Total Coliform Rule (2016 implementation) an exceedance of the 5% positive is no longer an MCL violation. This means that public notification no longer needs to occur, BUT a Level 1 Assessment must occur within 30 days of being notified of the 5% exceedance. Refer to Section 6.1 of this Plan for information on a Level 1 Assessment.

8.0 Distribution of Routine Sampling Stations

Water samples are collected for bacteria analysis following the City laboratory's standard operating procedure: 1.1 Bacteria Sampling Procedure, which is included in Appendix 2.0 of this report. At the time of collection, a free chlorine residual sample is also taken utilizing a field colorimeter. If no free chlorine is detected, a HPC is analyzed for the site. Samples are transported at <6° C to the Water Treatment Plant shortly after their collection. These samples are analyzed by trained Lab Analyst at the state accredited laboratory at the City of Bellingham's Water Treatment Plant. Coliforms are analyzed by the Chromogenic Substrate Coliform Test, (SM 9223B), per the 23rd edition of Standard Methods for the Examination of Water and Wastewater, and in the laboratory procedure 1.2 Enzyme Substrate Coliform Test, which is included here in Appendix 3.0.

Routine sampling tap locations in the water distribution system are selected to proportionately represent the population consuming water in each of the City's eleven distinct pressure zones. Figure 8.0 breaks down the distribution of routine taps by zone.

Figure 8-1. Routine sampling stations by pressure zone (April 2021 population estimate)

		% POP*	TAPS :	% of Total	DIFF
North (Gravity)	35,721	36.7	30	29.7	**-7.0**
South	24,359	25.0	20	19.8	**-5.2**
Dakin Yew	13,993	14.4	18	17.8	**3.5**
Cordata	12,111	12.4	12	11.9	**-0.6**
Alabama Hill	3,661	3.8	4	4.0	**0.2**
Padden-Yew	3,654	3.8	7	6.9	**3.2**
College Way	1844	1.9	3	3.0	**1.1**
Governor Road	864	0.9	1	1.0	**0.1**
Reveille	411	0.4	1	1.0	**0.6**
King Mountain	370	0.4	2	2.0	**1.6**
Birch Street	253	0.3	1	1.0	**0.7**
Huntington	110	0.1	1	1.0	**0.9**
Samish Hill	32	0.0	1	1.0	**1.0**
	97,383	100.0	**101**	100.0	

*Working to get more North and South Zone taps for the next TCRP update. Wanted to get unrepresented zones this update.

Also important in assessing water quality is the evaluation of dead end and/or low-pressure areas, reservoirs, and consecutive system feed lines. In an effort to adequately represent all water delivered by the City, routine stations are selected to also represent these specific water characteristics. It is important to note that current population estimates put the actual service population inside the Bellingham city limits at 89,902 with the remaining 7,481 residing in areas outside of the incorporated urban boundary.

Prioritization will be on ensuring sampling station distribution closely represents the service population per zone. Focus was made with this update on getting taps in unrepresented zones Birch and Huntington. Despite the fact that 4 new taps were added to the North Zone and 2 to the South Zone, to maintain representation based on customer base, additional taps in these zones will be an area to focus for future sampling station installations.

9.0 Total Coliform Plan Maintenance Program

Some of the possible changes that should be reflected in the next update to the Coliform Monitoring Plan would be any of the following: an addition or deletion of pump stations, reservoirs, or pressure zones; a hydraulic re-routing that would impact pressure zones; an expansion of a distribution area; or, the addition of sampling sites.

The Public Works Superintendent will inform the Laboratory Technical Supervisor, should the service population near the next trigger value of 130,001 customers. At this time, ten additional sampling stations will be added. This Plan will also be updated to ensure proper State notification.

Public Works Laboratory staff receive full training on the Total Coliform Rule Plan with each update. Staff enact potential scenarios where the Plan would need to be activated. Training has also occurred at intervals greater than the revision cycles.

The City has set up the protocol of preemptively adding sampling stations to parts of its distribution network that require new city infrastructure. This includes areas recently incorporated into the City urban growth or service area, such as Cordata north and the Bellingham waterfront redevelopment at the former Georgia Pacific Mill site.

APPENDIX S

WATER QUALITY DATA

Raw Water Quality Data

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General Contaminant Results							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	Value Range	Average	Median
Temperature		Degrees C	None	-	-	-	-
Turbidity	1,6	NTU	Treatment technique. ≤0.3 NTU for 95% of samples. <1.0 at all times	2038	0.26 - 0.87	0.5	0.4
Total Organic Carbon	2,5	mg/L	None	53	1.7 - 3.7	2.2	2.1
Dissolved Organic Carbon	3,5	mg/L	None	104	1.1 - 3.3	1.9	1.9
Alkalinity	6,7	mg/L as $CaCO_3$	None	283	19.8 - 22.4	21.0	21.0
Dissolved Oxygen	8	mg/L	None	67	8.4 - 11.86	10.2	10.3
Conductivity	8	Umho's/cm	None	67	54.2 - 68	60.0	60.0
Hardness	8	mg/L as $CaCO_3$	None	42	19.23 - 22.11	20.6	20.6

Microbial Contaminant Results							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	No. of Detects	Value Range	Average
E. Coli - Counts	6,12	(cfu/100ml)	-	23	9	1 - 3	1.3
Cryptosporidium	6,12	org/L	2-log inactivation	23	0	-	-
Giardia	6,12	org/L	4-log inactivation	23	0	-	-

Secondary Contaminants Results							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	No. of Detects	Value Range	Average
Aluminum	4,5	mg/L	0.05-0.20	20	5	0.008 - 0.098	0.034
Chloride	4,5	mg/L	250	27	7	2 - 3	2.4
Color	4,5	Color units	15 Color Units	27	21	5 - 10	6.62
Copper	4,5	mg/L	1 (1.3 Action Level)	27	1	0.004 - 0.004	0.004
Corrosivity	4,5	LSI	Non-corrosive	-	-	-	-
Fluoride	4,5	mg/L	2 (MCL 4.0)	27	0	0 - 0	-
Foaming Agents	4,5	mg/L	0.5	-	-	-	-
Iron	5,8	mg/L	0.3	67	42	0.01 - 0.03	0.01
Manganese	4,5	mg/L	0.05	27	7	0.001 - 0.012	0.005
Odor	4,5	Threshold Odor Number	3 Threshold Odor Number	-	-	-	-
pH	1,6	-	6.5 - 8.5	2038	2038	7.15 - 7.54	7.33
Silver	4,5	mg/L	0.1	27	0	0 - 0	-
Sulfate	4,5	mg/L	250	20	11	3.6 - 10	5.3
Total Dissolved Solids	4,5	mg/L	500	-	-	-	-
Zinc	4,5	mg/L	5	27	2	0.013 - 0.1	0.06

Inorganic Contaminants Results							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	No. of Detects	Value Range	Average
Antimony	4,5	mg/L	0.006	25	1	0.009 - 0.009	0.009
Arsenic	4,5	mg/L	0.01	28	0	0 - 0	-
Barium	4,5	mg/L	2	27	4	0.007 - 0.022	0.011
Beryllium	4,5	mg/L	0.004	25	0	0 - 0	-
Cadmium	4,5	mg/L	0.005	27	1	0.0007 - 0.0007	0.0007
Chromium	4,5	mg/L	0.1	27	0	0 - 0	-
Cyanide	4,5	mg/L	0.2	25	0	0 - 0	-
Lead	4,5	mg/L	0.015 (Action Level)	27	2	0.002 - 0.003	0.003
Mercury	4,5	mg/L	0.002	27	3	0.0005 - 0.0041	0.0017
Nickel	4,5	mg/L	None	25	1	0.026 - 0.026	0.026
Nitrate (as N)	4,5	mg/L	10	27	15	0.2 - 0.62	0.36
Nitrite (as N)	4,5	mg/L	1	27	0	0 - 0	-
Nitrate/Nitrite (as N)	4,5	mg/L	10	2	2	0.25 - 0.35	0.30
Selenium	4,5	mg/L	0.05	27	0	0 - 0	-
Sodium	4,5	mg/L	None	27	7	2 - 3.38	2.70
Thallium	4,5	mg/L	0.002	25	0	0 - 0	-

Regulated Synthetic Organic Compounds Contaminant Results							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	No. of Detects	Value Range	Average
1,2-Dibromo-3-Chloropropane	4,5	mg/L	0.0002	14	0	0 - 0	-
2,4,5-TP (Silvex)	4,5	mg/L	0.05	17	0	0 - 0	-
2,4-D	4,5	mg/L	0.07	17	0	0 - 0	-
Alachlor	4,5	mg/L	0.002	17	0	0 - 0	-
Atrazine	4,5	mg/L	0.003	17	0	0 - 0	-
Benzo(a)pyrene	4,5	mg/L	0.0002	17	0	0 - 0	-
Carbofuran	4,5	mg/L	0.04	17	0	0 - 0	-
Chlordane	4,5	mg/L	0.002	17	0	0 - 0	-
Dalapon	4,5	mg/L	0.2	17	0	0 - 0	-
Bis(2-ethylhexyl)hexanedioate	4,5	mg/L	0.4	17	0	0 - 0	-
bis(2-Ethylhexyl) Phthalate	4,5	mg/L	0.006	17	0	0 - 0	-
Dinoseb	4,5	mg/L	0.007	17	0	0 - 0	-
2,3,7,8-TCDD (Dioxin)	4,5	mg/L	0.00000003	-	-	-	-
Diquat	4,5	mg/L	0.02	4	0	0 - 0	-
Endothall	4,5	mg/L	0.1	5	0	0 - 0	-
Endrin	4,5	mg/L	0.002	1	0	0 - 0	-
1,2-Dibromoethane	4,5	mg/L	0.00005	14	0	0 - 0	-
Glyphosate	4,5	mg/L	0.7	4	0	0 - 0	-
Heptachlor	4,5	mg/L	0.0004	18	0	0 - 0	-
Heptachlor Epoxide B	4,5	mg/L	0.0002	18	0	0 - 0	-
Hexachlorobenzene	4,5	mg/L	0.001	17	0	0 - 0	-
Hexachlorocyclopentadiene	4,5	mg/L	0.05	16	0	0 - 0	-
Lindane	4,5	mg/L	0.0002	18	0	0 - 0	-
Methoxychlor	4,5	mg/L	0.04	18	0	0 - 0	-
Oxamyl	4,5	mg/L	0.2	17	0	0 - 0	-
Pentachlorophenol	4,5	mg/L	0.001	17	0	0 - 0	-
Picloram	4,5	mg/L	0.5	16	0	0 - 0	-
Polychlorinated Biphenyls (PCB)	4,5	mg/L	0.0005	6	0	0 - 0	-
Simazine	4,5	mg/L	0.004	17	0	0 - 0	-
Toxaphene	4,5	mg/L	0.003	18	0	0 - 0	-

Unregulated Synthetic Organic Compounds Contaminant Results							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	No. of Detects	Value Range	Average
1,2,3-Trichloropropane	4,5	mg/L	None	4	0	0 - 0	-
1,3-Dichlorobenzene	4,5	mg/L	None	0	0	0 - 0	-
2,2',3,3',4,4',6-Heptachlorobiphenyl	4,5	mg/L	None	1	0	0 - 0	-
2,2',3,3',4,5,6,6' Octachlorobiphenyl	4,5	mg/L	None	1	0	0 - 0	-
2,2',3,4,6-Pentachlorobiphenyl	4,5	mg/L	None	1	0	0 - 0	-
2,2',4,4'-Tetrachlorobiphenyl	4,5	mg/L	None	1	0	0 - 0	-
2,2'4,4',5,6-Hexachlorobiphenyl	4,5	mg/L	None	1	0	0 - 0	-
2,3-Dichlorobiphenyl	4,5	mg/L	None	1	0	0 - 0	-
2,4,5-T	4,5	mg/L	None	13	0	0 - 0	-
2,4,5-Trichlorobiphenyl	4,5	mg/L	None	1	0	0 - 0	-
2,4-Db	4,5	mg/L	None	13	0	0 - 0	-
2-Chlorobiphenyl	4,5	mg/L	None	1	0	0 - 0	-
3,5-Dichlorobenzoic Acid	4,5	mg/L	None	11	0	0 - 0	-
3-Hydroxycarbofuran	4,5	mg/L	None	17	0	0 - 0	-
4.4-Ddd	4,5	mg/L	None	13	0	0 - 0	-
4.4-Dde	4,5	mg/L	None	13	0	0 - 0	-
4.4-Ddt	4,5	mg/L	None	13	0	0 - 0	-
Acenaphthylene	4,5	mg/L	None	11	0	0 - 0	-
Acenapthene	4,5	mg/L	None	11	0	0 - 0	-
Acetochlor	4,5	mg/L	None	3	0	0 - 0	-
Acifluorfen	4,5	mg/L	None	12	0	0 - 0	-
Aldicarb	4,5	mg/L	None	17	0	0 - 0	-
Aldicarb Sulfone	4,5	mg/L	None	17	0	0 - 0	-
Aldicarb sulfoxide	4,5	mg/L	None	17	0	0 - 0	-
Aldrin	4,5	mg/L	None	18	0	0 - 0	-
Anthracene	4,5	mg/L	None	12	0	0 - 0	-
Aroclor 1016	4,5	mg/L	None	14	0	0 - 0	-
Aroclor 1221	4,5	mg/L	None	14	0	0 - 0	-
Aroclor 1232	4,5	mg/L	None	14	0	0 - 0	-
Aroclor 1242	4,5	mg/L	None	14	0	0 - 0	-
Aroclor 1248	4,5	mg/L	None	14	0	0 - 0	-
Aroclor 1254	4,5	mg/L	None	14	0	0 - 0	-
Aroclor 1260	4,5	mg/L	None	14	0	0 - 0	-
Aroclor 1262	4,5	mg/L	None	0	0	0 - 0	-
Aroclor 1268	4,5	mg/L	None	0	0	0 - 0	-
Bentazon	4,5	mg/L	None	12	0	0 - 0	-
Benzo(A)Anthracene	4,5	mg/L	None	12	0	0 - 0	-
Benzo(B)Fluoranthene	4,5	mg/L	None	12	0	0 - 0	-
Benzo(G,H,I)Perylene	4,5	mg/L	None	12	0	0 - 0	-
Benzo(K)Fluoranthene	4,5	mg/L	None	12	0	0 - 0	-
Bromacil	4,5	mg/L	None	12	0	0 - 0	-
Butachlor	4,5	mg/L	None	16	0	0 - 0	-
Butylbenzylphthalate	4,5	mg/L	None	12	0	0 - 0	-
Carbaryl	4,5	mg/L	None	17	0	0 - 0	-
Chloramben	4,5	mg/L	None	4	0	0 - 0	-
Chlordane Alpha	4,5	mg/L	None	3	0	0 - 0	-
Chlordane Beta	4,5	mg/L	None	3	0	0 - 0	-

Chrysene	4,5	mg/L	None	12	0	0 - 0	-
Cyanazine	4,5	mg/L	None	11	0	0 - 0	-
Dacthal (Dcpa)	4,5	mg/L	None	12	0	0 - 0	-
Diazinon	4,5	mg/L	None	11	0	0 - 0	-
Dibenzo(A,H)Anthracene	4,5	mg/L	None	12	0	0 - 0	-
Dicamba	4,5	mg/L	None	17	0	0 - 0	-
Dichlorprop	4,5	mg/L	None	12	0	0 - 0	-
Dieldrin	4,5	mg/L	None	18	0	0 - 0	-
Diethylphthalate	4,5	mg/L	None	12	0	0 - 0	-
Dimethylphthalate	4,5	mg/L	None	12	0	0 - 0	-
Di-N-Butylphthalate	4,5	mg/L	None	12	0	0 - 0	-
Disulfoton	4,5	mg/L	None	0	0	0 - 0	-
Endosulfan I	4,5	mg/L	None	2	0	0 - 0	-
Endosulfan Ii	4,5	mg/L	None	2	0	0 - 0	-
Endosulfan Sulfate	4,5	mg/L	None	2	0	0 - 0	-
Endrin	4,5	mg/L	None	18	0	0 - 0	-
Endrin Ketone	4,5	mg/L	None	2	0	0 - 0	-
Eptc	4,5	mg/L	None	11	0	0 - 0	-
Fluoranthene	4,5	mg/L	None	11	0	0 - 0	-
Fluorene	4,5	mg/L	None	13	0	0 - 0	-
Hexaclorcyclohexane - A (Alpha Bhc)	4,5	mg/L	None	2	0	0 - 0	-
Hexaclorcyclohexane - B (Beta Bhc)	4,5	mg/L	None	2	0	0 - 0	-
Hexaclorcyclohexane - D (Delta Bhc)	4,5	mg/L	None	2	0	0 - 0	-
Indeno(1,2,3-Cd)Pyrene	4,5	mg/L	None	12	0	0 - 0	-
Malathion	4,5	mg/L	None	11	0	0 - 0	-
Mcpa	4,5	mg/L	None	0	0	0 - 0	-
Mcpp	4,5	mg/L	None	0	0	0 - 0	-
Methiocarb	4,5	mg/L	None	12	0	0 - 0	-
Methomyl	4,5	mg/L	None	17	0	0 - 0	-
Metolachlor	4,5	mg/L	None	16	0	0 - 0	-
Metribuzin	4,5	mg/L	None	16	0	0 - 0	-
Molinate	4,5	mg/L	None	3	0	0 - 0	-
Napthalene	4,5	mg/L	None	11	0	0 - 0	-
Parathion	4,5	mg/L	None	11	0	0 - 0	-
Pentachlorophenol Method 525.2	4,5	mg/L	None	11	0	0 - 0	-
Phenanthrene	4,5	mg/L	None	9	0	0 - 0	-
Prometon	4,5	mg/L	None	12	0	0 - 0	-
Propachlor	4,5	mg/L	None	12	0	0 - 0	-
Propoxur (Baygon)	4,5	mg/L	None	12	0	0 - 0	-
Pyrene	4,5	mg/L	None	13	0	0 - 0	-
Terbacil	4,5	mg/L	None	11	0	0 - 0	-
Total Dcpa	4,5	mg/L	None	3	0	0 - 0	-
Trans-Nonachlor	4,5	mg/L	None	1	0	0 - 0	-
Triclopyr	4,5	mg/L	None	0	0	0 - 0	-
Trifluralin	4,5	mg/L	None	11	0	0 - 0	-

Regulated Volatile Organic Compounds Contaminants Results

Contaminant	Note	Unit	Finished Water MCL	No. of Samples	No. of Detects	Value Range	Median
1,1,1-Trichloroethane	5,10	mg/L	0.2	13	0	0 - 0	-
1,1,2-Trichloroethane	5,10	mg/L	0.005	13	0	0 - 0	-
1,1-Dichloroethylene	5,10	mg/L	0.007	13	0	0 - 0	-
1,2,4-Trichlorobenzene	5,10	mg/L	0.07	12	0	0 - 0	-
1,2-Dichlorobenzene	5,10	mg/L	0.6	13	0	0 - 0	-
p-Dichlorobenzene	5,10	mg/L	0.075	13	0	0 - 0	-
1,2-Dichloroethane	5,10	mg/L	0.005	13	0	0 - 0	-
1,2-Dichloropropane	5,10	mg/L	0.005	13	0	0 - 0	-
Benzene	5,10,11	mg/L	0.005	13	1	0.00007 - 0.00007	0.00007
Carbon Tetrachloride	5,10	mg/L	0.005	13	0	0 - 0	-
Chlorobenzene	5,10	mg/L	0.1	13	0	0 - 0	-
cis-1,2-Dichloroethylene	5,10	mg/L	0.07	13	0	0 - 0	-
Ethylbenzene	5,10	mg/L	0.7	13	0	0 - 0	-
Dichloromethane	5,10	mg/L	0.005	13	0	0 - 0	-
Styrene	5,10	mg/L	0.1	13	0	0 - 0	-
Tetrachloroethene	5,10	mg/L	0.005	13	0	0 - 0	-
Toluene	5,10	mg/L	1	13	0	0 - 0	-
trans-1,2-Dichloroethene	5,10	mg/L	0.1	13	0	0 - 0	-
Trichloroethylene	5,10	mg/L	0.005	13	0	0 - 0	-
Vinyl Chloride	5,10	mg/L	0.002	13	0	0 - 0	-
Total Xylenes	5,10	mg/L	10	12	0	0 - 0	-

Unregulated Volatile Organic Compounds Contaminant Results							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	No. of Detects	Value Range	Median
1,1,1,2-Tetrachloroethane	5,10	mg/L	None	13	0	0 - 0	-
1,1,2,2-Tetrachloroethane	5,10	mg/L	None	13	0	0 - 0	-
1,1-Dichloroethane	5,10	mg/L	None	13	0	0 - 0	-
1,1-Dichloropropene	5,10	mg/L	None	13	0	0 - 0	-
1,2,3-Trichlorobenzene	5,10	mg/L	None	12	0	0 - 0	-
1,2,3-Trichloropropane	5,10	mg/L	None	14	0	0 - 0	-
1,2,4-Trimethlybenzene	5,10	mg/L	None	13	0	0 - 0	-
1,3,5-Trimethylbenzene	5,10	mg/L	None	13	0	0 - 0	-
1,3-Dichloropropane	5,10	mg/L	None	13	0	0 - 0	-
2,2-Dichloropropane	5,10	mg/L	None	13	0	0 - 0	-
Bromobenzene	5,10	mg/L	None	13	0	0 - 0	-
Bromochloromethane	5,10	mg/L	None	13	0	0 - 0	-
Bromodichloromethane	5,10	mg/L	None	13	0	0 - 0	-
Bromoform	5,10	mg/L	None	12	0	0 - 0	-
Bromomethane	5,10	mg/L	None	13	0	0 - 0	-
Chlorodibromomethane	5,10,11	mg/L	None	12	0	0 - 0	-
Chloroethane	5,10	mg/L	None	13	0	0 - 0	-
Chloroform	5,10	mg/L	None	13	0	0 - 0	-
Chloromethane	5,10	mg/L	None	13	0	0 - 0	-
cis-1,3-Dichloropropene	5,10	mg/L	None	12	0	0 - 0	-
Dibromomethane	5,10	mg/L	None	13	0	0 - 0	-
Dichlorodifluoromethane	5,10	mg/L	None	13	0	0 - 0	-
Hexachlorobutadiene	5,10	mg/L	None	12	0	0 - 0	-
Isopropylbenzene	5,10	mg/L	None	13	0	0 - 0	-
Methyl tert-butyl ether (MTBE)	5,10	mg/L	None	6	0	0 - 0	-
Naphthalene	5,10	mg/L	None	12	0	0 - 0	-
n-Butylbenzene	5,10	mg/L	None	13	0	0 - 0	-
n-Propylbenzene	5,10	mg/L	None	13	0	0 - 0	-
o-Chlorotoluene	5,10	mg/L	None	13	0	0 - 0	-
p-Isopropyltoluene	5,10	mg/L	None	13	0	0 - 0	-
sec-Butylbenzene	5,10	mg/L	None	13	0	0 - 0	-
Tert-Butylbenzene	5,10	mg/L	None	13	0	0 - 0	-
Total Trihalomethane	5,10,13	mg/L	None (0.08 mg/L)	7	0	0 - 0	-
trans-1,3-Dichloropropene	5,10	mg/L	None	12	0	0 - 0	-
Trichlorofluoromethane	5,10	mg/L	None	13	0	0 - 0	-
P-Chlorotoluene	5,10	mg/L	None	13	0	0 - 0	-
1,2-Dibromoethane	5,10	mg/L	None	0	0	0 - 0	-
M-Dichlorobenzene	5,10	mg/L	None	13	0	0 - 0	-
M/P-Xylene	5,10	mg/L	None	13	0	0 - 0	-
O-Xylene	5,10	mg/L	None	13	0	0 - 0	-
Ethylene Dibromide	5,10	mg/L	None	5	0	0 - 0	-
1,2-Dibromo-3-Chloropropane	5,10	mg/L	None	5	0	0 - 0	-

Notes:

(1) From daily operating data January 2018 to July 2023.

(2) From quarterly testing for TOC and alkalinity between January 2013 and May 2023.

(3) From sampling conducted near-monthly between 1999 and 2007.

(4) From periodic inorganic contaminant grab sampling of raw water between 1990 and 2009.

(5) Value range is minimum to maximum of all samples.

(6) Value range is 5th percentile to 95th percentile.

(7) From weekly sampling data between January 2018 and July 2023.

(8) From monthly sampling of raw water, finished water, and distribution system locations.

(9) From periodic synthetic contaminant grab sampling of raw water between 1990 and 2009.

(10) From periodic volatile organic contaminant grab sampling of raw water between 1990 and 2009.

(11) Detections listed as estimated values in source data.

(12) From LT2ESWTR sampling between 2015 and 2017.

(13) MCL of 0.08 mg/L for Stage 2 DBPR in distribution system.

Finished Water Quality Data

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General Contaminant Results							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	Value Range	Average	Median
Temperature	1,6	Degrees C	None	2038	6.6 - 19.5	12.0	11.0
Turbidity	1,6	NTU	Treatment technique. ≤0.3 NTU for 95% of samples. <1.0 at all times	2038	0.02 - 0.04	0.03	0.03
Total Organic Carbon	2,5	mg/L	None	49	0.98 - 1.7	1.21	1.20
Dissolved Organic Carbon	3,5	mg/L	None	104	0.5 - 2.3	1.14	1.10
Alkalinity	6,7	mg/L as $CaCO_3$	None	283	24.3 - 28.3	26.0	26.0
Dissolved Oxygen	8	mg/L	None	67	8.4 - 13.5	10.5	10.6
Conductivity	8	Umho's/cm	None	67	63 - 103	87.0	88.0
Heterotrophic Plate Count	8	colonies/mL	None	67	1 - 6	1.4	1.0
Hardness	8	mg/L as $CaCO_3$	None	42	20 - 23.8	21.2	21.0

Secondary Contaminants Results							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	No. of Detects	Value Range	Average
Aluminum	4,5	mg/L	0.05-0.20	34	17	0.01 - 0.078	0.019
Chloride	4,5	mg/L	250	42	19	3 - 5.6	4.10
Color	4,5	Color units	15 Color Units	42	10	5 - 5	5.00
Copper	4,5	mg/L	1 (1.3 Action Level)	43	0	0 - 0	-
Corrosivity	4,5	LSI	Non-corrosive	-	-	-	-
Foaming Agents	4,5	mg/L	0.5	-	-	-	-
Fluoride	4,5	mg/L	2 (MCL 4.0)	42	0	0 - 0	-
Iron	5,8	mg/L	0.3	67	10	0.01 - 0.02	0.01
Manganese	4,5	mg/L	0.05	42	5	0.001 - 0.006	0.003
Odor	4,5	Threshold Odor Numbe	3 Threshold Odor Number	-	-	-	-
pH	1,6	-	6.5 - 8.5	2038	2038	7.97 - 8.02	7.98
Silver	4,5	mg/L	0.1	42	1	0.0014 - 0.0014	0.0014
Sulfate	4,5	mg/L	250	35	26	6 - 12	8.48
Total Dissolved Solids	4,5	mg/L	500	6	6	45 - 72	55.50
Zinc	4,5	mg/L	5	43	2	0.013 - 0.1	0.06

Inorganic Contaminants Results							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	No. of Detects	Value Range	Average
Antimony	4,5	mg/L	0.006	40	0	0 - 0	-
Arsenic	4,5	mg/L	0.01	43	0	0 - 0	-
Barium	4,5	mg/L	2	42	16	0.006 - 0.022	0.008
Beryllium	4,5	mg/L	0.004	40	1	0.0006 - 0.0006	0.0006
Cadmium	4,5	mg/L	0.005	43	0	0 - 0	-
Chromium	4,5	mg/L	0.1	43	0	0 - 0	-
Cyanide	4,5	mg/L	0.2	40	0	0 - 0	-
Lead	4,5	mg/L	0.015 (Action Level)	43	0	0 - 0	-
Mercury	4,5	mg/L	0.002	42	0	0 - 0	-
Nickel	4,5	mg/L	None	41	0	0 - 0	-
Nitrate (as N)	4,5	mg/L	10	43	29	0.1 - 0.65	0.31
Nitrite (as N)	4,5	mg/L	1	43	1	0.35 - 0.35	0.35
Nitrate/Nitrite (as N)	4,5	mg/L	10	15	14	0.1 - 0.42	0.26
Selenium	4,5	mg/L	0.05	42	0	0 - 0	-
Sodium	4,5	mg/L	None	42	41	5.5 - 10.6	8.39
Thallium	4,5	mg/L	0.002	2	0	0 - 0	-

Regulated Synthetic Organic Compounds Contaminant Results							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	No. of Detects	Value Range	Median
1,2-Dibromo-3-Chloropropane	5,9	mg/L	0.0002	26	0	0 - 0	-
2,4,5-TP (Silvex)	5,9	mg/L	0.05	28	0	0 - 0	-
2,4-D	5,9	mg/L	0.07	28	0	0 - 0	-
Alachlor	5,9	mg/L	0.002	28	0	0 - 0	-
Atrazine	5,9	mg/L	0.003	28	0	0 - 0	-
Benzo(a)pyrene	5,9	mg/L	0.0002	28	0	0 - 0	-
Carbofuran	5,9	mg/L	0.04	28	0	0 - 0	-
Chlordane	5,9	mg/L	0.002	28	0	0 - 0	-
Dalapon	5,9,11	mg/L	0.2	28	2	0.00066 - 0.0008	0.00073
Bis(2-ethylhexyl)hexanedioate	5,9	mg/L	0.4	28	0	0 - 0	-
bis(2-Ethylhexyl) Phthalate	5,9	mg/L	0.006	28	0	0 - 0	-
Dinoseb	5,9	mg/L	0.007	28	0	0 - 0	-
2,3,7,8-TCDD (Dioxin)	5,9	mg/L	0.00000003	-	-	-	-
Diquat	5,9	mg/L	0.02	2	0	0 - 0	-
Endothall	5,9	mg/L	0.1	2	0	0 - 0	-
Endrin	5,9	mg/L	0.002	0	0	0 - 0	-
1,2-Dibromoethane	5,9	mg/L	0.00005	25	0	0 - 0	-
Glyphosate	5,9	mg/L	0.7	6	0	0 - 0	-
Heptachlor	5,9	mg/L	0.0004	28	0	0 - 0	-
Heptachlor Epoxide B	5,9	mg/L	0.0002	28	0	0 - 0	-
Hexachlorobenzene	5,9	mg/L	0.001	28	0	0 - 0	-
Hexachlorocyclopentadiene	5,9,11	mg/L	0.05	28	8	0.00003 - 0.00009	0.00004
Lindane	5,9	mg/L	0.0002	28	0	0 - 0	-
Methoxychlor	5,9	mg/L	0.04	28	0	0 - 0	-
Oxamyl	5,9	mg/L	0.2	28	0	0 - 0	-
Pentachlorophenol	5,9	mg/L	0.001	21	0	0 - 0	-
Picloram	5,9	mg/L	0.5	22	0	0 - 0	-
Polychlorinated Biphenyls (PCB)	5,9	mg/L	0.0005	10	0	0 - 0	-
Simazine	5,9	mg/L	0.004	28	0	0 - 0	-
Toxaphene	5,9	mg/L	0.003	28	0	0 - 0	-

Unregulated Synthetic Organic Compounds Contaminant Results							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	No. of Detects	Value Range	Median
1,2,3-Trichloropropane	5,9	mg/L	None	15	0	0 - 0	-
1,3-Dichlorobenzene	5,9	mg/L	None	2	0	0 - 0	-
2,2',3,3',4,4',6-Heptachlorobiphenyl	5,9	mg/L	None	0	0	0 - 0	-
2,2',3,3',4,5,6,6' Octachlorobiphenyl	5,9	mg/L	None	1	0	0 - 0	-
2,2',3,4,6-Pentachlorobiphenyl	5,9	mg/L	None	0	0	0 - 0	-
2,2',4,4'-Tetrachlorobiphenyl	5,9	mg/L	None	0	0	0 - 0	-
2,2'4,4',5,6-Hexachlorobiphenyl	5,9	mg/L	None	0	0	0 - 0	-
2,3-Dichlorobiphenyl	5,9	mg/L	None	0	0	0 - 0	-
2,4,5-T	5,9	mg/L	None	22	0	0 - 0	-
2,4,5-Trichlorobiphenyl	5,9	mg/L	None	0	0	0 - 0	-
2,4-Db	5,9	mg/L	None	27	0	0 - 0	-
2-Chlorobiphenyl	5,9	mg/L	None	0	0	0 - 0	-
3,5-Dichlorobenzoic Acid	5,9	mg/L	None	23	0	0 - 0	-
3-Hydroxycarbofuran	5,9	mg/L	None	24	0	0 - 0	-
4.4-Ddd	5,9	mg/L	None	17	0	0 - 0	-
4.4-Dde	5,9	mg/L	None	21	0	0 - 0	-
4.4-Ddt	5,9	mg/L	None	17	0	0 - 0	-
Acenaphthylene	5,9	mg/L	None	15	0	0 - 0	-
Acenapthene	5,9	mg/L	None	13	0	0 - 0	-
Acetochlor	5,9	mg/L	None	8	0	0 - 0	-
Acifluorfen	5,9	mg/L	None	26	0	0 - 0	-
Aldicarb	5,9	mg/L	None	28	0	0 - 0	-
Aldicarb Sulfone	5,9	mg/L	None	28	0	0 - 0	-
Aldicarb sulfoxide	5,9	mg/L	None	26	0	0 - 0	-
Aldrin	5,9	mg/L	None	28	0	0 - 0	-
Anthracene	5,9	mg/L	None	17	0	0 - 0	-
Aroclor 1016	5,9	mg/L	None	27	0	0 - 0	-
Aroclor 1221	5,9	mg/L	None	27	0	0 - 0	-
Aroclor 1232	5,9	mg/L	None	27	0	0 - 0	-
Aroclor 1242	5,9	mg/L	None	27	0	0 - 0	-
Aroclor 1248	5,9	mg/L	None	27	0	0 - 0	-
Aroclor 1254	5,9	mg/L	None	27	0	0 - 0	-
Aroclor 1260	5,9	mg/L	None	27	0	0 - 0	-
Aroclor 1262	5,9	mg/L	None	0	0	0 - 0	-
Aroclor 1268	5,9	mg/L	None	3	0	0 - 0	-
Bentazon	5,9	mg/L	None	22	0	0 - 0	-
Benzo(A)Anthracene	5,9	mg/L	None	17	0	0 - 0	-
Benzo(B)Fluoranthene	5,9	mg/L	None	17	0	0 - 0	-
Benzo(G,H,I)Perylene	5,9	mg/L	None	13	0	0 - 0	-
Benzo(K)Fluoranthene	5,9	mg/L	None	17	0	0 - 0	-
Bromacil	5,9	mg/L	None	27	0	0 - 0	-
Butachlor	5,9	mg/L	None	28	0	0 - 0	-
Butylbenzylphthalate	5,9	mg/L	None	17	0	0 - 0	-
Carbaryl	5,9	mg/L	None	28	0	0 - 0	-
Chloramben	5,9	mg/L	None	5	0	0 - 0	-
Chlordane Alpha	5,9	mg/L	None	0	0	0 - 0	-
Chlordane Beta	5,9	mg/L	None	0	0	0 - 0	-

Chrysene	5,9	mg/L	None	17	0	0 - 0	-
Cyanazine	5,9	mg/L	None	13	0	0 - 0	-
Dacthal (Dcpa)	5,9	mg/L	None	27	0	0 - 0	-
Diazinon	5,9	mg/L	None	11	0	0 - 0	-
Dibenzo(A,H)Anthracene	5,9	mg/L	None	13	0	0 - 0	-
Dicamba	5,9	mg/L	None	28	0	0 - 0	-
Dichlorprop	5,9	mg/L	None	21	1	0.0005 - 0.0005	0.0005
Dieldrin	5,9	mg/L	None	28	0	0 - 0	-
Diethylphthalate	5,9	mg/L	None	17	0	0 - 0	-
Dimethylphthalate	5,9	mg/L	None	17	0	0 - 0	-
Di-N-Butylphthalate	5,9	mg/L	None	17	0	0 - 0	-
Disulfoton	5,9	mg/L	None	2	0	0 - 0	-
Endosulfan I	5,9	mg/L	None	2	0	0 - 0	-
Endosulfan Ii	5,9	mg/L	None	0	0	0 - 0	-
Endosulfan Sulfate	5,9	mg/L	None	0	0	0 - 0	-
Endrin	5,9	mg/L	None	28	0	0 - 0	-
Endrin Ketone	5,9	mg/L	None	0	0	0 - 0	-
Eptc	5,9	mg/L	None	19	0	0 - 0	-
Fluoranthene	5,9	mg/L	None	17	0	0 - 0	-
Fluorene	5,9	mg/L	None	27	0	0 - 0	-
Hexaclorcyclohexane - A (Alpha Bhc)	5,9	mg/L	None	0	0	0 - 0	-
Hexaclorcyclohexane - B (Beta Bhc)	5,9	mg/L	None	0	0	0 - 0	-
Hexaclorcyclohexane - D (Delta Bhc)	5,9	mg/L	None	0	0	0 - 0	-
Indeno(1,2,3-Cd)Pyrene	5,9	mg/L	None	13	0	0 - 0	-
Malathion	5,9	mg/L	None	13	0	0 - 0	-
Mcpa	5,9	mg/L	None	1	0	0 - 0	-
Mcpp	5,9	mg/L	None	1	0	0 - 0	-
Methiocarb	5,9	mg/L	None	18	0	0 - 0	-
Methomyl	5,9	mg/L	None	28	0	0 - 0	-
Metolachlor	5,9	mg/L	None	28	0	0 - 0	-
Metribuzin	5,9	mg/L	None	28	0	0 - 0	-
Molinate	5,9	mg/L	None	12	0	0 - 0	-
Napthalene	5,9	mg/L	None	12	0	0 - 0	-
Parathion	5,9	mg/L	None	13	0	0 - 0	-
Pentachlorophenol Method 525.2	5,9	mg/L	None	19	0	0 - 0	-
Phenanthrene	5,9	mg/L	None	18	0	0 - 0	-
Prometon	5,9	mg/L	None	20	0	0 - 0	-
Propachlor	5,9	mg/L	None	19	0	0 - 0	-
Propoxur (Baygon)	5,9	mg/L	None	18	0	0 - 0	-
Pyrene	5,9	mg/L	None	23	0	0 - 0	-
Terbacil	5,9	mg/L	None	21	0	0 - 0	-
Total Dcpa	5,9	mg/L	None	3	0	0 - 0	-
Trans-Nonachlor	5,9	mg/L	None	0	0	0 - 0	-
Triclopyr	5,9	mg/L	None	1	0	0 - 0	-
Trifluralin	5,9	mg/L	None	17	0	0 - 0	-

Regulated Volatile Organic Compounds Contaminants Results							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	No. of Detects	Value Range	Median
1,1,1-Trichloroethane	5,10	mg/L	0.2	34	0	0 - 0	-
1,1,2-Trichloroethane	5,10	mg/L	0.005	35	0	0 - 0	-
1,1-Dichloroethylene	5,10	mg/L	0.007	35	0	0 - 0	-
1,2,4-Trichlorobenzene	5,10	mg/L	0.07	33	0	0 - 0	-
1,2-Dichlorobenzene	5,10	mg/L	0.6	35	0	0 - 0	-
p-Dichlorobenzene	5,10	mg/L	0.075	35	0	0 - 0	-
1,2-Dichloroethane	5,10	mg/L	0.005	35	0	0 - 0	-
1,2-Dichloropropane	5,10	mg/L	0.005	33	0	0 - 0	-
Benzene	5,10	mg/L	0.005	35	0	0 - 0	-
Carbon Tetrachloride	5,10	mg/L	0.005	35	0	0 - 0	-
Chlorobenzene	5,10	mg/L	0.1	35	0	0 - 0	-
cis-1,2-Dichloroethylene	5,10	mg/L	0.07	35	0	0 - 0	-
Ethylbenzene	5,10	mg/L	0.7	35	0	0 - 0	-
Dichloromethane	5,10	mg/L	0.005	35	0	0 - 0	-
Styrene	5,10	mg/L	0.1	35	0	0 - 0	-
Tetrachloroethene	5,10	mg/L	0.005	35	0	0 - 0	-
Toluene	5,10	mg/L	1	35	0	0 - 0	-
trans-1,2-Dichloroethene	5,10	mg/L	0.1	35	0	0 - 0	-
Trichloroethylene	5,10	mg/L	0.005	35	0	0 - 0	-
Vinyl Chloride	5,10	mg/L	0.002	35	0	0 - 0	-
Total Xylenes	5,10	mg/L	10	28	0	0 - 0	-

Unregulated Volatile Organic Compounds Contaminant Results							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	No. of Detects	Value Range	Median
1,1,1,2-Tetrachloroethane	5,10	mg/L	None	35	0	0 - 0	-
1,1,2,2-Tetrachloroethane	5,10	mg/L	None	35	0	0 - 0	-
1,1-Dichloroethane	5,10	mg/L	None	35	0	0 - 0	-
1,1-Dichloropropene	5,10	mg/L	None	35	0	0 - 0	-
1,2,3-Trichlorobenzene	5,10	mg/L	None	33	0	0 - 0	-
1,2,3-Trichloropropane	5,10	mg/L	None	36	0	0 - 0	-
1,2,4-Trimethlybenzene	5,10	mg/L	None	35	0	0 - 0	-
1,3,5-Trimethylbenzene	5,10	mg/L	None	35	0	0 - 0	-
1,3-Dichloropropane	5,10	mg/L	None	35	0	0 - 0	-
2,2-Dichloropropane	5,10	mg/L	None	35	0	0 - 0	-
Bromobenzene	5,10	mg/L	None	35	0	0 - 0	-
Bromochloromethane	5,10	mg/L	None	35	0	0 - 0	-
Bromodichloromethane	5,10	mg/L	None	35	35	0.00088 - 0.005	0.002
Bromoform	5,10	mg/L	None	33	0	0 - 0	-
Bromomethane	5,10	mg/L	None	35	0	0 - 0	-
Chlorodibromomethane	5,10,11	mg/L	None	33	2	0.0002 - 0.0004	0.0003
Chloroethane	5,10	mg/L	None	35	0	0 - 0	-
Chloroform	5,10	mg/L	None	35	35	0.0056 - 0.04	0.012
Chloromethane	5,10	mg/L	None	35	1	0.0006 - 0.0006	0.0006
cis-1,3-Dichloropropene	5,10	mg/L	None	32	0	0 - 0	-
Dibromomethane	5,10	mg/L	None	35	0	0 - 0	-
Dichlorodifluoromethane	5,10	mg/L	None	35	1	0.0005 - 0.0005	0.0005
Hexachlorobutadiene	5,10	mg/L	None	33	0	0 - 0	-
Isopropylbenzene	5,10	mg/L	None	35	0	0 - 0	-
Methyl tert-butyl ether (MTBE)	5,10	mg/L	None	20	0	0 - 0	-
Naphthalene	5,10	mg/L	None	33	0	0 - 0	-
n-Butylbenzene	5,10	mg/L	None	35	0	0 - 0	-
n-Propylbenzene	5,10	mg/L	None	35	0	0 - 0	-
o-Chlorotoluene	5,10	mg/L	None	35	0	0 - 0	-
p-Isopropyltoluene	5,10	mg/L	None	35	0	0 - 0	-
sec-Butylbenzene	5,10	mg/L	None	35	0	0 - 0	-
Tert-Butylbenzene	5,10	mg/L	None	35	0	0 - 0	-
Total Trihalomethane	5,10,16	mg/L	None (0.08 mg/L)	33	33	0.00648 - 0.045	0.015
trans-1,3-Dichloropropene	5,10	mg/L	None	32	0	0 - 0	-
Trichlorofluoromethane	5,10	mg/L	None	35	0	0 - 0	-
P-Chlorotoluene	5,10	mg/L	None	35	0	0 - 0	-
1,2-Dibromoethane	5,10	mg/L	None	3	0	0 - 0	-
M-Dichlorobenzene	5,10	mg/L	None	35	0	0 - 0	-
M/P-Xylene	5,10	mg/L	None	33	0	0 - 0	-
O-Xylene	5,10	mg/L	None	33	0	0 - 0	-
Ethylene Dibromide	5,10	mg/L	None	17	0	0 - 0	-
1,2-Dibromo-3-Chloropropane	5,10	mg/L	None	16	0	0 - 0	-

Disinfectant							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	Value Range	Average	Median
Chlorine Residual	1,6	mg/L	4	2038	0.78 - 0.96	0.854013739	0.85

PFAS							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	No. of Detects	Value Range	Median
HFPO-DA	12	ng/L	10	2	0	0 - 0	-
PFOA	12,13	ng/L	4 / 10 (Action Level)	2	0	0 - 0	-
PFOS	12,13	ng/L	4 / 15 (Action Level)	2	0	0 - 0	-
PFNA	12,13	ng/L	10 / 9 (Action Level)	2	0	0 - 0	-
PFHxS	12,13	ng/L	10 / 65 (Action Level)	2	0	0 - 0	-
PFBS	13	ng/L	345 (Action Level)	2	0	0 - 0	-
Hazard Index	14	-	1	2	0	0 - 0	-

Notes:

(1) From daily operating data January 2018 to July 2023.

(2) From quarterly testing for TOC and alkalinity between January 2013 and May 2023.

(3) From sampling conducted near-monthly between 1999 and 2007.

(4) From periodic inorganic contaminant grab sampling of finished water between 1990 and 2023.

(5) Value range is minimum to maximum of all samples.

(6) Value range is 5th percentile to 95th percentile.

(7) From weekly sampling data between January 2018 and July 2023.

(8) From monthly sampling of raw water, finished water, and distribution system locations.

(9) From periodic synthetic organic contaminant grab sampling of finished water between 1990 and 2023.

(10) From periodic volatile organic contaminant grab sampling of finished water between 1990 and 2023.

(11) Detections listed as estimated values in source data.

(12) April 2024 final rule determintation MCL.

(13) Action Level is Washington State Department of Health Action Level.

(14) Hazard index is sum of fractions comparing level of PFBS, PFNA, PFHxS and HFPO-DA against established health-based value.

(15) PFAS data shown from two rounds of UCMR5 sampling in 2024.

(16) MCL of 0.08 mg/L for Stage 2 DBPR in distribution system.

Distribution System Water Quality Data

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General Contaminant Results							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	Value Range	Average	Median
Dissolved Oxygen	1,4	mg/L	None	1606	8 - 18.7	10.5	10.7
Turbidity	1,4	NTU	Treatment technique. ≤0.3 NTU for 95% of samples. <1.0 at all times	1607	0.0136 - 2.92	0.2	0.1
pH	1,4	-	None	1607	7.2 - 10.06	8.4	8.3
Alkalinity	1,4	mgCaCO3/L	None	1606	14.8 - 36.2	27.1	26.8
Iron	1,4	mg/L	0.3	1607	0.01 - 0.21	0.02	0.01
Conductivity	1,4	Umho's/cm	None	1607	62 - 142	90.8	91.0
Heterotrophic Plate Count	1,4	colonies/mL	None	1608	1 - 7800	64.7	3.0
Temperature	1,4	°C	None	1606	4.7 - 24	13.2	12.2
Hardness (EDTA)	1,4	mg/L as $CaCO_3$	None	1007	19 - 29.4	21.5	21.2

Lead and Copper Rule Sampling Results							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	No. of Detects	Value Range	Average
Lead	2,4	mg/L	0.015 (Action Level)	268	152	0.001 - 0.99	0.002
Copper	2,4	mg/L	1.3 (Action Level)	268	268	0.001 - 0.135	0.036

Disinfection Byproducts and Chlorine Residuals							
Contaminant	Note	Unit	Finished Water MCL	No. of Samples	No. of Detects	Value Range	Median
TTHM	3,4,5	ug/L	80	356	356	10.3 - 79.9	32
TTHM - LRAA	3,4,5	ug/L	80	-	-	14.3 - 54.1	33
TTHM - OEL	3,4,5	ug/L	80	-	-	13.3 - 58	33
HAA	3,4,5	ug/L	80	356	356	6.9 - 27.2	15
HAA - LRAA	3,4,5	ug/L	80	-	-	9.2 - 22.1	15
HAA - OEL	3,4,5	ug/L	80	-	-	8.8 - 23.2	15
Chlorine Residual	1,4,6	mg/L	4	6479	6455	0 - 0.98	0.4

Notes:

(1) Data reported for monthly sampling throughout the distribution system between January 2018 to July 2023.

(2) From Lead and Copper Rule testing every 3 years between 2005 and 2020.

(3) Data reported quarterly from 2011 to June 2023.

(4) Value range is minimum to maximum of all samples.

(5) MCL compliance is based on running annual average for each sampling location. Data presented is full dataset across all eight sampling locations.

(6) There were a total 7 total coliform detections between 2018 and 2023 during distribution system chlorine residual sampling between 2018 and 2023.

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UCMR 3 Data

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City of Bellingham
UCMR3 Summary

Contaminant	Range of Detects (µg/L)		
	OR/WA	WTP EPTDS	Maximum Residence Time Point
List 1 Contaminants			
1,1-dichloroethane	0.036 - 0.15	ND	
1,2,3-trichloropropane	ND	ND	
1,3-butadiene	ND	ND	
1,4-dioxane	0.072 - 0.36	ND	
bromomethane	ND	ND	
chlorate	20 - 3472.288	ND	ND
chloromethane	0.2 - 2.2	ND	
chromium	0.2 - 55	ND	0.21
chromium-6	0.03 - 9.9	0.039 - 0.074	0.052 - 0.078
cobalt	1.8 - 1.9	ND	ND
Halon 1011	0.087 - 1	ND	
HCFC-22	0.088 - 0.673	ND	
molybdenum	1 - 13	ND	ND
PFBS	ND	ND	
PFHpA	0.0127 - 0.0258	ND	
PFHxS	0.201 - 0.241	ND	
PFNA	0.0266 - 0.028	ND	
PFOA	0.02 - 0.0511	ND	
PFOS	0.514 - 0.6	ND	
strontium	0.9 - 620	48 - 59.7	48 - 60.8
vanadium	0.2 - 50	0.2 - 0.44	0.2 - 0.45
List 2 Contaminants (not required for City of Bellingham)			
17-beta-estradiol	ND		
17-alpha-ethynylestradiol	ND		
4-androstene-3,17-dione	0.0004		
equilin	ND		
estriol	ND		
estrone	ND		
testosterone	0.0005		

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UCMR4 Data

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City of Bellingham
UCMR4 Summary

Entry Point to the Distribution System Sampling		
Contaminant	OR/WA Range of Detects (µg/L)	Bellingham WTP Entry Point (µg/L)
1-butanol	3.5 - 13	ND
2-methoxyethanol	0.452	ND
2-propen-1-ol	ND	ND
alpha-hexachlorocyclohexane	ND	ND
anatoxin-a	0.036 - 0.06	ND
butylated hydroxyanisole	ND	ND
chlorpyrifos	ND	ND
cylindrospermopsin	ND	ND
dimethipin	ND	ND
ethoprop	ND	ND
germanium	0.3 - 6.8	ND
manganese	0.4 - 1590	0.41 - 2
microcystin-LA	ND	
microcystin-LF	ND	
microcystin-LR	ND	
microcystin-LY	ND	
microcystin-RR	ND	
microcystin-YR	ND	
nodularin	ND	
o-toluidine	0.0091 - 0.024	ND
oxyfluorfen	ND	ND
profenofos	ND	ND
quinoline	0.026 - 0.15	ND
tebuconazole	ND	ND
total microcystin	0.32 - 0.34	ND
total permethrin	ND	ND
tribufos	ND	ND

Distribution System Sampling		
Contaminant	OR/WA Range of Detects (µg/L)	Bellingham Distribution System (µg/L)
HAA5	0.2 - 130.8	9.8 - 22
HAA6Br	0.3 - 26.48	1.53 - 2.7
HAA9	0.2 - 131.32	11.33 - 24.7

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UCMR5 Data

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City of Bellingham
UCMR5 Summary

WTP Entry Point to the Distribution System Sampling				
Contaminant	# Samples	# Detects	Units	Range
11Cl-PF3OUdS	2	0	µg/L	ND
4:2 FTS	2	0	µg/L	ND
6:2 FTS	2	0	µg/L	ND
8:2 FTS	2	0	µg/L	ND
9Cl-PF3ONS	2	0	µg/L	ND
ADONA	2	0	µg/L	ND
HFPO-DA	2	0	µg/L	ND
lithium	2	0	µg/L	ND
NEtFOSAA	2	0	µg/L	ND
NFDHA	2	0	µg/L	ND
NMeFOSAA	2	0	µg/L	ND
PFBA	2	0	µg/L	ND
PFBS	2	0	µg/L	ND
PFDA	2	0	µg/L	ND
PFDoA	2	0	µg/L	ND
PFEESA	2	0	µg/L	ND
PFHpA	2	0	µg/L	ND
PFHpS	2	0	µg/L	ND
PFHxA	2	0	µg/L	ND
PFHxS	2	0	µg/L	ND
PFMBA	2	0	µg/L	ND
PFMPA	2	0	µg/L	ND
PFNA	2	0	µg/L	ND
PFOA	2	0	µg/L	ND
PFOS	2	0	µg/L	ND
PFPeA	2	0	µg/L	ND
PFPeS	2	0	µg/L	ND
PFTA	2	0	µg/L	ND
PFTrDA	2	0	µg/L	ND
PFUnA	2	0	µg/L	ND

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APPENDIX T

WATER TREATMENT INFRASTRUCTURE REMAINING USEFUL LIFE ANALYSIS

System	Equipment	Install Date	Age (years)	Useful Life Low End Range	Useful Life High End	Exceeds Useful Life in 10 Years?		Exceeds Useful Life in 20 Years?	
						Low End Useful Life Range	High End Useful Life Range	Low End Useful Life Range	High End Useful Life Range
Raw Water	Screenhouse screens	2001	23	15	30	YES	YES	YES	YES
DAF	Flash Mixer	2018	6	10	30	YES	NO	YES	NO
	Recirculation Pump / Motors	2018	6	10	30	YES	NO	YES	NO
	Flocculators	2018	6	15	25	YES	NO	YES	YES
	Valves	2018	6	20	50	NO	NO	YES	NO
	Gates	2018	6	20	40	NO	NO	YES	NO
	Flow Meters	2018	6	10	25	YES	NO	YES	YES
Rapid Mix	Flume valves								
	Flowmeter								
Filter 1	F1 Effluent Act	1999	25	10	30	YES	YES	YES	YES
	F1 Effluent Valve	1986	38	20	50	YES	NO	YES	YES
	F1 Influent Act	1997	27	10	30	YES	YES	YES	YES
	F1 Waste Valve	2021	3	20	50	NO	NO	YES	NO
	F1 Waste Act	2009	15	10	30	YES	NO	YES	YES
	F1 Left Bay Act	2003	21	10	30	YES	YES	YES	YES
	F1 Left Bay Valve	1984	40	20	50	YES	NO	YES	YES
	F1 Right Bay Act	2003	21	10	30	YES	YES	YES	YES
	F1 Filter To Waste Act	2001	23	10	30	YES	YES	YES	YES
	F1 Filter To Waste Valve	2005	19	20	50	YES	NO	YES	NO
	F1 Back Wash Act	2008	16	10	30	YES	NO	YES	YES
	F1 Back Wash Valve	1986	38	20	50	YES	NO	YES	YES
Filter 2	F2 Effluent Act	1999	25	10	30	YES	YES	YES	YES
	F2 Effluent Valve	1986	38	20	50	YES	NO	YES	YES
	F2 Influent Act	2013	11	10	30	YES	NO	YES	YES
	F2 Waste Act	2001	23	10	30	YES	YES	YES	YES
	F2 Waste Valve	1987	37	20	50	YES	NO	YES	YES
	F2 Left Bay Act	2003	21	10	30	YES	YES	YES	YES
	F2 Left Bay Valve	1984	40	20	50	YES	NO	YES	YES
	F2 Right Bay Act	2003	21	10	30	YES	YES	YES	YES
	F2 Right Bay Valve	1984	40	20	50	YES	NO	YES	YES
	F2 Back Wash Act	2008	16	10	30	YES	NO	YES	YES
	F2 Backwash Valve	1986	38	20	50	YES	NO	YES	YES
	F2 Filter to Waste Valve	2008	16	20	50	YES	NO	YES	NO

System	Equipment	Install Date	Age (years)	Useful Life Low End Range	Useful Life High End	Exceeds Useful Life in 10 Years?		Exceeds Useful Life in 20 Years?	
						Low End Useful Life Range	High End Useful Life Range	Low End Useful Life Range	High End Useful Life Range
Filter 3	F3 Effluent Act	2016	8	10	30	YES	NO	YES	NO
	F3 Effluent Act	2016	8	10	30	YES	NO	YES	NO
	F3 Waste Act	2008	16	10	30	YES	NO	YES	YES
	F3 Waste Valve	1987	37	20	50	YES	NO	YES	YES
	F3 Left Bay Act	2003	21	10	30	YES	YES	YES	YES
	F3 Left Bay Valve	2005	19	20	50	YES	NO	YES	NO
	F3 Right Bay Act	2003	21	10	30	YES	YES	YES	YES
	F3 Right Bay Valve	1984	40	20	50	YES	NO	YES	YES
	F3 Back Wash Act	2008	16	10	30	YES	NO	YES	YES
	F3 Back Wash Valve	1986	38	20	50	YES	NO	YES	YES
	F3 Filter to Waste Act	2001	23	10	30	YES	YES	YES	YES
	F3 Filter to Waste Valve	2003	21	20	50	YES	NO	YES	NO
Filter 4	F4 Effluent Act	1998	26	10	30	YES	YES	YES	YES
	F4 Effluent Valve	1986	38	20	50	YES	NO	YES	YES
	F4 Waste Act	2008	16	10	30	YES	NO	YES	YES
	F4 Waste Valve	1987	37	20	50	YES	NO	YES	YES
	F4 Left Bay Act	2002	22	10	30	YES	YES	YES	YES
	F4 Left Bay Valve	1983	41	20	50	YES	YES	YES	YES
	F4 Right Bay Act	2002	22	10	30	YES	YES	YES	YES
	F4 Right Bay Valve	1984	40	20	50	YES	NO	YES	YES
	F4 Backwash Valve	1986	38	20	50	YES	NO	YES	YES
	F4 Filter to Waste Act	2001	23	10	30	YES	YES	YES	YES
	F4 Filter to Waste Valve	2008	16	20	50	YES	NO	YES	NO
Filter 5	F5 Effluent Act	1999	25	10	30	YES	YES	YES	YES
	F5 Waste Act	2008	16	10	30	YES	NO	YES	YES
	F5 Waste Valve	1987	37	20	50	YES	NO	YES	YES
	F5 Left Bay Act	2001	23	10	30	YES	YES	YES	YES
	F5 Left Bay Valve	1984	40	20	50	YES	NO	YES	YES
	F5 Right Bay Act	2002	22	10	30	YES	YES	YES	YES
	F5 Right Bay Valve	1984	40	20	50	YES	NO	YES	YES
	F5 Back Wash Act	2008	16	10	30	YES	NO	YES	YES
	F5 Back Wash Valve	1986	38	20	50	YES	NO	YES	YES
	F5 Filter to Waste Act	2001	23	10	30	YES	YES	YES	YES

System	Equipment	Install Date	Age (years)	Useful Life Low End Range	Useful Life High End	Exceeds Useful Life in 10 Years?		Exceeds Useful Life in 20 Years?	
						Low End Useful Life Range	High End Useful Life Range	Low End Useful Life Range	High End Useful Life Range
Filter 6	F6 Effluent Valve	1986	38	20	50	YES	NO	YES	YES
	F6 Waste Act	2008	16	10	30	YES	NO	YES	YES
	F6 Waste Valve	1987	37	20	50	YES	NO	YES	YES
	F6 Left Bay Act	2002	22	10	30	YES	YES	YES	YES
	F6 Left Bay Valve	1984	40	20	50	YES	NO	YES	YES
	F6 Right Bay Act	2002	22	10	30	YES	YES	YES	YES
	F6 Right Bay Valve	1984	40	20	50	YES	NO	YES	YES
	F6 Back Wash Act	2008	16	10	30	YES	NO	YES	YES
	F6 Back Wash Valve	1986	38	20	50	YES	NO	YES	YES
	F6 Filter to Waste Act	2001	23	10	30	YES	YES	YES	YES
	F6 Filter to Waste Valve	2008	16	20	50	YES	NO	YES	NO
Filter Backwash Pumps	1	1968	56	10	30	YES	YES	YES	YES
	2	1968	56	10	30	YES	YES	YES	YES
	3	2010	14	10	30	YES	NO	YES	YES
Alum System	Metering Pumps	2009	15	5	25	YES	NO	YES	YES
	Storage Tank	1968	56	10	30	YES	YES	YES	YES
	Pump 1	2009	15	5	25	YES	NO	YES	YES
	Pump 2	1982	42	5	25	YES	YES	YES	YES
	Pump 3	2005	19	5	25	YES	YES	YES	YES
Polymer System	Metering Pumps			5	25				
	Blending/Aging System	1983	41	7	20	YES	YES	YES	YES
Soda Ash	Silos	1994	30						
	Dust Collection	2008	16	7	30	YES	NO	YES	YES
	Belt Feeders	2008	16	7	20	YES	YES	YES	YES
	Solution Pumps	2024	0	15	25	NO	NO	YES	NO
	Tank mixers								
Sodium Hypochlorite	Generators	2018							
	Metering Pumps	2018	6	5	25	YES	NO	YES	YES
	Tanks	2018	6	10	30	YES	NO	YES	NO
Power / Controls	Switchboard	2018	6	15	35	YES	NO	YES	NO
	MCC 1	2011	13	10	30	YES	NO	YES	YES
	MCC 2	1993	31	10	30	YES	YES	YES	YES
	MCC 3	1993	31	10	30	YES	YES	YES	YES
	Generator	2010	14	10	30	YES	NO	YES	YES
	WTP PLC	2012	12	10	20	YES	YES	YES	YES
	SCADA Software	2012	12						

APPENDIX U

WATER SHORTAGE RESPONSE PLAN AND SERVICE RELIABILITY

WATER SHORTAGE CONTINGENCY PLAN



SUPPLEMENT TO THE BELLINGHAM WATER SYSTEM PLAN

April 2015 update

CITY OF BELLINGHAM
WATER SHORTAGE CONTINGENCY PLAN

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CITY OF BELLINGHAM
WATER SHORTAGE CONTINGENCY PLAN
April 2015

SECTION I

Introduction

This plan provides guidelines for the City of Bellingham to manage water supply and demand in the event of a supply disruption. This plan addresses both environmental situations, such as those that are weather-related, and more drastic and immediate situations such as infrastructure emergencies (e.g., a pipeline break).

This document supplements the 2009 Water System Plan.

Objective of Water Shortage Contingency Plan (WSCP)

The objective of the WSCP is to establish actions and procedures for managing water supply and demands during events that cause water service disruptions. The plan helps the City of Bellingham maintain essential public health and safety and minimize adverse impacts on economic activity, environmental resources and the region's lifestyle.

Integration into Other Emergency Planning

This plan complements the Bellingham Water System Emergency Response Plan. That plan is a supplement to the City of Bellingham Disaster Readiness and Response Plan (City Disaster Plan). Bellingham's Water System Emergency Response Plan defines decision-making authority in emergencies and creates specific emergency action plans for a number of systems, security, and management procedures, including information.

As part of the City Disaster Plan, the Mayor convenes a unified incident command as a disaster response command team at the Emergency Operations Center. These team leaders will determine policies and strategies for handling major disasters. Individual departments, working on a common incident, will coordinate their field efforts through the incident command structure.

Relationship to Resale Water Customers' WSCPs

The City of Bellingham currently provides water to approximately 24,978 water customer accounts which includes homes, businesses and institutions in the service area, representing approximately 90,000 people. The City provides water to an additional 8,300 people in Whatcom County, through contracts with 8 resale water customers (purveyors). Water supply disruptions affect Bellingham's retail customers and the retail customers of each purveyor.

Each purveyor is responsible for developing a Water Shortage Contingency Plan for its own planning purposes. Inter-local Agreements include a provision that the purveyor's water supply is subject to interruptions caused by necessary repairs or other causes beyond the control of the City of Bellingham. Purveyors are expected to assist and support emergency curtailment measures required to manage water demand during an emergency or shortage.

This document has been developed by the City of Bellingham, in consultation with its purveyors and other participants, based on the premise that an effective demand management strategy must be regionally consistent. This is based on several considerations:

- Public support and cooperation is likely to be higher if actions are equitable, i.e., all water users are experiencing the same service level and degree of hardship

- A unified message and approach is easier to understand and distribute through the media, which is key in communicating information to the public

- Consistency makes it easier for the City of Bellingham to forecast demand reductions, which is essential to effectively manage the water system during a supply disruption

SECTION 2

Overview of Water Shortage Strategy

Water supply disruptions can occur for a variety of reasons: weather-related water shortages, source water quality declines that impede filtration and treatment processes, pump station malfunctions, or main breaks.

Droughts are naturally occurring but unpredictable weather events of varying frequency, duration and severity. In the region served by the Bellingham water system, available data indicate a very low probability of a multi-year drought, but the region has experienced short-term droughts.

This region is generally faced with a relatively dry summer period. In Bellingham, only about 5 of the 38 inches of annual precipitation fall during the summer (mid-June to mid-September)[1]. The Bellingham water system operates with an annual refill and draw-down cycle of its water supply storage reservoir, Lake Whatcom, and a diversion dam on the Middle Fork Nooksack River to supplement water supply to the Lake Whatcom reservoir. Highly unusual weather events affect this cycle and can cause potential shortages. This can manifest in one or more of the following ways:

- Less than normal winter snowpack, which could limit the volume of Middle Fork Nooksack River stream flows available from snowmelt in the spring to supplement Lake Whatcom reservoir for peak season demands
- Unusually warm spring weather bringing with it early melting of the snowpack, which could limit the volume of Middle Fork Nooksack River stream flows available from snowmelt in the spring to supplement Lake Whatcom reservoir for peak season demands
- Unusually warm and dry summer weather which can significantly increase peak season demands, and create low reservoir level conditions in Lake Whatcom and low stream flow conditions in Whatcom Creek
- A delayed return of the fall rains, or a dry winter, which can delay the fall reservoir refill cycle (which replenishes Lake Whatcom reservoir after the peak season), and create extended low stream flow conditions in Whatcom Creek
- Annual seasonal algae blooms in Lake Whatcom that can affect the ability to produce water resulting in the need to reduce consumption
- Low stream flows that could impact fishery resources and result in limiting the volume of Middle Fork Nooksack River stream flows available for diversion into Lake Whatcom

[1] Western Regional Climate Center. Period of Record Monthly Climate Summary 1971 to 2000 for Bellingham 2N, Washington (450564)

The specific cause of any supply disruption will affect the utility's response and its timing.

Stream flow is one critical consideration in managing water supply and demand when there is a potential water shortage. In addition to meeting the needs of Bellingham's retail and resale customers, the Middle Fork Nooksack River and Whatcom Creek are managed to assist in achieving stream flow needs for fish and wildlife habitat. The City's diversion dam on the Middle Fork Nooksack River is currently operated to allow stream flows for salmon and other species downstream of the dam, particularly during periods of weather induced low stream flow conditions and drought. Additionally, the Diversion provides a portion of the inflow to Lake Whatcom Reservoir on an annual average basis.

Another critical concern is that the Lake Whatcom reservoir level is managed to provide for flood control during the winter and storage during the summer. The Superior Court of Whatcom County has set a maximum controlled reservoir level at 314.5 due to flooding concerns. The City must target reservoir levels necessary to meet flood control requirements, and protect water supply structures for the delivery of essential water to its customers.

Strategy

Bellingham's strategy for dealing with the hydrologic uncertainty associated with drought management involves several components:

- Information
- Forecasting
- Communication
- Dynamic operating rules

Information - To deal with hydrologic uncertainty in real-time and in longer term planning horizons, Bellingham's water management team uses a number of available informational and data gathering sources. Bellingham continuously monitors Lake Whatcom Reservoir level, Whatcom Creek and real-time Middle Fork Nooksack River stream flows. Bellingham contracts with the U.S. Geological Survey (USGS) and Western Washington University (WWU) to provide stream-flow monitoring and data collection services. Strategic placement of USGS stream gauging stations provides real-time information for understanding the hydrologic state of the water supply and river systems. Bellingham also contracts with the Natural Resources Conservation Service (NRCS) to provide real-time snow monitoring and data collection services. Bellingham's water supply partly relies on the water stored as snow in its mountain watersheds. Quantifying the snow conditions

in our watersheds is an important activity during the winter and spring months as we make reservoir management, diversion and downstream flow decisions.

Forecasting - Bellingham regularly monitors daily weather forecasts (National Oceanic and Atmospheric Administration (NOAA)), mid-range weather forecasts (Climate Prediction Center), 30- and 90-day and multi-season climate outlooks (Climate Prediction Center), and daily hydrometerological forecasts (Northwest River Forecast Center in Portland, Oregon). Bellingham also monitors Environment Canada weather forecasting web-sites. The Internet has greatly improved access to these sources of information. For example, NOAA's El Niño Theme Page on the internet provides a wealth of timely information on current and forecasted El Niño and La Niña conditions with enough lead time for water resource managers to prepare for such events.

Bellingham uses a number of analytical tools for forecasting hydrologic conditions as they relate to water supply and fisheries including:

- Stream flow forecasts prepared by the USGS and NRCS;
- weather, climate and river forecasts from NOAA;
- weather and climate forecasts from Environment Canada

Communication - Bellingham's water management team has relationships with members of other local, state, federal and tribal resource agencies including, Whatcom County, Washington State Department of Ecology, Washington State Department of Health, Washington State Department of Fish and Wildlife, U.S. Fish and Wildlife Service, National Marine Fisheries Services, Lummi Nation and Nooksack Tribe.

Recognizing that stream flows are important to the survival of salmon and other fish, Bellingham has an agreement with resource agencies and Indian Tribes regarding how it responds to fluctuations in Middle Fork Nooksack River stream flows. The agreement affects Bellingham's ability to manage the water supply when there is a shortage.

Dynamic Operating Rules - Operational flexibility is key, with operating plans changing as conditions and forecasts change. Dynamic reservoir rule curves must be used since these can better reflect watershed conditions and allow risk and uncertainty to be managed. A key assumption is that abundance, shortage and risk must be shared among all beneficiaries of the water resource. **For example, interrupting Middle Fork Nooksack River minimum instream flow levels are only resorted to when public health and safety are at risk.** All of the tools, information sources

and communications outlined above, are needed for coordinating and decision-making related to real-time operations.

Regional Experiences

1992 Drought - Because the winter was unusually dry and warm in 1992, snowpack and flows into the Lake Whatcom reservoir were below normal levels. In June, above average temperatures resulted in an increase in water consumption. Water consumption was a record high for the month of June averaging over 2 million gallons per day (or 17%) higher than the prior high record. Concerns about continued drought conditions and consumption trends led to the development of measures to reduce water demand.

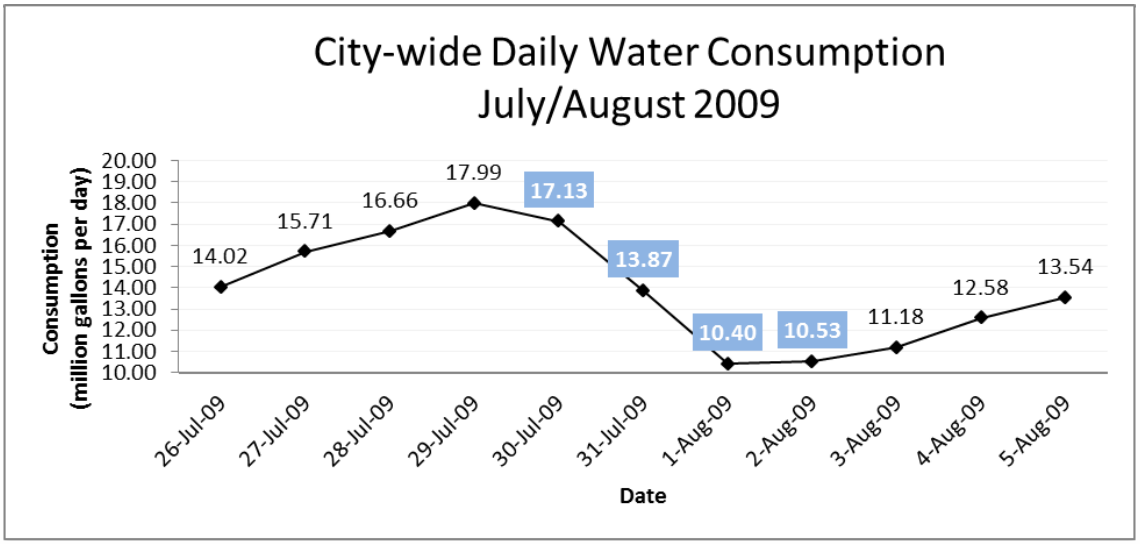
On July 1, 1992, a voluntary odd/even lawn and garden watering policy was implemented in the Bellingham service area. A brochure describing the odd/even watering policy was mailed to every residence and business. Local media (newspaper, radio, TV) promoted the policy. The Bellingham area also benefited from regional (Puget Sound) media reports and public service announcements. The result was an average consumption 2 to 3 million gallons less per day throughout the months of July and August – a reduction of 12% to 18%. Peak day consumption was 5 million gallons per day (22%) less than prior years. The odd/even policy was rescinded in September as supply levels returned to normal and outdoor watering subsided with the onset of fall rains.

2009 Water quantity issue - In 2009, higher water temperatures combined with the high level of nutrients in Lake Whatcom, resulting in increased algal blooms on the surface of the lake and exacerbated dissolved oxygen deficits in the lake. A Declaration of Emergency Water Shortage and Order Imposing Mandatory Outdoor Water Restrictions was signed by the Public Works Director. Residential, commercial, and multi-family water customers were required to discontinue all watering of lawns and landscaping until further notice.

High levels of algae in the raw water coming from Lake Whatcom impacted the City's ability to produce enough water for residents, businesses and critical facilities, while still maintaining water reserves required for fire flow and emergency services. The quality of the drinking water was not comprised and continued to meet all state and federal regulations.

On July 30, 2009, the Public Works Director determined that mandatory outdoor watering restrictions were needed until the City could ensure an ample water supply. The community's efforts to reduce outdoor water consumption through the Voluntary Watering Schedule and other conservation measures were not enough to remedy the situation.

Watering lawns and landscaping (e.g. shrubs, trees, and flower beds) was prohibited for five days. Minimal watering of vegetable gardens was allowed, as well as hand watering potted plants. Violators were subject to fines and water service shut off for continued violations per Bellingham Municipal Code 15.04.040 and .050. This was the first, and to date only, time the WSCP has been implemented.



The restrictions resulted in a demand reduction of 59%. Throughout the water shortage event, consistent conservation messages and information on appropriate demand reduction measures were delivered to water users through the media and by direct contact.

These experiences reflected the following principles:

- Given specific information on supply conditions and the necessary actions to forestall worsening conditions, customers prefer the opportunity to meet targeted demand reduction levels through **voluntary** compliance measures. The decision to move to mandatory restrictions is more acceptable if the voluntary approach has been tried first but has not resulted in enough demand reduction to ensure public health, safety and adequate stream flows through the projected duration of the shortage;

- Each drought or other shortage situation has enough unique characteristics that a plan cannot specifically define all the scenarios and specific supply and demand management actions. The usefulness of a Water Shortage Contingency Plan lies in planning the range of supply and demand management actions in advance of the situation, and in defining the communication mechanisms by which decisions will be made during the event;

- Given the effective long-term conservation program operated by Bellingham, it is important to distinguish between the short term **curtailment** measures necessitated by a water supply disruption, and the **conservation** measures Bellingham promotes to its customers. In short, conservation focuses on efficiencies which generally do not affect the quality of life, whereas curtailment measures can involve short term actions potentially impacting the quality of life;

- The City recognizes that there may be medical facilities and others (e.g. dialysis patients) who cannot fully participate in response to shortage situations and will incorporate this into communication actions and decision-making during any shortage events; and

- It is essential to closely monitor water quality during a supply disruption and particularly during a warm weather drought. Water quality issues must be considered when supply management decisions are made.

Alternative Water Supplies

Depending on the nature and timing of a potential water shortage, alternative water supplies may be useful to supplement existing supplies.

While the City of Bellingham does not currently have alternative water supplies, Bellingham resale purveyors may be requested to use alternative water supplies when possible.

The Nooksack River is an undeveloped secondary alternate supply.

Reclaimed water - This is using secondary treated effluent instead of potable water for irrigation, street washing, construction purposes, etc. While secondary treated effluent is produced by the City at its wastewater treatment plant, significant issues include costs, public safety, obtaining permits to use this water, and obtaining and distributing adequate amounts to decrease potable water demands. These issues – costs, public safety, availability, permitting and distribution – currently make reclaimed water use an impractical alternative water supply. For example, building a reclaimed water distribution network is currently cost prohibitive. While not currently practical, the City will continue to evaluate possible uses of reclaimed water and work with customers who have an interest in utilizing reclaimed water.

Rainwater Harvesting - Rainwater harvesting is the collection of rainwater from an impervious surface, such as a roof, and storage of it in a tank or cistern. Once harvested, the water is routed to where it is beneficially used-

for toilet flush, irrigation, and other outdoor watering needs. The City has promoted rainwater harvesting since 2002. Approximately 1,500 rain barrels and several large-scale demonstration systems have been installed on both residential and commercial properties. The City can continue to encourage citizens that have rainwater catchment systems to use this non-potable water source for non-potable needs. Under extreme situations, the water could potentially be boiled for consumption.

SECTION 3

Phased Curtailment Plan

This plan provides four stages of response based of increasing severity, as progressively more serious conditions warrant. This type of response would be appropriate to a summer drought or other long-range disruption. The four stages include a variety of communications, internal operations, and supply and demand management strategies as appropriate, and are characterized as follows:

- **Advisory Stage** -The public is informed that a possible shortage may occur.
- **Voluntary Stage** - If supply conditions worsen, the plan moves to the "Voluntary" stage which relies on voluntary cooperation of customers to meet target consumption goals. During this stage, specific voluntary actions are suggested for both residential and commercial customers.
- **Mandatory Stage** – If the Voluntary Stage does not result in the reduction needed, the Mandatory Stage prohibits or limits certain actions. This stage would be accompanied by an enforcement plan that could include fines for repeated violation.
- **Emergency Stage** – This addresses the most severe need for demand reduction, and supply management, and could include a combination of mandatory measures, fines, and rate surcharges. This could be used as the last stage of a progressive situation, such as a drought of increasing severity, or to address an immediate crisis, such as a facility failure.

Recommendations about implementing the WSCP are made to the Director of Public Works by Bellingham's water management team. This team would consider the following factors in making its recommendations:

- Total supply availability, production capacity, stream flow conditions, and modified diversion operations
- The rate of decline in total reservoir storage compared to the normal operating rule curve
- Short and long term weather forecasts
- Computer modeling of stream flow, weather and demand assumption data
- The trends and forecasts of the system's daily water demands
- The estimated margin of safety provided by the demand reduction, compared with the level of risk assumed if no action is taken
- Consultation with elected officials, purveyor representatives, state resource agencies, Lummi Nation and Nooksack Tribe

- ❑ The length of time between stage changes (avoid abrupt starts and stops), and required time lags to shift administrative gears and implement program
- ❑ Current events
- ❑ Customer response

ADVISORY STAGE

Objectives

- ❑ To prepare the Department, City, relevant agencies and water users for potential water shortage - thereby allowing all parties adequate planning and coordination time

- ❑ To undertake supply management actions that forestall or minimize the need later for more stringent demand or supply management actions

Triggers

As presented earlier, there are a variety of weather and other conditions that may cause concern about water availability and a potential water shortage. The "Advisory Stage" may be implemented when one or more of the following factors applies:

- ♦ Lake Whatcom reservoir levels are **less than historical averages** for the current time of year, and predicted inflows and supply modeling indicates that expected demands may not be met if this trend continues or worsens. See appendix F for Lake Whatcom Reservoir "rule curve" which shows month by month historical lake level averages.

- ♦ Demand levels increase to **67%** of the peak capacity of the Water Treatment Plant (i.e., 29 million gallons per day) and forecasts indicate continuing trends.

The Advisory is withdrawn when projected Lake Whatcom reservoir storage returns to **above average** levels and predicted inflows and water supply modeling indicates return to normal conditions, and/or when demand levels decrease below **67%** of peak WTP capacity, and when forecasts indicate normal trends.

Sample Public Message

"Potential exists for lower than normal water supply; conditions **may** return to normal or, later on, we may need to reduce consumption. We will keep you informed."

Or

"Potential exists for water consumption to reach abnormally high levels: conditions **may** return to normal or, later on we may need to reduce consumption. We will keep you informed."

Advisory Stage Actions

Communication Actions

- ❑ City of Bellingham water management team to meet as often as appropriate to evaluate conditions, determine actions and make assignments. Team members include:
    - ♦ Director of Public Works
    - ♦ Assistant Public Works Director - Operations
    - ♦ Assistant Public Works Director - Natural Resources
    - ♦ Assistant Public Works Director - Engineering
    - ♦ Superintendent of Plants
    - ♦ Superintendent of Maintenance
    - ♦ Water Conservation Program Coordinator
    - ♦ Public Works Communications Coordinator
- ❑ Intensify ongoing media education effort about the water system, particularly relationship of drought/lake conditions to supply and demand; provide up to date data and implications for water use, if known
- ❑ Initiate notice to resale purveyors requesting that they trigger their Water Shortage Contingency Plans (see purveyor list Appendix F)
- ❑ Prepare and distribute public information materials explaining the Water Shortage Contingency Plan stages and range of actions
- ❑ Intensify coordination with other regional water suppliers to learn what conditions they are projecting for their systems
- ❑ Evaluate ability, resources, plans to move into Voluntary stage; as appropriate, begin preparatory measures
- ❑ Brief elected officials

Internal Operating Actions

- ❑ Intensify tracking of data collection (stream flows, snow pack conditions) and monitoring of weather forecasts
- ❑ Review current supply and demand management/operations
- ❑ Assess current water main flushing and reservoir cleaning activities to

determine whether they should be accelerated prior to the peak season, postponed to after the peak season, and/or modified to conserve supply

- ❑ Assess current Parks and Recreation watering schedules and pool filling to determine which watering schedules could be reduced or modified to off-peak hours
- ❑ Monitor water quality in reservoirs and distribution system.
- ❑ Initiate planning and preparation for Voluntary Stage actions, including an assessment of potential staffing impacts, training needs, and communications strategies

VOLUNTARY STAGE

Objectives

- ❑ To maintain or reduce demand to meet target consumption levels by customer voluntary actions
- ❑ To forestall or minimize need for more stringent demand or supply management actions
- ❑ To minimize the disruption to customers' lives and businesses while meeting target consumption goals
- ❑ To maintain water quality standards throughout the shortage

Triggers

The "Voluntary Stage" may be implemented when one or both of the following factors applies:

- ♦ Lake Whatcom reservoir reaches **10%** of historical "normal" levels for the current time of year, and predicted inflows and supply modeling indicates that expected demands may not be met if this trend continues or worsens. See appendix F for Lake Whatcom Reservoir “rule curve”.
- ♦ Demand levels increase to **80%** of the peak capacity of the Water Treatment Plant (i.e., 24 million gallons per day) and forecasts indicate continuing trends.

The Voluntary action is withdrawn when projected Lake Whatcom reservoir storage trends return to **average** levels and predicted inflows and water supply modeling indicates return to average conditions, and/or when demand levels decrease below **67%** of peak WTP capacity, and when forecasts indicate normalizing trends.

Consideration will be given to potential water quality issues in defining the supply and demand management strategies.

Sample Public Message

"We are relying on the support and cooperation of all water users to efficiently use the available water supply. Demand needs to be reduced by _____%. Customers are responsible for determining how they will meet that goal. Water waste is not allowed. If everyone cooperates, we may avoid imposing more stringent restrictions. In addition to meeting essential water needs of customers, fish habitat and other environmental concerns are priorities"

Voluntary Stage Actions

Communication Actions

- ❑ The water management team will meet frequently to re-evaluate the situation based on current and projected supply conditions and the season, and determine the appropriate actions and strategies. The team will determine target consumption goals to be achieved on a voluntary basis which may be revised as necessary.

- ❑ Establish systematic communications with elected officials; Director and water management team communicates the nature and scope of voluntary measures and strategy to Mayor and Council, purveyors, tribes and resource agencies

- ❑ Water management team evaluates whether targeted consumption levels and supply conditions warrant a rate surcharge; the Director makes recommendation to Mayor and Council

- ❑ Continue and intensify coordination and communication with county, state and federal resource agencies and tribes about supply conditions, demand management actions and stream flow levels

- ❑ Establish regular communication mechanism to keep Department employees, especially utility account representatives, water service consultants, Mayor's office and Dispatch up to date on goals, conditions, and actions.

- ❑ Consult with purveyors to help develop public information messages and materials and to obtain feedback on utility actions (see contact lists Appendix A)

- ❑ Contact large water users, such as WWU, Port of Bellingham, Water Districts, School District, Bellingham Country Club, Bellingham Cold

Storage, Bellingham Parks and Recreation and other major water using industries to inform them of conditions and request their cooperation

- ❑ Initiate public information, media and advertising campaign:
    - ♦ In daily newspapers, publish and promote information that presents the consumption goal and previous 24 hour consumption;
    - ♦ Promote consumption goals for typical households, and a percentage reduction goal for commercial customers (Appendix D contains a list of recommended actions to reduce consumption)
    - ♦ Develop and implement a plan to keep customers informed about supply and demand conditions; reinforce desired customer actions; recommend customer actions to reduce demand sufficiently; and, depending on conditions, remind customers that if goals are not achieved, mandatory restrictions may be necessary
    - ♦ Identify potential next steps needed to reduce demand, including timing, what type of restrictions and/or surcharges will be imposed
    - ♦ Establish routine timing for press releases (e.g., every Monday morning) that provides current status and outlook; present information in a format that becomes familiar to media and public
    - ♦ Publicize the water supply conditions on the City web site and local BTV 10, government access channel. Ensure the information provided covers the needs of all key interests: the public, news media and resale purveyors
- ❑ Initiate remaining planning and preparation for Mandatory Stage

Internal Operating Actions

- ❑ Intensify tracking of data collection (stream flows, snow pack conditions) and monitoring of weather forecasts
- ❑ Review current supply and demand management/operations
- ❑ Assess current water main flushing and reservoir cleaning activities to determine whether they should be accelerated prior to the peak season, postponed to after the peak season, and/or modified to conserve supply
- ❑ Monitor water quality in reservoirs and distribution system
- ❑ Eliminate all operating system water uses determined not to be essential to maintain water quality. Communicate this to resale purveyors
- ❑ Implement staffing reassignments as needed, and plan staffing changes which may be needed for the Mandatory Stage, including staff to enforce mandatory restrictions

Supply and Demand Management Actions

- ❑ Prepare appropriate legislation regarding emergency surcharges, if required
- ❑ Evaluate ability to accelerate, enhance or expand long term conservation programs; implement as appropriate
- ❑ Promote/Implement list of recommended actions for customers (see appendix C)

MANDATORY STAGE

Objectives

- ❑ To achieve targeted consumption reduction goals by restricting defined water uses
- ❑ To ensure that adequate water supply will be available during the duration of the situation to protect public health and safety and to balance the need for stream flows for fish habitat
- ❑ To minimize the disruption to customers' lives and businesses while meeting target consumption goals
- ❑ To maintain the highest water quality standards throughout the shortage
- ❑ To promote equity amongst customers by establishing clear restrictions that affect all customers

Triggers

The Director approves progression to this stage, as recommended by the water management team, if goals established in the "Voluntary Stage" have not been met, and additional action is needed. The specific restrictions imposed during the mandatory stage would be determined based on the season, targeted demand levels, and other considerations previously mentioned. Variations of the specific restrictions may be applied based on water supply conditions. The "Mandatory Stage" may be implemented when one or both of the following factors applies:

- ♦ Lake Whatcom reservoir reaches **5%** of historical "normal" levels for the current time of year, and predicted inflows and supply modeling indicates that expected demands may not be met if this trend continues or worsens. See appendix F for Lake Whatcom Reservoir “rule curve”.
- ♦ Demand levels increase to **100%** of the peak capacity of the Water Treatment Plant (i.e., 30 million gallons per day) and forecasts indicate continuing trends.

The Mandatory action is withdrawn when projected Lake Whatcom reservoir storage trends return to **average** levels and predicted inflows and water supply modeling indicates return to average water supply conditions, and/or when demand levels decrease below **80%** of peak WTP capacity, and when forecasts indicate normalizing trends.

Consideration will be given to potential water quality issues in defining the supply and demand management strategies.

Sample Public Message

"It is necessary to impose mandatory water restrictions to reduce demand by _____% because the voluntary approach has not resulted in the necessary savings (or conditions have deteriorated requiring additional reductions in water use). We are continuing to rely on the support and cooperation of the public to comply with these restrictions but need the certainty and predictability of restricting certain water uses in order to ensure that throughout the duration of this shortage an adequate supply of water is maintained for public health and safety."

Mandatory Stage Actions

Communication Actions

- ❑ The water management team will meet frequently to re-evaluate the situation based on current and projected supply conditions and the season, and determine the appropriate actions and strategies; and determine target consumption goals to be achieved on a mandatory basis which may be revised as necessary
- ❑ The water management team determines that water supply and demand management strategies will not result in unacceptable water quality degradation
- ❑ The water management team evaluates whether targeted consumption levels and supply conditions warrant a rate surcharge; the Director makes recommendation to Mayor and Council
- ❑ The Director recommends to the Mayor and City Council moving to Mandatory Stage and other appropriate actions
- ❑ The Council adopts legislation on mandatory restrictions and/or emergency surcharges, if needed and not already in place
- ❑ Continue systematic communications with elected officials; Director and water management team communicates the nature and scope of mandatory measures and strategy to Mayor and Council, purveyors, tribes and resource agencies
- ❑ Continue and intensify coordination and communication with county, state and federal resource agencies and tribes about supply conditions, demand management actions and stream flow levels

- ❑ Intensify regular communication mechanism to keep Department employees, especially utility account representatives, water service consultants, Mayor's office and Dispatch up to date on goals, conditions, and actions; consider necessity of implementing myStates all-call system

- ❑ Intensify consultation with customer groups to help develop public information messages and materials and to obtain feedback on utility actions (see contact lists Appendix A)

- ❑ Contact large water users, such as WWU, Port of Bellingham, Georgia-Pacific, Water Districts, School District, Bellingham Country Club, Bellingham Cold Storage, Bellingham Parks and Recreation and other major water using industries to inform them of conditions and request their cooperation

- ❑ Intensify public information, media and advertising campaign:

    - ♦ In daily newspapers, publish and promote information that presents the consumption goal and previous 24 hour consumption;
    - ♦ Promote consumption goals for typical households, and a percentage reduction goal for commercial customers (Appendix C contains a list of recommended actions to reduce consumption)
    - ♦ Develop and implement a plan to keep customers informed about supply and demand conditions; reinforce desired customer actions; recommend customer actions to reduce demand sufficiently; and, depending on conditions, remind customers that if goals are not achieved, emergency restrictions may be necessary
    - ♦ Identify potential next steps needed to reduce demand, including timing, what type of restrictions and/or surcharges will be imposed
    - ♦ Establish routine timing for press releases (e.g., every Monday morning) that provides current status and outlook; present information in a format that becomes familiar to media and public
    - ♦ Publicize the water supply conditions on the City web site and local BTV10 government access channel. Ensure the information provided covers the needs of all key interests: the public, news media and resale purveyors

- ❑ The public is informed about the nature and scope of the mandatory restrictions through a press conference, paid advertising and other means, including direct mail and/or phone messages. The enforcement mechanisms, fines/penalties, rate surcharges, target consumption goals, projections for how long restrictions will be in place and the reasons for imposing restrictions will also be identified, as will the possible consequences if goals are not met

- ❑ Any exemptions from restrictions will be clearly identified

- ❑ In communicating mandatory restrictions to the public, a clear distinction will be made between lawn/turf watering and watering gardens and ornamental plantings, the type and amount of watering allowed will be clearly defined
- ❑ Evaluate if an after-hours phone number to report violations of restrictions is necessary
- ❑ Continue and enhance communication actions from the Advisory and Voluntary stages
- ❑ Review plans for moving into the fourth stage - Emergency Curtailment - and begin preparatory measures as appropriate

Bellingham Internal Operating Actions

- ❑ Finalize and implement procedures for exemptions from restrictions and/or emergency surcharges
- ❑ Finalize and implement enforcement procedures for restrictions including the highly visible water "DROP" (Drought Response Operating Personnel - see appendix XXX)
- ❑ Intensify tracking of data collection (stream flows, snow pack conditions) and monitoring of weather forecasts
- ❑ Review current supply and demand management/operations
- ❑ Monitor water quality in reservoirs and distribution system
- ❑ Eliminate all operating system water uses determined not to be essential to maintain water quality. Coordinate with Parks and Recreation water schedules and pool operations. Communicate this to resale purveyors
- ❑ Implement staffing reassignments as needed, and plan staffing changes which may be needed for the Emergency Stage, including staff to enforce emergency restrictions

Supply and Demand Management Actions

- ❑ **Possible Water Use Restrictions**

  The following are several possible approaches to water use restrictions. The nature of the restrictions used will depend on the situation, and may change as severity of the situation changes.

- Prohibit all outdoor water use (washing cars, watering lawns and gardens, etc) during the warmest hours of the day. Water use would be allowed between 7:00 p.m. and 9:00 a.m.

- Restrict all outdoor water use on an odd/even address basis, changing the Voluntary Watering Schedule to a Mandatory Watering Schedule. Odd addresses water Sunday, Wednesday, and Friday. Even addresses water Tuesday, Thursday, and Saturday. Monday no watering would occur. This choice will depend on target consumption goals, the time of year and the extent to which water use is occurring, and how much demands have already decreased.

- Ban lawn watering and car washing (see exemptions below). Allow garden watering during the coolest hours of the day, for example, between 7:00 p.m. and 9:00 a.m. and/or on the odd/even address basis described above.

❑ Other Possible Water Use Restrictions

- Prohibit use of any ornamental fountain using drinking water for operation or make-up

- Suspend bulk water permits, except as necessary for public health and safety

- Prohibit washing of sidewalks, streets, decks or driveways except as necessary for public health and safety

- Limit pressure-washing of buildings to situations that require it as part of scheduled building rehabilitation project (e.g., painting)

- Prohibit water waste including untended hoses without shut-off nozzles, obvious leaks and water running to waste such as gutter flooding and sprinklers/irrigation whose spray pattern unnecessarily and significantly hits paved areas. Have Bellingham Water DROPs "tag" observed obvious water waste such as hoses without shutoff nozzles, gutter flooding, etc. with notice that informs customer about the supply conditions and need to conserve

❑ Exemptions from Water Use Restrictions

- **Car washing exemptions** – Commercial car washes may be exempt from a ban or restrictions if the procedures below are followed.
  1. Commercial car wash provides information to the City on whether they recycle wash water, the approximate number of

gallons used for washing one car, and the percentage of recycled water used for washing one car.

2. Commercial car wash provides information to the City on actions they will implement to reduce water usage during water use restrictions.
3. In the event that the shortage continues to worsen and the Emergency Curtailment Stage is invoked, these exemptions could be revoked.

- **Lawn watering ban exemption -** Newly installed lawns may be exempted from a ban if the procedures listed below are followed**.** For purposes of this exemption, "new lawn" refers to a lawn installed in the current calendar year and 30 days prior to the initiation of mandatory restrictions. Over-seeded or otherwise renovated lawns would not be exempt. New lawns installed within 30 days of, or after, the initiation of mandatory restrictions would not be exempt. Those wishing to use this exemption would need to contact Bellingham Public Works in advance of the exemption being granted, providing their name, address, phone number, size of lawn and type of watering system. This information would be used to quantify the amount of water used under this exemption and to spot check for compliance. The procedures relating to the exemption and the requirements of the exemption would be clearly outlined at the time of the ban. The following procedures are subject to change :

  1. Each applicant would be mailed a packet stating the requirements
  2. Once the requirements are met, an authorization packet would be mailed to the customer indicating that utility requirements are being complied with.
  3. New lawns must be watered according to guidelines to be provided in the packet mentioned above.
  4. In the event that the shortage continues to worsen and the Emergency Curtailment Stage is invoked, this exemption would be revoked. It would also be revoked on a case by case basis if the rules stated above are not followed, or in the case of a water system emergency.
  5. Monitoring and enforcement are at the discretion of the utility.

- **Automatic Irrigation System Exemption -** Users of automatic irrigation systems for large areas may be exempt from certain mandatory watering restrictions if proper procedures are followed– **but not from a total watering ban**. **In the event of a total**

watering ban, these users would also be prohibited from watering. The following procedures are subject to change:

1. Time of day restrictions, allow watering only between 7 PM and 9 AM.
2. Watering limitations by odd/even address would have to be followed.
3. A request may be made to switch to a different schedule.

- **Dust Control -** For purposes of dust control, water may be applied to construction areas or other areas needing to comply with air quality requirements**.**
- **Ballfields and playfields -** may be watered at the minimum rate necessary for dust control and safety purposes

- ❑ Promote/Implement list of recommended actions for customers (see appendix C)

Water Supply Actions

- ❑ Intensive supply side management measures will be continued including possible changes in diversion operations in consultation and cooperation with Tribes, and county, state and federal resource agencies
- ❑ If not already implemented, contact resale purveyors and request that they activate other alternative sources of supply

EMERGENCY CURTAILMENT STAGE

At this stage, Bellingham recognizes that a critical water situation exists. Without additional significant curtailment actions, a shortage of water for public health and safety will be imminent. To date, no prior emergency in the Bellingham water system's history fits this description.

This stage is characterized by three basic approaches. First, increasingly stringent water use restrictions are established and enforced. Secondly, emergency operation of the Middle Fork Nooksack River diversion dam will be implemented. Thirdly, penalties for violation of restrictions will be increased.

Emergency Curtailment Stage Actions

Communication Actions

- ❑ Communicate with county, state and federal resource agencies and tribes about supply conditions, demand management actions and stream flow levels and the need to modify diversion operations to protect public health and safety
- ❑ Define the problem to the public as an emergency and institute formal procedures to declare a city emergency
- ❑ Coordinate with police, fire, Parks and Recreation, and other departments requesting their assistance in enforcing prohibition of water waste
- ❑ Inform customers about possible pressure reductions and problems this may entail
- ❑ Define and communicate exemptions for medical facilities and other public health situations
- ❑ Continue all previous, applicable actions

Bellingham Internal Operating Actions

- ❑ Implement staffing reassignments as needed, including staff to enforce emergency restrictions
- ❑ Continue and enhance "Water DROPs" enforcement (see Appendix XXX)
- ❑ Continue actions listed in prior stages
- ❑ Curtail fire line testing unless it can be shown to be essential to protect the immediate public health and safety

- ❑ Curtail water meter testing, hydrant/main flushing unless it can be shown to be essential to protect the immediate public health and safety

- ❑ Continue water quality monitoring actions

Possible Supply and Demand Management Actions

- ❑ Modify diversion operations as necessary

- ❑ All lawn and turf irrigation will be prohibited. Ornamental and gardens hand watering only

- ❑ Require that all fire fighting agencies discontinue the use of water in training exercises until emergency restrictions are rescinded.

- ❑ Suspend all bulk water permits

- ❑ Require local parks departments to close down spray parks

SECTION 4

SHORT TERM EMERGENCY CURTAILMENT PLAN

Introduction

Although many of the demand reduction measures employed would be similar to those used during a progressive, weather-related shortage, short term emergencies are unique because of a lack of preparation time and the urgency of immediate, large-scale demand reductions. Each emergency scenario is different, but most of them require major curtailment actions by customers. Also, unlike drought, some emergencies would be localized, requiring demand reduction for only a limited geographic area.

Strategies for dealing with emergencies have been developed based on lessons learned from previous water utility events, other utility experiences, and a sorting of measures based on specific criteria. In order to provide a frame of reference for future emergency situations, a short discussion of recent water supply emergencies is provided.

Background and experience with emergency demand reduction

In June 1999, the Olympic Pipe Line explosion created one of the most significant water system disruption events on record. Severe damage to a major pump station initiated immediate emergency water restrictions (no outdoor water use). Consumption was reduced by 40% for the duration of these restrictions (2 days). Water restrictions were relaxed to allowing outdoor use on an every-other-day schedule through the summer months to allow for the rebuilding of the pump station to original capacity. Consumption was reduced by 20% during this period (three months – June, July and August) compared to historical consumption. This past experience is a good example of what can be expected during emergency water shortage situations.

Throughout the water shortage event, consistent conservation messages and information on appropriate demand reduction measures were delivered to water users through the media and by direct contact. Although exact demand reduction goals were not always met by water users, water use was curtailed enough to be beneficial and avoid more serious water shortages.

There are several criteria by which to decide which demand management measures are appropriate to initially reduce demand during an emergency:

- ❑ Timing: can the measure(s) or action(s) deliver the necessary savings in

the necessary timeframe, i.e., are immediate savings needed or can the system support a gradual reduction in demand;

- Magnitude of savings: will the measure produce enough savings to make a meaningful difference i.e., reduce demand to the level the impaired water system can handle;

- Season: does the action make any impact at the time of year that the emergency occurs, i.e., banning lawn watering will have little impact in November;

- Costs: How severe are the cost implications of the measure to the customer, including local business and industry.

Supply and Demand Management During Emergencies

- No single strategy can be created which will meet the needs of the department for all emergency scenarios. The criteria listed above create a framework for decision-making. Emergencies initially require quick and immediate response. Once an assessment is made as to how long it will take to restore the system, the immediate response strategy may change if it appears that the repair process will be lengthy.

- The strategy for most emergencies can be narrowed to measures having the most immediate impact on water supply and consumption. All needed and available back up supplies would be activated during an emergency:

- The table attached in Appendix C presents a range of potential demand management savings. The range depends on factors including the season, weather conditions, how effectively and urgently the message is communicated, whether or not an emergency surcharge is included, etc.

Appendix A

CONTACT LISTS

A working list of contacts for easy reference in case of a drought or emergency should be developed and regularly updated in consultation with others in the Department. In addition to the communication elements contained in the WSCP, the following will be contacted directly in the event of a drought or emergency to inform them and ask for their support and cooperation in reducing demand.

❑ **MyStates USA AlertSense**

Emergency Management Duty Officer	360 – 778 - 8442

❑ **Customers**

List of resale purveyors	see attached list
List of large water users	see attached list
List of car washes	see attached list
List of recirculating fountains	see attached list
List of fire system testers	see attached list
List of neighborhood representatives	see attached list

❑ **City of Bellingham Contacts**

Public Works Department Water Management Team*	see page 10
Bellingham Mayor (Mayor's Office)	360 – 778 - 8100
Bellingham City Council (Council Office)	360 – 778 - 8200
Bellingham Fire Department (Non-emergency number)	360 – 676 - 6814
Bellingham Police Department	360 – 676 - 6811
Bellingham Department of Parks and Recreation (Operations)	360 – 778 - 7000
Bellingham Key Employee List (Education and Enforcement)	see attached list
Public Works Communications Coordinator	360 – 778 - 7905
Bellingham City Library Communications Manager	360 – 778 - 7206
Web Systems Analyst	360 – 778 - 8058
Possible 24 hr hotline	TBD

❑ **Other public agencies with high water use**

Western Washington University (Facilities Dept)	360 – 650 - 3420
Bellingham Technical College (Maintenance Dept)	360 – 752 - 8355
Whatcom Community College (Facilities and Operations)	360 – 383 - 3390
Bellingham School District (Main Office)	360 – 676 - 6400
PeaceHealth St. Joseph Hospital (Marketing and Communications)	360 – 788 - 6792
Port of Bellingham (Main Office)	360 – 676 - 2500
Washington State Department of Transportation (Bellingham Office)	360 – 788 - 2500
Whatcom County Parks and Recreation (Mt Baker Hwy)	360 – 733 - 2900
Whatcom Transit Authority (Main Office)	360 – 676 - 6843
Whatcom Transit Authority (Facilities)	360 – 715 - 4514
Fire District	

❑ **Landscape Interests**

Whatcom County WSU Cooperative Extension	360 – 676 - 6736
Washington State Nursery and Landscape Association	253 – 661 - 6055
Washington Association of Landscape Professionals	425 – 385 - 3333
List Nurseries (Yellow Pages)	see attached list
List of Lawn and Grounds Maintenance (Yellow pages)	see attached list

List of Landscape Contractor s and Designers (Yellow Pages)	see attached list

❑ **Business Groups**

Bellingham/Whatcom County Chamber of Commerce	360 – 734 - 1330
Building Industry Association	360 – 671 - 4247
Associated General Contractors of Washington	360 – 223 - 8757

❑ **Media**

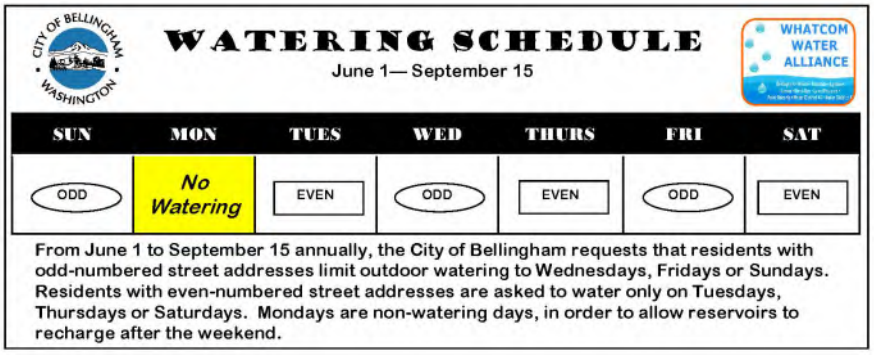
List of Radio/TV/Press media*	List updated in PIER

Appendix B

VOLUNTARY WATERING SCHEDULE

Residents are asked to limit watering to the following Voluntary Watering Schedule to help reduce stress on the City's drinking water supply from June 1 to September 15 annually:

- ❑ Odd numbered street addresses water only on Wednesdays, Fridays, and/or Sundays.
- ❑ Even numbered street addresses water only on Tuesdays, Thursdays, and/or Saturdays.
- ❑ No outdoor watering on Mondays to allow the City's reservoirs to recharge.



- ❑ The voluntary watering schedule does not apply to:
- ❑ Drip irrigation systems
- ❑ Handheld watering methods
- ❑ Flower and vegetable gardens
- ❑ Outdoor potted plants and hanging baskets
- ❑ Newly planted lawns

Appendix B

POSSIBLE VOLUNTARY/MANDATORY CUSTOMER CURTAILMENT ACTIONS

Residential Indoors

- ❑ Don't use the toilet as a waste basket. Saves 1.28 to 3.0 gallons per flush.
- ❑ Use dish and clothes washing machines only when full. Saves up to 10 to 40 gallons per load.
- ❑ Keep drinking water cold in the refrigerator rather than running the faucet until the water gets cold. Saves 1 to 2 gallons per minute.
- ❑ Take shorter showers. Saves 2 1/2 to 5 gallons per minute.
- ❑ Don't let the faucet run while shaving or brushing teeth. Saves 1 to 2 gallons per minute.
- ❑ When washing vegetables, use a pan or bowl of water instead of letting water run. Saves 1 to 2 gallons per minute.
- ❑ Collect and reuse the cold water while waiting for it to get hot. Saves 1 to 2 gallons per minute. Use this water for use on plants or for pet water bowl.
- ❑ Install low-flow fixtures (e.g. low-flow faucet aerators, showerheads).

Residential Outdoor Use

- ❑ Wash cars less often; instead of using the hose consider a commercial car wash that recycles water. Hose nozzles use 5 to 10 gallons per minute.
- ❑ Always use shut-off nozzle on hoses for window washing, etc. Hose nozzles use 5 to 10 gallons per minute.
- ❑ Install a rain barrel or large rainwater tank for collecting roof rainwater. Water can be used for watering plants, garden, washing the car, and other non-potable uses.

Landscape Measures - Commercial and Residential

- ❑ Water lawns and gardens only early in the morning or late in the evening to reduce evaporation.
- ❑ Consider letting established lawns go dormant until the shortage is over. Homes that normally water lawns will save from 25% to 50% by not watering lawns.
- ❑ Plant plants that are adapted to the wet winters and dry summers typical of our area. Native and drought-tolerant plants require less watering and maintenance.
- ❑ If it is raining don't water lawns.
- ❑ Eliminate outdoor water play that requires frequent re-filling (like wading/swimming pools), or use water collected from rain barrel.

- ❑ Eliminate all hosing of sidewalks, driveways, and decks- use a broom instead. Hose nozzles use 5 to 10 gallons per minute.
- ❑ Water established plants only when necessary: Probe into the soil to see if the root zone is dry. Mulch--from two to four inches--in planting beds will help retain moisture.
- ❑ Create "wells" around trees to minimize runoff when they are watered.
- ❑ If there is an automatic irrigation system have it audited to ensure that it is using water efficiently.
- ❑ Learn how to change the program that controls the irrigation system in order to cut back on irrigation time.
- ❑ Equip your irrigation system with a rain sensor that will shut down the system during rainfall.

Commercial

- ❑ Restrict bulk water permits to essential purposes.
- ❑ Request that Fire Department limit training exercises that use water.
- ❑ Request that Public agencies reduce washing fleet vehicles.
- ❑ Set goals for reduced water use and inform employees.
- ❑ Repair all leaks and dripping faucets. Urge employees to report leaks.
- ❑ Reduce or eliminate routine vehicle cleaning (including automobile dealerships, etc.) during shortage.
- ❑ Ensure that all hoses are fitted with shut-off nozzles.
- ❑ Eliminate all hosing of walkways, parking lots, loading docks, unless required for public safety.
- ❑ Postpone routine building washing until after shortage.
- ❑ Post signs informing customers and ask for cooperation in reducing water use.
- ❑ Turn off fountains on windy days, where there is significant water loss.
- ❑ Restaurants: provide water only on request.
- ❑ Parks: limit spray pool hours to days that are forecasted to be 70 degrees or warmer

Appendix C

ENFORCEMENT PROCEDURAL CHECK LIST MANDATORY/EMERGENCY RESTRICTIONS

- ❑ Determine number of warnings before penalties are applied (see water code BMC 15.04.060);
- ❑ Self-duplicating "Notice of Violation" forms printed; one copy to leave at property, one to record warning/violation with billing
- ❑ Staff with customer service and communication experience assigned to "Water DROP". DROP = Drought Response Operation Personnel
- ❑ Establish/Implement procedure for "Water DROP" to record warnings and penalties on customer accounts
- ❑ Publicize phone number for customers to report violations; a recorded message should note that only reports with name and address recorded can be responded to
- ❑ Vehicles for "Water DROP" made available; vehicles that are signed as "Water DROP" will increase visibility and effectiveness of enforcement
- ❑ "Water DROP" inspection routes established (will likely use lists in Appendix C as well as neighborhoods when outdoor water use restrictions are in place)
- ❑ All field and customer service staff provided, Frequently asked Question and Answer sheets; briefed on restrictions, enforcement procedures; field staff trained on tagging obvious violations (expect that Press release information will be utilized as the information sheets)

Appendix D

WATER SHORTAGE/DROUGHT PLAN KEY EMPLOYEES

The following employees (in addition to the Water Management Team and City Department contacts) need to be in the loop regarding questions about Water Shortage/Drought actions so that they can intelligently answer and direct questions to appropriate personnel

- PWOPS front office staff
- PWEngr front office staff
- PWEngr Inspectors
- PWOps Field Personnel
- Building Services Inspectors
- Mayor's Office staff
- City Council Office staff
- Any employee that has regular contact with customers
- Code enforcement officers
- Police Blockwatch and Community Outreach personnel
- 911 Dispatch
- PWOPs Plant Operators
- PWOps Service Reps
- Natural Resources staff
- Finance Counter staff

Appendix E

WATER DISTRIBUTION SYSTEM DEMAND TRIGGER LEVELS
LAKE WHATCOM RESERVOIR SUPPLY TRIGGER LEVELS

Scenario A: Water distribution (demand capacity) triggers assuming no supply concerns

When daily demand equals **20 mgd** implement advisory
When daily demand equals **24 mgd** implement voluntary
When daily demand equals **30 mgd** implement mandatory

Implement emergency if mandatory restrictions not meeting needs

The above triggers may need to be adjusted if full capacity is not available

See attached Demand "Rule Curve A" for water demand "triggers".

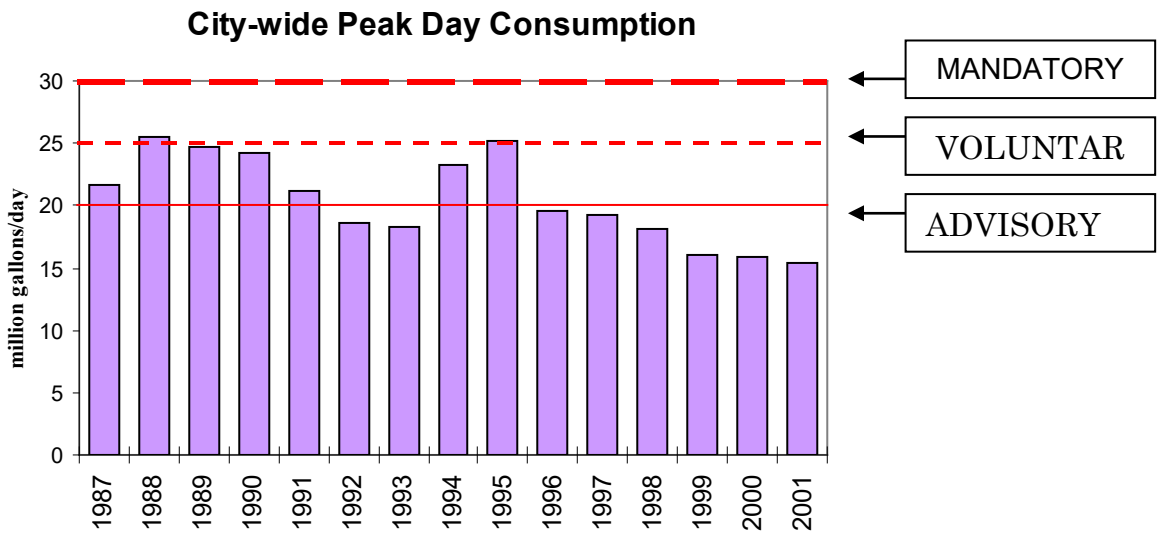
Scenario B: Lake Whatcom Reservoir (supply capacity) triggers assuming no demand concerns

Level reaches **average or 50% of normal** with trend continuing down implement advisory
Level reaches **10_% of normal** with trend continuing down implement voluntary
Level reaches **5% of normal** with trend continuing down implement mandatory

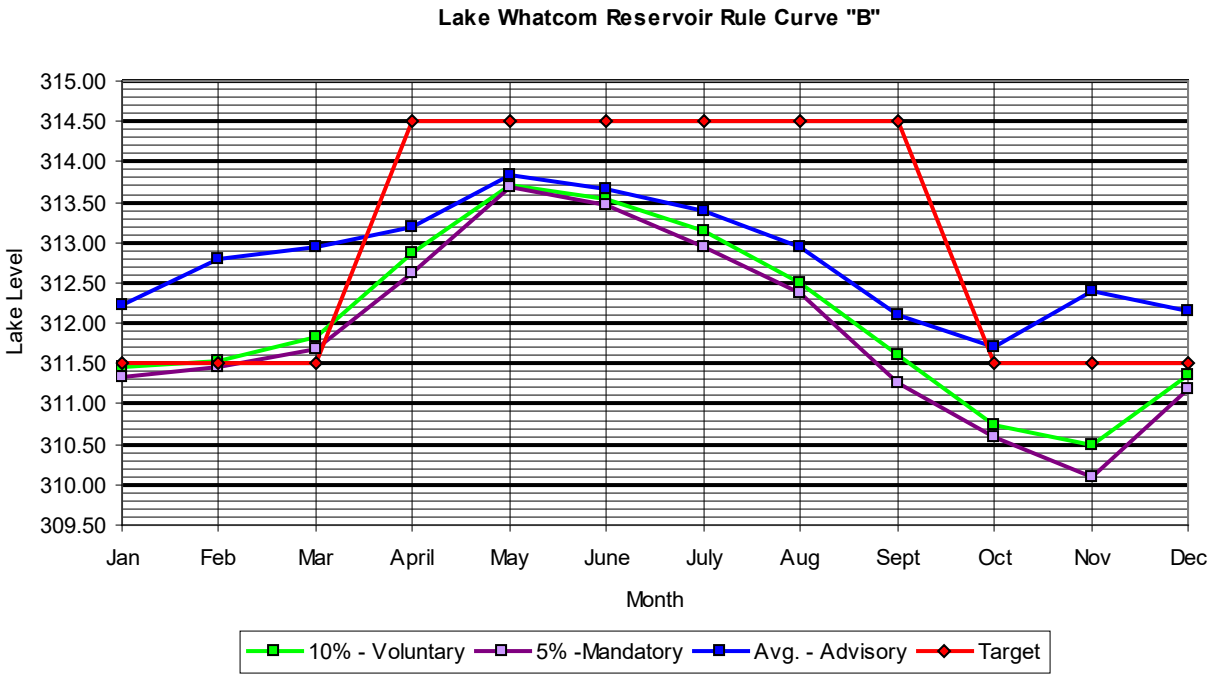
Implement emergency if mandatory not meeting needs

See attached Lake Whatcom Reservoir "Rule Curve B" for month by month "triggers"

DEMAND RULE CURVE "A"



Year	Peak Day mgd	# DAYS above 20 mgd advisory	# DAYS above 25 mgd voluntary	# DAYS above 30 mgd mandatory
1987	21.60	3	0	0
1988	25.50	12	1	0
1989	24.67	2	0	0
1990	24.30	11	0	0
1991	21.10	2	0	0
1992	18.56	0	0	0
1993	18.36	0	0	0
1994	23.23	8	0	0
1995	25.25	11	1	0
1996	19.51	0	0	0
1997	19.24	0	0	0
1998	18.07	0	0	0
1999	16.02	0	0	0
2000	15.84	0	0	0
2001	15.33	0	0	0



Rule Curve 'B' Table

Month	Average Advisory Trigger	10% Voluntary Trigger	5% Mandatory Trigger	Current Target Lake Level
Jan	312.2			311.5
Feb	312.8			311.5
Mar	312.9			311.5
April	313.2	312.9	312.6	314.5
May	313.8	313.6	313.4	314.5
June	313.6	313.3	313.1	314.5
July	313.4	313.1	312.8	314.5
Aug	312.9	312.5	312.3	314.5
Sept	312.1	311.6	311.3	314.5
Oct	311.7			311.5
Nov	312.4			311.5
Dec	312.2			311.5

This Rule Curve is based on historical Lake Levels for the period 1987 – 1998. The Lake Level target for April through September was increased from 314.0 to 314.5 in 1999. Two other significant changes that have and will affect the achievement of the spring/summer Lake level target are: 1) Reduced Diversion Dam operation due to instream flow considerations since 1998, and 2) greater than 60% reduction in Georgia-Pacific industrial flows starting in 2001. Because of these recent, significant changes, it is recommended that the Rule Curve "B" triggers be evaluated annually, and modified as needed.

Appendix F

WATER ASSOCIATIONS & DISTRICTS

Glenn-Cove Water Association
J William Freudenberger
1704 Euclid Ave
Bellingham, WA 98226
Phone: 360.734.5283

Lummi Water and Sewer
Chip Anderson District Manager
(W)Victor Solomon
(S) Levi Jefferson
2156 Lummi View Dr
Bellingham, WA 98226
Phone: 360.758.7167

Whatcom County Water Dist #2
Lori Whitfield
1615 Bayon Rd
Bellingham, WA 98225
Phone: 360.733.5770

Whatcom County Water Dist #7
Lori Whitfield
PO Box 28700
Bellingham, WA 98228
Phone: 360.752.9208

Lake Whatcom Water & Sewer
Patrick Sorensen, Mgr
1220 Lakeway Drive
Bellingham, WA 98229
Phone: 360.734.9224

Montgomery Road Water Association
Paul Troutman
632 Montgomery Rd
Bellingham, WA 98226
Phone: 360.671.6310

California Street Water Association
George Dodge/Douglas W Gallagher
2500 California St
Bellingham, WA 98225
Phone: 360.756.8710

Deer Creek Water Association
Douglas Wittinger
PO Box 30230
Bellingham, WA 98228
dcwa@deercreekwater.org
Phone: 360.820.4314

APPENDIX V

OPERATIONS AND MAINTENANCE MANUAL

WATER SYSTEM OPERATIONS MANUAL

Volume I
Water Supply and Water Treatment Plant

City of Bellingham, Washington
Public Works Department

Prepared by:

Barrett Consulting Group
10800 NE 8th Street, 7th Floor
Bellevue, WA 98004
(206) 455-9494
March 1995

Revised by:

City of Bellingham
Chief Operator
Water Treatment Plant
July 2016

FORWARD

This manual is intended to be used as a tool for training operators and as a guide for system operation. Electronic copy of this manual is located at the following path:

M:\Data\Plants\Water Filtration Plant\System Operation & Maintenance\ Water Treatment Plant\ Plant Documents\Water System Manual Vol I Revised02_15

Revision Record

Date
April 6, 1995
June 3, 2011
July 20th, 2011
May 15, 2012
August 27, 2012
November 19, 2013
March 17, 2014
February 2015
July 2016

Manual Locations
Water Treatment Plant
Post Point Operations
Post Point Maintenance
PWK Engineering
PWK Operations
PWK Utilities Section

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WATER SYSTEM OPERATIONS MANUAL
Volume II
Pressure Zones

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WATER SYSTEM OPERATIONS MANUAL
Volume III
Pump Stations

Otis Street Pump Station

Balsam Lane Pump Station

Short Street Pump Station

Woburn Park Pump Station

38th Street Pump Station

Governor Road Pump Station

Dakin-Consolidation Pump Station

College Way Pump Station

Reveille Street Pump Station

Bonanza Way Pump Station (Off Line)

Haggin-Huntington Pump Station

James Street Pump Station

Birch Street Pump Station

Raymond Street Pump Station

Samish Highlands Pump Station

CHAPTER 1

GENERAL SYSTEM DESCRIPTION

1.1 DESCRIPTION OF WATER SYSTEM

Water consumed within the City of Bellingham is treated surface water. The raw surface water originates primarily as rainfall and snowmelt in the mountains and foothills of the Cascade Mountain Range. The raw water source includes the Middle Fork of the Nooksack River and Lake Whatcom drainage basins. The raw water supply system facilities are shown in Figure 1.1-1.

Lake Whatcom has historically been a source of water for the City. The Middle Fork of the Nooksack River has been a source of water since 1961, when a diversion dam, tunnel and pipeline were constructed to transfer water to Lake Whatcom. Water is conveyed from the Middle Fork of the Nooksack River to the Lake Whatcom basin through a horseshoe arch tunnel and a single transmission pipeline. The crossing of the South Fork Nooksack River is 42-inch. The remainder of the pipeline is 40-inch. Lake Whatcom provides storage for the raw water prior to water treatment. The maximum amount of river water diverted from the Middle Fork of the Nooksack River varies throughout the year dependent upon river flow rates shown in Table 1.1-0.

A hydroelectric powerhouse was constructed on the diversion pipeline in 1985. The powerhouse is capable of producing 1,000 kW. The facility contains four dual nozzle impulse turbines.

The Lake Whatcom raw water intake is about 38 feet deep and consists of a 72-inch wood stave pipe to the gatehouse. A 75-inch horseshoe arch tunnel then connects to the Screenhouse. Pretreatment chemicals and chlorine can be added to the raw water at the screenhouse and conveyed through a 66-inch pipe to the water treatment plant. An independent 48-inch pipeline bypasses the water treatment plant to the industrial facilities on the waterfront. Treatment of the industrial water supply is limited to screening and chlorination. Screening occurs at the screenhouse. Chlorine is added where the industrial pipeline passes by the treatment plant in the driveway to the lower parking lot.

The Water Treatment Plant is an in-line filtration plant which consists of six gravity filters, each with two filter bays. The process capacity of the treatment plant is currently 24 million gallons per day (mgd) with a hydraulic capacity of 36 mgd. The 24-mgd capacity is based on 6 gallons per minute per square foot of filter surface area. After filtration, the water enters the clearwell and then flows to Whatcom Falls Reservoir No. 2 which is also called the CT reservoir. This facility provides storage to meet disinfection requirements and also provides operational storage for plant flexibility. Water flows out of the reservoir via gravity into the North 276 Zone and is pumped to the other distribution zones with in the city. Refer to O & M Volume II for more information on the water distribution system reservoirs.

A schematic plan of the domestic distribution system is shown in Figure 1.1-2. A schematic profile of the system is shown in Figure 1.1-3. The City's distribution system consists of about 413 miles of City-maintained pipelines as of January 1, 2013. Each year, a portion of the pipes are replaced based on priorities of age, condition, material, and ability to transmit peak demands and fire flows. This City program, along with requirements for development to upgrade systems within their area, is continually improving the ability of the City to provide consistent water service. The most recent

inventory of the distribution system was completed in 2013. The inventory of pipelines is summarized in Table 1.1-1

The water system currently contains 14 water storage reservoirs. The elevations and capacities of the reservoirs are summarized in Table 1.1-2. The water system also contains nine major pumping facilities and three small booster pump facilities. The small facilities are Governor Road, James Street. The pumping facilities are summarized in Table 1.1-3. Street addresses for the various facilities are shown in Appendix C.

TABLE 1.1-1

Distribution System Inventory - 2013

Size	Footage
less than 4"	74,135
4"	115,029
6"	520,308
8"	741,579
10"	156,977
12"	284,038
14"	3,713
16"	135,633
20"	61,425
24"	47,649
30"	7,437
36"	10,651
42”	78
48"	17,664
60”	974
66”	1,717
72”	513
Approx. Total	413 mi.

Table 1.1-2

Water Storage Facilities

Name	Bottom Elev. (feet)	Overflow or Top Elev. (feet)	Total Volume (mil.gal)	Pressure Zone	Constr. Mater.[1]
Clearwell	264.50	276.50	1.0	North 276	Conc
Whatcom Falls No.1	259.30	276.50	4.1	North 276	Stl
Whatcom Falls No.2	254.50	276.50	15.6	North 276	PC
Kearney	251.00	276.50	2.5	North 276	PC
Marietta	225.00	275.00	3.0	North 276	Stl
Padden	432.00	457.00	0.5	South 457	Stl
College Way	433.00	457.00	0.5	South 457	Conc
Sehome	442.00	457.00	0.7	South 457	Conc
Dakin No.1	496.83	519.00	0.5	Dakin-Yew 519	Conc
Dakin No.2	500.50	519.00	0.5	Dakin-Yew 519	PC
Consolidtaion	496.83	519.00	0.5	Dakin-Yew 519	Conc
Revielle	672.50	696.25	0.3	Yew Street 696	Conc
40th Street	669.50	696.25	0.5	Padden 696	Conc
Parkhurst	838.00	872.50	0.185	830 Zone	Conc

[1] Materials: Conc - reinforced concrete
Stl - welded steel
PC - prestressed concrete

Table 1.1-3
Pumping Facilities

Name	Source Zone	Discharge Zone	No. of Pumps	On-Site Emergency Power
Dakin-Consolidation	North 276	Dakin-Yew 519	5	Yes[1]
Otis	North 276	South 457	4	No
Woburn Park	North 276	Dakin-Yew 519	2 Fire/ 2 Diurnal	Yes
Short Street	North 276	Cordata 350	5 Diurnal,2 fire	Yes
38th Street	South 457	Padden-Yew 696	3	No
College Way	South 457	Highland Dr. 541	2 Fire/ 2 Peak/ 2 Diurnal	Yes
Balsam Lane	Dakin-Yew 519	Alabama Hill 730	4	Yes
Consolidation Ave.	Dakin-Yew 519	Padden-Yew 696	1	No
Bonanza Way	Dakin-Yew 519	Bonanza Way 635	1	No
Reveille Street	Padden-Yew 696	Upper Yew 830	2	No
Governor Road	Padden-Yew 696	Governor Road 816	3	No
James Street	North 276	James Street 460	2	No

[1] Emergency power for Dakin-Yew Pump Station provided by the water treatment plant.

1.2 WATER DEMAND

Water Treatment Plant flow records are summarized by the operations staff on a daily, monthly, and yearly basis. Finished water exits the CT reservoir facility through the treated water flow meter west of the Dakin-Yew Pump Station. The average annual water demand (AAD) for 2000 to 2008 is summarized in Table 1.2-1.

The distribution of the AAD was evaluated in conjunction with the 1993 Comprehensive Water Plan. The total system demand is distributed to the various pressure zones as shown in Table 1.2-2. The water distribution is based on data from July 23 and 24 and August 6 and 7, 1990.

A variety of peaking factors are used to evaluate and design water system facilities. Extensive analysis of historical peaking factors were conducted for the Water System Analysis and the 2009 Comprehensive Water Plan. This analysis resulted in a peak day to average annual demand (PDD/AAD) peaking factor of 2.3 and a peak hour to peak day demand (PHD/PDD) peaking factor of 1.4. Actual average and peak system demands for the last 10 years are summarized in Table 1.2-3.

Water demand variation throughout the day as a function of the daily demand is described by a diurnal curve. The diurnal curves are used in conjunction with computer modeling to evaluate pumping capacities and storage volumes. If the system demand exceeds the pumping capacity, water will be withdrawn from storage. Conversely, when pumping exceeds system demand, the storage facilities will refill. The diurnal curves also identify the time of day that peak demands occur within each zone. Detailed system flow and pumping information was obtained at 10-minute intervals on four separate days in July and August of 1990. This information was used to develop diurnal curves for the water system.

The diurnal curves for each major pressure zone were developed by calculating the total inflow to the zone from all pump stations and reservoirs and subtracting all outflow from the zone to pump stations and reservoirs. The remainder is the demand within the zone.

The City's water system currently provides water to 7 water districts, associations, or co-ops. The districts and associations served, and their average annual demands are summarized in Table 1.2-4.

Consumption for customers within the City limits is measured at individual service meters where meters are installed. A summary of the consumption by City customer class is presented in Table 1.*2-5* for the years 2000 through 2007.

Table 1.2-1
Average Annual Water Demands

Calendar Year	AAD (mgd)
2000	8.95
2001	8.92
2002	9.80
2003	10.03
2004	10.20
2005	9.63
2006	9.86
2007	9.37
2008	9.22
2009	9.39
2010	8.93
2011	8.82
2012	8.70
2013	8.72

Table 1.2-2
Water Demand by Zone

Pressure Zone	Percent of Total Demand
North 276	52.7
South 457	21.3
Dakin-Yew 519	18.1
Padden 696	2.7
Yew Street 696/Upper Yew 830	1.3
Cordata 350	1.7
Alabama Hill 730	1.2
College Way 541	1.0
TOTAL	100

Table 1.2-3
Average, Max and Peak Historical Demands

Calendar Year	AAD (mgd)	MDD (mgd)	PHD (mgd)
2003	10.22	19.52	22.62
2004	10.39	20.69	24.51
2005	9.81	17.77	20.43
2006	10.05	19.38	24.01
2007	9.55	18.34	21.05
2008	9.39	17.37	17.74
2009	9.39	17.99	21.82
2010	8.93	15.66	18.14
2011	8.82	13.54	16.57
2012	8.70	13.88	16.95
2013	8.72	14.56	17.92
2014	7.48	16.21	15.67

Table 1.2-4
Water District Average Annual Demands for 2002 - 2011

Description	AAD (K-Gals)
Lummi Tribal District	4.5
Lake Whatcom Water and Sewer District	8.8
Water District 2	73.1
Water District 7	58.6
Glen Cove	1.8
California	0.57
Montgomery Road	1.9
Deer Creek Association (2008 – 2011)	5,957

Table 1.2-5
Water Consumption by City Customer

	Daily Consumption (mgd)								
Customer Class	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**200**	**2007**	**Average**
WTP Usage	**0.17**	**0.17**	**0.18**	**0.17**	**0.16**	**0.13**	**0.14**	**0.12**	**0.15**
Flat-rate and Metered Single Familv Residential	**3.23**	**3.06**	**3.72**	**3.95**	**3.80**	**3.55**	**3.90**	**3.83**	**3.63**
Multi-Unit Residential	**1.51**	**1.51**	**1.67**	**1.64**	**1.72**	**1.70**	**1.77**	**1.75**	**1.66**
Institutional	**0.47**	**0.47**	**0.40**	**0.43**	**0.45**	**0.42**	**0.42**	**0.42**	**0.43**
Commercial	**1.80**	**1.76**	**1.83**	**1.84**	**1.87**	**1.83**	**1.85**	**1.74**	**1.81**
Industrial	**0.31**	**0.24**	**0.30**	**0.32**	**0.31**	**0.32**	**0.33**	**0.29**	**0.30**
Irrigation	**0.25**	**0.29**	**0.47**	**0.45**	**0.48**	**0.44**	**0.46**	**0.44**	**0.41**
Water District[1]	**0.52**	**0.50**	**0.50**	**0.52**	**0.39**	**0.33**	**0.33**	**0.30**	**0.42**
Total	**8.26**	**8.01**	**9.07**	**9.32**	**9.17**	**8.73**	**9.20**	**8.89**	**8.83**

[1]The Water District customer class refers to the purveyors served by the City.

1.3 FLOW RECORDS

Bellingham maintains a variety of records on the performance of the water system. Such record keeping covers the issues of water quality, flow, reservoir level, and chemical use. These records provide historical reference for future operation of the water system, provide information to plan for future maintenance and replacement, and ensure that the system provides high quality water for its customers. The water utility keeps the following records:

* Date
* Influent volume
* Effluent volume
* Backwash water volume
* Plant usage volume
* Dakin & Yew pump station volume
* Raw water turbidity
* Raw water pH
* Raw water hardness (twice a month)
* Raw water alkalinity(twice a month)
* Raw water temperature
* Treated water turbidity reduction (percent)
* Treated water pH
* Treated water hardness (twice a month)
* Treated water alkalinity (twice a month)
* Treated water chlorine residual concentration
* Treated water minimum chlorine residual concentration
* Filter run times
* Ultimate filter run volumes
* Filter turbidities
* Filter headloss
* Filter rates
* Chemicals used
* Watershed data
* Peak hourly flow to system
* Contact time
* Contact Time (CT) Calculated
* CT required
* CT ratio

The Water Treatment plant staff prepare a monthly flow report, which is sent to WADOH as documentation of the treatment plant operation. These reports are archived in the City's record system. In addition, Bellingham's SCADA system also creates daily reports showing reservoir levels, flow rates at the plant, and pump station flow rates hourly throughout the day. These reports are also archived in the City's record system.

The monthly flow reports are sent to the Washington State Department of Health as documentation of the treatment plant operation and are archived in the City's record system. A sample report is included in Appendix A.

In addition, the City's Supervisory Control and Data Acquisition (SCADA) system also creates daily reports showing reservoir levels, flow rates at the plant, and pump station flow rates hourly throughout the day. These reports are also archived in the City's record system. Sample reports are included in Appendix A.

CHAPTER 2
WATER SOURCE FACILITIES

2.1 DOCUMENTS

Various reports have been prepared summarizing analyses of the water source facilities. These reports are as follows:

1965 Water Systems Study, Stevens, Thompson & Runyan, Inc.
1978 Water Supply Analysis, STRAAM Engineers, Inc.
1982 Comprehensive Water Plan, Pool Engineering, Inc.
1986 Evaluation of Lake Whatcom as a Continued Source of Water Supply, J.M. Montgomery
1993 Comprehensive Water Plan, Barrett Consulting Group
2009 Water System Plan, CH2M Hill

The City's Lake Whatcom water right certificate dates back to 1894 and permits the city to use 100 cubic feet per second (64.5 mgd) with an annual volume of 92,000 acre feet. The city also has a water right on the Middle Fork of the Nooksack River for 116 cfs (78.3 mgd) or 83,980 annual acre feet.

2.2 CONSTRUCTION PROJECTS

Various water source facility projects have been constructed. These projects and the estimated date of completion are summarized in Table 2.2-1.

Table 2.2-1

Water Source Construction Projects

Construction Project	Project Number	Approximate Date of Completion
Lake Whatcom Dam		1937
Lake Whatcom Intake Screenhouse		1940
Intake Pipeline		1940
Gatehouse		1940
Tunnel to Screenhouse		1940
Diversion Dam	WA-99	1960
Anderson Creek Development	WA-101	1960
Diversion Tunnel		1961
40-inch diversion pipeline from tunnel to Mirror Lake	WA-100	1961
42-inch South Fork crossing		1962
Diversion Pipe line Hydroelectric Facility		1985
New Diversion Dam Bridge across MF river	ER-2	1999

New Diversion Dam Access Road	EW-0174	2012

2.3 MIDDLE FORK NOOKSACK RIVER WATERSHED

2.3.1 General Description

Water from the Middle Fork Nooksack River is diverted through a dam structure, tunnel, pipeline, Mirror Lake and Anderson Creek to Lake Whatcom as shown in Chapter 1, Figure 1.1-1. The pipeline discharges to Mirror Lake which is in the Lake Whatcom watershed.

The diversion dam is located on the Middle Fork Nooksack River about 18 miles east of downtown Bellingham. The watershed upstream of the dam encloses about 58 square miles. The watershed extends eastward from the dam to the summit of Mount Baker.

The Middle Fork Nooksack River has been an auxiliary source of water for Bellingham since 1961, when the diversion dam and associated tunnel and pipeline were completed. The Middle Fork Nooksack River provides some additional water to Lake Whatcom during the higher summer demand period if in stream flows in the river will allow. The capacity of the diversion pipeline is 61 mgd (95 cfs). The pipeline capacity is reduced to 43 mgd (67 cfs) when the power generation facility is in operation.

2.3.2 Diversion Dam



The dam is a reinforced concrete ogee (reverse curve) type structure with a crest elevation of 840 feet. The dam is 25 feet high at the deepest portion tapering to approximately an 8-foot height at the north abutment. The dam is about 175 feet wide at the crest. It is designed to accommodate a flood of 20,000 cfs and can pass floods of greater capacity without damage. The entire dam and intake structure are founded on a hard, greenstone formation.

The general configuration of the dam and its components is shown in Figure 2.3-1. At the south abutment, a 16-foot-wide sluiceway is provided with a 16-foot by 12-foot-high structural steel truck type sluice gate and hoist. Two intake chambers are located at right angles to the sluiceway with sill elevations of 833 feet. The intakes are provided with coarse screens to prevent debris from entering. Each chamber is equipped with a 6-foot by 8 foot cast iron channel inlet gate and pedestal. Water passing these gates enters a 100-foot-long sedimentation channel. The river side wall of the channel is an auxiliary spillway. This channel serves as a stilling and regulating



basin, permitting sediment to settle out as well as to spill excess water back into the river during floods when the dam is unattended.



This channel widens out and deepens at the lower end, forming two depressed pits. Each of the pits is provided with a 12-inch-square sluice gate to wash out the sediment accumulating in the channel. Downstream of the sluice gates are two 4-foot by 6-foot tunnel inlet gates to control the flow into the tunnel and pipeline. Access to the tunnel floor can be gained by means of a vertical shaft located on the gate operating deck. On the tunnel inlet side of the tunnel there a bolted steel plate that has an 4'-9" by 7'-0" opening for equipment access.

When the diversion dam main gate is closed. All water entering the intake screens from the river in excess of that entering the tunnel inlet passes over the crest of the dam. The main gate occasionally should be opened only to remove accumulated deposits of sand and gravel that accumulate upstream of the gate at the entrance to the intake screens. The submerged portion of the gate can be made accessible for painting or for repairs by placing 10-inch-thick timber stop plank in the grooves in the walls ahead of the gate.



Leaves, twigs, and other rubbish collecting on the intake screens should be removed periodically. The frequency of removal will vary depending on season and river conditions.

The two 4-foot by 6-foot tunnel inlet gates are provided for regulating the flow into the tunnel and pipeline. When partially closed, the gates also help prevent debris from entering the sedimentation channel and tunnel. No more water should be allowed to enter the tunnel than can be conveniently carried away by the pipeline. Excess water in the tunnel will flood the tunnel outlet placing the pipeline under greater pressure. After proper adjustment of the various control gates, about one to two inches of water will be flowing over the auxiliary spillway. This depth will automatically increase during floods occurring while the dam is unattended. Additional depth will not significantly increase the flow into the tunnel. Furthermore, a continuous flow over the auxiliary spillway will prevent the formation of ice during winter which might be destructive to the walls of the structure. When properly adjusted, the water level equalizes from the sedimentation basin to the tunnel outlet.

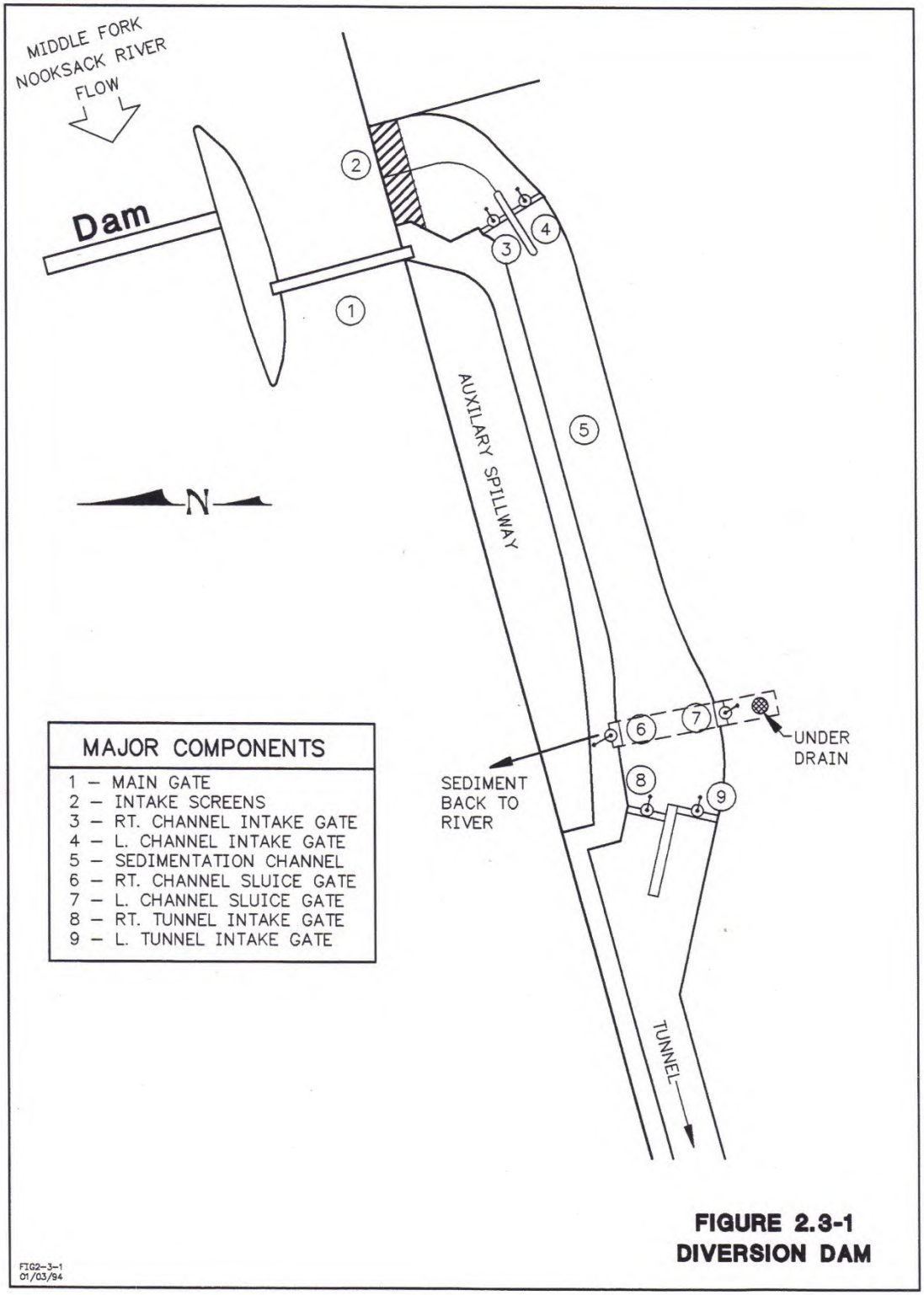


Figure 2.3-1
Diversion Dam Major Components

2.3.3 Diversion Tunnel



The picture to the right is the inlet portal at the dam end of the tunnel with one of the 4 by 6 foot gates open. (The picture is from the inside looking out the inlet portal at the dam end.) The tunnel inlet is at an elevation of 832.58 feet. The tunnel is a 7'-6"-wide by 8-foot-high horseshoe arch type passing through Bowman Mountain with a design capacity of 250 cfs. Actual inside dimensions are shown on Figure 2.3-2. It is lined throughout with concrete and is approximately 8,900 feet long. The lower 1,450 feet penetrate glacial till and the upper 7,450 feet were drilled through basalt and phyllite rock. The tunnel is a straight bore, sloping 0.6 feet per 1,000 feet with the outlet 5'-4" lower than the inlet. An 8-inch underdrain, with open joints and embedded in gravel, was placed under the invert where the tunnel lies in glacial till to relieve ground water hydrostatic pressure on the outside of the lining. For the same purpose, weep holes were placed at intervals in the crown of the rock section of the tunnel.



The tunnel outlet portal consists of a reinforced section with transitions and terminating in a reinforced concrete structure. The general configuration of the tunnel outlet portal and its components is shown in Figure 2.3-3. One side of the structure is connected to the present 40-inch transmission pipeline. The other is blocked off for a future pipe connection. Both pipe inlets are provided with 4-foot by 6-foot cast iron pipeline intake gates and hoists. Coarse screens are installed ahead of the gates. Access to the tunnel outlet portal can be gained by means of a shaft whose top elevation is at 845 feet. A bolted 5-foot by 7-foot steel plate covers an access opening in case equipment is required in the tunnel.

2.3.4 Diversion Pipeline

The pipeline is 40-inch-inside-diameter concrete cylinder pipe, having a 10-gage welded steel cylinder. The pipe is lined with 3/4 inch of cement mortar, wrapped with 5/16-inch steel wire spaced 1.32 inches on centers, and coated with 1-inch-thick cement mortar. The spigot joint is made up of a special rolled steel shape, formed to enclose a rubber ring gasket which fits snugly into the bell of the adjacent pipe. The line is about 9-1/2 miles in length and discharges at an elevation of 358 feet. The South Fork Nooksack River crossing was replaced in 1992 with 42-inch ductile iron pipe. The ductile iron pipe extends from about Sta 305+25 to Sta 315+00.

The pipeline is designed for a working pressure of 125 pounds per square inch. This pressure is not exceeded under free flow in any part of the pipe line. At no time should a valve be installed in the pipe for the convenience of regulating or shutting off the flow nearer to the City. Such a valve when closed will subject the pipe to static head conditions with serious consequences and possible rupture of the pipe.

When flowing full, the water moves at an approximate velocity of about 11 feet per second. This velocity is sufficiently high to carry any sediment completely through the pipe and prevent deposition at low points in the line. During periods when water is not being diverted, the pipeline should not be dewatered.

2.3.5 Pipeline Appurtenances

Access manholes are spaced about 1,000 feet apart along the pipeline. The manholes are 14-inch by 16-inch oval boiler type with cast iron crab and bolted cover. The manholes are provided for access to the interior of the pipe.

Air valves are placed at high points in the pipeline and offset to the side of the pipe. The air valves are either 2-inch or 4-inch and are used to admit air into the pipe when being dewatered, to exhaust air while the pipe is being filled, and to discharge accumulated air while the line is in operation. Each valve is provided with a buried gate valve shut off, with standard valve box permitting removal of the air valve without interrupting service. The air valve is housed in a cylindrical chamber with a dished head cover. About 1,000 feet from the discharge of the pipeline, near Mirror Lake, an 8-inch vent has been installed.

Blow-offs are installed at low places for the purpose of dewatering the pipe. The blow-offs are 6-inch and 8-inch tee outlets tangent with the bottom of the pipe, and each is provided with a shutoff valve and valve box. There are three types of blow-offs:

- Straight Outlet Pipe - This type is installed adjacent to a stream which is lower than the outlet. The pipe here can be dewatered by gravity by merely opening the outlet valve.

- Riser Pipe - This type is installed adjacent to a receiving stream which is higher than the outlet. The pipe can be only partially dewatered by gravity down to the top of the riser. Pumping must be used to remove the residual water. The blind flange on top of the riser must be removed and a pump suction hose inserted to the bottom of the riser.

- Outlet Chamber - This type is installed usually in cultivated or pasture land where there is no immediate receiving stream. The outlet valve is installed in a sewer type manhole and is opened only slightly to permit the water to spread out uniformly over the adjacent land to be disposed of by percolation. The residual water below the top of the manhole must be pumped for complete dewatering, as in the riser type.

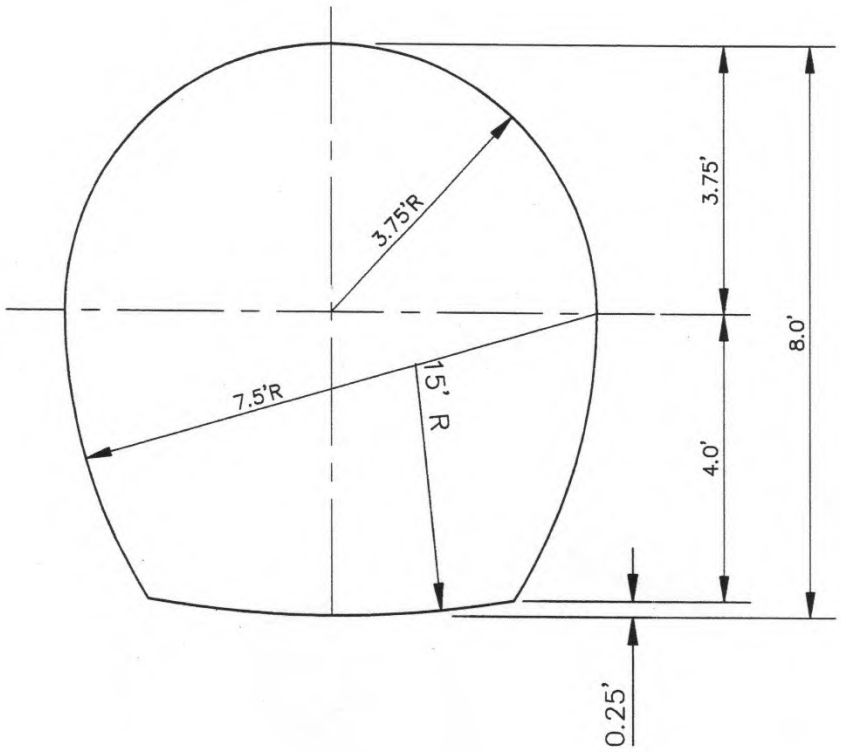


FIGURE 2.3-2
DIVERSION TUNNEL DIMENISONS

FIG2-3-2
01/03/94

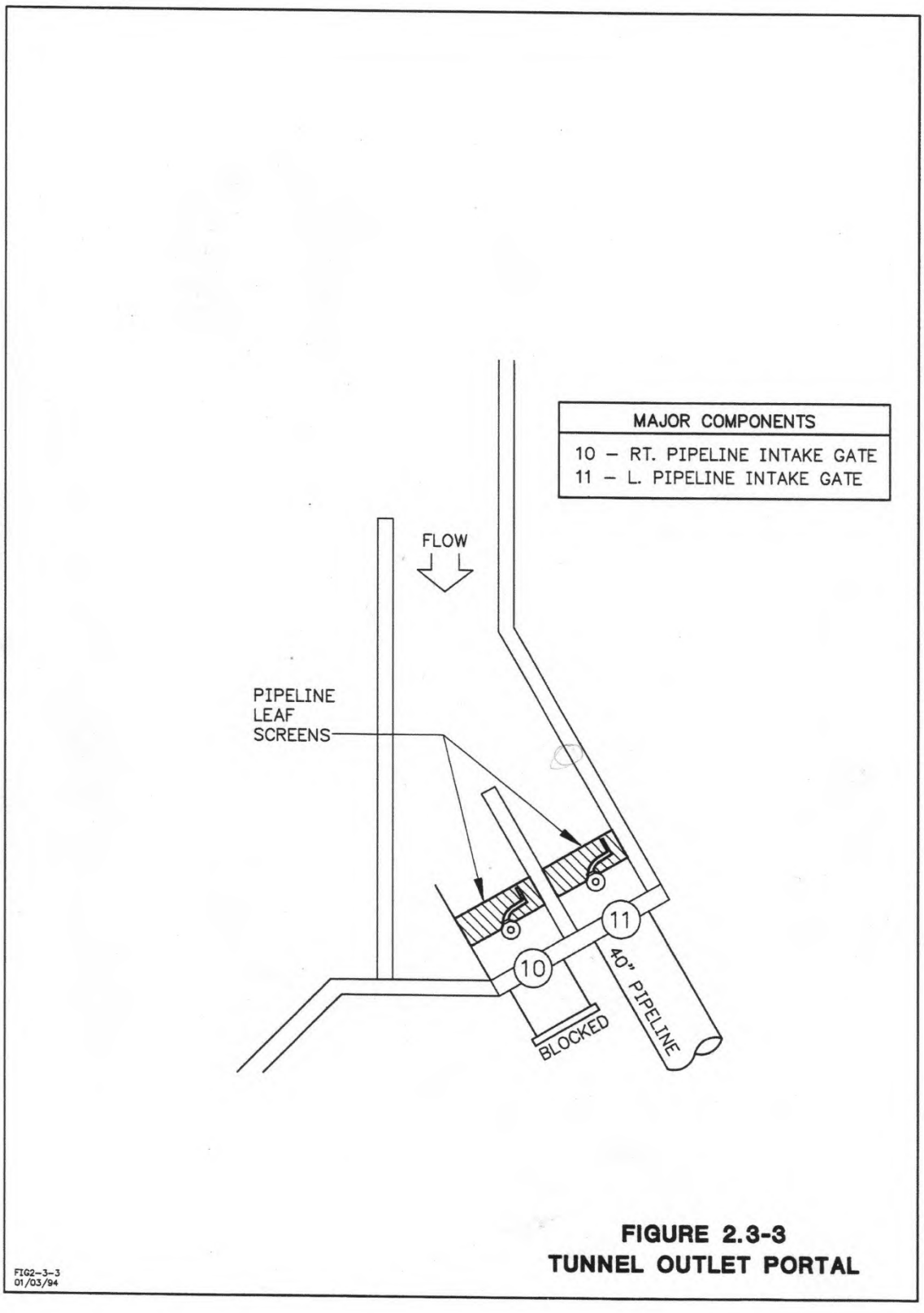


FIGURE 2.3-3
TUNNEL OUTLET PORTAL

2.3.6 Hydroelectric Facility

A powerhouse and hydroelectric facility were constructed on the diversion pipeline in 1985. The facility is currently operated by Canyon Industries. The facility straddles the pipeline and contains four 480-rpm dual-nozzle impulse turbines. Each turbine is coupled to a speed increaser and a 250-kW induction generator. The facility is capable of producing 1,000 kW, and the City receives 10 percent of the gross revenues on anything above $50,000. At the end of the least, the facility ownership will transfer to the City.

The powerhouse normally operates at about 120 psi and 30 cfs. Power is transmitted from the facility to Puget Power over a 7,000-foot-long buried 35-kV cable.

The flow rate of water diverted from the Nooksack River is measured by a flow meter at the powerhouse.

2.3.7 Operation of the Diversion Facilities

1. Diversion Dam Startup for Operation - **Not Diverting Water**

When performing these tasks, it is VERY important that the sequence be followed exactly. Refer to Figures 2.3-1 and 2.3-3 when performing these tasks:

A. Verify the following conditions if the diversion dam is off line:

- Pipeline intake gate is fully closed
- Tunnel intake gates are open
- Channel sluice gates are fully open
- Channel intake gates are closed

B. Close the dam's main gate and wait for the water level behind the dam to raise to the level of the spillway

C. Open the right channel intake gate 4 to 6 inches to create a fast-running flow in the sedimentation channel. This will allow the proper amount of flow to clean out the channel to remove any sand and sediment that might be left in the channel.

D. For safety reasons, this task requires a minimum of two personnel. This task is necessary to ensure the channel is clean before the system is placed in service. It is imperative that this channel-cleaning procedure be carried out prior to placing the system on line. If sediment, sand, and gravel are allowed to enter the tunnel, it will degrade the flow capability of both the tunnel and the pipeline and carry unnecessary deposits to Mirror Lake.

E. Safety is always the first concern. The amount of opening of the channel intake gate may periodically need to be adjusted to provide a safe environment for the worker in the channel and to enhance cleaning efficiency. Other than for an emergency shutdown, no gate shall be adjusted while a worker is in the channel. This task requires one standby worker as an observer above the channel. It is the standby worker's responsibility to observe conditions in the channel and be available to respond to any emergency

condition. The channel intake gates must be closed immediately if the flow has placed the channel worker in jeopardy.

Enter the sedimentation channel and remove sand and deposits. A shovel may be used to manipulate channels in the sediment and to direct the flow of water and sediment to the channel sluice gates. The specific channel intake gate used and the amount of opening may need to be changed or adjusted during the cleaning process based on the amount and location of accumulated deposits.

F. After the intake channel is cleaned, open both channel intake about 8 inches each. The channel sluice gates should both be open about 15 turns each to keep flushing out sediment from the channel.

G. As the intake channel begins to fill, open only one tunnel intake gate about one foot which equals about 220 turns from the direct drive spindle of the gate. (Open either tunnel intake gate is O.K.). This is the starting point for adjustment of final flow rates. Note the time. It takes about one hour for the flow to equalize at the pipeline entrance. After the flow has stabilized, adjust the channel intake gates to achieve approximately one inch of flow over the auxiliary spillway.

H. The water level can be checked at the outfall of the diversion tunnel. The water level should be just enough to cover the pipeline entrance. This may be measured as 13 feet below the grate opening next to the pipeline intake gate operator. If the water level is too low or too high, the level can be adjusted with the tunnel intake gate at the diversion dam. The water level is permitted to be 1 to 2 feet higher as long as the pipeline opening is completely covered.

I. Return to the dam site and adjust the tunnel intake gate, if required.

J. Repeat tasks G and H as often as necessary until a suitable level at the pipeline entrance is achieved

K. Verify the following conditions:

- Dam Main Gate : FULLY CLOSED.
- Dam Channel Intake Gates : ADJUSTED FOR 1" OVERFLOW or open 8 inches
- Channel Sluice Gates : Opened 15 turns each.
- Tunnel inlet Gates : AS ADJUSTED IN STEPS G AND H.
- Outfall Pipeline Gate : Closed.

2. Placing the Diversion Dam into Operation - **Diverting water - Remote Operation, Dam Already on line**

A. Operating the dam from a remote location using SCADA. The following dam conditions are in effect:

- Pipeline intake gate is fully closed.
- Tunnel intake gates are open
- Channel sluice gates are fully open

- Channel intake gates are opened
- There is enough water in the MF of the Nooksack River to divert.

B. Operation of the diversion dam is based on In Stream Flow requirements in the Middle Fork of the Nooksack River. To divert water from the river to Lake Whatcom depends on the time of the year and the amount of water that can be diverted. Table 2.3-1 below is the in stream flow requirements for each month of the year in CFS (Cu.Ft. per Second).

C. When opening the valve on the Diversion pipe line it withdraws from the river approximately 1 cfs for every 1 percent of valve opening. Example: If the valve at the diversion outfall was open 30% there is approximately 30 cfs going into the pipeline from the diversion tunnel and that would equal about 30 cfs being taken out of the river.

TABLE 2.3-1
In Stream Flow Requirements

Month	CFS
Jan	275
Feb	380
March	380
April	380
May	450
June	525
July	525
August	275
September	275
October	275
November	275
December	275

D. The control for the operation of the Diversion outfall valve is handled by the PLC located at the site. There is a single valve on the 40 inch diversion pipe line with an electric actuator installed. The PLC program has been programmed to slowly open the diversion outfall valve to keep it from dropping the river elevation to fast. The program has been adjusted to open the valve only 15 % at a time and then waits 30 minutes before allowing another change. If the operator entered a 30% open command on the diversion screen the valve would open in 2 increments of 15% each for a total of 30% and it will take one hour to be fully open to 30%
    a. Operator should make an entry in the watershed excel spreadsheet with the following information: Date, Operator name, time, % the gate was open/closed, total open mount, and any comments.
    b. When opening or closing the diversion outfall valve to divert water. Canyon Industries the hydroelectric power operators must be notified.

E. Continue the diverting of water for as long as the river flows are above the in stream flow requirements. When the river flows drop below the in stream flow requirement than close the diversion outfall valve. When the valve is opened or closed make an entry into the watershed excel spreadsheet.

3. Taking the Diversion Dam out of Service

Refer to Figures 2.3-1 and 2.3-3 when performing these tasks:

a. CLOSE the tunnel intake gates (#8 and #9)

b. OPEN the channel sluice gates (#6 and #7). Allow system to flow freely for 15 to 30 minutes.

c. CLOSE the channel intake gates (#3 and #4).

d. OPEN the main gate (#1) all the way open.

F. The pipeline intake gate (#11) is already closed.

e. Leave the channel sluice gates (#6 and #7) OPEN.

4. Special Conditions

A. Work in the Pipeline

Special care must be taken to ensure the safety of downstream workers whenever the pipeline is opened up. All lock out procedure are to be followed.

a. CLOSE the tunnel intake gates (#8 and #9).

b. OPEN the channel sluice gates (#6 and #7). Allow system to flow freely for 15 to 30 minutes.

c. CLOSE the channel intake gates (#3 and #4).

d. OPEN the main gate (#1)

e. CLOSE the pipeline intake gate (#11)

f. OPEN the pipe line outfall valve to drain the diversion pipe line**. Note**: draining the pipe line during the winter months will cause the pipeline to float out of the ground. It's not recommended during the winter months.

B. Work in the Tunnel or Outlet Area

a. Follow the Diversion Dam out of Service procedures.

b. OPEN the pipe line outfall valve to drain the remaining water in the diversion Dam tunnel**.**

c. Follow all lock out procedures.

2.4 LAKE WHATCOM WATERSHED

2.4.1 General Description

The pipeline from the Middle Fork Nooksack River diversion discharges about 540 feet southeast of Mirror Lake. The water flows from Mirror Lake to Lake Whatcom via Anderson Creek. Water is then withdrawn from Lake Whatcom via an intake pipeline, gatehouse and tunnel.

The surface area of Mirror Lake is about 13.5 acres and the lake is located one third of a mile west of highway SR-9. The water surface elevation is at about 357 feet. The lake has a total volume of 263 acre-feet (per City records dated February 3, 1988). Anderson Creek between Mirror Lake and Lake Whatcom was rechanneled in 1960 to accommodate the City's water flow. The creek is 2.4 miles long.

Lake Whatcom is located a few miles east of Bellingham. The surface area of the lake is about 5,000 acres. Six major creeks (excluding Anderson Creek) flow into Lake Whatcom at various locations. Fir, Brannian, and Austin Creeks flow into the lake along the south shore and Smith, Olsen, and Carpenter Creeks flow into the lake along the north shore. Other minor creeks also flow into the lake at numerous locations.

The City has an existing water right to store up to 20,000 acre-feet of water in Lake Whatcom. This is approximately 6.5 billion gallons, or about 4 feet of water depth.

The discharge from Lake Whatcom is controlled by a dam at the lake outlet. The lake level is controlled at the dam by the City staff. The maximum permissible regulated lake level is 314.94 as established by court order. There is no minimum legal lake level established. The City's operations staff operate the Lake Whatcom dam to achieve a lake level within an acceptable range. The current ranges are described subsequently in the section on operation of the control dam.

Lake Whatcom is divided into three general basins. The largest is the east basin. The two westerly basins are about the same size. The City's water supply is withdrawn from the central basin. An anaerobic zone frequently develops in the central basin during the summer. To date, the anaerobic zone has not reached an elevation high enough to enter the City's water supply. The zone is monitored yearly to allow assessment of long term impacts.

The raw water intake is about 36 feet deep and is located about 1,300 feet offshore. The water is conveyed from the intake structure to the shore via a 72-inch-diameter wood stave pipeline. A gatehouse is located at the shore. The raw water is conveyed from the gatehouse to the Screenhouse via a horseshoe arch tunnel. The treatment of the water begins at the Screenhouse. The treatment system is discussed in Chapter 3, Water Treatment Facilities.

2.4.2 Control Dam



This section provides the information and guidance needed to assure thorough and complete operation of Lake Whatcom Control Dam. It will also provide people knowledgeable in reservoir operation, but unfamiliar with the conditions at this particular dam, to operate the dam and reservoir when regular operators cannot perform their duties. Ultimately, with correct operation and maintenance, the safety of those living below the dam will be maintained, and the dam will operate with maximum efficiency.

2.4.2.1 Location and Purpose

Whatcom Lake Dam is located in west Whatcom County, 2 miles east of downtown Bellingham, within T 38 N, R 3 E, Section 28. The dam is located at the west end of Lake Whatcom where the lake outflows into Whatcom Creek. The primary purpose of the dam is to regulate lake water levels in Lake Whatcom. Lake Whatcom is the raw water source for Bellingham's municipal water supply. The dam is owned and operated by the City of Bellingham's Water Division.

At the spillway overflow elevation of 308.7 feet, the lake has a surface area of 5,000 acres and a natural (inactive) storage volume of 700,000 acre-feet. At a winter pool water surface elevation of 311.5 feet, the lake has a surcharge storage volume of 14,000 acre-feet. At a summer water surface elevation of 314.5 feet, the lake has a surcharge storage volume of 29,000 acre-feet. At a water level equal to the dam crest elevation of 322.7 feet, the lake would store a surcharge volume of 70,000 acre-feet.

Lake Whatcom is filled by runoff from the surrounding watershed, and also by a diversion from the Nooksack River from spring until fall. As noted above, the primary purpose of the dam is to regulate lake water levels in Lake Whatcom. The spillway gates are operated to accomplish

the following objectives. During the winter period November through February, a lake water level of 311.5 feet is maintained to allow for flood storage. In March, the spillway gates are closed to allow the lake water level to gradually rise to elevation 314.5 feet per the Lake Whatcom Operating Level Policy (Prior to June 2000, the mandated summer lake level was 314.0 feet). During the summer period April through September, a lake water level of 314.5 feet is maintained. In October, the spillway gates are adjusted to allow the lake water level to gradually drop to elevation 311.5 feet.

In addition, to maintain a base flow in Whatcom Creek to supply the fish hatchery downstream, a sluice gate opening of three inches is maintained, at least during the summer period. For the typical summer water level of 314.5 feet, this sluice gate setting would maintain a base flow of about 10 cfs in Whatcom Creek, in addition to whatever leakage occurs in the spillway gates.

2.4.2.2 General Description of Dam

The lake has a surface area of 5,000 acres and a natural (inactive) storage volume of 700,000 acre-feet. The Whatcom Lake Dam is a concrete gravity gate structure rising 14 feet above original grade to a crest elevation of 322.7 feet, with a crest length of 109 feet and a crest width of 7.75 feet. The overflow spillway has 3 bays, each 18 feet wide, with radial taintor gates.

A downstream hazard classification of Hazard Class 1B, *High* downstream hazard potential has been assigned to the Whatcom Lake Dam. The dam was constructed in 1937.

2.4.2.3 Base Slab Description

The base slab for the concrete structure is 69 feet long and 26 feet wide, with a top elevation (overflow elevation for the spillway) of 308.7 feet (shown as 310.0 feet on the original plan sheets). The base slab is 1.5 feet thick, with cutoff walls 5.0 feet deep (extending 3.5 feet below the bottom of the base slab) at the upstream and downstream edges of the base slab.

2.4.2.4 Gate Piers and End Walls Description

Three concrete piers with embedded trunnion bearings support the taintor gates. Each pier is 26 feet long at the base (on top of the base slab), 8 feet high, 2 feet thick, sloped at 3H: 12V at each end, with a top length of 22 feet. Sitting atop the piers are concrete walls that support the spillway bridge and gate hoist deck slabs. Each concrete support wall is 13.5 feet long at the base (on top of the pier), 6 feet high, 2 feet thick, sloped at 3H: 12V at each end, with a top length of 10.5 feet.

The two end walls have a configuration somewhat similar to the three piers and support walls. The lower section of each end wall is 26 feet long at the base (on top of the base slab), 8 feet high, 1.5 feet thick, vertical at each end, with a top length of 26 feet. The upstream end of the end wall makes a sharp 90 degree rounded bend into a wing wall that extends 12 feet into the earth abutment. The downstream end of the end wall transitions into a curved wing wall having a radius of curvature of 10.5 feet, and also extends 12 feet into the earth abutment. The right end wall also has embedded trunnion bearings to support the right taintor gate.

The upper section of each end wall supports the spillway bridge and gate hoist deck slabs. The upper section of each end wall is 14.5 feet long at the base (on top of the lower section), 6 feet high, 1.5 feet thick, sloped at 4H: 12V at each end, with a top length of 10.5 feet. In addition, triangular sections 1 foot thick at slope 1H: 1V extend the upper wall section up to 4 feet in each

direction, extending from the top of the lower wall section up to the bridge deck. These triangular sections match the slope of the earth embankment adjacent to the end wall where the concrete structure abuts into the embankment.

2.4.2.5 Gate Operating Deck (Dam Crest) Description

The spillway bridge and gate operating deck for the concrete structure is 69 feet long and 7.75 feet wide, with a top elevation (overflow elevation for the spillway) of 322.7 feet (shown as 324.0 feet on the original plan sheets). The deck slab is 4 inches thick over the spill-way bays. A short section of the operating deck 9.5 feet long over the sluiceway adjacent to the left abutment is 10.5 feet wide and 6 inches thick.

2.4.2.6 Abutments and Embankment Sections Description

(Source: Landau Associates. *Results of Geotechnical Assessment for Lake Whatcom Dam*. Landau Associates Inc. June 1989. Pages 5, 9, 10).

The earth fill sections at the abutments consist of earth embankments which are retained at the upstream side by gravity concrete wing walls extending from the concrete structure into the abutments. The embankments are retained at the downstream side by curved gravity concrete wing walls, designed to extend from the downstream cutoff wall of the concrete structure into the abutments. The earth fill embankment at the left abutment is about 28 feet in length, and provides a transition from the concrete gravity spillway structure to the soil foundation at the east bank of the Whatcom Creek channel. The earth fill embankment at the right abutment is about 12 feet in length provides a short transition to a rock foundation at the west bank of the creek channel.

The tops of the wing walls are at elevation 316.7 feet (shown as 318.0 feet on the original plan sheets); about 6 feet below the dam crest elevation, and have unsupported heights varying from about 8 feet at the concrete structure to zero into the abutments. The embedment depths of the wing walls into the foundation are unknown; however, the design drawings require 3 feet minimum embedment into rock and 5 feet minimum embedment into impervious clay. The walls are 1.5 feet thick at the top, and were designed with 2H: 12V batters at the backs of the walls. The base widths of the earth fill sections are a maximum of 36 feet.

The earth fill surface at the crest is protected by concrete paving at the left abutment and vegetation at the right abutment. The surface earth fill slopes at the left abutment are protected only by sparse vegetation, while the surfaces at the right abutment are protected by dense vegetation. Rubble slope protection shown on the design drawings is not present.

Concrete cutoff walls are located at the upstream edge of the crest of the earth fill sections. The cutoff walls are 1 foot thick and extend from the concrete spillway structure into the foundations at the abutments. The embedment depths of the cutoff walls are unknown, but the cutoff walls are presumed to extend full depth from the dam crest to apparent design cutoff depths into the foundations. As noted above, the design drawings require 3 feet minimum embedment into rock and 5 feet minimum embedment into impervious clay.

2.4.2.7 Overflow Spillway Hydraulics Description

The overflow spillway for Whatcom Lake Dam is a concrete gate structure located at the center of the dam. The control section is rectangular in shape, with an open width of 54 ft. (3 spillway bays, each 18 feet wide) and vertical side slopes. Overflow elevation is 308.7 feet per City of Bellingham datum (shown as 310.0 feet on the original plan sheets). Taintor (radial) gates in the spillway bays can close to impound water to a height of 6 ft. (to elevation 314.7 ft.), or can rise to an open height 9 feet above the base of the spillway (USACE, 1980, page 2-1). A log boom is provided to prevent blockage of the spillway by floating debris. Flows through the spillway discharge directly to Whatcom Creek.

2.4.2.8 Radial Taintor Gates Description

The three taintor gates are approximately 18 feet wide and six feet high. The gates consist of 3/16 inch steel plate, bent about a 7.5-foot radius. Structural members for the gate structural members consist of 5 horizontal steel channels spanning the full width of each gate. The channels are bolted or riveted at their ends, through intermediate backing plates, to 4x4 inch angle struts. The struts are attached to trunnion hub flanges consisting of doubled 3/8 inch plate. The trunnion hub flanges have a 2-31/32 inch hole to mount the gate on the embedded steel pier pin.

Each gate is operated by a motor-operated wire-rope hoist located on the Spillway Bridge and gate operating deck located above the respective gate. The hoist cables are 5/8 inch thick braided steel wire. Operational controls for the spillway gates are located on the gate operating deck at the left (east) end of the concrete structure.

For identification purposes, the spillway gates are numbered One through Three from left to right looking downstream. Gate one, the left gate is located between the left and center-left piers; Gate Two, the center gate, is between the center-left and center-right piers; and Gate Three, the right gate, is located between the center-right pier and the right end wall.

2.4.2.9 Low Outlet Sluice Gate Description

The low-level outlet for Whatcom Lake Dam is a 4 ft x 4 ft square orifice located at the left side of the concrete structure between the left end wall and the left pier. The orifice has an invert elevation of 309.4 feet (shown as 310.67 feet on the original plan sheets). A rectangular open sluiceway 6 feet wide and 18.5 feet long conveys water through the structure. The sluice-way discharges directly to Whatcom Creek near the left bank.

Flow control for the low outlet is provided by a 4 ft x 4 ft sluice gate. Operational controls for the sluice gate are located on the gate operating deck directly above the sluice gate and operated by a hand wheel.

2.4.3.0 Downstream Hazard Assessment

A downstream hazard classification of Hazard Class 1B, *High* downstream hazard potential is assigned to the Whatcom Lake Dam. The consequences of a failure of the dam would include the potential for loss of life and property damage to as many as 27 commercial/industrial structures located near Whatcom Creek, with an undetermined population at risk.

The flood from a dam failure would travel for 3 miles down Whatcom Creek to Bellingham Bay. For a single-gate failure, flood depths are estimated on the order of 4 to 5 feet deep. For a sudden failure of all three spillway gates, flood depths are estimated on the order of 7 to 8 feet deep, with some reaches flooded as much as 11 to 12 feet deep. Businesses (and possibly a few residences) that would probably be inundated by the dam break flood are located 1½ to 2 miles downstream from the dam, along Iowa Street on the east side of Interstate 5, in an area already vulnerable to natural flooding. Aerial photographs indicate at least 22 commercial/industrial structures on the south side of Iowa Street near Whatcom Creek, with at least 5 more commercial/industrial structures on the south side of the creek along Fraser Street near I-5.

2.4.3.1 Dam Data Sheet

1. General

State I.D. No.	WH 01-0158
Owner and Operator	City of Bellingham, Water Division
Location	T 38 N, R 3 E, Section 28 2 miles east of downtown Bellingham
Construction Completed	1937
Purpose	Municipal water supply
Public Water System WFI No.	05600
Downstream Hazard Potential	High, Hazard Class 1B
Downstream Flood Path	Whatcom Creek to Bellingham Bay

2. Reservoir Data

Watershed	Lake Whatcom
Drainage Area	55.9 square miles
Other Inflows	39 MGD from Nooksack River (summer)
Spillway Overflow Elevation	308.7 feet
Surface Area at Spillway Overflow	5,000 acres
Natural (Inactive) Lake Storage	700,000 acre-feet
Winter Pool Operating Elevation	311.5 feet
Active Storage at Winter Pool	14,000 acre-feet
Summer Pool Operating Elevation	314.5 feet
Active Storage at Summer Pool	29,000 acre-feet
Dam Crest Elevation	322.7 feet
Active Storage at Dam Crest	70,000 acre-feet (corrected value)

3. Dam

Type	Concrete gravity gate structure with earth embankments at each end
Structural Height	19.0 feet
Hydraulic Height	14.0 feet
Crest Elevation	322.7 feet
Elevation Datum	City of Bellingham datum (Subtract 1.3 ft from plan sheet elevs)
Crest Length	109 feet

Crest Width	7.75 feet (Spillway Bridge) 10.5 feet (earth embankment sections)
Upstream Slope	1 H: 1V (earth embankment sections)
Downstream Slope	1 H: 1V (earth embankment sections)

4. Overflow Spillway

Type	Concrete gate structure, 3 bays with taintor (radial) gates.
Location	Center of dam
Discharge Capacity (gates full open)	1125 cfs at water level 314.0 feet 3980 cfs at water level 318.0 feet 5330 cfs at water level 320.0 feet 7190 cfs at water level 322.7 feet
Spillway Overflow Elevation	308.7 feet
Spillway Control Section	Open width 54 feet, vertical side slopes (3 spillway bays, each 18 feet wide)
Upstream Sill Overflow Elevation	311.0 feet
Upstream Sill Control Section	Base width 66 feet, side slopes 2 H: 1V
Drawdown Capacity (Max drawdown at minimal inflow)	1.6 feet/day at water level 318.0 feet 0.4 feet/day at water level 314.0 feet
Inflow Design Flood – Storm	Step 8, 100% PMP; Long, high volume
Inflow Design Flood – Precipitation	24 hr = 11.40 inches, 72 hr = 19.35 inches; Rain on snow, snowmelt = 5.28 inches.

5. Low Outlet

Type	4 ft x 4 ft square orifice
Location	Left side of overflow spillway
Overflow Elevation	309.4 feet
Discharge Capacity	200 cfs at water level 318.0 feet 120 cfs at water level 314.0 feet
Flow Controls	Sluice gate
Drawdown Capacity (Max drawdown at minimal inflow)	0.5 feet/week at water level 318.0 feet 0.3 feet/week at water level 314.0 feet

2.4.4 Control Dam Operational Guidelines

A. The goal for the operation of the control dam is to maintain a continuous and steady flow down Whatcom creek with little or no large flow swings. The lake level shall be maintained high enough to allow for a continuous flow down Whatcom Creek without having to close all the control dam gates.

   Note: All lake level references in this operational guide are based on using SCADA lake level hourly averages.

B. March is the transition month to bring the lake level from winter mode to summer mode by slowly closing all Tanitior gates to bring the lake level up to 314.5 feet with the following conditions:
   - Open screen house well drain valves to release approximately 40 cfs to maintain water quality in intake pipe.
   - Open sluice gate to release approximately 3 cfs for state fish hatchery.
   - If more than one Taintor gate is open due to spring rains. Then slowly close each gate 6 inches at a time every 8 hours.

C. During the summer period (April to October) , Use **sluice gate** to maintain lake level at summer elevation.
   - Maintain lake level between 314.5 to 314.6. If the lake level rises above 314.6 operate sluice gate to maintain the level in this range.
   - Follow sluice gate operation in winter mode for operational procedures.
   - For storm events follow Taintor gate procedures in winter mode if necessary.

D. Use **sluice gate only** to bring lake level down slowly during October to transition lake down to winter elevation. Unless there are storm events and the larger gates need to be used to get the lake level down.
   - Bring lake level down to 311.5 feet by calculating difference from current lake level and 311.5 feet. Determine cfs release necessary to bring lake level down to 311.5 feet by November 1.
   - Open sluice gate and set opening to cfs flow as determined above using the Derby Pond Gauge.
   - If the lake level should climb during this period then re-adjust the sluice gate opening to bring the lake level within the 311.5 feet. If necessary to use a Taintor gate then follow Taintor gate procedures.

E. Use Sluice Gate to maintain lake level at winter elevation of 311.5 feet. Open or close sluice gate at 6 inch intervals and monitor lake level.
   NOTE: Use this procedure only when all the Taintor gates are closed and the sluice is the only gate open.

F. For increasing lake levels
   - If lake level increases approximately 0.03 feet in a 4 to 8 hour period or less, then open sluice gate 6 inches and monitor lake level again for same amount of time.
   - If the lake level continues to climb by the rate above then open the sluice gate another 6 inches and monitor lake level for same amount of time above.
   - If the lake continues to climb and the sluice gate is opened to 24 inches, then

proceed to Taintor gate opening sequence.

- If at any time the lake level increases by 0.05 feet or more in a 4 to 8 hour period, then proceed to the Taintor gate procedure.

G. For decreasing lake levels

- If lake level drops approximately 0.03 feet in a 4 to 8 hour period or less, then close sluice gate 6 inches and monitor lake level again for same amount of time.
- If lake level remains at the same level then monitor it for another 24 hours. If no change in level then no gate change is necessary at this time as long as the lake level is between 311.5 and 312.0 feet.
- If the lake level is dropping below 311.5 feet then adjust the sluice gate opening amount to 3 inches or less.

H. **Taintor Gate** Use Taintor gate procedures to continue to bring lake level down. Follow the sequence below:

I. For increasing lake levels

- If lake level continues to increase approximately 0.05 feet in a 4 to 8 hour period or less, then open one Taintor gate 3 inches and continue to monitor lake level for change in level for another 4 to 8 hour period.
- If lake level continues to increase, then open the Tanitor gate another 3 inches and continue to monitor lake level for change in level for another 4 to 8 hour period.
- If lake level continues to increase at the 0.05 feet rate then continue to open the Tanitor gate 3 inches at a time until the gate is opened a total of 24 inches.
- If however, at any time the lake level continues to increase at the rate of approximately 0.10 feet in a 4 to 8 hour period or less. Then start opening the second (or third depending on where you are in the sequence) Tanitor gate 3 inches and continue to monitor lake level for change in level using the same criteria above.
- Once the gate is opened 24 inches and the lake level continues to climb. Then follow the above sequence using another Tanitor gate.
- If required, continue the above sequence of operation until all 3 Taintor gates are opened 24 inches.
- If all the Taintor gates are opened to 24 inches and the lake level continues to increase then open each Taintor gate 3 inches at a time and monitor the lake level for another 4 to 8 hour period.
- Continue in this mode until the lake level starts to drop or all the gates are opened to their maximum opening.

J. For decreasing lake levels

- If the lake level remains at the same level or slightly drops in level 0.03 feet or less, then monitor the level for another 24 hours.
- If after 24 hours the lake level continues to drop by the 0.03 to 0.05 feet rate, then close the Taintor gate 3 inches and monitor lake level for same amount of time.
- If 2 or 3 Taintor gates are open then close each gate 3 inches at a time and monitor lake level.
- If lake level continues to drop then continue the closing and monitoring sequence of the Taintor gates until the lake level is between 311.75 and 312.0

feet.

NOTE: The ideal situation would be to keep closing the Taintor gates with the above closing sequence so that by the time the lake level reached 312.0 feet all the Taintor gates would have been closed anyway.

- Once the lake level reaches 311.75 feet then all the Taintor gates should be closed or no more open then 3inches. (each gate if more than 1 Tanitor gate is open)
- If the lake level remains at the same level or slightly drops in level 0.03 feet or less, then monitor the level for another 24 hours.
- If after 24 hours the lake level continues to drop by the 0.03 to 0.05 feet rate, then close all the Taintor gate(s) and monitor lake level for same amount of time.
- If after 24 hours the level is still dropping then proceed to the sluice gate operational procedures.

K. **Dupont Stream Gauge** - If at any time during the winter mode of operation, the Dupont stream gauge reads 900 cfs or higher there may be flooding around the Iowa street and I5 freeway exits.
   - Flood conditions on Iowa street will have to be verified before the control dam gates can be further opened. If after hours this may require a call out for a storm crew person or anyone else that may already be called out to verify this situation.
   - If flooding is an issue on Iowa street then call the Chief Water Plant Operator.

L. When the Middle Fork Nooksack River diversion Dam is in operation during the winter, the following conditions will prevail:

   - All dam gates are to be closed when the lake level falls below 311.35 feet.
   - The diversion dam must be shut down and gates on the dam are to be opened to bring the lake level below 312.0 feet.

2.4.5 Major Storm Events

- During major storm events, the gates will be closed only enough to restrict flow from the lake so that flooding will not occur on Iowa Street.

- During storm events, when the lake is rising rapidly, and the lake elevation goes above **314.5 feet**, notify Water Treatment Plant Chief Operator. If the lake rises above **314.8,** notify Superintendent of plants at once.

- If it becomes apparent that the lake level is rising at a rate that will over-top **314.94** foot level, then notify Superintendent of plants at once. If this person is not available then contact the Assistant Director of Public Works for Operations.

- If the lake level reaches elevation **314.94** feet or above, all dam gates including the sluice gate are to be fully opened.

- If any action is taken that would initiate flooding on Iowa Street, contact **Whatcom County Emergency Services** and the **Bellingham Police Department**.

2.4.6 Log Entries - Computerized Control Dam Operation

- Enter the following information on the Control Dam Operations Log on the electronic Watershed excel spreadsheet.
  1. Today's date, Time and operators initials.
  2. Enter amount that the sluice gate was opened or closed. If the sluice gate was not opened or closed then enter current status under ***tot open***. **Readings should be in inches**.
  3. Enter amount that gate #1 was opened or closed. If not opened or closed then enter current status under ***tot open***. **Readings should be in inches**
  4. Follow the above procedure for gates #2 and #3.
  5. The "Tot. All" gates open column is an auto calculation.
  6. Enter the current lake level.
  7. Enter the Derby Pond flow, in cfs, at time of gate changes.
  8. Enter a comment as to why the gate change was made.

- Before leaving the control dam, double check that all the dam gate settings are correct. The log sheet could be a legal piece of paper should there be property damage during a flood event.

2.4.7 Control Dam Operating Procedures



- The control Dam should not be operated without the consent of the Chief Operator for water treatment or the Superintendent of Plants. The exception to this rule would be if the previous two supervisors were not available.

- The gate to the Control Dam and the panel boxes can be opened using a 4E25 key. Will require a small crescent winch to get the outside bolts loosened.

- The Local gate control panel contains the controls for each gate and switches to open or close each gate.

2.4.8 MANUAL DAM GATE OPERATION _ Local Panel



2.4.8.1 MANUAL OPEN/CLOSE

- Local-Remote Switch must be in LOCAL POSITION
- Turn and hold the Open-Off-Close switch in the OPEN/CLOSE position (the switch is spring-return)
- Release the Open-Off-Close Switch when the desired set point is obtained (or as necessary to control the rate of change).
- The gate opening in inches can be read on the local control panel display.
    - Gate cables are also marked with colored marks that can be read as they come thru the hole in the concrete.
        - Blue marks are every 6 inches.
        - Orange marks are every 12 inches.
- If the switch is not released, the gate will also stop when the gate reaches the close limit.
- The gate control should be place back in REMOTE POSITION when completed and before leaving.

2.4.9 REMOTE DAM GATE OPERATION _ SCADA

2.4.9.1 OPEN

- Local-Remote Switch at the site must be in REMOTE POSITION
- Enter the desired gate open set point in inches on the scada display.
- Click on the selected Gate Control & Status Point, and then select OPEN.
    - The Gate will open up to 3", or, until it reaches the desired set point position if less the 3 inches, or the maximum open limit/stop (whichever occurs first).
    - The Maximum open amount programmed in the PLC is 3 inches increments.
    - The gate open command will time out in 10 seconds.
        - This is a back-up safety setting to ensure the open command does not remain latched in the energized position in the event of a gate position indication or drive/motor failure.
        - If the gate does not open by 3", or, does not reach the desired set point within the timed period, a gate failure will result (in addition to the unlatching of the open command.)
- Example: If the entered gate open set point was 12 inches and the open command was executed. The PLC program will open the gate 3 inches then stop. The operator must again click on the open command again to open the gate another 3 inches. The gate is now open a total of 6 inches. The operator must continue to use the open command until the gate is opened to the desired level.
    - This will allow the operator to control the rate of opening
    - Gate changes will be minimized to minimize the impact on the stream.
    - Significant gate changes will require frequent and significant operator attention.
- Gate operation may be stopped at any time by clicking on the selected gate Control & Status Point and then select STOP

- If the gate position is within 3” or less of the desired set point when the OPEN command is sent, the gate will automatically stop when the gate position matches the set point.

2.4.9.2 CLOSE (Normal)

- Local-Remote Switch must be in Remote
- Enter the desired gate Set point (in inches)
- Click on the selected Gate Control & Status point, and then select Close.
- The gate will automatically close, in 3” increments, every 15 minutes, until the gate position matches the set point or until the gate reaches the lower stop (gate closed) limit.
    - If the gate does not move as expected, a gate operation failure will occur within 20 seconds of the requested operation.
    - Once the close command is sent, no further operator action is required.
- Gate operation may be stopped at any time by clicking on the selected gate Control & Status Point and then select STOP

2.4.9.3 EMERGENCY CLOSE *(Normal)*

- Local-Remote Switch must be in Remote
- Click on the desired gate Control & Status Point, select Emergency Close.
- Gate will close at full speed until the gate reaches the lower stop (gate closed) limit.
- Emergency gate operation may be stopped at any time by clicking on the selected gate Control & Status Point and selecting STOP.

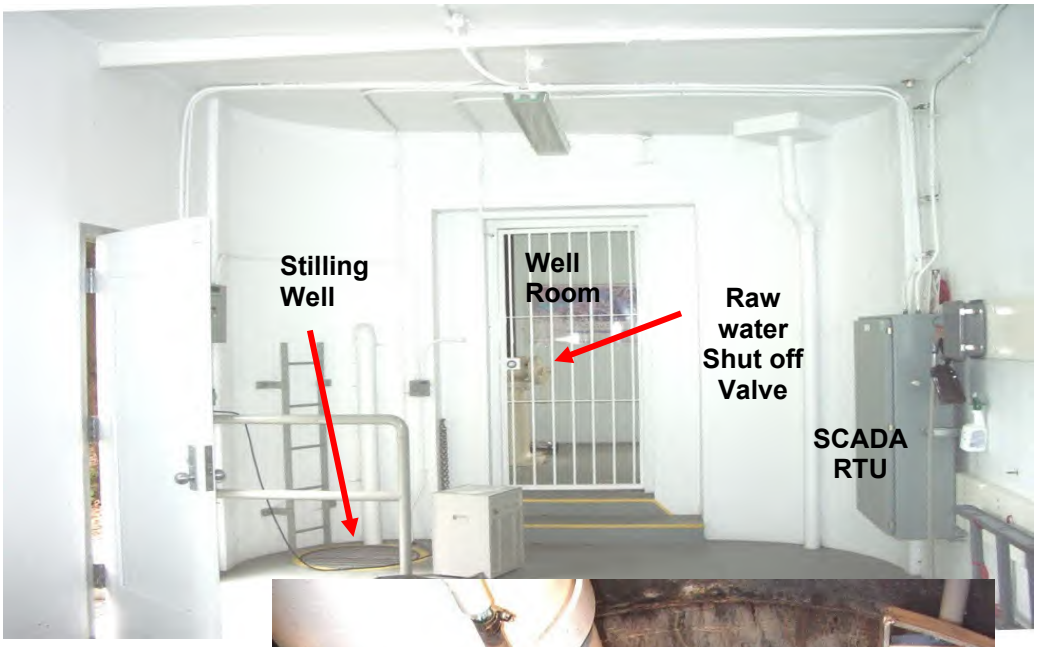
2.5 Raw Water Intake Facility - Gate House



The raw water intake pipeline in Lake Whatcom terminates at gatehouse where it connects to a tunnel. The gatehouse is located at the end of Lakeway Drive. The raw water intake pipe is located in the second basin of the Lake and about 38 feet under water. The intake pipe extends about 1,200 feet offshore. The intake pipe is a 6-foot-diameter wood stave

pipeline. The facility encloses a 6-foot-square gate that is connected to the tunnel which conveys the water to the screenhouse. The tunnel is concrete-lined and is a 6'-3" by 6'-6" horseshoe arch shaped tunnel. The tunnel length from the gatehouse to the screenhouse is 7,560 feet.

The lake level gauging station is located inside the gate house. A lake level sight tube is located in the stilling well where there is a level transmitter and piping from the lake. The lake level, rain gauge data and station entry/intrusion are transmitted to the system operators via the SCADA RTU cabinet.





CHAPTER 3
WATER TREATMENT FACILITIES

3.1 SCREENHOUSE

3.1.1 CONSTRUCTION, PLANNING AND DESIGN REPORTS

At various times in the past, specific facilities within the treatment system have been evaluated in conjunction with contemplated improvements. These evaluations and design reports and projects are summarized in Table 3.1-1.

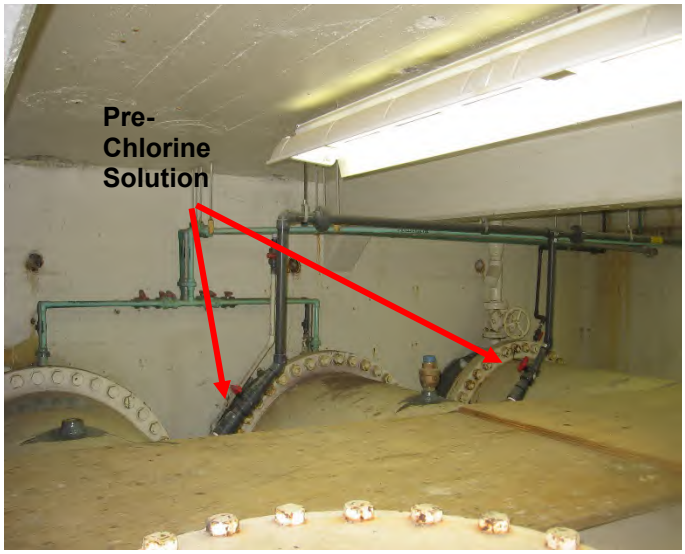
Table 3.1-1
Screenhouse Construction Projects

Construction Project	Project Number	Approximate Date of Completion
Screenhouse	WA-56 to WA-70	1940
Chemical Feed Modifications		1983
Screen 1 Replacement		5/2003

3.1.3 General Description



The screenhouse is located in Whatcom Falls Park. One 6 foot horse shoe shaped tunnel from the Gatehouse runs into the influent well of the screenhouse. The water is then channeled into one of two available screens wells which contain the traveling screens. During normal operation only one screen is on line at any one time. The screen that is not in use is left empty and the screen controls are in the off position. After the water travels thru the screen well, and gets screened, it runs into the effluent well portion of the screenhouse where there are three 48 inch water mains. One 48 inch main goes directly to the industrial pipe line that supplies raw water down to the water front and the other 2, 48 inch mains supply water for the water treatment plant. The PLC at the water treatment plant controls the operation and trouble indication for the screenhouse. The screens operate on a programmed time clock that can be changed on SCADA and is currently set to wash the screens every 24 hours for 30 minutes. While the back wash cycle is in process there are water jet nozzles spraying water out thru the screens to clean them. The material washed off the screens goes into a wash trough which is connected to the screenhouse waste system. The coagulation chemicals that are used at the water treatment plant have been run up to the screenhouse. There are 5 underground vaults about 250 feet apart along the Whatcom falls trial that heads up to the screenhouse. There is an electrical conduit that is also ran in the vaults for the signal wires between the water plant PLC and the PLC that is in the screenhouse. The chemical feed lines for aluminum Sulfate, soda



ash, polymer, and chlorine gas all run thru these vaults and enters the basement of the screenhouse. Refer to Chemical Vaults figure 3.1-2. From there they run down to the pipe gallery where the 48 inch pipes are located to the water treatment plant. The chlorine injector for the pre-chlorine is located in the basement of the screenhouse and the water service for the injector creates the vacuum necessary to suck the chlorine gas from the water treatment plant chlorinator room. The chlorine is injected into both 48 inch raw water mains to the plant. The pre-chlorine gas lines are individually valved to allow for the gas to be shut off for the main that is not in use.

3.1.3.1 Travelling Screens



The raw water from Lake Whatcom passes thru the gate house which is connected to a tunnel and 7,560 feet later ends up at the Screenhouse. The Screenhouse is where all the raw water passes thru and all the larger objects are screened before continuing on to the water treatment plant and the industrial water supply. The Screenhouse has the capability to operate only one or both screens. The Screenhouse valves are arranged so that each traveling screen well can be isolated for maintenance or cleaning. Usually one screen is left off line and drained and all the flow goes thru the single online screen. The controls for the online screen are set to auto and will operate based on the time set in SCADA which ends up in the locate PLC. It is currently set for running every 24 hours for about 30 minutes. It takes about 20 minutes for the screens to travel one revolution from the start position to finish and having the run time set to 30 minutes will run the screen longer so it does not stop in the same place as it started.

3.1.3.2 Screen 1 (North) off line procedure

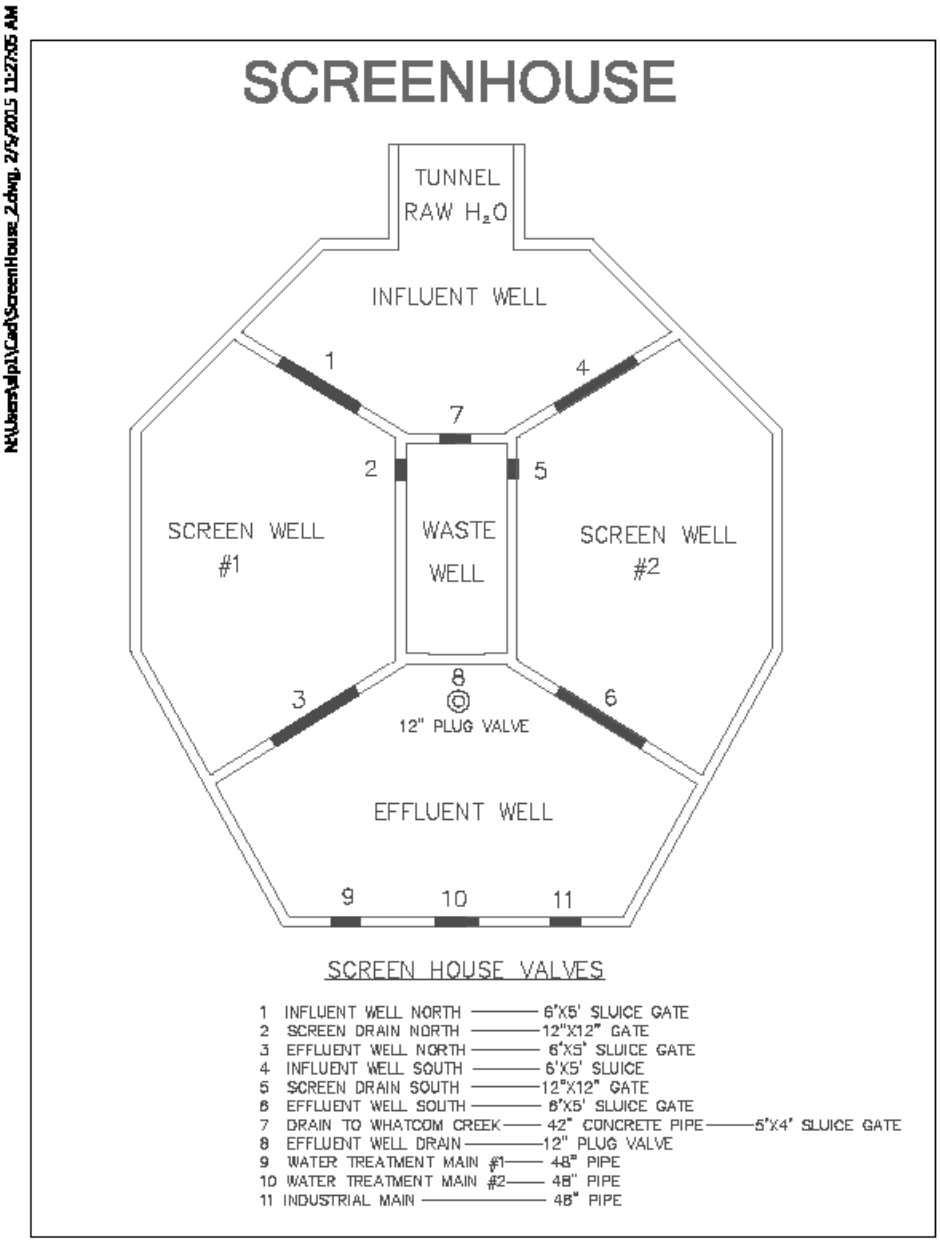
1) To isolate #1 screen from service, shut off power to the screen drive down on the control panel on the main floor . Then close the following gates (refer to the figure 3.1 for gate locations):
    a. When using the drill motor. Care should be taken when the gate is getting close to being fully open or closed positions. Do not want to force the gate pedestal out of the concrete.
    b. Close gate SH#1 and SH#3
    c. Open gate SH#2 - this is the screen well drain gate.

3.1.3.3 Screen 1 (North) on line procedure

1) To place screen #1 on-line you first must slowly refill the screen well with raw water. Usually do this step the day before you place the screen on line to give it time to refill with water.
   a. Close gate SH#2
   b. Open SH#1 just enough to fill up the well slowly. If already full of water then you can open up the gate all the way.
   c. Open SH#3 all the way open.
   d. Test the operation of the screen by placing it in manual position and verify that it works properly. If it operates normally then place the screen control HOA into auto position on the control panel on the main floor.

3.1.3.4 Screen 2 (South) off line procedure

1) To isolate #2 screen (south) from service, shut off power to the screen drive down on the control panel on the main floor. Then close the following gates (refer to the figure 3.1 for gate locations):
   a. Close gate SH#4 and SH#6.
   b. Open gate SH#5 - this is the screen well drain gate.



Screen House Screen Room
Figure 3.1

Chemical Vaults
Figure 3.2

Drawing is located at M:/data/plants/water plant/o&m1/drawings/fig.3.1-1.pdf

3.1.3.5 Screen 2 (South) on line procedure

1) To place screen #2 on-line you first must slowly refill the screen well with raw water. Usually do this step the day before you place the screen on line to give it time to refill with water.
    a. Close gate SH#5
    b. Open SH#4 just enough to fill up the well slowly. If already full of water then you can open up the gate all the way.
    c. Open gate SH#6 all the way open.
    d. Test the operation of the screen by placing it in manual position and verify that it works properly. If it operates normally then place the screen control HOA into auto position on the control panel on the main floor.

3.1.3.6 Influent Well Draining Procedure

1) To drain the influent well of the screenhouse requires the raw water to be shut off at the gate house and the whole tunnel to be dewatered. In doing so also requires the water filtration plant to be also shut off and you must notify the industrial users that they will be out of water. Close and open the following gates:
    a. Close gates SH#1 and SH#4.
    b. Open gate SH#7 - this is the influent well and tunnel drain gate.

3.1.3.7 Effluent Well Draining Procedure

1) To drain the effluent well of the screenhouse requires the water filtration plant to be also shut off and you must notify the industrial users that they will be out of water. Close and open the following gates:
    a. Close gates SH#3, SH#6, SH#9, SH#10 and SH#11.,
    b. Open gate SH#8 - this is the effluent well drain gate.
        i. This part of the Screenhouse can only be drained if the three 48-inch mains are closed from the Screenhouse.
2) All the drains in the Screenhouse drain into Whatcom Creek.
3) To shut off the flow to the 48-inch industrial line from the Screenhouse, close the following gate:
    a. Close gate SH#11.
4) To shut off the flow to both 48-inch water mains to the Water Treatment Plant from the Screenhouse, close the following gates:
    a. Close valve SH#9 and SH#10.

3.1.3.8 Taking Screen House offline and Draining Sequence

1) Notify the industrial users that the raw water system will be shut down. **NOTE**: This notification should be done several months in advance of shut down.
2) **Two days prior to Screen House shut down date**, Start filling, and keep all distribution system reservoirs full. CT reservoir should be at 21 + feet on shut down day.
3) **Screen House Shut Down Day**
   a) Adjust WTP production to 5.76 mgd or 4,000 gpm to drain SH & Tunnel.
   b) Close Tunnel Inlet Gate at Gate House all the way, Follow lock out /Tag out procedures to secure the gate.
   c) Open tunnel access lid in Gate House gate to allow air into tunnel for draining.
   d) Open up all access hatches on the operating floor of the screen house to allow air movement. Ensure that there are safety cones to mark the hazard.
   e) **Approximately 15 minutes** after closing the tunnel inlet gate the water level in the screen house inlet well should be about 10 feet down.
   f) If not already open, open both screen house screen drain gates all the way.
   g) **Approximately 60 minutes** after closing the tunnel inlet gate the water level in the screen house inlet well should be at the top of tunnel.
   h) Shut off pre-chlorine gas to screen house and lock out gas line at the WTP.
   i) Open off line raw water valve to the plant.
   j) Lock out/Tag out both Screen House traveling screens.
   k) At this point, there should be 2 operators at the water plant to monitor the water level coming into the plant.
   l) **Approximately 120 minutes** after closing the tunnel inlet gate the water level in the screen house inlet well should be at the top of the concrete edge into the screen well. Screen House should be empty.
   m) Shut down Water Plant as per SOP procedures when the flume level in the WTP is down to around 3 feet.
   n) Open screen House tunnel drain gate and finishing draining remaining water in screen house and tunnel. Approximately 12 inches of water at this point.
   o) The screen House & Tunnel should be empty at this point with the WTP off line.

3.1.3.9 Placing Screen House on-line After Draining

1) Placing the Screen House back in Operation after Draining. Procedure as follows.
    a. Ensure that all personnel are out of the screen house and tunnel.
    b. During the refilling of the tunnel and screen house have both screen well gates open with both screen well drain gates fully open.
    c. Remove lockout locks on traveling screens and leave control in off position.
    d. Close blow off valve on **Industrial pipeline** at the Bay Street Bridge location if it was open previously.
    e. Open Gate House tunnel inlet gate 14 inches to start filling tunnel and observe water coming into screen house.
    f. Ensure that all access hatches in screen house operating floor are fully open to allow air movement when filling the tunnel.
    g. **Approximately 60 minutes** after opening the tunnel inlet gate at the gate house. The water should start flowing into the inlet well at the screen house.
    h. Leave screen well drain gates open fully to help remove some of the turbidity that will be coming into the screen house. Once the turbidity level drops down then the drain gates can be set to normal operating position.
    i. The water level in the screen house inlet well will appear to climb rather slowly until the water level in the inlet well gets to the top of the tunnel. At this point the water level will climb rather quickly.
    j. Once water level in screen house is close to normal operating levels. The tunnel inlet gate at the gate house can be opened all the way open.
    k. Remove one screen well from service and close one of the raw water pipes to the WTP. Place control for the on-line screen back to auto.
    l. Open pre-chlorine gas line valve for the raw water pipe to the water treatment plant that will be on line.
2) Once the Screen House has been filled up with raw water the Water Treatment plant can be started up as per SOP procedures. NOTE: After the water plant is started back up there we be a turbidity increase due to the tunnel being emptied about one hour after the raw water system is filled back up.
3) System back in full operation at this point.

3.1.4.0 Manual Screen Operation

1) The on/off switch located by each screen should be in the "On" position in order for the screens to work in the auto or manual.

a. Place the HOA switch, located on the main control panel downstairs from the screens, to the HAND position. Note: Each time the screens are run, manually or in auto position. The screen backwash water is running.

3.1.4.1 Power Failure

1) There is no emergency generator to power the Screenhouse during a power failure.
2) A power fail at the Screenhouse will be indicated on SCADA.
3) Puget Power should be called to determine the length of time power will be out at the Screenhouse.
4) The screens can go without washing for several days.

3.1.4.2 Screen Failures

1) Any time the screens are called to run and the local PLC does not get a feedback from the sensor installed on the socket for the screens. A screen failure will be generated on SCADA.
2) A screen failure could be caused by one of the following:
    a. Tripped circuit breaker for the screen on the main control panel.
    b. Broken shear pin on the screen.
        i. A broken shear pin can be recognized by the chain driven sprocket turning without the shaft to the screens moving.
3) For any screen failure, fill out a defective report and notify maintenance the next working day.

3.1.4.3 Entry/Intrusion Condition

1) To enter the Screenhouse, you must enter through the front door, otherwise an intrusion alarm will be activated and sent to SCADA.
    a. The front door is the one with the glass in the door.
2) The front door at the Screenhouse requires a type AB1 Key.
3) Once you enter the front door, you have two minutes to push the security system disable button behind the main control panel.
4) Once the disable button is pushed, an amber light will start to flash indicating the security system is disabled.
5) When you leave the Screenhouse, push the disable button again to enable the security system. You then have two minutes in which to leave.
    a. The amber light will continue to flash at a faster rate even though you pushed the enable/disable button to leave.
6) To reset an intrusion alarm, enter the Screenhouse and push the disable button. The amber light will start to flash.
    a. To leave, push the disable button again to enable the security system, then leave through the front door.

b. The Bellingham Police Department should be notified of any intrusion alarm received from the Screenhouse after normal working hours.



c. The maintenance callout procedures should be followed after an intrusion condition.

3.1.5.0 Static Mixers

The Kenics 48 KMA stainless steel style mixer are element assemblies that were supplied to be assembled in the field. The mixers are manufactured with precise tolerances on each element diameter and are designed to slip fit into the existing 48 inch concrete lined pipe to meet ASTM specifications. The right hand and left hand individual elements are joined radially together at 90 degrees to form the horizontal mixer. See drawing below. The static mixers were designed for a side stream introduction of the coagulation chemicals from the water treatment plant. The treatment chemicals of aluminum sulfate, polymer, soda ash, and chlorine can be routed to the screen house if more time is required for the coagulation process. See picture on page 48 for the chemical feed line injection points.

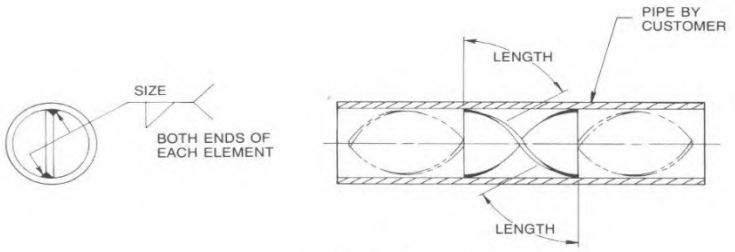


FIGURE 2
WELDING OF INDIVIDUAL ELEMENTS (14" DIA. & LARGER)
ALTERNATE RIGHT AND LEFT HAND ELEMENTS WITH
ENDS RADIALLY DISPLACED AT 90° AS SHOWN.

PIPE SIZE	RETENTION WELD		MAX. NUMBER OF ELEMENTS PER SINGLE SECTION OF PIPE	RETENTION WELD NUMBER & LOCATION
	SIZE	LENGTH		
½	1/16	3/16	24	TWO WELDS (4 TOTAL) ON BOTH ENDS OF ELEMENT ASSEMBLY AS SHOWN IN FIGURE 1
¾	⅛	¼		
1	⅛	5/16		
1 ½	⅛	¾	18	
2	3/16	1		
2 ½	3/16	1 ½		
3	3/16	2	12	
4	3/16	3		
6	3/16	4	6	
8	¼	5		
10	¼	6		
12	¼	7		
14	3/16	5	3	TWO WELDS (4 TOTAL) ON BOTH ENDS OF EACH ELEMENT AS SHOWN IN FIGURE 2
16	3/16	6		
18	3/16	6		
20	3/16	7		
24	3/16	8	LIMITED ONLY BY LOCAL SAFETY REQUIREMENTS	
30	¼	10		
36	¼	12		
42	¼	14		

WELDING DATA SHEET — STYLE KMA

Figure 3.1-2:
Details Screenhouse Screening Wells (11 x 17)

Drawing is located at M:/data/plants/water plant/o&m1/drawings

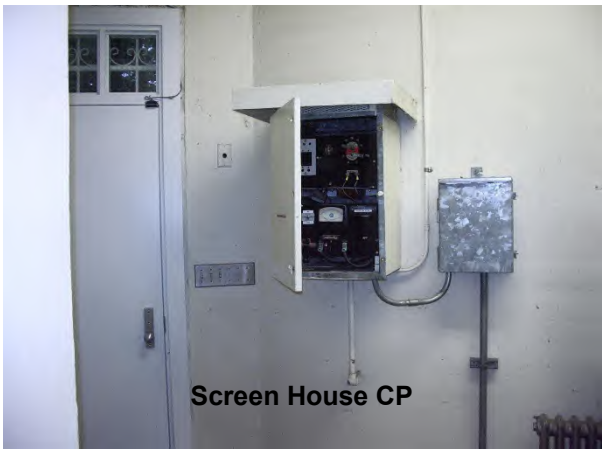
3.2 WATER TREATMENT PLANT SUPPLY PIPELINE (future section)

3.3 INDUSTRIAL SUPPLY PIPELINE

3.3.1 General Description

The third 48 inch water main leaving the screenhouse was originally a 48 inch wood stave pipe that was installed in the late 1940's. The wood stave pipe was replaced in 1980 with concrete cylinder pipe. The pipeline carried the industrial water by gravity directly to the Georgia Pacific Corporation located on the Bellingham Bay waterfront. Water for industrial use did not require the same high quality drinking water that was supplied to the city and therefore the water was only screened and chlorinated at the screenhouse. The concrete cylinder pipeline is approximately 1.73 miles long and travels from the screenhouse westerly across town, under the I-5 freeway and under both Burlington Northern and Milwaukee railroad tracks before terminating on the waterfront at Bay street. During its operational years, the pipeline carried up to 55 million gallons of water to Georgia Pacific each day (see table below). Then in 1996 Georgia Pacific started using less water due to water conservation and Mill operations and over the years dropped their daily use to around 30 million gallons per day. In 2000 Georgia Pacific shut down the tissue operations at the plant and their water consumption dropped to around 10 million gallons per day. By 2007 the water requirements had been reduced to 0.6 to 3.88 mgd. And eventually, the Georgia Pacific Corporation shut down completely early in 2008. The only water that is now going down the pipeline is water being used by Puget Sound Energy Co-generation facility when they need to generate electricity to meet peak electrical demand periods.

Industrial Pipeline	Year	Industrial Flows mg/d	Elevation
	1969	55	
Screenhouse	1980		292.25 feet
Georgia Pacific Mill			8.4 feet
	1986	41	
	1996	37	
	2000	30	
	2001	9	
	2006	4	


Screen House CP

system protects the 3 large 48 inch pipelines at the Screenhouse that go to the Water Treatment Plant and the industrial pipe as well.


Fraser Street CP

The third CP is alongside of Fraser Street, and the fourth CP is on Railroad Street.

The anodes for the Screenhouse CP system are either installed in a horizontal ground bed or in a deep well as this was not clear on the drawings. The other CP systems utilize seven deep well anodes that consist of a platinum-clad niobium mesh. The anodes are installed in approximately a 350 foot deep, 8 inch diameter coke breeze column. This system was designed by Intermountain Corrosion Service, Inc. and installed by Norton Corrosion Limited in 1989.

3.3.2 Industrial Pipe Line Catholic Protection System

There are four Catholic protection (CP) systems in place to protect the pipe. The first is located at the screenhouse and is estimated to have been installed around 1968. This CP


Woburn Street CP

The second CP system is installed at the foot of the pipe corridor down from the Water Treatment plant on Woburn Street.


Railroad Street CP

3.3.3 Industrial Pipe Line Equipment Stations

On pages 62,63 and 64 is a list of locations for test stations, air release valves, blow off valves, access manholes and pipeline valves starting from the Screen House all the way to where the pipeline connects to the Georgia Pacific Mill on Bay Street.

INDUSTRIAL PIPELINE
Air Release/Test Station/Access Manhole Locations
Page 1

Sta #	Distance	Description	Comments
1	49+73	**ScreenHouse** Connection	Pipe buried 7 feet down at SH
2	45+00	Air Release Valve	
3	45+72 - 44+72	Polyethylene Top Half of Pipe	Gas line and power cable
4	42+28	Blow Off Assembly	Road to WTP
	41+00 - 37+20	Polyethylene Top Half of Pipe	Gas line and power cable
5	39+90	2 wire Test Station	Rd. to plant Left side of road
6	38+70	Air Release Valve	
7	34+94	Water Main Location	66 inch water pipe to PLT
	32+80 - 33+80	Polyethylene Encasement of Pipe	Under oil line, meter vault, and phone line
8	29+45.5	Access Man Hole	
9	21+41	2 wire Test Station	By Trans-mountain pipe crossing
10	16+95	Blow Off Assembly	
11	15+34.5	Air Release Valve	
12	14+23	Blow Off Assembly	
13	13+44	Air/Vacuum Assembly	
14	9+26	1 wire test station	Bethlehem Israel Cemetery
15	8+23.7	Air Release Valve	Starting downhill side
16	1+87	Blow Off Assembly	
17	1+85	**30 inch Butterfly Valve**	50 ft. west side from Woburn St.
			45 deg. Bend in Pipe heading south down Woburn St. towards Fraser St.
18	115+17	Access Manhole	Distance from 30 butterfly Valve Woburn Connection
19	109+34	2 wire test station	Corner of Woburn and
20	109+17	Air Release valve	Fraser Street
	102+70	Cemetery Creek	Crossing
21	95+16	2 wire test station	On Fraser St. 350 ft. from corner west Undine St.
22	90+45	Access Manhole	On Fraser St. by N. Puget creek

23	88+50	2 wire test station	2x4 marker 3ft up with painted white letters, test station

INDUSTRIAL PIPELINE
Air Release/Test Station/Access Manhole Locations
Page 2

24	77+01	Blow off assembly	On Fraser St. approx. 900ft north from hill on Fraser St.
25	71+85	2 wire test station	Approx.. 50 Ft from Moore St.
	66_63	I-5 Freeway	Crossing, Pipeline encased in 66 inch pipe filled with sand
	64+85	I-5 Freeway	Crossing
26	64+84	2 wire test station	West Side of freeway on Fraser and King St.
27	64+50	Access Manhole	N. side of freeway crossing on King St.
28	59+00	Air/Vacuum release valve	75 ft. east of Iron St.
29	58+30	2 wire test station	Corner of Fraser and Iron St.
	58+10 - 57+10	Pipe Polyethylene Encased	10 inch gas main
30	51+80	2 wire test station	Fraser and Grant streets
31	51+38	Blow Off assembly	Fraser and Grant streets
32	51+01	**30 inch butterfly valve**	Fraser and Grant streets
33	47+12	2 wire test station	At intersection of Grant & York St.
34	47+00	Access Manhole	Grant & York St.
35	46+75	Air/Vacuum Release valve	Grant & York St.
	38+86 - 37+86	Pipe Polyethylene Encased	10 inch gas main
36	38+80	2 wire test station	York St. at intersection of Forrest and Ellis St.
	37+18 - 36+16	State St. Crossing	Pipe Encased
37	35+70	2 wire test station	Just after crossing state St.
			On York before Burlington R.R.
38	35+70	Blow Off Assembly	
39	35+70	Access Manhole	
	35+31 - 34+71	Burlington Northern R.R	Crossing, Pipe Encased
40	29+87	Access Manhole	On Railroad 125 ft. east of Champion St.

41	28+00	2 wire test station	Intersection of railroad & Champion
42	22+00	2 wire test station	125ft. west of Magnolia St. and railroad
43	18+47	Air Release Valve	On Railroad just before Holly St. intersection
44	12+08	2 wire test station	On Chestnut about 150 ft. from Railroad.

INDUSTRIAL PIPELINE
Air Release/Test Station/Access Manhole Locations
Page 3

45	3+93	Blow Off Assembly	Corner of Bay St.
46	3+55	Flow Meter	"
47	3+25	Access Manhole	Corner of Bay St.
48	3+10	Air Release Valve	"
49	2+56	Blow Off Assembly	Just before connection at GP. site
50		1 wire test station	End of Casing
51		Connection to G.P. site	Just Pass MILWAUKEE R.R. Crossing

3.3.3 Industrial Chlorine Feed System

The industrial chlorinator has a capacity of 500 lb/day. The chlorinator feed rate can be set manually at the chlorinator or by the operators using SCADA (WonderWare). The chlorinator injection location can be changed from applying chlorine to the industrial pipe line or it can be changed to feeding chlorine into the water plant clearwell. The industrial chlorinator is capable of automatic control from SCADA or manual control at the chlorinator. The chlorine is added to the industrial pipeline in the vault located in the driveway north of the treatment plant garage. Chlorinator #5 located in the Water Treatment plant chlorinator room was usually set up for feeding chlorine to the 48 inch industrial pipe line. The supply water to run the chlorine injector came from the water pressure from the plant. A chlorine residual of approximately 0.50 mg/L was maintained as the flow enters Georgia Pacific, which is about three (3) miles west of the plant. The chlorine feed was turned off when Georgia Pacific shut down in 2008.

3.3.4 Chlorinator Room Operation

Under normal conditions of operation the following valve positions are observed in the chlorinator room.

1. Chlorinator #5 (industrial)

    A. clg/c-5 is open
    B. clg/H-14 is open
    C. clg/H-13 is closed
    D. clg/H-15 is open

2. Startup of chlorinator

    A. Industrial chlorinator: Chlorine gas is fed from the one ton containers to the industrial chlorinator through the automatic switchover module. All the valves should be in the “normal operations” position. Before feeding gas into the industrial chlorinator, the water supply to the injector must be turned on. The chlorine injector for the industrial chlorinator is in the vault located in the driveway in front of the plant garage directly above the 48” industrial water line. The valve for the water supply is located in the industrial injector vault. The main water supply can be turned on in the garage. Once the water supply is on and there is a vacuum indication on the chlorinator. Then the gas valve #clg/C-5 may be turned on, thus allowing chlorine gas to enter the chlorinator.

    B. The industrial chlorinator can be operated either manually or automatically. In manual, the chlorinator is placed in the manual mode and flow adjustments are made at the controller located on the front of the chlorinator. In the auto mode, adjustments to the flow of chlorine can either be made at the chlorinator or at the SCADA console. If there is a power fail, then to keep gas flowing you must use the by-pass mode - by simply opening the black knob in front of the chlorinator to the desired pounds per day setting.

    C. If the industrial chlorinator failed or needed to be taken o/s for maintenance, then chlorinator #4 can be used. Refer to water treatment plant chlorine section for procedures on switching chlorinators.

3. Chlorinator Manual Operation

A.

D. figure 3.3-1: Industrial pipeline location (11 x 17) photographs

3.2 WATER TREATMENT PLANT

3.2.1 General Description

Treatment of Bellingham's water supply begins at the Screenhouse. The raw water is screened and pretreatment chemicals can be added. The water then flows through two 48-inch pipelines for about 200 feet where the pipes are connected to a single 66-inch pipeline to the treatment plant. The treatment plant is an in-line filter plant consisting of rapid mix chambers, gravity filters, and a clearwell. The treatment plant includes chemical feed, filter backwash, and disinfection facilities. A general treatment process schematic is shown in Figure 3.2-1. A hydraulic profile through the treatment facilities, based on future plant capacity of 48 mgd, is shown in Figure 3.2-2. A similar profile, based on current treatment capacity of 24 mgd, is shown in Figure 3.2-3.

The capacity of the plant is determined by two operational parameters. The first is the treatment capacity of 24 mgd with 5 filters online and one filter off line for a spare. The treatment capacity of 24 mgd is based on a filter rate of 6 gpm per square foot as define under the Department of Health WAC. Each filter consists of two 14-foot by 20-foot filter bays each. The total area of each filter bay is therefore 280 square feet. There are six filters for a total of 12 filter bays. The second operational parameter is plant production can exceed 24 mgd if the 6^{th} filter is placed on line or filter rate exceeds the Department of Health value of 6 gpm per square foot.

The water treatment plant was constructed in 1968 and 1969 at a cost of about $1.5 million. The project was financed by the sale of water revenue bonds and a $1.3 million grant from the Department of Housing and Urban Development.

Figure 3.2-1
Water Treatment Plant
General Process Schematic

Drawing is located at M:/data/plants/water plant/o&m1/drawings

Figure 3.2-2
Water Treatment Plant
2015 Hydraulic Profile

Drawing is located at M:/data/plants/water plant/o&m1/drawings

Figure 3.2-3
Water Treatment Plant
Current Hydraulic Profile

Drawing is located at M:/data/plants/water plant/o&m1/drawings

3.3 PLANNING AND DESIGN REPORTS

At various times in the past, specific facilities within the treatment system have been evaluated in conjunction with contemplated improvements. These evaluations and design reports are summarized as follows:

1965	Water Systems Study, Stevens, Thompson & Runyan
1976	Filter Backwash Water Treatment Study, Stevens, Thompson & Runyan
1978	Water Supply Analysis, STRAAM Engineers
1978	Backwash Water Disposal System, STRAAM Engineers
1979	Water Supply Analysis, STRAAM Engineers
1979	Evaluation of Water Treatment Plant and Pilot Plant Studies for facilities improvement, Kennedy Engineers
1982	Comprehensive Water Plan, Pool Engineering Dakin-Yew/Alabama Hill Water System Analysis, Pool Engineering
1982	Dakin-Yew/Alabama Hill Water System Analysis, Pool Engineering
1983	Preliminary Design Analysis, Water Treatment Plant Improvements, Pool Engineering
1986	Evaluation of Lake Whatcom as a Continued Source of Water Supply,J.M. Montgomery
1993	Comprehensive Water Plan, Rapid mix characteristics for Bellingham water treatment pilot plant, David Hendricks/Barrett Consulting Group
1994	Lead and Copper Rule, Corrosion Control optimization Study, Economic and Engineering Services Inc.
1995	COB, Water Treatment Plant Tracer Study, Contact Time CT Reservoir
1998	Operational Issues and procedure Project, Carollo Engineers
1998	Water Treatment Plant Phase 1, Pilot Plant Testing, EarthTech Inc.
2006	Water Treatment Plant Filter Underdrain Upgrade EW-112
2009	Additional Clearwell Baffles added to improve chlorine mixing within the tank, Carollo Engineers
2010	Add Filter Air Scour System to reduce backwash water usage, Carollo Engineers
2011	Dissolved Air Flotation Pilot Study EW - 180 CH2M Hill

3.4 PLANT CONSTRUCTION PROJECTS

Many water treatment facility projects and new equipment have been completed or installled over the past several years. These projects and equipment and there estimated date of completion are summarized in Table 3.3-1.

Table 3.4-1

Water Treatment Construction Projects

Construction Project	Project Number	Approximate Date of Completion
Water Treatment Plant		1969
Backwash Water Disposal System		1978
Filter Media Replacement		1982
Chemical Feed Modifications		1983
Clearwell Baffle		1983
WTP Modifications - Filter Troughs, Generator Room, and Chlorine Handling Facility	WA-345	1985
WTP Improvements Ph. II - Filter Control and Standby Generator	WA-356	1986
WTP Improvements Ph. III - Laboratory Renovation	WA-356	1986
Pilot Filter System		1993
Derby Dam Improvements		1994
Waste Site Closure/Reservoir Drain Air Gap addition		1994
New Dakin-Yew Pump Station, Reservoir Pipelines, and Chemical Feed	WA-454B	1995
Whatcom Falls Reservoir No. 2	WA-454	1995
METONE, Particle Counters added to all filters		1996
Dakin/Yew P.S. 5th Pump Addition		1996
Raw/Treated Water Pipe Separation Project		2001

New SCADA System		2002
CHEMTRAC, Streaming Current Meter Added to coagulation process		2004
Variable speed Alum Pump #3 added		2005
Replaced Filter rate controllers with PLC programming		2005
Installed 5HP flash mixer in Rapid mix #1 tank		2006
Replaced all Filter Underdrains with AWI Stainless Steel Units	EW-112	2007
Replaced all filter turbidity meters with Hach 1720 E units		2008
Replaced single UPS with Dual UPS's, divided loads of critical processes.		2008
Replaced Weight Belt Feeders on Soda Ash System		2008
Replaced Soda Ash Dust Collector system		2008
Added 3rd Variable speed backwash pump		2009
Added additional Clearwell Baffles-To improve mixing with Chlorine		2009
New Plant Electrical Service Equipment –including Automatic Transfer Switch		2009
Filter Air Scour piping System	EW - 171	2010
MCC #1 Upgrade		2010



3.5 WATER TREATMENT PLANT

3.5.1 General Description

Surface water is delivered by gravity to the Bellingham water treatment plant from a submerged intake in Lake Whatcom. Raw water is conveyed from the intake structure to the gate house and then to the screenhouse. After screening, water enters a 66-inch diameter line which terminates at the water treatment plant.



The 66-diameter pipeline bifurcates into two 48 - inch diameter lines, one going to rapid basin #1 and the other going to rapid mix basin #2. Water from the two rapid mix basins flow into a common filter flume channel. Water flows through the plant by gravity to the filters and then to the clearwell. Chlorine is added at the screenhouse followed by alum and a cationic polymer at the water plant. Aluminum Sulfate can be applied to the 66-inch diameter pipe line as it

comes into the plant or at the inlet to each rapid mix basins. Cationic polymer is added downstream of the rapid mix basins in the filter flume channel or it can be added as well to the plant influent. Staff also has the ability to add all the coagulant chemicals at the screenhouse. The Water Treatment plant, constructed in 1968, has a total capacity of 29 millions gallons per day (mgd) while meeting the Department of Health (DOH) filtration requirement of 6 gallons per square foot per of filter media. The plant has six granular media filters with dimensions and operating conditions as shown in table 3.7-1. Each filter has two cells which are controlled by one rate of flow effluent control valve. Each cell is backwashed separately using a pumped backwash system. The filter media consist of 32 inches of anthracite, 11 inches of sand all on top of the AWI underdrain. Each filter cell has three wash water troughs and two rotary arm surface wash sweeps. The filter piping includes a filter-to-waste system which can be used when a clean filter is placed in service. Currently, the practice of sub fluidization during a filter backwash is being used to keep the filter startup turbidity profile from going above 0.10 ntu during filter startups.

Photographs (oblique aerial, ground, and interior)
Figure 3.7-1: Main floor plan (11 x 17)
Figure 3.7-2: Filter Floor Plan (11 x 17)
Figure 3.7-3: Treatment Plant Section (11 x 17)

Water Treatment Plant
Operator's Daily Duties

GENERAL INFORMATION

1. Each day the operator should remove an "Operations Data Sheet" from the desk drawer. Enter operator's name and the date.

DATA COLLECTION

1. After your name and date have been filled out on the Operations Data Sheet. Fill in the line containing the filtering rate, (gals/sq.ft.), number of filters on-line, arrival time and when you have completed the readings the time that they were completed.
   1.1. **Arrival Time**: The arrival time is the time you arrived at the plant and started doing the readings. For example: If you arrived at the plant at 0730 and were reading emails and reviewing scada trends and did not start readings until 0800 then record 0800 as the arrival time.
   1.2. **Readings**: Plant readings are defined as everything involved with filling out the Operations Data Sheet which includes going around the plant to collect the required data, doing the calculations, SCADA comparsion readings, and the lab process control checks. They also include the daily WTP monthly log entries and the data for the partnership. Things that would not be included in the readings time would be such things as backwashing filters, answering long phone calls, chemical deliveries etc
   1.3. **Readings Completed** : When you have completed all the readings then enter the time they were completed. .(Minimum 1 to 2 Maximum hours)

SCADA COMPARISON READINGS

1. Filter Turbidity & Headloss - This section of the sheet is for comparing the plant instruments with SCADA (Supervisory,Control and Data Acquisition). Write down the headloss and turbidity values on the the meters and the values from SCADA.
   1.1. Try to get them at the same time period.

WATER QUALITY TESTING

1. pH - The pH section compares the on-line pH meters, SCADA, and the actual testing of pH with grab samples. The pH locations that should be tested are the treated water, CT out, and the raw water. All the pH meters are located in the polymer room.
   1.1. The grab samples should be grab at the same time that the meter and scada readings are written down.
   1.2. Refer to “Process Control Samples” section for the plant control standards.

2. Chlorine residuals - The chlorine section compares the chlorine analyzers, SCADA, and the actual testing of grab samples. The chlorine residuals locations that should be tested are the treated water (trim), CT out, CT res. or clearwell, and the pre chlorine (Screenhouse). The chlorine analyzers are located in the chlorinator room. Refer to daily readings sample point sheet for exact locations
   2.1. The grab samples should be grab at the same time that the meter and scada readings are written down.
   2.2. Refer to “Process Control Samples” section for the plant control standards.

3. Water temperature - Record the CTOUT water temperature.

CHEMICALS

1. Alum Tank Level: Record the number of gallons on hand by reading the level transmitter amount.
   1.1. If there was a delivery that day record the amount delivered and this amount for a total on hand.
   1.2. Record the mls per minute feed rate of the on-line alum pump.

2. Soda Ash Silo Levels: The silo level indications are located in the silo room
   2.1. Record the silo level from the level transmitters in the silo room. Use the level to pounds conversion sheet to determine the amount in each silo.
   2.2. Add the soda ash pounds in each silo to determine the total amount of soda ash on hand. If there was a delivery then add this amount as well.

3. Chlorine On Hand: Record the scale weight for each chlorine bank as well as the amount of cylinders that are in the storage area.

4. Chlorinator Feed rates: Record the pounds per day feed rates for each on-line chlorinator.
   4.1. Total the feed rates for clearwell, screeenhouse, and the trim to get a total pounds per day usage.
   4.2. The correct feed rate is read from the middle of the rotometer ball.

5. Manifold Vacuum - Record the vacuum reading on the chlorine manifold gauge. This reading should be around **-3**. This is an indication of the status of the chlorine system manifold pressure. Any number higher may be an indication that the chlorine tanks are starting to go empty. The chlorine transfer valve will switch to the other bank when the vacuum gets to around **– 10**.

6. Chlorinator Vacuums : The record the injector vacuum on each chlorinator. Reading these values each day gives the operator a history of previous vacuum which will be useful to determine if there is problem developing. The operator could look back a few days to determine if the the reading is a normal value.

7. Carbon Dioxide: Record the rotometer settings of the Carbon Dioxide going to the chlorine analyzers. Carbon Dioxide is used for lowering the pH of the sample being supplied to the analyzers to reduce instrument reading fluctuations.
   7.1. The CO2 flow for each analyzre should be as follows:
      7.1.1. Clearwell residual analyzer should be **10**
      7.1.2. CT out analyzer should be **10**
      7.1.3. Trim analyzer should be set for **15**.

Daily Total Plant Flows

1. The treatment plant flows are located in the SCADA HISTORY SYSTEM. Record the total flow values from the SUM column in the history file for filtered water, CT Effluent , and GP flow totals. The readings should be taken at the same time each day.

Filter water flow total - This flow total is used for calculating the Chlorine, Alum, and Poly Parts Per Million (PPM) dose rate.

CT Effluent flow total - This flow total is used for calculating the Soda Ash PPM

The operator can then enter the amount of chemicals used for the day, and the computer will calculate the ppm.

DATA CALCULATION

Chemical dose rate

1. During the plant rounds the operator records the current meter readings from the soda ash feeders, and make-up water used, alum tank level, polymer drum level and make-up water used, and the scale weight for both chlorine banks. These are the plants current readings and are written down on the days operations/reading sheet under “**Today**”.

2. When the "**Yesterdays**" readings are subtracted from "**Todays**" readings the results can be then used to calculate the daily dose rate for the plant. Using the total gallons used for alum and poly and the total plant flow the operator can calculate a dose rate for the plant. To determine gallons used per day the operator checks calibration of the metering pumps for proper output. This output is then used with the totalized flow of the plant to determine the dose rate for the previous day.

DATA ENTRY & RECORDKEEPING

Operations/Reading sheet

1. Record all the "**Today**" readings taken for the day on the backside of the operations/reading sheet. The 24 hour readings for soda ash, alum, polymer and water usage should be recorded on the "**Yesterday**" line.

Daily Chemical Dose Culculations Sheet

1. Each day record all the plant flows, chemical usage, and dose rates for the plant on this sheet.

WTP Monthly Log (Computer enteries)

1. At the end of each week or sooner, update the water plant monthly log database. The following information should be entered:
    a. Chemical usage and doses, Industrial flow, Raw pH if Missing, Hardness & Alkalinity, distribution sample testing

2. The rest of the data is entered by the Post Point graveyard operator.

A. To calculate the dose rate use the total filter output flow. This flow can be seen on the SCADA display by calling up the F3 display. These values are the daily check of the chemical feed pumps.

B. The formula to be used is as follows:
    1. Alum - mils/min. x 1440 /3785 x 5.32 #/gal/flow,MGD

C. The formula to be used is as follows:
    1. Poly - mils/min. x 1440 /3785 x 8.34 #/gal x .01 %/ flow,MGD

3.7.2 *Process Control*

Process Control Sampling Schedule

RAW WATER

Turbidity: The raw water turbidity meter receives its sample from the industrial main located outside the plant. To calibrate the meter the sample should be collected from the raw turbidity meter. The turbidity meter is continuously monitored by on-line meter and tested weekly by lab staff. This valve is recorded each day in the WTP monthly log.

Continuously Monitored
Tested Weekly , Grab Sample
By Lab Staff
Expected Range*:* Between .2 NTU and .6 NTU, normally

Lake Whatcom Raw pH: To test the raw water lake pH. The sample is collected from the raw water turbidity meter. The industrial main is without coagulation chemicals. The pH of the industrial main is used in the WTP monthly log as Raw pH. The pH of the raw water is tested daily by the plant operator. The valve is recorded in the WTP monthly log.

Continuously Monitored by SCADA
Tested Daily , Grab Sample
By Plant Operator
Expected Range: Between 7.1 and 7.5 pH

Inplant Raw pH: The inplant water pH meter located in the poly room measures the pH of the coagulated water before filtration. For calibration the sample is collected from the plant influent flume. The pH is continuously monitored at the plant only. This pH measurement is used as an indicator that the coagulation chemicals are working properly. The calibration is checked weekly by lab personnel.

Tested Weeky , Grab Sample
By Lab Staff
Expected Range: Between 6.5 and 7.1 pH

Hardness & Alkalinity: The sample is collected from the raw water turbidity meter. The test are run twice each month by lab personnel. These valves are recorded in the WTP monthly log.

Alkalinity Tested weekly, Hardness monthly by Grab Sample
By Lab Staff
Expected Range: Hardness between 23 mg/l to 35 mg/l
Alkalinity between 18 mg/l to 21 mg/l

Prechlorine Residual: The prechlorine is manually tested daily by the plant operator. The sample is collected from the rapid mix tank that is on-line.

Tested Daily , Grab Sample
By Plant Operator
Expected Range: .25 to .30 mg/l or less

Temperature: The water temperature of the water coming out of the CT reservoir is measured at the CT out sample line in the poly room. The temperature is recorded daily by the plant operator. The temprature is located on the CT outlet pH meter. The temperature probe is checked monthly for accurturey by lab staff. The valve is recorded in the WTP monthly log.

Recorded Daily
By Plant Operator
Expected Range: 6° to 18°C

Raw Water TOC & DOC: Water samples are collected at the gate house on Lake Whatcom by lab staff each month and sent to a local lab for analysis.

Tested Monthly , Grab Sample

Samples sent to outside lab
Expected Range: 1.80 to 3.3 mg/l

Raw Water Crypto & Giardia: Water samples are collected at the gate house on Lake Whatcom by lab staff each quarter and sent to a lab for analysis.

Tested Quartery
Pass water through filter system for 24hours
Filter Tested by Outside Lab
Expected Range: Usually Zero

TREATED WATER

Combined Filter Turbidity: The meter is located in the poly room. The turbidity sample is supplied by the clearwell sample pump. (smp pmp 10). To test or calibrate the meter the sample is collected from the turbidity meter discharge hose. The valve is recorded in the WTP monthly log.

Continuously Monitored
Tested Weekly , Grab Sample
By Lab Staff
Expected Range: Between .03 NTU to .06 NTU

Treated pH: The meter is located in the poly room on the pH meter board. The sample comes from the treated water pipe leaving the CT reservoir. To test or calibrate the pH meter, the sample is collected from the sample line #9 in the polymer room. The valve is recorded in the WTP monthly log.

Continuously Monitored
Tested Daily , Grab Sample

By Plant Operator
Expected Range: Between 7.8 to 8.2

CT Outlet pH: The meter is located in the poly room on the pH meter board. The sample comes from the effluent pipe right outside the CT reservoir. The pH is continuously monitored and checked daily by grab sample The sample is pumped from the effluent pipe by sample pump 8, located in the CMV (Chlorine Manifold Vault). To test or calibrate the pH meter, the sample is collected from the sample line #8 under the pH meter board. This pH value is used in the WTP monthly log for determining inactivation/CT values.

Continuously Monitored
Tested Daily , Grab Sample
By Plant Operator
Expected Range: Between 6.5 to 7.1

CT Outlet Chlorine Residual: This analyzer is located in the chlorinator room. The sample comes from the effluent pipe right outside the CT reservoir. The sample is pumped from the line by sample pump 8, located in the CMV (Chlorine Manifold Vault). To test or calibrate the analyzer, the sample is collected from the waste line tube on sample pipe #8. This chlorine residual value is used in the WTP monthly log for calculating contact time for the CT reservoir.

Continuously Monitored
Tested Daily , Grab Sample
By Plant Operator
Expected Range: Between .25 mg/l to .35 mg/l

CT Inlet Chlorine Residual: This analyzer is located in the chlorinator room. The sample comes from 1 of 9 sample locations within the CT reservoir or the plant clearwell. The sample is currently coming from the plant clearwell pumped from the sample pump 10, located in the pump room of the plant.. To test or calibrate the analyzer, the sample is collected from the sample tube going to the chlorine analzyer.

Continuously Monitored
Tested Daily , Grab Sample
By Plant Operator
Expected Range: Between .38 mg/l to .46mg/l
Winter between .35 to .42 - summer between .45 to .50

Trim Chlorine Residual: This analyzer is located in the chlorinator room. The sample comes from the effluent pipe on the CT reservoir just outside the Dakin/Yew pump station. The sample is pumped from the CT effluent pipe by sample pump 9, located in the DYPS. To test or calibrate the analyzer, the sample should be collected from the sample tube on sample line #9 in the chlorinator room.

Continuously Monitored
Tested Daily , Grab Sample
By Plant Operator
Expected Range: Between .58 mg/l to .65 mg/l

Hardness & Alkalinity: This sample should be collected from the sample pipe #9 under the pH meter board in the poly room.

Alkalinity Tested Weekly, Hardness monthly by Grab Sample
By Lab Staff
Expected Range: **Hardness between 23 mg/l to 27 mg/l**
Alkalinity between 20 mg/l to 24 mg/l

Treated Water TOC & DOC: Water samples are collected at the CT reservoir effluent pipe by lab staff each month and sent to a local lab for analysis.

Tested Monthly , Grab Sample

Samples sent to outside lab
Expected Range: 1.05 to 1.5 mg/l

Treated Water Crypto & Giardia: Water samples are collected at the CT reservoir effluent pipe by lab staff each quarter and sent to a lab for analysis.

Tested Quartery
Pass water through filter system for 24hours
Filter Tested by Outside Lab
Expected Range: Usually Zero

3.7.2 Influent Piping, Rapid Mix, and Flume

3.7.3 Filtration and Backwashing

Filtration is used to remove the particulate matter in the water. The particles may be inorganic (clays and silts), organic (humic and fulvic acids) or algae, bacteria, viruses, or cysts. Various screens and granular materials can be used for filters. The treatment plant uses a two component granular mixed-media system. The largest media is anthracite coal and exhibits the lowest specific gravity. The coal media therefore rises to the top of the filter bed during backwash. The smallest media is sand and exhibits the highest specific gravity. The sand media therefore falls to the bottom of the filter during backwash. The sand falls in the bottom both in size and density. The media is supported on AWI underdrains characteristics of the filter media are summarized in Table 3.7-1:

Table 3.7-1
Filter Media (Top to Bottom)

	Filter No.

	1,2,3,4	5	6
Media			
Anthracite Coal (1.5 SG)	1.10[1]	1.15[1]	1.25[1]
Sand (2.6 SG)	0.525	0.525	0.525
Garnet (4.0 SG)	0.35	0.35	0.35
Support Gravel			
High Density (4.0 SG)	0.0555-0.1875[2]	0.0555-0.1875[2]	0.0555-0.1875[2]
Fine Gravel (2.6 SG)	0.1875-0.375	0.1875-0.375	0.1875-0.375
Medium Gravel (2.6 SG)	0.375-0.75	0.375-0.75	0.375-0.75
Coarse Gravel (2.6 SG)	0.75-1.5	0.75-1.5	0.75-1.5

[1] Approximate effective size in mm
[2] Approximate range in inches

Filtration consists of three principal mechanisms: transport, attachment, and detachment. Transport mechanisms move the particles through the filter so that they come very close to the media and to previously deposited material. Attachment mechanisms serve to retain the particles that contact the media or previously deposited material. Detachment mechanisms result from the hydrodynamic forces that cause a part of previously attached material to break away and travel further through the filter or result in turbidity breakthrough.

The filters are operated on a constant-rate basis. Any increase in flow is likely to result in a brief increase in turbidity. For this reason, the filters are operated at a constant rate throughout the filter run or result in turbidity breathrough, as discussed above.

Filtration efficiency is dependent on the quantity of finished water produced and the quantity of water wasted during backwash and startup of the filter. The parameter used to assess filter production is termed the unit filter run volume (UFRV). This is the total volume of water produced by a filter before backwashing is required. The parameter used to assess backwashing is the unit backwash volume (UBWV). The filter production efficiency is described as follows:

Efficiency = (UFRV - UBWV)/UFRV

It is usually necessary to achieve UFRVs in excess of 5,000 gal/ft^2 of filter area to obtain a filter efficiency greater than 95 percent. Optimization of the filter process to achieve a high filter efficiency is usually only possible by using pilot filters to define the optimum coagulation process. Operational guidelines can be developed based on results of a pilot filter testing program.

As particulate matter penetrates and accumulates within the filter media, the headloss across the filter slowly increases. As filtration containing more and more particulate material is deposited within the media, this results in increasing resistance to flow and, hence, higher headloss across the filter. At some point, the hydrodynamic forces of filtration will cause particulate material to be “sheared” off the filter media. This material will eventually pass through the filter and result in increased turbidity of the filter effluent. This phenomena is called “turbidity breakthrough.” It is important to initiate cleaning of the filter prior to breakthrough.

Filter cleaning is called “backwashing.” Backwashing removes most of the particulate material that has penetrated the filter media. Backwashing is typically composed of two parts: 1) a flow-through the media in the opposite direction of filtration; and 2) a separate washing of the upper portion of the media, called a “surface wash.” A brief period of higher turbidity normally occurs after backwashing. As a result, a period of filtering to waste before bringing the filter back on line may be necessary.

Backwashing of the filters is initiated either by an increase in effluent turbidity or the occurrence of excessive headloss through the filter. Normally, a treatment plant is designed so that the filters need to be backwashed due to excessive headloss just prior to an increase in turbidity. Backwash initiation for City's filters varies seasonally between headloss and turbidity.

Optimum filtration and backwash rates cannot be determined solely on theory. It is necessary that full scale or pilot filter testing be conducted to optimize these parameters. Typical filtration rates range from about 2 to 8 gpm/ft^2 and backwash rates from about 15 to 20 gpm/ft^2. A general discussion of media selection and backwash parameters follows; however, specific

parameters must be developed for each individual installation. In particular, these parameters should be determined for Bellingham using the pilot filters.

The filter effluent quality as well as the filter backwash procedures are very dependent on the filter media. A mixed media filter bed over supporting gravel is used to provide initial contact with the largest media followed by further contact with progressively smaller media. The size distribution of a filter media layer is defined by its uniformity coefficient (UC). The UC is equal to the ratio of the 60 percent size (60 percent is finer) to the 10 percent size (10 percent is finer) of the media. Low UC media is used so that there is minimal gradation within each layer and the gradation is therefore from one media to another. All media in a low UC layer is fluidized at about the same backwash flow rate. Properly selected filter media layers should all fluidize at about the same flow rate. In effect, the garnet, sand, and coal should all fluidize at about the same backwash rate. This can be achieved because the coal is lighter and larger, and vice versa for the other materials.

The typical backwash sequence for a filter with rotating surface wash arms with nozzles is as follows:

> Surface wash is activated alone for about 1 to 3 minutes. Low flow rate water wash is then added to expand the filter bed about 10 percent and continued for an additional 5 to 10 minutes. The surface wash is terminated and the filter is backwashed for an additional 1 to 5 minutes at a higher rate to expand the bed to 20 to 50 percent and to restratify the multi-media.

Currently the City uses a single-rate backwash. The flow rate is slowly increased until the desired rate is achieved. The filter is then backwashed at this constant rate.

The initial surface wash period is used to breakup particles and surface layers collected on top of the filter. The period with surface wash and low flow rate backwash is used to remove the captured particles and clean the filter. This phase may be continued until a 90 percent reduction in backwash water turbidity is achieved. The final phase at the second, higher backwash rate is intended primarily to restratify the bed and prepare it for another filter run. It is important that the backwash rate not be too high so as to expand the support gravel.

Fluidization of filter media is dependent on the temperature of the backwash water. Higher temperature water is less dense and therefore a greater velocity is necessary to achieve the same level of expansion. In general, the flow rate must be increased 2 percent for each degree celsius increase. This phenomena is illustrated in Table 3.7-2. Backwash rates may be varied based on temperature; however, in most treatment plants, backwash flow rates are relatively constant throughout the year.

Plant Filters

Determining Filter Media elevation & Adding New media

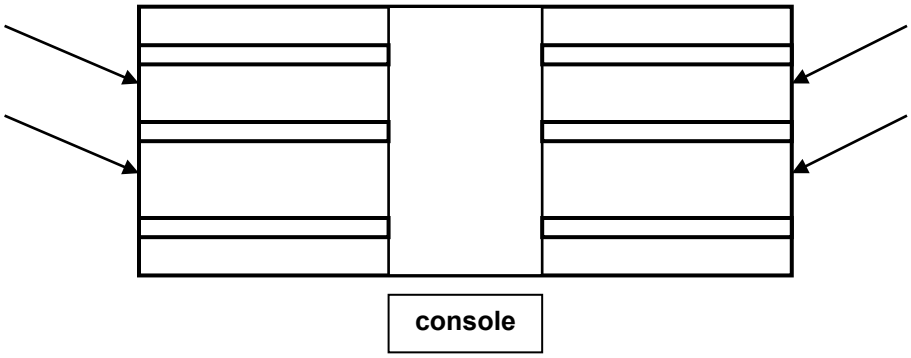
Procedure

Use this procedure to determine the amount of anthracite required to bring the filter media level up to the original specifications and adding new anthracite if required. The procedure calls for measurements to be taken at 4 different locations within the filter along the concrete walkway. These measurements are then used to calculate the amount of anthracite required.

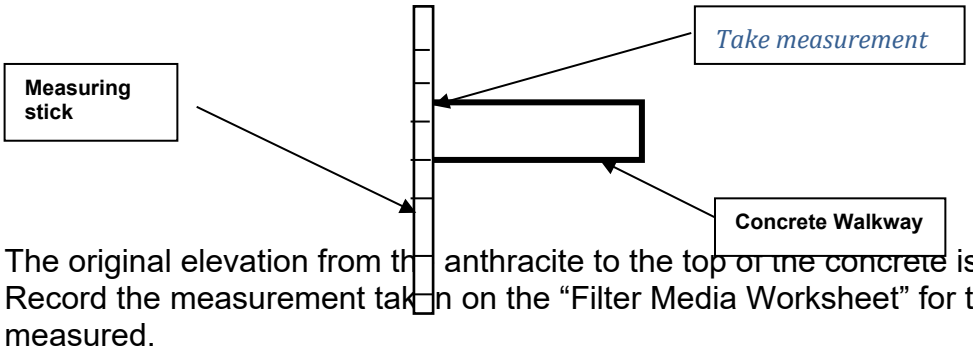
Elevation Determination

1. Prior to conducting the measurements the filter must be off line and backwashed.

2. There are two measurements taken in each bay. The measurements are taken between the filter backwash troughs as indicated below.



3. At each location use the wood measuring stick to determine the distance from the top of the anthracite to the top of the concrete walkway.
   3.1. Ensure when taking the measurements that the measuring stick is vertical and just resting on the top of the anthracite.
   3.2. The distance is read from the measuring stick where the top of the concrete edge lines up with the numbers on the stick. See below:



   3.3. The original elevation from the anthracite to the top of the concrete is 8 feet. Record the measurement taken on the "Filter Media Worksheet" for the filter bay measured.
   3.4. If the elevation is more then 8 feet then add media to bring the level back up to 8 feet. If the elevation is less then 8 feet then there is too much media in the filter.

4. Once all the filters levels have been checked. Then the required amount of anthracite for each filter can be calculated based on the following criteria.
   4.1. Each 50 pound bag of anthracite is equal to 1 cubic foot of media.
   4.2. For every ½ inch of media depth there is 12 cubic feet of Anthracite.
   4.3. Using the above parameters calculate the number of bags required for each filter bay and record the amount on the “Filter Media Worksheet”.

5. Currently, there are three different media types installed in the plant filters.
   5.1. Filters 1,3,& 4, Effective size mm, = 1.10 +/- .05 (fine)
   5.2. Filter 5 & 2 Effective size mm, = 1.15 +/- .05 (medium)
   5.3. Filter #6 , Effective size mm, = 1.25 +/- .05 (course)
   5.4. Determine the amount of each media type required.

Adding New Anthracite

1. Carry the required amount of anthracite for each filter and place along the walkway of the filter. The anthracite is kept at the screen house or the basement of the plant.

2. Prior to adding new anthracite the filter must be off line and backwashed.

3. Drain the filter down to below the wash troughs. But leave about a foot of water over the media.

   3.1. When adding new media the water will help reduce the amount of dust.
   3.2. You must wear a respirator with a dust cartridge when dumping new anthracite.

4. Evenly distribution the required new media around each filter bay. Taking care not to get pieces of the media bag into the filter.

5. When all the media has been dumped into the filter.

   5.1. Back wash the filter at a slow rate to bring the water level up to the top of the filter troughs.
   5.2. When the water level gets to the top of the troughs increase the backwash flow to 7000 gpm and turn on the bay surface sweep.
   5.3. The new media will contain fine anthracite dust in each bag. Back washing will remove this finer material. It may take several backwashes to remove the finer material.
   5.4. Wash both left and right filter bays.

6. When both filter bays have been washed. Open both bay valves if not open already. Drain the filter bays down to the level of the sweep arms by using the filter-to-waste valve.

6.1. Shut off each filter bay valve when the water level gets to the sweep arms. This will leave the filter-to-waste valve open.

7. Turn on the left surface sweep and let the sweep operate. While the sweep is in operation mix up some chlorine solution.
   7.1. In a 5 gallon bucket, slowly add approximately 5 pounds of Calcium Hypochorite to hot water while stirring. (Need to dissolve the Calcium Hypochorite into a solution)
      7.1.1. **Don't forget to wear a respirator for the chlorine flumes & eye protection**.
   7.2. Do not get the bucket so full that you have difficulty moving it to the filter or spill it on the carpet in which case the carpet would be destroyed.
   7.3. While the surface sweep is in operation pour the chlorine solution into the left bay. The sweep arm will keep the chlorine solution mixed up through out the filter bay.
   7.4. Rinse out the bucket to remove all the Calcium Hypochorite into the filter bay.
   7.5. Allow the surface sweep to run until the water level in the filter bay gets up to the top of the filter backwash trough.
   7.6. At this point shut off the surface sweep and open up the left bay valve and lower the water level in the filter down to just above the rail which supports the surface sweep.
      7.6.1. Do not let the water go below this level, because the sweeps usually create a creator while they have been running.
      7.6.2. This completes the left bay.
   7.7. At this point, do the same for the right filter bay.
   7.8. When both filter bays have been disinfected then let the filter sit out of service for 24 hours.
   7.9. After 24 hours the filter can be washed and returned to service.

FILTER OPERATION

1. SCADA Remote Control

1. The supervisory control and data acquisition computer system (SCADA) allows the operator at the Post point plant to remotely control the functions for each filter operation at the water treatment plant. The operators can change filtering rates, turn filters on and off-line, and backwash filters. They also have the capability to start and stop the chemical feed pumps, adjust chlorine concentrations, and soda ash feed rates for pH control. The operators at this time do not have remote control for the raw water influent/flume level controls.

2. Plant Production

1. Alum pump #3 is automatically adjusted according to the SCM setpoint by a Dart controller and Polymer pumps #1 and #2 may be adjusted remotely via SCADA by motor speed percentage. The remaining alum pumps #1 and #2 are set mechanically for high and low production rates respectively.

2. Winter mode operation: During this period the plant production will be set below (under produce) the city's water demand so that the CT reservoir level will drop to 12 feet. When the reservoir gets to 12 feet then the plant production is increased above (over produce) the water demand so that the CT reservoir will be refilled to 20 or 21 foot level over several weeks. This routine is continued throughout the winter months.

3. Summer mode operation: When the winter mode of operation will not keep up with the system demand by using 5 of the 6 filters a filter rate change is required. The filter rate is changed on all the filters and the process of under and over producing is continued. However, during this period the minimum CT reservoir level is raised from 12 to 16 feet for emergencies due to the higher water demand.

3. Changing Filter Rates

1. When water system demand is such that a plant production change is required the filtering rate must be change to meet system demand. The plant operator reviews the previous days treated water flow total plus the amount of backwash water used. This value is then compared to the current plant production rate. If the treated water flow total plus the backwash water used exceeds the total plant production rate then a filter rate increase is required. If the total is less than the plant production rate then the filter rate is lowered. Another important variable that the operator must take into consideration when deciding to make a plant production change is the weather forecast. The procedures for making filter rate changes are described below:

2. When the filtering rate must be decreased the rate to each on-line filter is lowered 100 gpm each 24 hour period. Any new filter placed on-line well be at the new rate.

3. When the filtering rate must be increased, the rate to each on-line filter is increased by 100 gallons per minute each day or, if demand is requires it, each 8 hour shift. Making these small flow changes prevents increases in filter effluent turbidity and particle counts.

4. Controlling Filter Rates

1. With the rate controller in the auto/remote position the controller receives it's flow rate set point from the plants Programmable Logic Controller (PLC) via the SCADA computer system or individual filters may be operated manually from two

HMI touch screen at filters #3 and #5. When the filter is placed on-line by the operator, the rate controller ramps up the filter effluent flow at 1 gpm/sq.ft/min. The rate controller maintains the effluent flow at a constant rate throughout the filter run. Normal operation is to have all the filter rate controllers in the auto/remote position.

5. Filter Inservice

1. Filters are placed in service remotely via the SCADA computer system. The plant operators can start new filters to increase plant production, or decrease plant production by backwashing a filter, and then leaving it off line. Once a filter is backwashed it is left in the ready for operation mode. A filter can be started remotely by commanding the filter "start" from the filter control display. When the filter is started the computer system zero's out the previous run time and starts logging the new time. The operator logs the starting headloss and turbidity, filter rate in gpm, and the start time onto the filter log sheet.

6. Filter Stopping

1. The filters are stopped by commanding the filter "stop" from the filter control display on SCADA. Before the filter is returned to service it must be backwashed.

7. Terminating A Filter Run

1. In most cases, a clean filter is put into service to replace the filter that is backwashed. A filter can be backwashed remotely by initiating a backwash command from the filter control display. When the backwash is started the computer system records the ending filter run time, headloss, turbidity, average filter rate in gpm, and calculates the filter Unit Filter Run Volume.(UFRV). This same information is logged on the filter log sheet along with the amount of backwash water used. The termination of a filter run by backwashing for any of the following reasons:

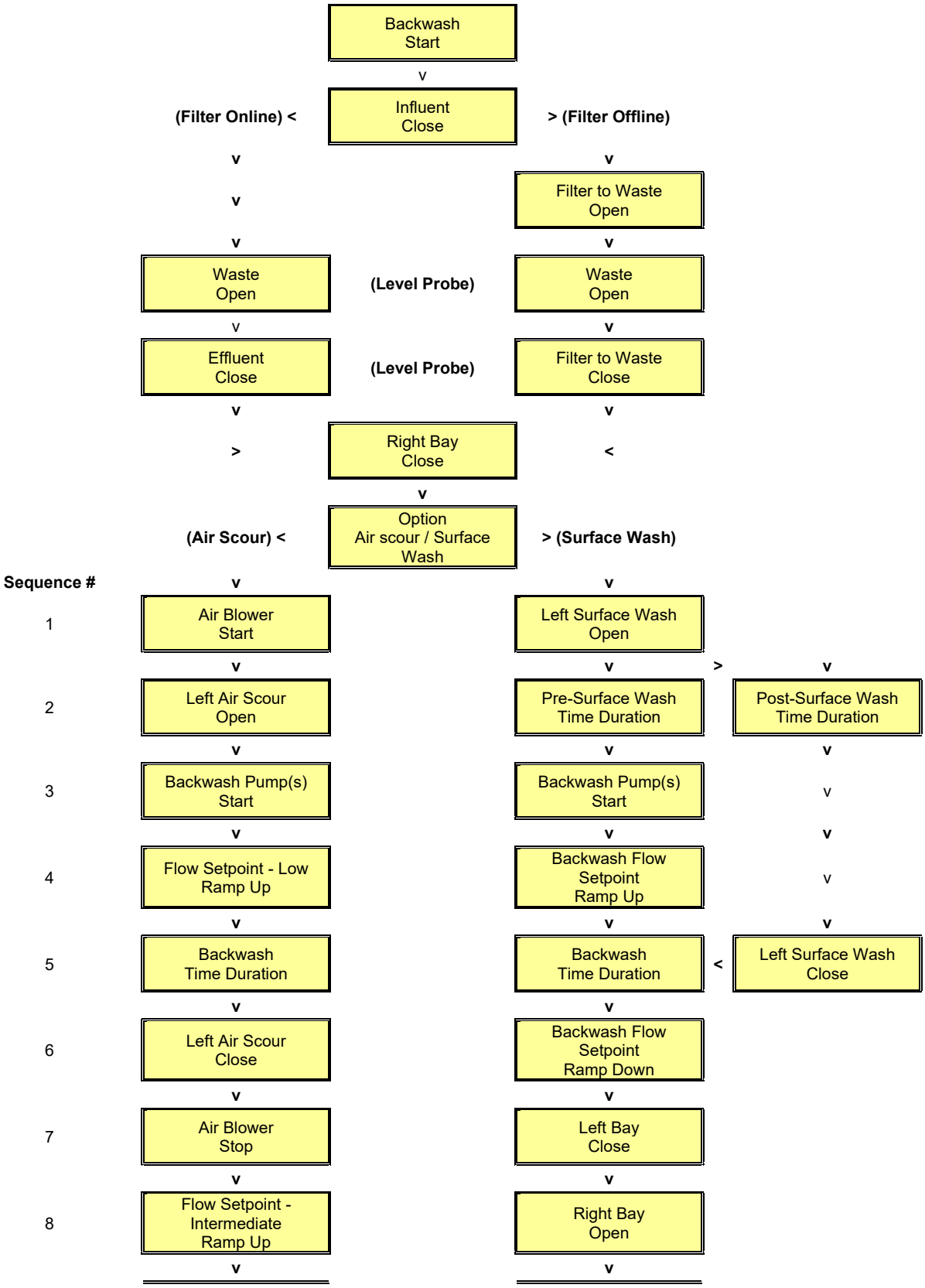
    1. High headloss, city standard is 8 feet.
    2. Turbidity breakthrough, city standard of .07 NTU.
    3. Particle counts greater than 20 particles/ml in the greater than 2 micron range.
    4. Plant production, or filtering rate change.
    5. Any water quality concerns.

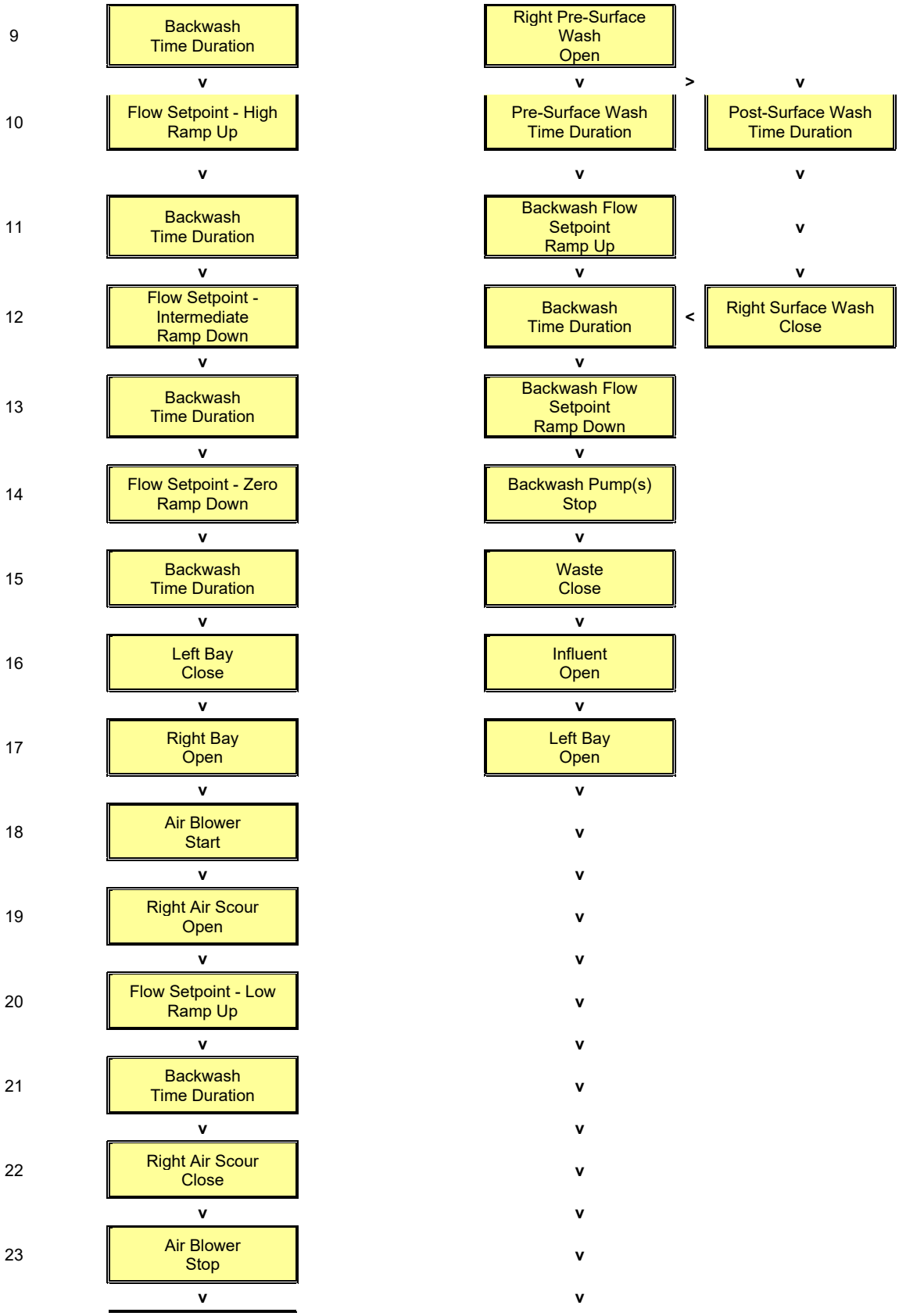
8. Filter Backwashing

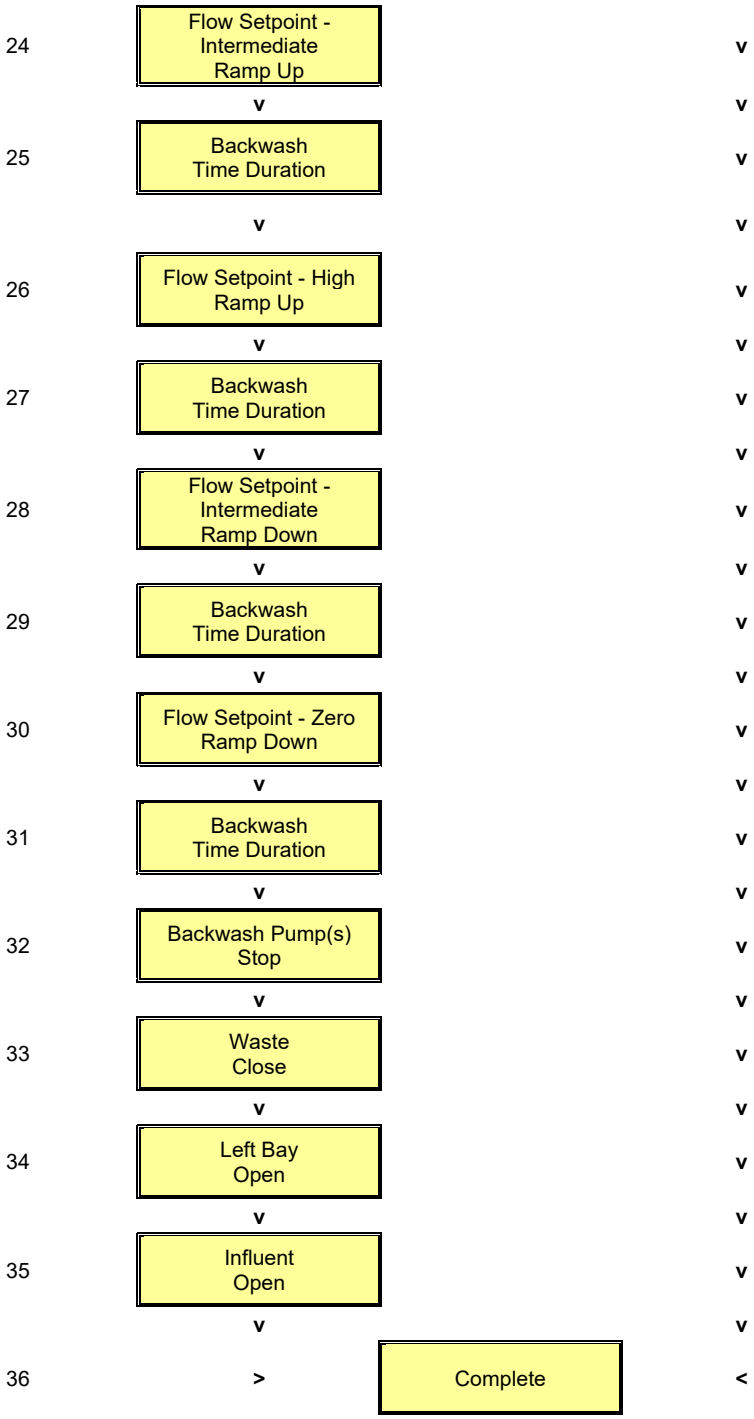
1. There are three ways that an operator can perform a filter backwash. The remote auto backwash and the off-line backwash both from SCADA, and a manual backwash from the filter console. The remote auto backwash assumes the filter to be in operation, while the off-line backwash is initiated after the filter

has been stopped using the stop command. The off-line backwash is used for filters which are dirty and have been shut off because of a failure, or for other maintenance activities.

2. The operator can select whether the backwash will use the air scour or the surface sweep mode of operation. Both the auto and off-line backwashes are the same except for the beginning of the backwash sequence. The backwash sequence for both modes can be reviewed from the flow chart on the next 3 pages.

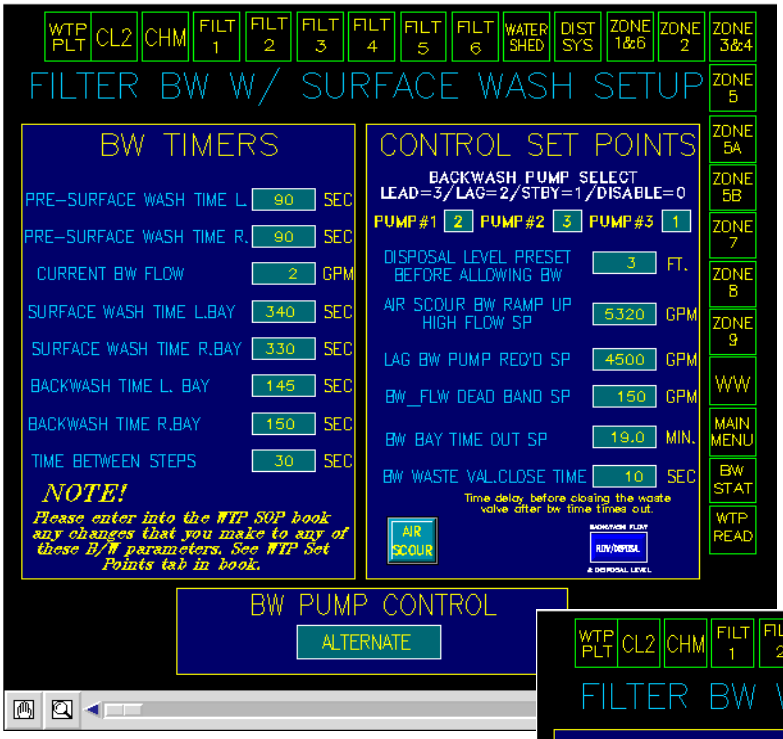

Backwash Start
Influent Close
(Filter Online) <
> (Filter Offline)
Filter to Waste Open
Waste Open
(Level Probe)
Waste Open
Effluent Close
(Level Probe)
Filter to Waste Close
Right Bay Close
Option Air scour / Surface Wash
(Air Scour) <
> (Surface Wash)
Sequence #
1
Air Blower Start
Left Surface Wash Open
2
Left Air Scour Open
Pre-Surface Wash Time Duration
Post-Surface Wash Time Duration
3
Backwash Pump(s) Start
Backwash Pump(s) Start
4
Flow Setpoint - Low Ramp Up
Backwash Flow Setpoint Ramp Up
5
Backwash Time Duration
Backwash Time Duration
Left Surface Wash Close
6
Left Air Scour Close
Backwash Flow Setpoint Ramp Down
7
Air Blower Stop
Left Bay Close
8
Flow Setpoint - Intermediate Ramp Up
Right Bay Open


9
Backwash Time Duration
Right Pre-Surface Wash Open
10
Flow Setpoint - High Ramp Up
Pre-Surface Wash Time Duration
>
Post-Surface Wash Time Duration
11
Backwash Time Duration
Backwash Flow Setpoint Ramp Up
12
Flow Setpoint - Intermediate Ramp Down
Backwash Time Duration
<
Right Surface Wash Close
13
Backwash Time Duration
Backwash Flow Setpoint Ramp Down
14
Flow Setpoint - Zero Ramp Down
Backwash Pump(s) Stop
15
Backwash Time Duration
Waste Close
16
Left Bay Close
Influent Open
17
Right Bay Open
Left Bay Open
18
Air Blower Start
19
Right Air Scour Open
20
Flow Setpoint - Low Ramp Up
21
Backwash Time Duration
22
Right Air Scour Close
23
Air Blower Stop


24
Flow Setpoint - Intermediate Ramp Up
25
Backwash Time Duration
26
Flow Setpoint - High Ramp Up
27
Backwash Time Duration
28
Flow Setpoint - Intermediate Ramp Down
29
Backwash Time Duration
30
Flow Setpoint - Zero Ramp Down
31
Backwash Time Duration
32
Backwash Pump(s) Stop
33
Waste Close
34
Left Bay Open
35
Influent Open
36
Complete

3. All the backwash flow and timer set point requirements for either the surface sweep or the air scour mode can be entered on the SCADA backwash setup control displays. The SCADA backwash setup display for both modes are shown below. **Note: A "zero" value entered for an air scour timer will cause the program to skip that step of the B/W sequence.**

SCADA BACKWASH SETUP DISPLAY



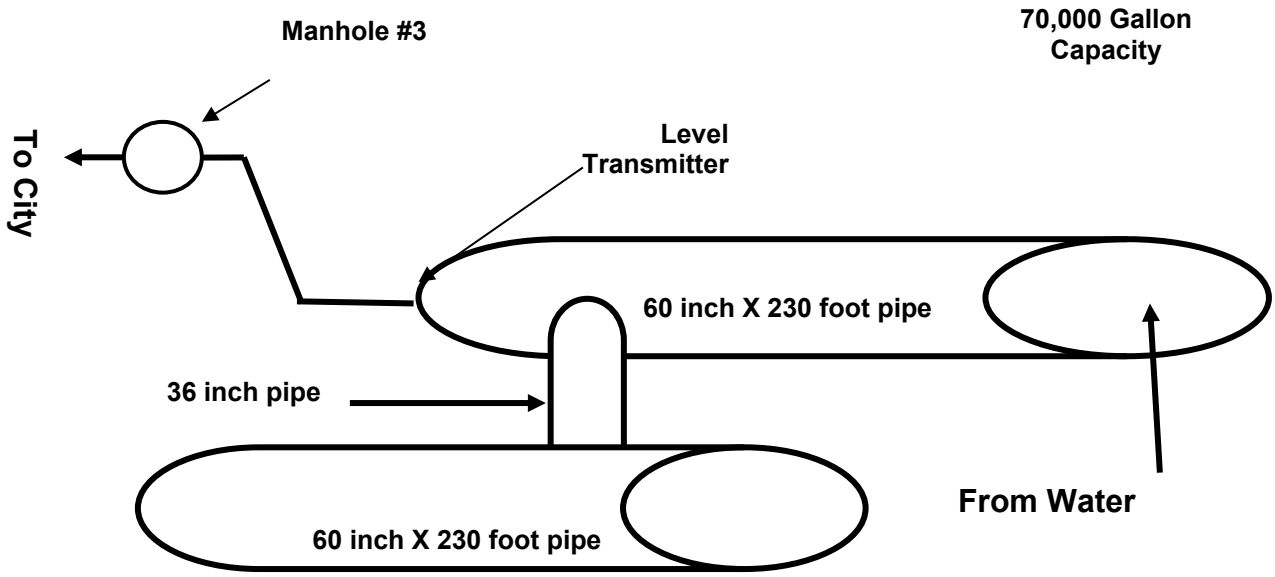
4. The last way an operator can backwash a filter is by manually at the filter console following the same sequence as the automatic backwash program in the plant PLC.

5. If a problem occurs during either the on-line or off-line backwash sequence, the filter is placed out of service and the filter is left in the "failed" condition. An operator must correct the problem then complete the backwash sequence manually from the filter console. The filter then must be reset through the PLC before it can be returned to service.



9. Backwash Detention Piping

1. The backwash water that leaves the plant enters a network of detention piping. This piping limits the amount of flow into the City's sewer system. A diagram of the backwash waste detention piping can be seen below.



10. Process Monitoring

1. Filter performance is monitored by the SCADA computer system. All the data logged by the system is printed on daily reports. The operators monitor the status of the water treatment plant by reviewing operation display 24 hours a day, seven days a week. When an on-line filter reaches the backwash criteria stated above, the operator sends off an "on" command to start up a clean filter. This "on" command has several functions. It resets, to zero, the run time for that filter and it unblocks the headloss and turbidity for the new filter run. While the new filter is starting up the operator sends off a "backwash" command to initiate a backwash on the dirty filter. This "backwash" command also has several functions. It records the filter run time, the ending headloss and turbidity, and the average effluent flow rate. It also calculates the unit filter run volume (UFRV) and total gallons produced. It then blocks the signals for headloss and turbidity and resets the "backwash" command back to "Ready" for the next filter run. All these functions are performed from each filter's operational display on SCADA. At the end of the day a daily report is printed with all the filter backwash collected above.

11. Emergency Operation

1. We have on-site back-up emergency generation at the Water Treatment Plant in case normal power is interrupted. This E-generation system is tested on a weekly basis and is run under a plant load every month. Emergency power procedures are located in the Hazmat Section.

3.7-2 Backwash Flow Rate Temperature Corrections

Temperature (°C)	Multiply Flow Rate Used at 5°C Value by:
5	1.00
6	1.02
7	1.04
8	1.06
9	1.08
10	1.10
11	1.13
12	1.15
13	1.17
14	1.20
15	1.22
16	1.24
17	1.27
18	1.29
19	1.32
20	1.35

Several scientific studies since the 1960s have shown that with adequate pretreatment, filtration rates from 2 to 6 gpm/ft^2 will produce the same effluent water quality. Electrical destabilization of the particulate material by chemical feed is an essential prerequisite for effective filtration.

Chemical feed is discussed in Section 3.7.4. Poor pretreatment may produce poor quality water even at rates less than 2 gpm/ft^2.

The selection of filter media impacts the performance and effectiveness of the filters. The following conflicting and competing requirements control filter media selection:

1. The finer the media, the better the water quality
2. The finer the media, the higher the head loss
3. The finer the media, the shorter the run length
4. Coarser media requires higher backwash rates
5. Simultaneous surface wash and backwash is most effective for cleaning
6. Simultaneous surface wash and backwash destratifies mixed media filters
7. Mixed media must be fluidized to restratify

Filter run times can vary depending on filtration rate, influent water quality, and extent of backwashing. Recommended filter run times fall within the range of 18 to 24 hours. Shorter run times result in lower plant efficiencies and greater run times can result in problems associated with algae growth.

Geometry (Future Section)
- Photographs
- Figure 3.7-4: Filter Piping - Isometric (11 x 17)

Media (Future Section)
Turbidity Meters (Future Section)
FRP Extensions (Future Section)
Backwash System (Future Section)
- Media wash
- Surface wash
- Backwash pumps

Operation (Future Section)
- Filtration rates
- Media headloss
- Filter run length
- Valve positions
- Backwash initiation
- Standard backwash procedures
- Resume operation
- Filter to waste
- Local/remote/manual operation

Manual Filter Backwash from HMI with filter out of service

1. Change the control from “remote” to “local” on the HMI. Ensure you are controlling the correct filter
2. Open bay valves and filter to waste valve in manual and drain filter bays to backwash levels
3. Open waste valve in manual
4. Close filter to waste valve and right bay valve when backwash level is reached
5. Turn on air blower (or surface sweeps) and open left air scour valve when blower is running. Don’t open air valve if using surface sweeps

6. Turn on any two backwash pumps, one at a time, waiting 10 seconds between starts
7. Input backwash set point (gpm) on backwash screen. Backwash valve should start to open
8. Turn off blower when backwash level reaches trough flange
9. Close air scour valve after blower has stopped and trapped air is released
10. Continue with backwash until backwash set point is reached and filter surface water begins to clear
11. Input backwash set point of 1700gpm. Backwash valve should begin to close
12. Leave backwash flow at 1700 when set point is reached for one minute. This helps fluidize the bed
13. Input a backwash set point of zero. Backwash valve should resume closing
14. When backwash flow is at zero, repeat steps 3-12 for the right bay
15. When completed, stop backwash pumps one at a time, return backwash pumps and all valves to auto
16. Ready filter for service on the HMI and return filter control to remote

3.7.4 Chemical Feed Systems

Various chemicals are used to assist in producing high quality water. Chemicals are initially used prior to coagulation to promote aggregation of very small particulate matter into larger particles which can be effectively removed by filtration. Particulates can be of inorganic origin, such as clay and silt, or of organic origin, such as humic and fulvic acids. At a water pH above 4, most particulates are negatively charged. The inorganic particulates are most common in the raw water and result in increased turbidity. The organic particulates are less common and usually result in color. The organic particulates are frequently trihalomethane (THM) precursors. These chemicals react with chlorine to form THM's, many of which are suspected or proven carcinogens (cancer causing compounds). Removal of the particulates also assists in the removal of algae, bacteria, viruses, and cysts.

The aggregation of particulate matter begins with coagulation. The raw water normally exhibits a pH of about 7. The particulate matter in the raw water is in general negatively charged. Like charges repel each other and hence the suspended particles are relatively stable and stay in suspension. In addition, the particles may exhibit adsorbed water molecules that provide a physical barrier to particulate collisions. The primary goal of coagulation is the formation of larger particles that are more readily removed in the filters. Coagulation is a chemical process that occurs fairly rapidly, on the order of a few milliseconds to a few seconds.

Elsewhere in the country, coagulation is frequently followed by flocculation. Flocculation basins usually include mixers which promote formation of larger particles suitable for filtration. Flocculation is a physical process that occurs much slower, on the order of several minutes to a few hours. True flocculation is not part of the City's treatment process.

According to current theory, there are two kinds of aluminum coagulation: (1) charge neutralization, and (2) sweep floc. The coagulation mechanism in the charge neutralization zone may be described as the bonding of transient aluminum species to the target particles in the raw water, giving a zeta-potential of near zero (i.e., ±5 mv). Once charge neutralized, these particles will adhere to the granular filter media. The transient aluminum species form only within certain pH-dosage zones, such as pH 4.5-5.5 and alum dosage 2-80 mg/L. In additon, they have a life

of only milliseconds. Therefore, to be effective in the charge neutralization of raw water particles, contacts between raw water particles and the transient alum species must occur within milliseconds. An effective rapid mix is needed to achieve contact. This requires short detention time, i.e., less than one second, and high mixing intensity.

The sweep floc zone occurs at higher pH, such as 7-8, and higher alum dosages, such as 15-200 mg/L. The sweep floc coagulation zone is characterized by the formation of aluminum hydroxide precipitate, which enmeshes the collodial particles, forming a microfloc. The microflocs will adhere to the filter media.

Chemicals are added to promote coagulation. The chemicals also strengthen the floc to reduce floc breakup. The primary coagulant used is alum (aluminum sulfate). Alum is an inorganic coagulant that is most effective in the pH range from 4.5 to 8.0. A synthetic organic polymer is also fed as a coagulant aid. The polymer used is positively charged (cationic) and hence is also referred to as a polyelectrolyte. The negatively charged particulates are attracted to the positively charged polyelectrolyte resulting in more effective charge neutralization. In addition, the long-chain polymer molecules provide bridging between the particles and result in formation of larger, more shear resistant floc. The floc strength of alum particulates is generally low. Effective charge neutralization requires a relatively high-energy rapid mix process. If the mixers are not running, the primary process is sweep coagulation. The particles come into contact as a result of turbulence and gentle mixing. This is more of a mechanical coagulation process than electrical.

Filtration aids are usually added to the water following sedimentation and prior to filtration. In the case of the Bellingham plant, there is no sedimentation process and hence the polyelectrolyte used as a coagulant aid can also act as a filter aid, if suited. In general, filter aids function much the same as coagulant aids but also may affect the way in which the particles interact with the filter media. This includes the way in which water-borne particles adhere to the media and the extent to which they penetrate or clog the filter. Filter aids are usually added at very small doses (0.001 to 0.1 mg/l) just prior to filtration. Addition of filter aids may make backwashing more difficult due to higher attachment forces and surface washing becomes much more important.

Chlorine is used as a disinfectant at the treatment plant. The chemical is added at the screenhouse to prevent algae buildup in the plant and to improve filter performance, in Whatcom Falls Reservoir No. 2 to meet CT requirements, and in the reservoir outlet pipeline (trim chlorinator), to achieve a suitable chlorine residual. There are nine possible feed locations in the reservoir. The feed locations and contact times are summarized in Appendix C. Suitable contact time is provided prior to delivery to the system.

Soda ash (sodium carbonate) is used at the plant for pH adjustment. The alum used as a primary coagulant can significantly lower the pH. Soda ash is used to raise the pH to suitable levels for domestic uses and for corrosion control. Corrosion control currently dictates the soda ash feed rate.

The treatment plant has the capability of adding powdered activated carbon (PAC) in the flume downstream of the rapid mix chambers. No PAC is currently being fed. PAC is normally used for taste and odor control and for removal of several trace organic compounds and THM precursors.

A general chemical feed schematic for the Water Treatment Plant is shown in Figure 3.7-5. The schematic indicates current possible feed locations. Chemicals are not being added at all possible locations.

3.7.5 Alum

Purpose
Photographs
Feed system
Basic geometry
Feed locations
Design conditions
Feed rate control
    local operation
    remote operation
Bulk alum handling
Piping and valving
Typical dosage
    summer
    winter

ALUM DELIVERIES **Procedure**

Description

Aluminum sulfate is used as the primary coagulant for the Water Treatment Plant. The coagulation process requires facilities for chemical storage and feeding. Aluminum sulfate is delivered in solution form. The solution is approximately 47 percent dry alum in water and having an AL_2O_3 (aluminum oxide) content of approximately 8 %

Aluminum sulfate is delivered to the Water Treatment Plant by tanker truck equipped with a compressor for offloading the alum into the plant storage tank. The plant storage tank has a 10,000-gallon capacity and is located in the garage.

Delivery

The vendor will provide the name of the driver who will be delivering the Alum and a residual last carried invoice if something other than alum has been carried in the tanker truck.

Upon arrival at the plant the operator shall check the following before allowing the driver to unload the alum.

1) Check the ID card of the driver to verify that he is the driver identified by the vendor prior to shipment.
2) Review “Residual Last Carried” invoice to determine what was carried in the tanker truck prior to delivering alum to the City of Bellingham. If aluminum sulfate was the last carried product as indicated on the invoice, then you can skip to section 4.

If another product other than alum was last carried in the tanker truck then the driver must produce a "Washout" checklist invoice from the nearest truck stop.

i) Review the dates of the washout invoice with the invoice of the alum delivery. The washout date should be after the residual last carried invoice and before the delivery to the city.
ii) Verify that the tanker and hoses were washed out using cold or hot water and for a period of at least 30 minutes.
iii) If the driver does not have a Washout invoice then notify the chief Operator before unload operation continues.

3) Have the driver grab a sample of alum from the truck. Place a 100 ml graduated cylinder on the scale and zero the scale. Place 100 ml of the sample into the graduated cylinder. Divide the weight of the alum by 100 to get the specific gravity. Use the conversion chart in this notebook to find the dry weight per gallon and write it on the whiteboard in the ops room.
4) Once the paper work is all in order the truck driver can start to unload the aluminum sulfate to the city's storage tank. This process usually takes about an hour. When done place the invoice receipt on the chief Operators desk.

ALUM FEED SYSTEM

Dose Check / Calibrating Metering pump

Procedure

Use this procedure when the operator wants to check, change, or determine the dose rate for the current feed rate of the alum feed pumps. This check is performed each time there is a plant production change or the plant dose rate requires changing. The piping is changed to connect a graduated cylinder to the metering pump. The draw down of the graduated cylinder is then timed for a two (2) minute period to determine feed rate. A stopwatch will be required for this test.

1. Fill the graduated cylinder located on the alum line from the tank with Alum.
   1.1. The cylinder can be filled with alum by opening valve **AS-1** just under the graduated cylinder.
   1.2. Fill the graduated cylinder above the 2000 ml mark.

2. Switch pump suction piping from alum tank to graduated cylinder. Operate these valves:
   2.1. Close valve AS-2
   2.2. Open valve AS-1

3. The on-line alum pump will start to remove alum from the graduated cylinder. When the alum level reaches the 2000 ml mark start the stop watch to time the draw down.

4. When two minutes has elapsed switch the valves back around to normal.
   4.1. Close valve AS-1
   4.2. Open valve AS-2
   4.3. It is important to operate the above valves in order listed. Otherwise alum will be forced out of the graduated cylinder by the pressure from the alum tank.
   4.4. Note the amount of alum removed from the graduated cylinder.

5. To determine the feed rate of the alum pump divide the volume of alum removed in the cylinder by 2. The result will be the ml's per minute feed rate of the metering pump.

6. Compare the pump feed rate with the required pump feed rate. If they are the same the chemical feed pump is adjusted properly. If the feed rate is more or less then the plant setting then adjust the chemical feed pump to match plant setting.
   6.1. To adjust the pump, turn the black adjusting knob counterclockwise to decrease the pump output and clockwise to increase the output.
   6.2. There are approximately 40 ml's per turn of the adjusting knob.

7. After increasing or decreasing the pump output then return to step 1 and repeat the procedure until the feed rate is the required amount. Do the same procedure for the other pump if required.

8. When both pumps are adjusted, verify that the alum pumps are connected back to the alum tank rather then the graduated cylinder. Failure to do so will result in no alum feed while the plant is on-line.

9. To calculate the dose rate of the polymer pump do the following:
   9.1. Determine the number of ml's per minute from step 5.
   9.2. Record the totalized plant flow rate in Millions Gallons per Day (MGD).
   9.3. Use the below formulas below to calculate dose rate:

Alum Feed Rate:

$$\text{ML/Minute} = \frac{(\text{Alum,ppm})(\text{Infl. Flow,mgd})(8.34\text{lb/gal})(3785\text{ ml/gal})}{(5.32\text{ \#alum/gal})(1440\text{ min./day})}$$

Alum Dose Rate:

PPM Alum = (mls/min. alum)(1440min./day)/(3785 mls/gal)(5.32#/gal)
(Infl.Flow, mgd)(8.34 #/gal)

9.4. Record the dose rate on the plant daily sheet.
9.5. Compare the pump dose rate with the plant setting. If they are the same the chemical feed pump is adjusted properly. If the dose rate is more or less then the plant setting then adjust the chemical feed pump to match plant setting.
9.5.1. The dose rate will then be checked again the next work day.

3.7.6 Soda Ash

Soda ash is the common name for sodium carbonate (Na_2CO_3). It is used to raise the pH of the treated water after disinfection and prior to delivery to the system. Disinfection using chlorine is more effective at a lower pH. Therefore, it is desirable to carry a lower pH through the coagulation and filtration process. Soda ash is fed downstream of the Whatcom Falls Reservoir No. 2 after the water has achieved suitable disinfection contact time. The soda ash raises the pH to a level desired for corrosion control in the distribution system.

Several chemicals can be used for raising pH. The most common are soda ash, lime, and caustic soda. Caustic soda is inexpensive but is very corrosive and hazardous to handle. Lime is more effective and less expensive than soda ash, and the feed equipment is similar; however, lime feed lines are very prone to plugging. Soda ash is easier to handle and permits using feed points a significant distance from the feeders.

Soda ash is commercially available in two grades: light and dense. Light soda ash has a consistency of a powder and is lighter per unit volume. Dense soda is similar to granulated sugar and is heavier per unit volume. A fixed volume (storage silo) is capable of storing more functional soda ash if it is dense rather than if it is light. The soda ash used in the treatment plant is dense soda ash.

Soda ash is delivered to the treatment plant in self-unloading semi-trucks. The trucks are equipped with air compressors to unload the material pneumatically. Four-inch-diameter feed lines are provided from the unloading station to each of two silos. Each silo is capable of storing about 35,000 pounds of dense soda ash. The silos are 6'-9" in diameter and are 18'-5" high from the top of the bin activator to the top of the silo.

Figure 3.7-5
Chemical Feed Schematic

The truck offloads to one silo at a time. Lockable dust caps must be removed by the plant operator before the soda ash can be unloaded. Limit switches on the dust caps start the dust collection system. The dust collection system must be running when soda ash is unloaded.

The soda ash level in the silo is monitored by ultrasonic level sensors. A silo level display is included on the Truck Unload Control panel to indicate the soda ash level in each silo.

At the bottom of each silo is a bin activator to promote free flow of the material to the feeders. Two digital weigh belt feeders, one below each silo, are installed to precisely measure the soda ash. Below each feeder is a mixing tank where the dry soda ash is dissolved in water. Two soda ash pumps, each with a capacity of 18 gpm, pump the soda ash solution from the mixing tanks to the feed point. A schematic of the soda ash system is shown in Figure 3.7-6. Each of the two soda ash systems is designed to feed up to 6,000 pounds per day. This capacity is equivalent to a treated water flow rate of about 48 mgd.

The soda ash feed rate is adjusted remotely via SCADA. Adjustments are made manually by the operators.

There are two soda ash feed locations. The primary feed location is in the chemical feed manhole southwest of the Dakin-Yew Pump Station. Soda ash is fed at this location to raise the treated water pH to 8.0. This pH has been shown to significantly reduce corrosion in the system. Current feed rate at the plant to maintain a pH of about 8.0 is 15 mg/l.

The emergency soda ash feed to the clearwell is only to be used when the Whatcom Falls Reservoir No. 2 is out of service for an extended period.

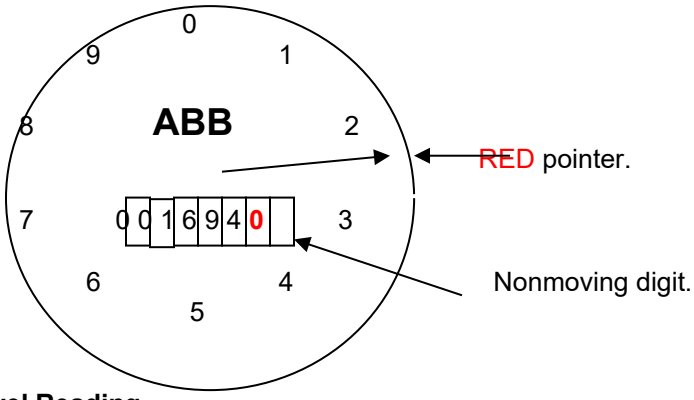
3.7.7 Polyelectrolyte (future section)

Purpose
Photographs
Feed system
    dry
    liquid
Basic geometry
Feed location
Design conditions
Feed rate control
    local operation
    remote operation
Piping and valving
Typical dosage
    summer
    winter

Poly System Water Meter

The below drawing is the new poly water meter that indicates in gallons. There seems 2 B some confusion on how to read it. After reading the meter description at ABB on-line & talking to a maint type person here's the scoop. The meter will read up 9,999,990 B4 it rolls over to 0. That should be good for about 55 yrs.. The white 0 on the black background (red on white here) is the 10's column. So, each revolution of the RED pointer is equivalent to

10 gallons. Each number is 1 gal. & each gradation between the numbers is 1/10th of a gal.. The below reading is 16,942.2 gal.. Hopefully we're all on the same wave link now.



Alum Level Reading

It seems that another point of confusion is getting the daily alum usage reading. Here's the scoop. Open the History file & click on Water Plant, 30 Days of 5 Min., enter point #1937, click on Display & then Data. Scroll down the display until U get to 23:55:00 the previous day. The 1st column of data is the average of the last 5 min. of the previous day. The 2nd column is the very last reading of the previous day. If we all use that number there shouldn't be any confusion. Example:

		Avg. of 5 samples ⩛	⩛ Last reading of 5 samples	
10-23-2006	00:00:00	4954.15	4953.81	
10-22-2006	**23:55:00**	4955.09	4954.50	<<The magic number.
10-22-2006	23:50:00	4956.12	4955.56	

I know that the tank level on SCADA can vary as much as 3 to 5 gallons sometimes as U watch the level. This is an electronic problem. At least it takes the operator error out of the calculation.

POLYMER FEED SYSTEM

Determining Liquid Polymer Pump Feed Rate

Procedure

Use this procedure to determine the feed rate for the liquid polymer pump. The feed rate takes into consideration the aging tank size, solution strength desired, and the flow rate into the aging tank. The polymer is a concentrate and requires dilution in order to keep the metering pumps operating continuously. By following these procedures the operator can determine the correct feed rate for the polymer feed pump for various solution strengths and or a change in water service to the polymer system..

10. The system parameters needed to calculate for the feed rate for the liquid polymer pump are listed below:
    - 10.1. A = Density of the water. (8.34 #/gal)
    - 10.2. B = Aging tank capacity between high & low probes. (250 gallons)
    - 10.3. C = Desired percent solution strength (Currently .5 %)
    - 10.4. Q = Flow rate of the water supply. (Currently adjusted for 15 GPM)

10.5. S = Sum of the post and pre flush timers. (Currently set at .75 minutes)
10.6. P = Density of polymer (9.6 #/gal)

11. Using the variables above and following the formula below you can determine pounds per minute of polymer required for the desired solution.

11.1. lbs./min. of polymer = B **x** A **x** C **/** [((B/Q) **–** S) **x** 100]
11.2. Example: **#/min. = (250 gals) * (8.34#/gal)*(.5%)**
(250 gals) - .75 min.)*100
15 gpm
#/min. = .6548

12. Use the formula below to convert the pounds per minute of polymer into gallons per minute.

12.1. Gals/min. = lbs./min. of polymer / P
12.2. Using above example: **Gals./Min = .6548 #/min**
9.6 #/gal
Gals./Min = .0682

13. To convert gallons per minute of polymer to milliliters per minute use the following conversion formula.

    13.1. ml/min. = Gal./min. x 3785 ml/gal
    13.2. Using above example: **Mls/min.= .0682 gals/min. * 3785 mls/gallon**

Mls/Min. = 258.18

14. Once the feed rate for the liquid polymer pump has been determined. The liquid polymer pump can now be adjusted for the correct feed rate. To adjust the pump follow the procedures for calibrating liquid polymer pump.

15. **Note**: As long as tank capacity = 250 Gallons, water supply flow rate = 15 GPM, and the internal timers stay set at 0.75 minutes. You can use this equation:

    15.1. ml/min = (desired concentration) * 51647.41.

Example: Desired Solution strength = 0.5%: (0.005) * 51599.74 = 258 ml/min

POLYMER FEED SYSTEM

Changing Polymer Drum

Procedure

Use this procedure when the operator wants to remove an empty polymer drum and replace with a new one. The polymer drum should be replaced when the level in the drum reaches about one or two inches. To replace the drum proceed as follows:

16. On the Polymer system control panel place the following switches as follows:
    16.1. Liquid polymer pump HOA switch from “Auto” to “Off” position
    16.2. System control HOA switches from “Auto” to “Off” position.

17. Disconnect the black tubing from the liquid polymer pump where it connects to the water fill line on the polymer-aging tank.
    17.1. Slide the nut and rubber washer up the tube to prevent losing.

18. Take the tubing and run it into the top of the new drum making sure that it’s secured or it will come out and create a mess on the floor.
    18.1. Record the amount of polymer left in the empty drum before removing measuring stick.

18.2. Tilt the empty drum over and position the pump suction line on the tilted end.

19. Start the liquid polymer pump by turning the HOA switch to the “hand” position. When the pump first comes on the tubing may come out of the new drum.

20. At this point the remaining polymer in the drum will be transferred to the new drum.

21. When the remaining poly has been transferred to the new barrel, as indicated by the presence of air in the clear pump suction tube, place the HOA switch for the liquid polymer pump in the “off” position.

22. Removed the measuring stick from the empty drum and place the new drum in the same location.
    22.1. Record the amount of polymer in the new drum.

23. Remove the polymer pump clear tubing suction line and barrel cap from the empty drum and install in the new drum.

24. Verify that the black discharge tubing is still secured on the new drum. Start the poly pump by turning HOA switch to “hand”.

25. This step is used to remove any trapped air that may be in the suction line.

    25.1. May have to move the suction tubing around to get all the air removed from the line.

26. When all the trapped air has been removed from the suction line then remove the black discharge line from the top of the new drum and reinstall it back to the inlet water line to the aging tank.

    26.1. Ensure that the nut and rubber gasket on the end of the tubing is still in place on the tubing.

27. On the Polymer system control panel return all switches back to Auto.

    27.1. Liquid polymer pump HOA switch from “Off” to “Auto” position
    27.2. System control HOA switches from “Off” to “Auto” position.

28. At this point the new drum has been changed and is ready for operation.

29. Locate the “Polymer Usage Sheet” which is kept on the clipboard usually kept on top of the polymer control panel.

    29.1. Enter the following data on the form and calculate PPM for the drum.
        29.1.1. Ending totaled filter flow total.

29.1.2. Beginning totaled filter flow total

29.1.3. Total number of poly gallons used from the empty drum. Make sure you subtract the amount remaining in the empty drum that was transferred to new drum.

29.1.4. Calculate the PPM for the drum.

30. Clean up any spilled polymer on the floor and wipe down the drum top and the suction hose..

31. Remove and flush out the empty drum to recycling.

POLYMER USAGE LOG SHEET

On Date	Poly Gals	Total Filter Flow	Off Date	Total Filter Flow	Total Water Used MGD	Poly Dose PPM	

Drum PPM = $\frac{\text{Polymer gals} * 9.6\ \#/gal}{MGD * 8.34\ \#/gal}$

POLYMER FEED SYSTEM

Calibrating Metering pump

Procedure

Use this procedure when the operator wants to check, change, or determine the dose rate for the current feed rate of the polymer feed pumps. This check is performed each time there is a plant production change or the dose rate requires changing. The piping is changed to connect a graduated cylinder to the metering pump. The draw down of the graduated cylinder is then timed for a two (2) minute period to determine feed rate. A stop-watch will be required for this test.

32. Fill the graduated cylinder that is above the solution tank with water.
    - 32.1. The cylinder can be filled with water by opening the valve on the water supply line that is connected to the tubing.
    - 32.2. Fill the cylinder above the 2000 ml mark.

33. Switch pump suction piping from solution tank to graduated cylinder. Operate these valves:
    - 33.1. Close valve PS-1
    - 33.2. Open valve PS-2.

34. The on-line polymer pump will start to remove water from the graduated cylinder. When the water level reaches the 2000 ml mark start the stop watch to time the draw down.

35. When two minutes has elapsed, switch the valves back to normal.
    - 35.1. Close valve PS-2
    - 35.2. Open valve PS-1
    - 35.3. Note the amount of water removed from the graduated cylinder.

36. To determine the feed rate of the polymer pump divide the volume of water removed in the cylinder by 2. The result will be the ml's per minute feed rate of the metering pump.

37. Compare the pump feed rate with the required dose rate setting. If they are the same the chemical feed pump is adjusted properly. If the feed rate is more or less then the plant setting then adjust the chemical feed pump to match plant setting.
    - 37.1. To adjust the pump, turn the black adjusting knob counterclockwise to decrease the pump output and clockwise to increase the output.
    - 37.2. There are approximately 40 ml's per turn of the adjusting knob.

38. After increasing or decreasing the pump output then return to step 1 and repeat the procedure until the feed rate is the required amount. Do the same procedure for the other pump if required.

39. When both pumps are adjusted, verify that the polymer pumps are connected back to the polymer solution tank rather then the graduated cylinder. Failure to do so will result in no polymer feed while the plant is on-line.

40. To calculate the dose rate of the polymer pump do the following:
    40.1. Determine the number of ml's per minute from step 5.
    40.2. Record the totalized plant flow rate in Millions Gallons per Day (MGD).
    40.3. Use the below formulas below to calculate dose rate:

Polymer Pump Feed Rate:

$$\text{ML/Minute} = \frac{(\text{poly,ppm})(\text{Infl. Flow,mgd})(8.34\text{lb/gal})(3785\text{ ml/gal})}{(9.6\text{ \#poly/gal})(1440\text{ min./day})(\%\text{Solution in Decimal})}$$

Polymer Dose Rate:

$$\text{PPM Poly} = \frac{(\text{mls/min. Poly})(1440\text{min./day})/(3785\text{ mls/gal})(9.6\#/\text{gal})(\%\text{solution}}{(\text{Infl.Flow, mgd})(8.34\ \#/\text{gal})}$$

    40.4. Record the dose rate on the plant daily sheet.
    40.5. Compare the pump dose rate with the plant setting. If they are the same the chemical feed pump is adjusted properly. If the dose rate is more or less then the plant setting then adjust the chemical feed pump to match plant setting.
        40.5.1. The dose rate will then be checked again the next work day.
        40.5.2.

Figure 3.7-6

Soda Ash System Schematic

3.7.8 Chlorine

Chlorine gas is used as a disinfectant for the treated water. Chlorine gas is fed at various locations during water treatment. The locations are summarized as follows:

- Screenhouse: Water is prechlorinated to reduce algae in the treatment processes and as a coagulant aid.
- Whatcom Falls Reservoir No. 2: This is the primary feed location. The reservoir is large enough to meet CT requirements. The water is disinfected to kill bacteria and deactivate viruses and cysts.
- Trim Chlorinator: The chlorine residual is increased, if necessary, to maintain the target 0.6 mg/l to the system.
- Industrial Pipeline: The water transmitted down the industrial pipeline is chlorinated depending on the needs of Georgia-Pacific. The target residual is currently about 1.0 mg/l.

Chlorine is purchased in ton containers. The ton containers are cylindrical and contain about 4,000 pounds of chlorine. Two chlorine scales are provided, each with a capacity of 4 containers. A vacuum regulator is mounted on each container. All chlorine gas piping carries the gas under a slight vacuum. This prevents significant leakage in the event of a piping break. The vacuum is maintained by the chlorine ejectors at the various feed points. The amount of chlorine that can be withdrawn from the ton containers without frost forming on the containers is dependent on air temperature and humidity. The allowable withdrawal can be estimated using 8 pounds per day per degree Fahrenheit (based on information from vendors and the Chlorine Institute). This allowable withdrawal can be greatly exceeded for short periods of time. For example, 4 containers at 20°F will produce up to 640 lbs/day. A schematic of the chlorine feed system is shown in Figure 3.7-7.

The screenhouse and trim chlorinators have an ultimate capacity of 500 pounds per day and are currently capable of feeding 200 pounds per day. The reservoir and industrial chlorinators have an ultimate capacity of 2,000 pounds per day. The indistrual chlorinator and one reservoir chlorinator have a capacity of 500 lb/day. The remaining reservoir chlorinator (No. 3) has a capacity of 2,000 lb/day.

The screenhouse chlorinator feed rate is set manually by the operators. The chlorinator and WonderWare (the plant control software) are capable of automatic control and the feed rate could be flow paced by WonderWare based on plant influent flow.

The reservoir chlorination feed rate is selected by the operator. A residual analyzer monitors chlorine residual downstream of the feed point. The chlorinator and WonderWare are capable of automatic control and the feed rate could be residual paced by WonderWare.

The trim chlorinator is set manually by the operators or residual paced by the treated water chlorine residual. Chlorine is fed whenever the residual to the system falls below 0.6 mg/l.

The industrial chlorinator feed rate is set manually by the operators using WonderWare. The current feed rate is 1.0 mg/l. The chlorinator and WonderWare are capable of automatic control

and the feed rate could be flow paced, if desired. The industrial pipeline is chlorinated in the vault north of the treatment plant garage.

A feed point selection manifold for the reservoir is located in the Chlorination Manifold Vault. Also located in the vault are the reservoir ejectors, the reservoir sample pump, and the reservoir outlet sample pump. The chlorine feed point and sample line are selected by opening a matched pair of feed point/sample point ball valves. Selection of a different feed point must be approved by the Water Plant Chief Operator.

The emergency chlorine feed to the clearwell is only to be used when the Whatcom Falls Reservoir No. 2 is out of service.

The Reservoir Outlet Sample Pump and the Reservoir Sample Pump discharge lines may be disinfected with chlorine solution by turning appropriate valves in the Chlorination Manifold Vault. Equipment connected to the sample line may be damaged by high chlorine concentrations. This equipment includes pressure gauges, pressure switches, pH sensors, turbidity meters, and chlorine residual analyzers.

Prior to disinfection of the sample lines, all isolation cocks or valves on the pressure gauges and switches should be closed. Equipment which could be damaged by chlorine solution should be taken off-line or isolated from being in contact with chlorine solution. When chlorination of sample lines is complete, turn on sample pump(s) for about 20 minutes to flush out concentrated chlorine solution. Then return all valves and equipment to their original position and location.

Figure 3.7-7

Chlorination System Schematic

3.7.8 Chlorination System

System Description

The water filtration plant uses five (5) gas chlorinators to dispense chlorine solution to various injection points in the plant and adjacent to the plant.

Chlorinator #5 is used to inject a chlorine solution into the 48" industrial pipeline. This is a continuous feed operation and approximately 220 #ld is used. We try to maintain a residual of approximately 0.50 mg/L as the flow enters Georgia Pacific, which is about three (3) miles west of the plant.

Chlorinator #4 is currently used as the CT reservoir chlorinator. We use this chlorinaytor to feed anywhere from 50 to 100 #ld of chlorine solution to the #1 injection point inside of the CT reservoir. The #1 injection point is located inside of the CT reservoir at an area closest to the influent or just as the water enters via a 72" line from the water filtration plant. A resudual of about 0.60 mg/L is maintained at the #1 injection point.

Chlorinator #3 is our stand-by or as currently labeld - our off-line chlorinator. This chlorinator can be used to take the place of any of the other chlorinators.

Chlorinator #2 is used to inject a chlorine solution to both of the 48" raw water lines located in the basement of the screenhouse. The scsreenhouse is located 400 yeards east of the water treatment plant. A feed rate of 30-50#ld is normally used to maintain a residual of approximately 0.07 to 0.12 mg/L.

Chlorinator #1 is used to inject a chlorine solution into the 60" effluent line from the CT reservoir. The injection point is about sixty feet (60') downstream from the 60" flow meter and sample pump #9^{s} suction line. We maintain a target residual of 0.65 mg/L at this point. lFeed rates vary with the flow but normal rates are 50-150#ld.

<u>Normal Positions of Valves: Chlorinator Room</u>

Under normal conditions of operation the following valve positions are observed in the chlorinator room.

2. Chlorinator #5 (industrial)

    E. clg/c-5 is open
    F. clg/H-14 is open
    G. clg/H-13 is closed
    H. clg/H-15 is open

2. Chlorinator #4 (CT reservoir)

    A. clg/C-4 is open
    B. clg/H-11 is open
    C. clg/H-13 is closed
    D. clg/H-10 is closed
    E. clg/H-12 is open
    F. clg/H-9 is closed

3. Chlorinator #3 (off-line)

    A. clg/C-3 is closed
    B. clg/H-8 is closed
    C. clg/H-7 is closed
    D. clg/H-10 is closed
    E. clg/H-4 is closed
    F. clg/H-9 is closed

4. Chlorinator #2 (pre-screenhouse)

    A. clg/c-2 is open
    B. clg/h-5 is open
    C. clg/h-7 is closed
    D. clg/h-3 is closed
    E. clg/h-6 is open

5. Chlorinator #1 (trim)

    A. clg/c-1 is open
    B. clg/h-1 is open
    C. clg/h-4 is closed
    D. clg/h-2 is open

<u>Normal position of valves = chlorine manifold room</u>

Under normal conditions of operation, the following valve positions are observed in the chlorine manifold room.

1. Automatic Switch Over Module

    A. clg/T-1 is open
    B. clg/T-2 is open
    C. clg/T-3 is open
    D. clg/B2-5 is closed
    E. clg/B2-6 is open
    F. clg/B1-5 is closed
    G. clg/B1-6 is open

2. Chlorine Ton Container Manifold

    A. If Bank #1 is on-line, then the following valves are open

        1) clg/B1-1 is open
        2) clg/B1-2 is open
        3) clg/B1-3 is open
        4) clg/B1-4 is open

    B. If Bank #1 is full and tested okay, then the following valves are open

1) clg/B1-1 is open
2) clg/B1-2 is open
3) clg/B1-3 is open
4) clg/B1-4 is open

C. If Bank #1 is empty, then the following valves are closed:

1) clg/B1-1 is closed
2) clg/B1-2 is closed
3) clg/B1-3 is closed
4) clg/B1-4 is closed

3. Cont. chlorine Ton Container Manifold

A. If bank #2 is on-line, then the following valves are open

1) clg/B2-1 is open
2) clg/B2-2 is open
3) clg/B2-3 is open
4) clg/B2-4 is open

B. If bank #2 if full and tested okay, then the following valves are open:

1) clg/B2-1 is open
2) clg/B2-2 is open
3) clg/B2-3 is open
4) clg/B2-4 is open

C. If bank #2 is empty, then the following valves are closed:

1) clg/B2-1 is closed
2) clg/B2-2 is closed
3) clg/B2-3 is closed
4) clg/B2-4 is closed

4. Valve positions for chlorine gas lines feeding the trim, clearwell and ct injectors located in the basement of WTP. Under normal conditions the following valves are closed:

A. clg/X-1 is closed
B. clg/X-2 is closed
C. clg/CW-1 is closed
D. clg/CW-2 is closed
E. clg/Cw-3 is closed

3. Start up of chlorination system

B. Industrial chlorinator: Chlorine gas is fed from the one ton containers to the industrial chlorinator through the automatic switchover module. All the valves should be in the "normal operations" position. Before feeding gas into the industrial chlorinator, the water supply to the injector must be turned on. The injector for the industrsial chlorinator is

located in front of the plant in a vault directly above the 48" industrial water line. The valve for the water supply is located in the industrial injector vault. After the water supply is on, then the valve #clg/C-5 may be turned on, thus allowing cl_2 gas to enter the chlorinator.

The industrial chlorinator can be operated either manually or automatically. In manual, the chlorinator is placed in the manual mode and athe flow adjustments are made at the controller located on the front of the chlorinator. In the auto mode, adjustements to the flow of chlorine can either be made at the controller or at the in-touch console. Currently, the industrial chlorinator is operated in the auto mode and adjustments in flow are made either at the controller or the in-touch. The industrial chlorinatoar is not controlled via SCADA. If power fails, then we can use the by-pass mode - simply open the black knob in front of the chlorinator to the desired setting.

B. CT Reservoir Chlorinator: Chlorine gas is fed from the one ton containers to the CT reservoir chlorinator (#4 chlorinator) through the automatic switchover module. All the valves should be in the "normal operations" position. Before feeding gas into the CT reservoir chlorinator, the water supply to the injector must be turned on. The injector is located inside of the chlorine manifold vault (cmv) and the water supply's valve is located in front of the DYPS (Dakin & Yew Pump Station). After the water supplyt is turned on then the valve #CLG/C-4 may be turned on thus allowing chlorine gas to enter the chlorinator

   The CT resevoir chlorinator can be operated either manually or automatically. In manual, the chlorinataor is placed in the manual mode and the flow adjustments are made at the controller located on the front of the chlorinator. In the auto made, adjustments to the flow of chlorine can either be made at the controller or at the in-touch console. Currently, the CT reservoir chlorinator is operated in the auto mode and adjustments in flow are made either at the controller or the in-touch console. The CT reservoir chlorinator is not controlled via SCADA.

C. Off-line chlorinator: This chlorinator is used as a back up for any of the other four chlorinators. It's use will be explained later.

D. Screenhouse (Pre) Chlorinator: Chlorine gas is fed from the one ton containers to the screenhouse (pre) chlorinator (#2 chlorinator) through the automatic switchover module. All the valves should be in the "normal operations" position. Before feeding gas into the screenhouse (pre) chlorinataor, the water supply to the injector must be turned on. The injector is located in the basement of the screenhouse and so is the water supply valve. After the water supply valve is turned on, then the valve #CLG/C-2 may be turned on thus allowing chlorine gas to enter the chlorinator. The screenhouse (pre) chlorinator can be operated either manually or automatically. In manual, the chlorinator is placed in the manual mode and the flow adjustments are made at the controller located on the front of the chlorinator. In the auto mode, adjustments to the flow of chlorine can either be made at the controller or at the in-touch console. Currently, the

screenhouse (pre) chlorinator is operated in the auto mode. The screenhouse (pre) chlorinator is not controlled via SCADA.

E. Trim chlorinator: Chlorine gas is fed from the one ton containers to the trim chlorinator (#1 chlorinator) through the automatic switchover module. All the valves should be in the "normal operations" position. Before feeding gas into the trim chlorinator, thw water supply to the injector must be turned on. The injector is located in the chemical feed vault in front of the DYPS (Dakin & Yew Pump Station) and so is the water supply valve. After the water supply valve is turned on, then the valve #clg/C-1 may be turned on thus allowing chlorine gas to enter the chloriantor. The trim chlorinator can either be operated manually or automatically. In manual, the chlorinator is placed in the manual mode and the flow adjustments are made at the controller located on the front of the chlorinator. In the auto mode, adjustments to the flow of chlorine can either be made at the controller or at the in-touch console. Currently, the trim chlorinator is operated in the automatic mode. The trim chlorinator is the only chlorinator that is operated also via SCADA.

6. Shut down of individual chlorinators

A. If any chlorinator, for any reason, needs to be put in an **off-line** status, then the gas valve (either clg/C-1, clg/C-2, clg/C-3, clg/C-4 or clg/C-5 must be turned off first.

B. When the rotometers ball has completely dropped to the bottom, then the chlorinators water supply valve may be shut-off.

3. Abnormal conditions

E. If the industrial chlorinator failed or needed to be taken o/s for maintenance, then the CT reservoir chlorinator would be used to take its place. To replace the CT reservoir chlorinator, the #3 or the off-line chlorinator would be used. Since the industrial chlorinator has a 500 #ld rotometer and the CT reservoir chlorinator has a 100 #ld rotometer, a setting of 100 #ld would be used for industrial chlorination. This represents somewhat less than one half the normal output of chlorine to the industrial line, so Georgia Pacific Corporation must be called saying the reason why the industrial chlorinator is out of service and they must be told how much chlorine per day will be flowing to the industrial line. Also, an estimated time of how long this situation will last must also be given to the Georgia Pacific Corporation.

F. If the CT reservoir chlorinator were to fail or go out of service for maintenance, then the industrial chlorinator would take its place and we would not feed any chlorine to Georgia Pacific Corporation. In this scenario, Georgia Pacific Corporation again would be notified with the same information as in A (above).

If the CT reservoir chlorinator were to fail or go out of service for maintenance, tehn the #3 (off-line) chlorinator would take its place.

C. If the screenhouse (#2) chlorinator were to fail or go out of service for maintenance, we would not replace it and there would be no chlorination of the screenhouse until failure was remedied an out of service condition was returned to normal.

D. If the #1 (trim chlorinataor were to fail or go out of service for maintenance, then the pre (#2) chlorinator would take its place and we would not feed any chlorine solution to the screenhouse for prechlorination until the trim (#1) chlorinator were placed back into service.

E. “Feeding a chlorine solution to the clearwell.”

1) To feed a chlorine solution to the clearwell using the CT reservoir’s two inch gas feed line requires some valve alterations:

    a) Valve #clg/CW-2 must be opened
    b) Valve #clg/CW-3 must be opened
    c) Valve #clg/CW-1 must be opened
    d) Valve #clg/X-2 must be opened

At this point, CL_2 gas will be flowing to the CW ejector and a chlorine solution will then be flowing to the clearwell. At this point, if so desired, the CLG valve (1” X 1 1/2”) located in the chlorine manifold vault (CMV) may be closed. With the (1” x 1 1/2”) CLG valve clossed, chlorine solution will be feeding only the CW, not the CT reservoir.

F. To feed a chlorine solution to the CW using the trim chlorinators 1” gas line requires some valve alterations:

    a) Valve #clg/CW-2 must be opened
    b) Valve #clg/CW=3 must be opened
    c) Valve #clg/CW-1 must be opened
    d) Valve #clg/X-1 must be opened

At this point, CL2 gas will be flowing to the CW ejector and a chlorine solution will then be flowing to the clearwell. At this point, if so desired, the CLG valve, then the water supply valve located in the chemical feed vault may be closed. With both of these valves closed, chlorine solution will be feeding only the CW, not the trim feed point in the 60” line.

G. Valve sequencing for switching chlorinators

1) To replace the industrial chlorinator with the CT reservoir chlorinator - close clg/C-5, close clg/H-14, close clg/H-12, open clg/H-13. Last, close the water suply valve at the industrial injector area, inside the vault.
2) To replace the CT chlorinator with the off-line chlorinator, close clg/C-4, open clg/C-3, close clg/H-11, open clg/H-8, open clg/H-10.
3) To replace the trim chlorinator with the screenhouse (pre) chlorinator - close clg/H-1, open clg/H-3.

8. Application of chlorine solution in the CT reservoir, and sampling points in the CT reservoir.

    A. There are nine chlorine solution application points within the CT reservoir. The #1 point being closest to the influent and the #9 point being closed to the effluent. The numbers 2 through 8 sample points are equally dispersed between the #1 point and the #9 point.

        Refer to CT sample locations drawing.

3.7.9 Powdered Activated Carbon (future section)

Purpose
Photographs
History
Current facilities
Feed locations
Feed rates

3.7.10 Partical Counter Verification

CHEMTRAC PC2400D PARTICLE COUNT VERIFICATION

REFERENCE

Chemtrac PC2400D Operations Manual

SAFETY

Use appropriate personal protective equipment and take all precautions as required by the Chemical Hygiene Plan. Read and understand all applicable MSDS's.

SUMMARY OF METHOD

This method provides a verification of particle counter accuracy at similar particle count ranges that the City of Bellingham Water Treatment Plant normally operates at. It is designed to accompany sensor cleaning and can be used for troubleshooting circumstances as well as for regular accuracy checks.

EQUIPMENT

Chemtrac cleaning brush (part # 06578)
1 Gallon distilled (nursery) water (available at Fred Meyer's)
3 feet of new, clean Nalgene 1/8 inch PVC tubing
Modified gallon jug bottle cap
Stopwatch
60 cc syringe

PROCEDURE

1) Stop the flow of water through the sensor, remove the tubing from the flow cell and carefully clean the sensor per operations manual using brush supplied by Chemtrac (part # 06578).
2) Re-connect the outlet tubing and connect approx. 3 feet of new, clean tubing to the sensor inlet.
3) Set a 1-gallon bottle of distilled (nursery) water on top of the particle counter, replace the cap with the cap modified for this purpose and feed the clean inlet tubing through the cap until it sits at approx. 1/2 to 2/3 the bottle depth.
4) Start siphon through the sensor by using the 60 cc syringe to apply suction to the outlet tubing. If necessary, elevate the distilled water further until flow through the

sensor approximates 100 ml/min (flow will decline as the bottle empties, but it isn't important for the purpose of this test.) Be sure there are no kinks in the tubing or blockages in the sensor inlet/outlet fittings.

5) After 5 minutes, begin tabulating particle channel counts above the 2 micron range for 10 complete count cycles (spreadsheet provided on next page). The average of total particle count per cycle (2 microns and higher) should be 5-50 per ml. If the total counts average > 50 particles/ml, the sensor is considered out of specification and should be sent to Chemtrac for calibration.
6) Stop the sample flow. Wait 1 minute and verify that the counts are zero in all size channels. If the count is > 0 particles/ml when no flow is running through the particle counter then the particle counter should be sent to Chemtrac for calibration.
7) Return the particle counter to service or send in for calibration as needed.

Chemtrac PC2400D Particle Counter verification spreadsheet.

Date: Time: Part. Counter#	Channels						Total Cycle Counts
Cycle (Start @ 5 min.)	2-3 µm	3-5 µm	5-10 µm	10-15 µm	15-100 µm	> 100 µm	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
Initials:	Notes:				**AVERAGE OF ALL TOTAL CYCLE COUNTS:**		

3.7.11 Plant Clearwell

PLANT CLEARWELL DRAINING with CHLORINE RESIDUAL

Use this procedure if the Water Treatment plant clearwell is to be drained for routine maintenance. These procedures are assuming that the distribution system reservoirs and the demand for water is such that the plant can be shut down**.**

1. Setup, Week prior to shutdown:
   1.1. Start filling Whatcom Falls #2 reservoir. **Date started**:_____
   1.2. Pre-shut down meeting with water distribution crews. Explain task at hand.
   1.3. Switch chlorine feed to CT Reservoir location #1
      1.3.1. Set up chlorine residual monitoring for location #2 in CT reservoir using sample pump #7. **Task Completed:_____**
      1.3.2. Switch chlorine feed from clearwell to CT reservoir injection location #1. **Task Completed & Record Time:_____**
      1.3.3. Shut down Clearwell Injector. _____
      1.3.4. It takes about 3 hours from time of switching feed location to see it on the chlorine analyzer. **Estimated time:_____Actual Time:_____**
      1.3.5. Install new labels on chlorinators and analyzer for new feed & sample locations.
      1.3.6. **Rule of thumb for initial chlorine feed setting**: Once CW chlorine feed is stopped, gradually increase chlorine feed to CT reservoir location #1 to eventually equal the combined feeds of the CTin and trim chlorine. Monitor after the for correct residual, reducing trim to eventually achieve a trim feed of zero. **Note:** You will be adding enough chlorine at location #1 to yield the final chlorine residual going to distribution on the CT out location of the reservoir.
      1.3.7. Gradually reduce pre-chlorine feed, compensate by increasing CTin feed, as needed. Approximately 12 hours prior to shut down, stop pre-chorine feed, increasing CTin Cl feed, as needed to maintain desired residual for distribution.
2. Shutdown Day Date:_____

   2.1. Prior to shutting down the plant. Do the following:
   2.2. Note the Headloss of each on-line filter. (Filters with headloss between 3 & 6 feet of headloss will be placed back in service on plant startup)

#1	#2	#3	#4	#5	#6

   2.3. Record the following:
      2.3.1 Alum pump SPEED (RPM) _____
      2.3.2 Poly pump %SPEED SP _____
      2.3.3 CT-in chlorine & pre-chlorine SCADA set points & actual feed rates.
      CT-in SCADA_____ CT-in actual_____
      Pre SCADA _____ Pre actual _____

   2.4. Have the Post Point Day Op. do the following:
      2.4.1 Send an “off” command on SCADA to shut off all on-line filters. Depending on the number of filters to shut down this could take several minutes. SCADA has

to see the READY indication on the filter before it will allow you to send another "off" command.

2.4.2 **Leave the soda ash system in operation.**

2.4.3 Send an "off" command on SCADA to the following:

On-line alum & poly pumps

Flash mixer, if using rapid mix #1.

2.5. While the Day Op. is performing item #2.4, go down stairs:

Record the plant influent valve/s % open & Flume Level (use as a reference for restart).

Influent #1 %	Influent #2 %	Flume Level

2.6. Close the influent valves; first locally then manually, to assure they close fully. (If these valves are not closed, raw water with chlorine and alum will overflow into Whatcom Creek.)

2.7. Shut the gas off to the CT-inlet chlorinator (clearwell) and the Screenhouse chlorinator. Leave trim Cl available, in case it's needed.

2.8. Place all filters "Out of Service" at the filter consoles.

2.9. The plant is now shut down and ready for maintenance.

2.10. Record plant shut time:_____

3. Test TOTAL chlorine residual in clearwell. Have lab personnel verify 'non-detect'.

4. Shut off clearwell sample pump (#10).

5. Operate the following valves is this order:

5.1.(Note: The reference to red and blue operator is referring to the color of the valve stem outside the plant.)

5.2. Close V83283-06 (CW to Ct line)(**crank hard** to close tight)

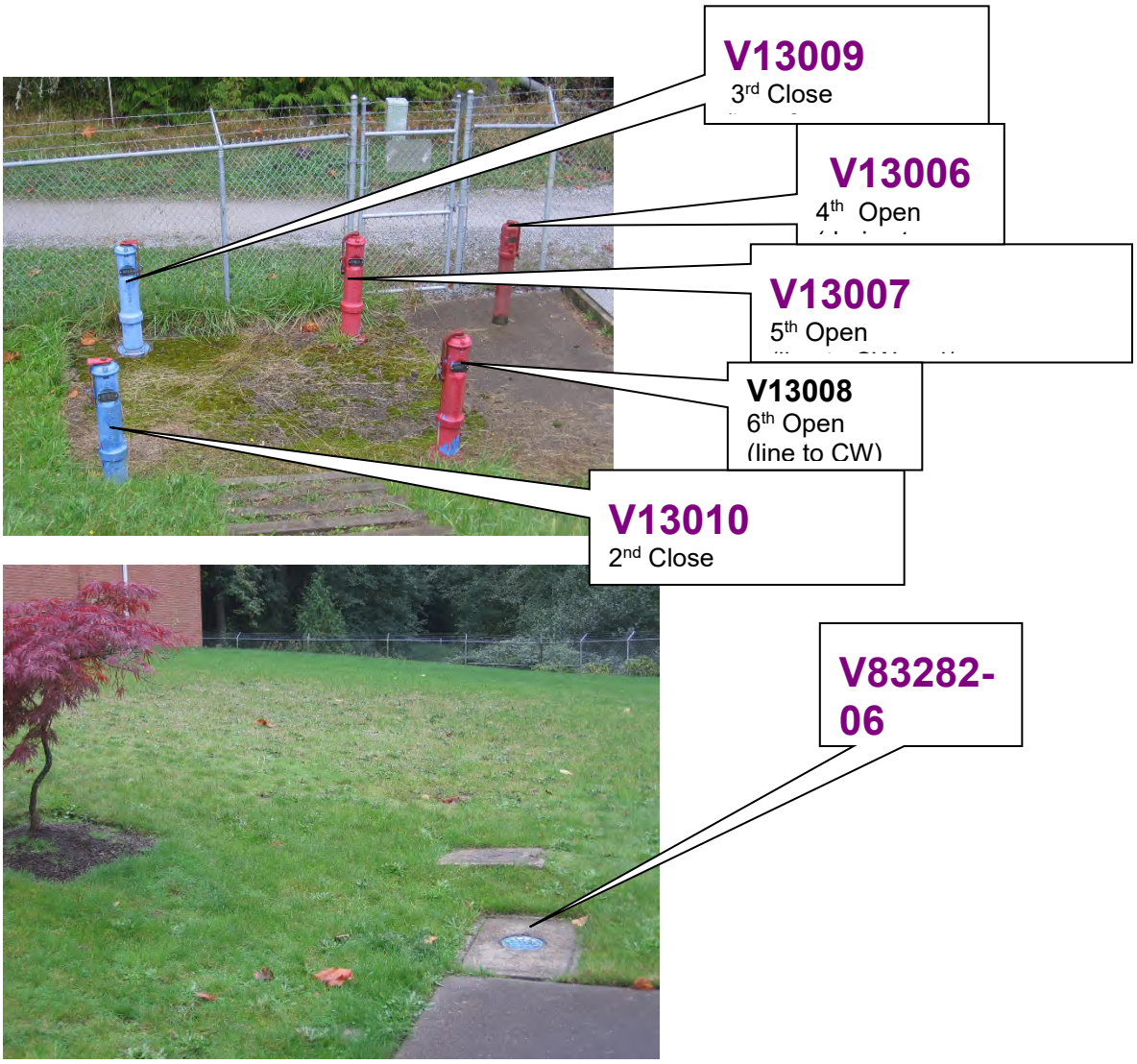
5.3. Close V13010 – Blue operator ("dead loop recirc")

5.4. Close V13009 – Blue operator ("dead loop recirc")

5.5. Open V13006 – Red operator (If not already open, CW **drain to creek**)

5.6. Open V13007 – Red operator (CW drain)

5.7. Open V13008 – Red operator (CW drain)



6. Wash selected filter(s) to use up water in the clearwell.
   6.1. Do not let the clearwell level drop below **4 ft** while using the backwash pumps.
   6.2.The clearwell is now draining to Whatcom creek. **(From the 5 foot level it will take 7 hours to drain.)**

7. The clearwell is now empty and ready for scheduled maintenance.

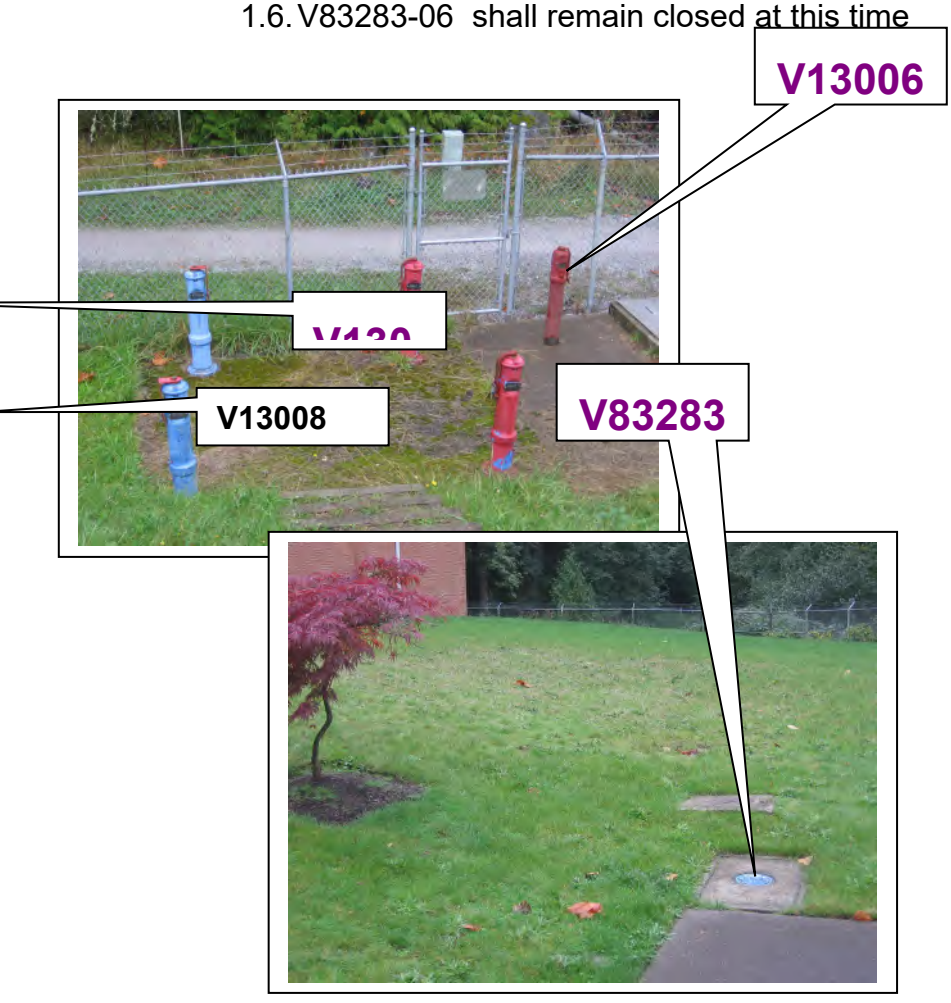
8. Refer to refilling procedure with empty clearwell when ready to go back into service.

WATER PLANT STARTUP WITH EMPTY CLEARWELL

Use this procedure if the Water Treatment plant was shut down and the plant clearwell was drained for routine maintenance. These procedures assume that the plant was shut down under normal circumstances.

By following the sequence of steps below the plant can be returned to service without having a large turbidity spike on the combine filter effluent (clearwell). The goal of this procedure is to keep the clearwell turbidity from going above .10 ntu during a plant startup.

1. Operate the following valve in this order: (Refer to drawing below for locations)
   1.1. V13006 open – Red operator
   1.2. V13007 closed – Red operator
   1.3. V13008 closed – Red operator
   1.4. V13009 open – Blue operator
   1.5. V13010 open – Blue operator
   1.6. V83283-06 shall remain closed at this time



2. If the chlorine feed was switched to the CT reservoir prior to draining the clearwell, then the chlorine must be switched back to the plant on startup. Refer to chlorine section for procedures.

3. Verify on SCADA that all the filters indicate “Out of Service”. Block the clearwell effluent turbidity.

4. Using Scada reset back to a ready condition the filters that are going to be placed back on-line. The plant should have been set up for 3 filters on-line prior to shutdown. Use filters 3 or 4 and 5 & 6.

5. These filters are used because they are at the end of the flume and will allow the flume to be filled with the proper coagulated water.

7. Calculate the chemical ml per minute feed rate for what the plant production rate was prior to the plant shut down. Divide the ml per minute value by the number of filters that were on-line. Example: Alum 440 tot ml’s/ 3 filters =147 ml’s/minute. For each filter on-line the alum should be increased by 147 ml’s. (If poly system is in operation then do the same calculations.)

8. Adjust the chemical feed pumps (alum & poly) and the pre and CT-inlet chlorine feed rate for a flow of **one** filter. Record the ml’s per minute feed rate of alum and poly so that you have a starting point in which to use the 40-ml’s per turn rule.

9. Manually open and adjust a plant influent valve to 1/3 the percent that it was open prior to shut down. This valve may have to be adjusted up or down to maintain the proper flume level.

10. On one of the filters reset earlier to a ready condition, open up the filter to waste valve manually on the filter.

    10.1 During the filter-to-waste mode it is very important to monitor the waste disposal level in the pipe corridor.
    10.2 **DO NOT LET THE WASTE LEVEL GO ABOVE 5 FEET. WE CAN NOT OVERFLOW THE MANHOLES**.
    10.3 This mode of operation is to stabilize the dose rate of the raw water and to purge out any water which may have been over or under dosed.

11. Filter to waste for as long as it takes to let the filter stabilize A stable condition is where the particle counts for the filter are below 20 particle/ ml and the filter effluent turbidity is dropping below .06 ntu.

11.1 Check the SCM reference number to make sure that there is enough chemical going into the raw water.

11.2 The SCM reference number should be reading a positive 50 if the chemical feed pumps are adjusted correctly.

11.3 If the filter will not stabilize then increase the chemical feed.

12. If the filter has stabilized to the above water quality parameters. Have the Post point operator turn on the filter through SCADA. When SCADA indicates that the filter is in filter to waste mode (WTP display not showing blank in filter area). Go out to the filter console and switch the HOA switch for the filter to waste valve back into auto.

13. Adjust the chemical feed pumps (alum & poly) and the pre and CT-inlet chlorine feed rate for a flow of **two** filters. Record the ml's per minute feed rate of alum and poly so that you have a starting point in which to use the 40-ml's per turn rule.

14. Manually open and adjust the plant influent valve to 2/3 the percent that it was open prior to shut down. This valve may have to be adjusted up or down to maintain the proper flume level.

15. On another filters reset earlier to a ready condition, open up the filter to waste valve manually on the filter.

15.1 Again while in the filter to waste mode keep an eye on the waste level.

16. Filter to waste for as long as it takes to let the filter stabilize. A stable condition is where the particle counts for the filter are below 20-particle/ ml and the filter effluent turbidity is dropping below .06 ntu.

17. If the filter has stabilized to the above water quality parameters. Have the Post point operator turn on the filter through SCADA. When SCADA indicates that the filter is in filter to waste mode (WTP display not showing blank in filter area). Go out to the filter console and switch the HOA switch for the filter to waste valve back into auto.

18. While the plant is stabilizing with two filters in operation. Depending on the flow rate of the filters, **allow the clearwell to fill up to the three foot level before adding another filter. The wood baffles in the clearwell may be blown out if too much water is added too quickly.**

18.1 Do not backwash any filters until the clearwell level is above 3 feet.

19. When the two on-line filters have stabilized to the levels previously mention. Adjust the chemical feed pumps (alum & poly) and the pre and CT-inlet chlorine feed rate for a flow of **three** filters.

19.1 The stroke on the alum pump can be adjusted by the 40 ml's per turn rule at this point.

20. Place the plant influent valves back into the auto position.

21. On another filters reset earlier to a ready condition, open up the filter to waste valve manually on the filter.
21.1 Again while in the filter to waste mode keep an eye on the waste level.

22. Filter to waste for as long as it takes to let the filter stabilize. A stable condition is where the particle counts for the filter are below 20-particle/ ml and the filter effluent turbidity is dropping below .06 ntu.

23. If the filter has stabilized to the above water quality parameters. Have the Post point operator turn on the filter through SCADA. When SCADA indicates that the filter is in filter to waste mode (WTP display not showing blank in filter area). Go out to the filter console and switch the HOA switch for the filter to waste valve back into auto.

24. While the third filter is stabilizing reset and perform an off-line backwash of another dirty filter.

25. When the plant is back to full production rate check the alum and poly pump feed rate to make sure that they are feeding at the proper dose.

26. When the clearwell level reaches the 6 foot level then the valve between the CT reservoir and the clearwell can be opened. V83832-06. However, If the CT reservoir water level is at a higher elevation (above 15 feet) then the clearwell level, then wait until the clearwell level is the same as the CT reservoir level before opening the valve.

26.1 Open valve V83283-06 when clearwell level matches CT reservoir level or if CT reservoir level is below 15 feet.

26.2 Startup the clearwell sample pump # 10 and have the operator unblock the combined filter effluent turbidity.

WTP SHUT DOWN

CLEARWELL MAINTENANCE

SAFETY

LOCKOUT/ TAGOUT

DATE	ACTION
	Screen House Raw Water Valve #1closed & locked out.
	Screen House Raw Water Valve #2 closed & locked out
	Plant Influent valve #1 closed valve & locked out.
	Plant Influent valve #2 closed valve & locked out.
	Confined space permit for flume work - Safety
	Drain down filter levels below influent valves
	Filter #1 Effluent valve & Influent Valve locked out.
	Filter #2 Effluent valve & Influent Valve locked out.
	Filter #3 Effluent valve & Influent Valve locked out.
	Filter #4 Effluent valve & Influent Valve locked out.
	Filter #5 Effluent valve & Influent Valve locked out.
	Filter #6 Effluent valve & Influent Valve locked out.
	Water distribution valves
	V83283-15 Tagged out – CT inlet valve – Drive vehicle open operator
	V13009 Locked out – 36-inch to distribution
	V13010 Locked out – 48-inch to distribution
	Chlorine gas lines to clearwell at injector locked/tagged out & Water
	Chlorine gas lines to Screen House at injector locked/tagged out &
	Run injector water several minutes to flush out chlorine solution in line.
	Backwash pumps locked and tagged out.
	Tag out Soda ash Solution line
	Sample Pump #10 (clearwell) Locked out

WATER PLANT SHUTDOWN

This procedure is to be used if the Water Treatment plant is to be shut down for routine maintenance. These procedures are assuming that the distribution system reservoirs and the demand for water are such that the plant can be shut down.

1. Prior to shutting down the plant. Do the following:
   1.1. Have Whatcom falls #2 (CT Res.) reservoir at 20 plus ft. Level @ shutdown. _____
   1.2. Note the Headloss of each on-line filter. (Filters with headloss between 3 & 6 feet of headloss will be placed back in service on plant startup)

#1	#2	#3	#4	#5	#6

   1.3. Record the following:
      2.3.4 Alum #3 % Speed SP _____ Motor speed (rpm) _____
      2.3.5 Alum #1 ml/min. _____ Alum #2 ml/min. _____
      2.3.6 SCM SP _____
      2.3.7 Poly #1 % Speed SP _____ Poly #2 % Speed SP _____
      2.3.8 CT-in chlorine & pre-chlorine SCADA set points & actual feed rates.
      CT-in SCADA_____ CT-in actual_____
      Pre SCADA _____ Pre actual _____

2. Have the Post Point Day Op. do the following:
   2.1. Send an "off" command on SCADA to shut off all on-line filters. Depending on the number of filters to shut down this could take several minutes. SCADA has to see the READY indication on the filter before it will allow you to send another "off" command.
   2.2. Enter a **zero** feed rate on SCADA to the Ct-in & Pre chlorinators. **Do not adjust the Trim or Ind.chlorine feed rates.**
   2.3. Send an "off" command on SCADA to the following:
      2.3.1. on-line alum & poly pumps
      2.3.2. Flash mixer, if using rapid mix #1.

3. While the Day Op. is performing item #2 go down stairs:
   3.1 Record the plant influent valve/s % open & Flume Level (use as a reference for restart).

Influent #1 %	Influent #2 %	SCADA' Flume Level LCP"
		Ft. | In.

   3.2 Watch the flume level closely. As the level starts to rise put the influent valve/s in manual & start closing the valve/s. (If these valves are not closed, raw water with chlorine and alum will overflow into Whatcom Creek.)

4. Place all filters "Out of Service" at the filter consoles.

5. The plant is now shut down and ready for maintenance.

6. Record plant shut down Date & Time: _____

Startup Set Point Table.

Date: _____ Time: _____ Initials _____

Filters	1	2	3	4	5	
Startup order, ie. 1st, 2nd						
Alum #3 % Spd SP						
Alum #3 Motor SP						
AL 1or2 ml/min.(40/turn)						
Poly 1 or 2 % Spd SP						
Clearwell Cl2 SCADA SP						
Pre Cl2 SCADA SP						
Inf Valve #___ % Open						
Start Time to Waste						
Start Time to Clearwell						

Circle each calculation as completed. (30)

Comments: _____

_____

_____

Date:_____

WATER PLANT STARTUP FOLLOWING NORMAL MAINTENANCE

Use this procedure if the Water Treatment plant was shut down for routine maintenance. These procedures are assuming that the plant was shut down under normal circumstances. By following the sequence of steps below the plant can be returned to service without having a large turbidity spike on the combined filter effluent (clearwell). The goal of this procedure is to keep the clearwell turbidity from going above .10 ntu during a plant startup.

1. Using SCADA reset back to a ready condition the filters that are going to be placed back on-line. The plant should have been set up for 3 filters on-line prior to shutdown. If possible only use filters 3 or 4 and 5 & 6.
   1.1. These filters are used because they are at the end of the flume and will allow the flume to be filled with the proper coagulated water.

2. Review the Pre & Clrearwell (CT in) chlorine feed rates & Alum pump #3 & Poly feed rates from the WTP Shutdown sheet. Divide these feed rates by the number of filters on-line prior to the shutsown. This will give you the Alum % speed SP's plus the motor speed rpm, the Poly % speed SP & the Pre & Clearwell (CT in) Chlorine feed rates for 1 then 2 then 3 & finally 4 filters. For Alum pump #3 the control will need to be in Manual to input the various % speed SP's. For Alum pumps 1 & 2 one complete turn on the stroke adjustment equals 40 ml/min Example: Alum pump #1 @ 440 tot ml's for 3 filters =147 ml/min. for each filter put back on-line. **Enter the data on the plant startup set point table Above**.

3. Start up plant flash mixer if using rapid mix tank #1 on SCADA

4. Manually open and adjust a plant influent valve to approximately 1/3 the percent that it was open prior to shut down. This will be for the 1st filter on-line. For each additional filter put on-line the needed percent openning will decrease. This valve needs to be adjusted up or down to maintain the proper flume level.

5. Select a filter with the highest headloss between 3 & 6 feet and furthest away from chemical injection location. Open the filter to waste valve manually using the correct HMI filter display.
   5.1. During the filter-to-waste mode it is very important to monitor the waste disposal level in the pipe corridor.
   5.2. DO NOT LET THE WASTE LEVEL GO ABOVE 5 FEET. WE CAN NOT OVERFLOW THE MANHOLES.
   5.3. This mode of operation is to stabilize the dose rate of the raw water and to purge out any water which may have been over or under dosed.

6. Filter to waste for as long as it takes to let the filter stabilize A stable condition is where the particle counts for the filter are below 20 particle/ ml and the filter effluent turbidity is dropping below .06 ntu.

6.1. Check the SCM reference number to make sure that there is enough chemical going into the raw water.
6.2. The SCM reference number should be reading a positive 50 if the chemical feed pumps are adjusted correctly.
6.3. If the filter will not stabilize then increase the chemical feed.
6.4. While your waiting for things to stabilize if there are other filters that need to be washed then wash them now. Keep an eye on the backwash deposal level while doing the backwashing.

7. If the filter has stabilized to the above water quality parameters. Have the Post point operator initiate a filter to waste cycle through SCADA. When SCADA indicates that the filter is in filter to waste mode (Usually indicated by blanks in filter area). Go out to the filter console and place the filter to waste control in auto on the HMI control screen for the filter.

8. Using SCADA, adjust the chemical feed pumps (alum & poly) and the pre and CT-inlet chlorine feed rate for a flow of **two** filters. Record the ml's per minute feed rate for alum and poly. Note: On the Encore pumps every 1% change in stroke equals approximately 12 mils/min. On the W&T pumps one complete turn on the stroke equals approximately 40-ml's per turn.

9. Manually open and adjust the plant influent valve to 2/3 the percent that it was open prior to shut down. This valve may have to be adjusted up or down to maintain the proper flume level.

10. Select a filter with the next highest headloss between 3 & 6 feet and furthest away from chemical injection location. Open the filter to waste valve manually using the correct HMI filter display.

    10.1. While in filter to waste mode. Keep an eye on the waste disposal level

11. Filter to waste for as long as it takes to let the filter stabilize. A stable condition is where the particle counts for the filter are below 20-particle/ ml and the filter effluent turbidity is dropping below .06 ntu.

12. If the filter has stabilized to the above water quality parameters. Have the Post point operator initiate a filter to waste cycle through SCADA. When SCADA indicates that the filter is in filter to waste mode (Usually indicated by blanks in filter area). Go out to the filter console and place the filter to waste control in auto on the HMI control screen for the filter.

13. While the plant is stabilizing with two filters in operation. Wash a dirty filter by resetting and performing an off-line backwash.

14. When the two on-line filters have stabilized to the levels previously mention. Adjust the chemical feed pumps (alum & poly) and the pre and CT-inlet chlorine feed rate for a flow of **three** filters.

14.1. The stroke on the W&T alum pump can be adjusted by the 40 ml's per turn or 12 mil's for the Encore pumps.

15. Place the plant influent valves back into the auto position.

16. On another filters reset earlier to a ready condition, open up the filter to waste valve manually on the filter.
16.1. Again while in the filter to waste mode keep an eye on the waste level.

17. Filter to waste for as long as it takes to let the filter stabilize. A stable condition is where the particle counts for the filter are below 20-particle/ ml and the filter effluent turbidity is dropping below .06 ntu.

18. If the filter has stabilized to the above water quality parameters. Have the Post point operator initiate a filter to waste cycle through SCADA. When SCADA indicates that the filter is in filter to waste mode (Usually indicated by blanks in filter area). Go out to the filter console and place the filter to waste control in auto on the HMI control screen for the filter.

19. While the third filter is stabilizing reset and perform an off-line backwash of another dirty filter.

20. When the plant is back to full production rate check the following:

20.1. Ensure the Alum and poly pump feed rates are feeding at the proper dose.
20.2. Verify that the plant flash mixer is on-line.
20.3. If using Alum pump #3, Place pump back in auto on SCADA

Alum Feed Rate:

$$\text{Ml/minute} = \frac{(\text{PPM Alum})\,(\text{Inf. Flow, MGD})\,(8.34\ \text{lb./gal})\,(3785\ \text{ml/gal})}{(\text{X lb. Alum/gal})\,(1440\ \text{min/day})}$$

X = This will be a variable, and will change with each shipment of Aluminum Sulfate. See "Operation Parameters" for Plant on first page of this book.

Alum Dosage:

$$\text{PPM Alum} = \frac{(\text{Alum, gal/day})\,(\text{X lb./gal})}{(\text{Inf. Flow, MGD})\,(8.34\ \text{lb./gal})}$$

X = This will be a variable, and will change wit each shipment of Aluminum Sulfate. See "Operation Parameters" for Plant on first page of this book.

3.7.11 Shut Down

3.8 INFLUENT, FILTER FLOW, AND BACKWASH CONTROL (future section)

3.8.1 Overall System

3.8.2 Influent Flow Contro

Influent Meter
Control Valves
Control Loop

3.8.3 Filter Control

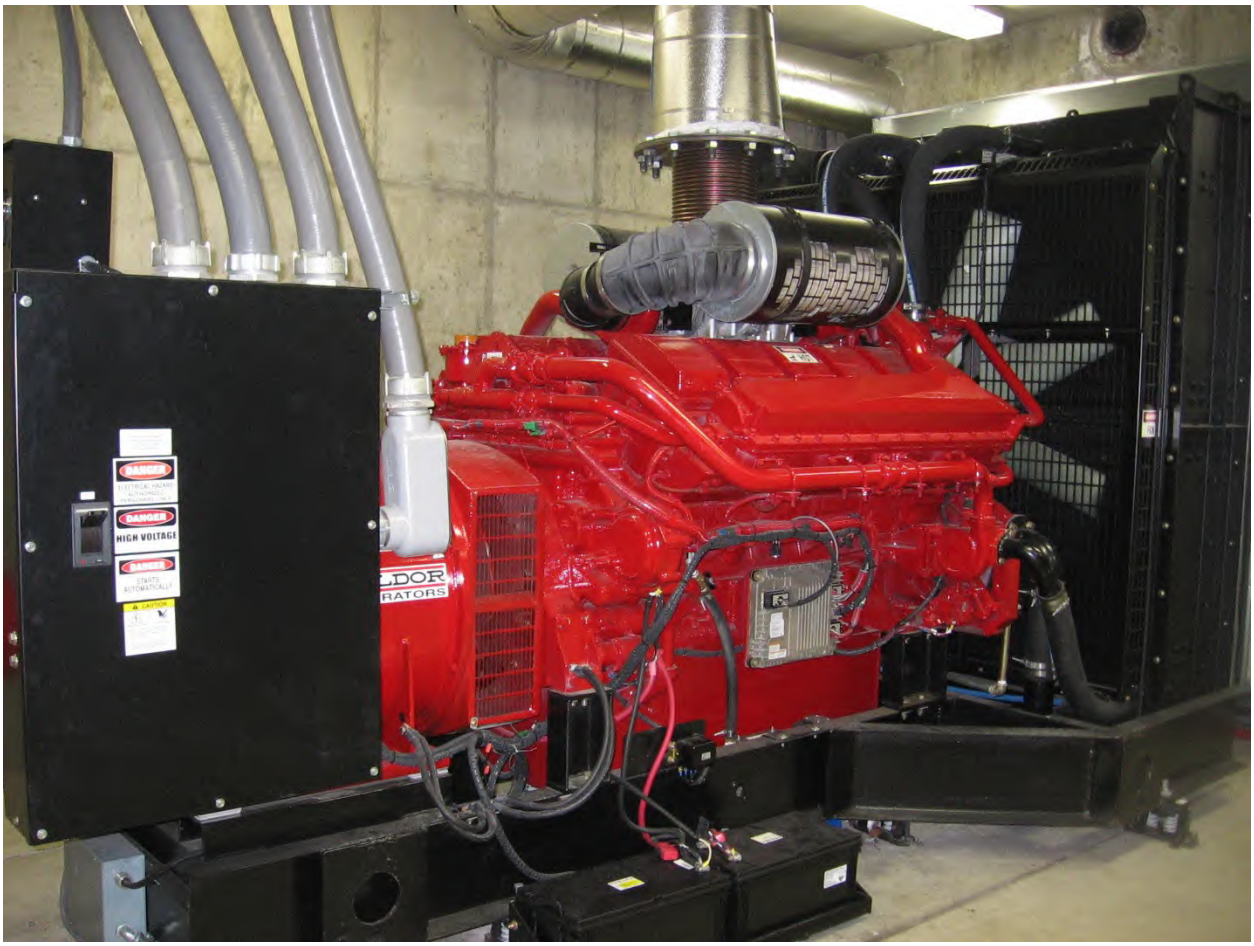
Figure 3.8-1: Filter Control Console (8 1/2 x 11)
Photographs
Effluent Flow Meters
Effluent Valves

3.8.4 Backwash Control

Photographs
Flow Meter
Control Loop

3.9 ELECTRICAL FACILITIES

3.9.1 Emergency Generator



The Mitsubishi Emergency Generator is a turbocharge, 4 cycle, 12 cylinder diesel engine with 1528 horse power. It provides enough power to operate all the equipment at the water treatment plant with all the Dakin high service pumps and the filter backwash pumps in operation. The generator runs at 1800 rpm and produces 3 phase 277/480 volts using a permanent magnet generator (PMG) which has a capacity of 1000 KiloWatts. The generator was installed in February 2011.

3.9.1.2 ATS - Automatic Transfer Switch

The ASCO 7000 Series Automatic Delayed Transition Transfer & Bypass Isolation Switch consists of an upper bypass isolation switch, a transfer switch, a monitoring and transfer control panel, and door mounted controls. The sequence for the load transfer to the emergency source begins automatically when the controller detects a normal source failure or a transfer test signal is received. The normal source is considered unacceptable when any one of the following is below parameters set in the controller, voltage, phase, or frequency. The Automatic Transfer switch was installed in March 2009.
Refer to ATS picture on page 94.

3.9.2 Generator Test and Power Transfer Procedure

To test the WTP generator under load, or to operate the plant on generator power (forced switch to generator):

Go to the main transfer switch cabinet in the basement.
Below is a picture of the switches on the front of this cabinet:



In the picture above, under normal operation, the Load Test Switch is set to NORMAL, and the Selector Switch (the multi position switch on the right) is in the AUTO position.

To run the generator UNDER LOAD, turn the Load Test Switch to TEST, and the Selector Switch to TEST. The generator may take up to a minute to start, and a few seconds later the transfer switch should transfer to generator power.

With the switches in these positions (TEST) the plant will not transfer back to Puget Power.

To transfer back to Puget Power, set the Load Test Switch back to NORMAL and the Selector Switch to AUTO. It may take up to a minute for the switch to transfer back to Puget Power. The generator will run for a few additional minutes to cool down.

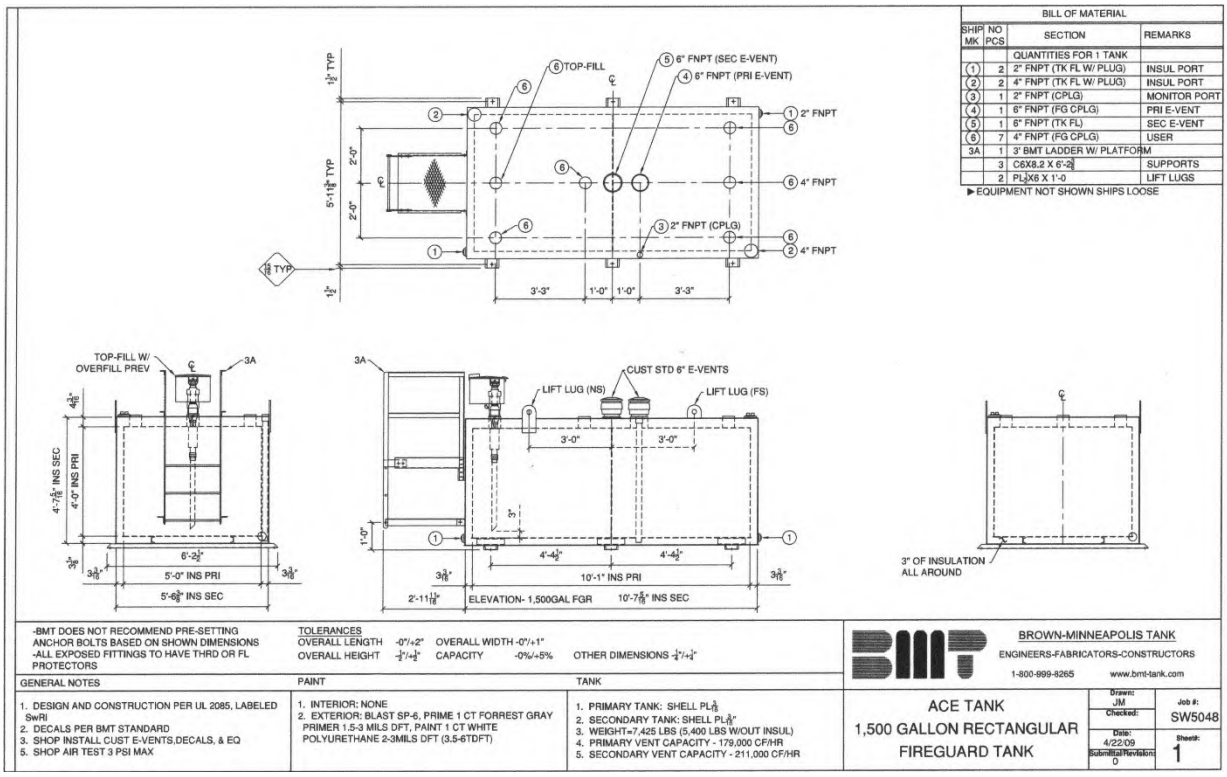
3.9.3 Emergency Generator Fuel Tank



Generator Fuel Tank

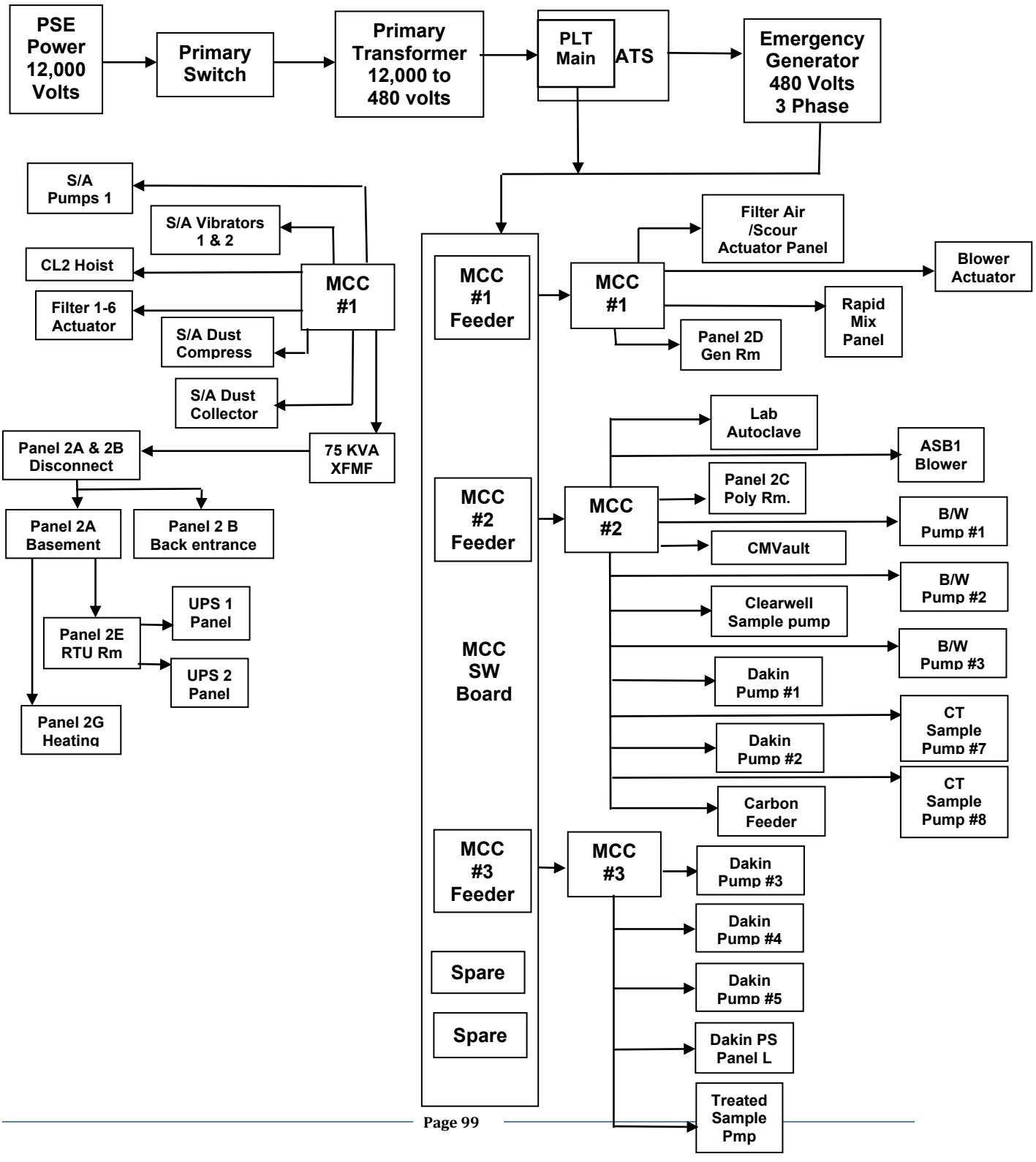
1500 gallon Fireguard aboveground Storage Tank with impact resistant and stream hose test ratings. This horizontal steel tank is double walled with an inner and outer liners with interstitial monitoring capabilities and a 2-hour fire rating. The tank contains 3 inches of light-weight insulation material which has 75% less weight than traditional concrete insulations. Fireguard tanks are built to Underwriters Laboratories, UL-142 and UL 2085 specifications and in accordance with the Steel Tank Institute's F-941 standard. Fireguard's UL-2085 construction standard meets and exceeds all the requirements set forth by UL-2080 for Fire Resistant Tanks. The tank is equipped with a Ametek Drexelbrook MM330 series Magnetostrictive level transmitter, a 7.5 gallon spill bucket, and an over fill level alarm an. The tank was installed in August 2011.

Figure 3.9.1 Above Ground Storage Tank



3.9.3 Plant Power Distribution

WATER TREATMENT PLANT POWER DISTRIBUTION





Equipment Breaker	
MCC 1 Circulation Pump #1 1) Spare 3) Filter valves #1 4) Filter valves #2 5) Filter valves #3 6) Filter valves #4 7) Filter valves #5 8) Filter valves #6 9) Influent #1 valve 10) Influent #2 valve Generator Room Heater Cl_2 Cyl. Hoist Generator Room Panel - 2D Flash Mixer #1 Spare Office Air Handling Unit Control Transfer/Feeder Timer/Fuse 75 KVA XFMR `	WTP East Wall of basement

Equipment Breakers	Location of MCC
MCC 1 Soda Ash Solution Pump #1 Soda Ash Solution Pump #2 Soda Ash Silo Vibrator #1 Soda Ash Silo Vibrator #2 Dust Collection System Dust Collection Compressor	WTP East Wall of Basement



Equipment Breakers	Location of MCC
MCC 2 Dakin-Yew Pump #1 Dakin-Yew Pump #2 Sample Pump #7: Chlorination Sample Pump #8: CT Reservoir Sample Pump #10: Clearwell Alum Pump #1 Alum Pump #2 Carbon Feeder Backwash Pump #1 Backwash Pump #2	**WTP Pump Room**

Backwash Pump #3 Feeder Panel 2C – Poly System Reservoir FDR/Panel CMV Air Scour Blower Panel **MCC 3** 10 KW Heater DYPS Panel L Transformer Sample Pump #9: Treated Water Pump Station Intake Fan Dakin-Yew Pump #3 Dakin-Yew Pump #4 Dakin-Yew Pump #5	**WTP Pump Room**

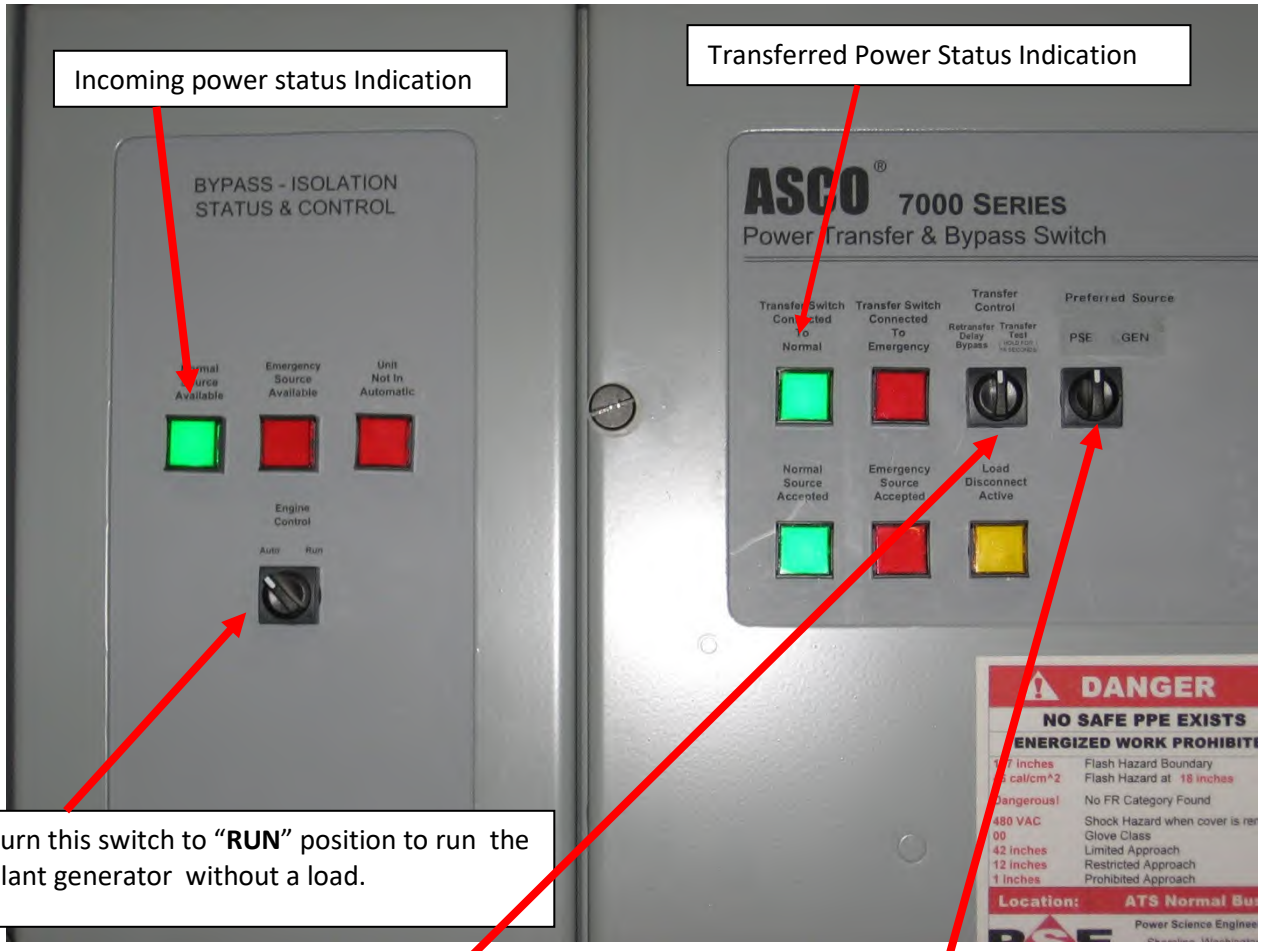


3.9.4 Automatic Transfer Switch

WATER TREATMENT PLANT

AUTOMATIC TRANSFER SWITCH

(ATS)



Turn this switch to "**RUN**" position to run the plant generator without a load.

Turn this switch towards "**Transfer Test**" position and hold for 40 seconds until the generator comes on-line and the ATS transfers the load.

The Generator will run with no- load condition for 30 minutes then shut down. The time frame and load/noload is adjustable thru the HMI controller HMI. Its currently set for 30 minutes with no-load.

The **Preferred Source** switch determines which electrical source is used to provide power for the plant. The switch in the "PSE" position is the normal utility power source. If the switch is moved to "GEN" position. The plant generator is the preferred source and the generator will come on-line and provide power for the plant until the switch is placed back in PSE position.

3.10 EFFLUENT FLOW METERS

Two effluent flow meters are located downstream of the clearwell. The reservoir influent meter is located 60 feet west of the treatment plant in the paved parking area for the main entrance. The treated water meter is located 50 feet northwest of the Dakin-Yew Pump Station in the access road to the Whatcom Falls reservoirs. The two flow meters will indicate significantly different flow rates most of the time. The reservoir influent meter essentially measures plant production. The reservoir effluent meter indicates the flow delivered to the system and may be used to pace the chlorine and soda ash feed rate. The effluent meter will be used to determine CT compliance.

The reservoir influent meter measures flow from the clearwell to Whatcom Falls Reservoir No. 2. The meter is a 48-inch propeller meter. There are two 60-inch butterfly valves, one at each end of the meter section, to shut off flow for meter maintenance. The piping and meter between the two butterfly valves can be replaced with 60-inch piping and a 60-inch flow meter in the future for increased capacity.

The treated water meter measures flow out of Whatcom Falls Reservoir No. 2. The meter is a 48-inch propeller meter. The meter will permit pacing of the trim chlorinator feed rate, if desired. There are two 60-inch butterfly valves, one at each end of the meter section, to shut off flow for meter maintenance. A 36-inch-diameter bypass is located west of the meter section. The bypass allows Whatcom Falls Reservoir No. 2 to remain in service during meter maintenance.

The 48-inch propeller meters are accurate to plus or minus two percent in the flow range from 2,500 gpm (3.6 mgd) to 35,000 gpm (50 mgd). The future 60-inch meters are accurate in the flow range from 4,000 gpm (5.8 mgd) to 60,000 gpm (86 mgd).

3.11 BACKWASH WATER DISPOSAL (future section)

3.11.1 Backwash Detention Tim

3.11.2 Pipeline

3.1.2 DISINFECTION CT

3.12.1 Regulatory Requirements

The Surface Water Treatment Rule (SWTR) of the 1986 Amendments to the Safe Drinking Water Act (SDWA) establishes minimum requirements for disinfection of drinking water. A minimum CT must be provided based on temperature, pH, residual chlorine concentration, and log inactivation of viruses and Giardia cysts. The CT value is the product of the residual chlorine concentration (C) and the effective contact time (T).

The SWTR requires a 99.9 percent inactivation of Giardia cysts (3-log) and a 99.99 percent inactivation of viruses (4-log). The SWTR specifies that a well-operated direct filtration plant can be credited with a 2-log (99 percent) inactivation for Giardia cysts and 1-log (90 percent) inactivation for viruses. The remaining inactivation must be provided by disinfection. Chlorine is much more effective inactivating viruses than Giardia cysts. The volume required to provide 1-log inactivation of Giardia cysts is much larger than the volume required to provide 3-log inactivation of viruses. As a result, the disinfection process provided by the disinfectant contact volume must provide 1-log inactivation for Giardia cysts.

3.12.2 Design Flow Rate

The 2040 peak daily demand is estimated to be 59.8 mgd. The treatment plant capacity is most easily increased in multiples of 8 mgd. The treatment plant capacity in 2040 should therefore be 64 mgd. The peak winter demand in 1989 occurred on February 5. The demand was equal to 172 percent of the average daily demand for 1989. The peak day demand is 230 percent of average day demand (per page 4-4 of the 1993 Comprehensive Water Plan). These percentages result in a ratio of peak winter demand to peak daily demand is 0.75. The peak winter demand for a plant with a capacity of 64 mgd is 47.0 mgd (product of 0.75 and 62.6 mgd).

3.12.3 Tank Efficiencies

Recent studies have shown that the contact tank efficiencies shown in the EPA Guidance Manual are probably too high. Based upon data from modeling and full-scale tracer studies, it appears that a very well baffled circular reservoir should result in a tank efficiency of at least 50 percent. An efficiency of 50 percent is defined as $T_{10}/T = 0.5$. T_{10} is the detention time corresponding to the time for 90 percent of the water to be in contact with the residual concentration, C. T is the time of theoretical disinfectant contact. The data also indicates that efficiency greater than 50 percent is difficult to achieve with practical baffling systems. Therefore the baffling configuration was developed to achieve an efficiency of at least 50 percent.

3.12.4 Required CT Volume

Required CT volume is dependent on water pH and temperature and on the residual chlorine concentration. Plant records indicate the following values for these parameters:

Maximum pH following filtration = 7.0
Low winter water temperature = 6°C
Residual chlorine concentration = 0.6 mg/l

Required CT increases as pH increases. Therefore, the CT volume should be based on the normal maximum pH level and the pH should not be raised above this value in both the filtration process and disinfection. The use of alum for coagulation tends to depress pH and any pH adjustment for corrosion control can be made after the CT product has been satisfied.

The temperature of 6° C is a typical historical winter low. Since required CT increases as the temperature decreases, the use of the historical low temperature will be conservative.

City practice has determined that a chlorine residual of 0.6 mg/l leaving the plant provides the desired residual in the distribution system. Therefore, 0.6 mg/l will be used for CT volume calculations.

Required CT values were determined from the EPA Guidance Manual by interpolation between Tables E-2 and E-3. The required CT value for 1.0-log inactivation is 46. The CT volume required is calculated as follows:

CT_{10}	=	46
T_{10}	=	46/C
		C = chlorine concentration = 0.6 mg/l
T_{10}	=	46/0.6 = 77 min
T_{10}/T	=	0.5 (see Section 3.12.3)
T	=	$T_{10}/0.5$
T	=	77 min/0.5 = 154 min
Volume	=	Flow ´ Time
		Flow = 47.0 mgd (32,600 gpm; see Section 3.12.2)
		Time = 154 min
Volume	=	32,600 gpm (154 min) = 5.0 mg

This volume has been provided in the bottom 7.11 feet of Whatcom Falls Reservoir No. 2. Reservoir volumes are discussed in greater detail in Chapter 5, Pressure Zones.

3.12.5 Determination of Inactivation Ratio

The inactivation ratio is equal to the CT provided divided by the CT required. To be in compliance, the ratio must always be greater than 1.0. The CT required is determined from the CT tables developed by EPA. The CT required is based on temperature and pH. The pH must be for the water in Whatcom Falls Reservoir No. 2, and therefore the reservoir outlet pH reading should be used. This pH reading is obtained prior to final pH adjustment with soda ash.

The CT provided is equal to the contact time multiplied by the chlorine residual leaving the tank. The chlorine residual must be taken from the reservoir outlet sample prior to chlorine addition from the trim chlorinator. When the trim chlorinator is in use, the chlorine residual leaving the reservoir will be less than 0.6 mg/l and the volume required to achieve CT compliance will be greater. Therefore, the reservoir outlet residual should be used. The contact time is based on the peak hourly demand and the actual reservoir level at the time of the peak hourly demand. Calculation of the contact time is described in Appendix C.

3.12.6 Streaming Current Meter (SCM)

3.12.7 CT Reservoir Draining Procedure

Use this procedure when the Contact Time (CT) reservoir is to be drained. The CT reservoir can only be taken off-line if the water demand is 14 millions gallons or less per day.

1. Two Days before draining

    1.1. Call DOH area engineer @ (XXX XXX-XXXX) to inform them the CT reservoir is going to be removed from the system.
    1.2. The daily CT value will be made by the detention time through the plant.
    1.3. The old 48-inch bypass line on the clearwell will be used while the CT reservoir is off line. This pipe will have to be flushed out before use.
    1.4. Arrange for a large pump to flush out 48-inch bypass line from the plant.
    1.5. Connect pump suction line to 8-inch drain line from the clearwell.
    1.6. The pump discharge line shall be run to the backwash disposal system.
    1.7. Have maintenance wire in effluent flow meter on bypass line from the plant to SCADA

2. One Day before draining

    2.1. Increase chlorine feed to the clearwell to raise the residual to .75 mg/l.
    2.2. Operate the following valves in order listed to start flushing bypass pipe: Refer to distribution map for location.
        2.2.1. Close valve V13010, 48-inch line to distribution
        2.2.2. Close valve V13009, 36-inch line to distribution
        2.2.3. Open valve V13006, Clearwell drain
        2.2.4. Open valve V13007, Clearwell drain
        2.2.5. Open Valve V13008 – (opening this valve may cause higher clearwell turbidity.)
    2.3. Start pumping water from the clearwell through the drain line to waste. This will flush out the standing water inside the pipe.
    2.4. Open the 24-inch sluice gate on top of the CT reservoir. This will allow the reservoir to be drained below the 15 foot level.

3. Drain day

    3.1. Increase chlorine feed to screen house to yield a residual of .7 PPM 45 minutes prior to shut down.
    3.2. Notify the fire department and the hospital about possible low water pressure during the draining of the CT reservoir.
    3.3. 1300 hours: (This starting time period could change depending on current water demand, time of year, and when you want the reservoir empty).
    3.4. Shut down the bypass pipe flushing pump and disconnect the hoses.

3.5. Start draining CT reservoir to distribution and isolate Whatcom falls I from distribution system. Proceed as follows:
  3.5.1. Close valve V83238-15, Isolates plant from CT reservoir.
  3.5.2. Close valve V83238-35, Isolates Whatcom falls I from distribution system.
  3.5.3. Close valve V13007, Clearwell drain
  3.5.4. Close valve V13006, Clearwell drain
  3.5.5. Close valve V13008, 48-inch to plant
  3.5.6. Open valve V13010, 48-inch line to distribution
  3.5.7. Open valve V13009, 36-inch line to distribution
3.6. Shut down water treatment plant as per shutdown procedures.
3.7. Keep the soda ash and trim chlorine feed systems in operation while the CT reservoir is on-line.

4. CT Reservoir Drained

4.1. Depending on the water demand the CT reservoir could be empty in the early morning hours on the third day depending on when it was started.
4.2. When the reservoir level is down to the one foot level.
4.3. Operate the following valves:
  4.3.1. Close valve V83283-17, Isolates CT reservoir from the distribution system.
  4.3.2. Open valve V83238-35, Returns Whatcom Falls I reservoir back to the distribution system.
  4.3.3. Note: The gravity reservoirs will be lower then normal and Whatcom Falls I will be full. Opening this valve too much may create high flow causing dirty water.
  4.3.4. Open the CT reservoir drain valve V83283-33
4.4. Shut down trim chlorine and soda ash feed systems.
  4.4.1. Shut down the trim chlorine gas feed by closing gas valve CLG-1 on the trim chlorinator.
  4.4.2. Shut down trim injector water supply in Dakin/Yew station.
  4.4.3. Shut down soda ash feeder by turning the feeder to stop

5. Water plant operation without CT reservoir

5.1. Open valve V13008, connect plant to distribution system.
5.2. Shut down the treated sample pump (#9) in the Dakin/yew pump station.
5.3. Shut down sample pump # 8 in the chlorine manifold vault. (#7 already off)
5.4. Prior to water plant start up make the below changes in order to monitor and comply with contact time requirements.
  5.4.1. While the water plant is in operation (without the CT reservoir) plant production cannot exceed 14 million gallons per day. This was the estimated maximum production rate based on tracer testing of the plant. At this flow rate the plant can still meet the contact time requirement by DOH.
  5.4.2. The pre-chlorine must be increased to .7 PPM residual while the plant is in operation. The detention time from the plant to the screen house will be used for part of the Contact Time requirement.

5.4.3. The piping for sample pump #7 will need to be connected to the pilot filter system piping. (This sample line is currently not being used) This will allow water to be pumped from the rapid mix to the chlorinator room where an analyzer can be use to monitor the chlorine residual coming into the plant. The piping and valves for this configuration are located in the ceiling of the garage above the pilot filter pump.

5.4.3.1. Because of the potential of a cross connection between raw water and the CT reservoir, make a physical break between the sample line #7 going back to the CT reservoir and the pilot filter piping.

5.4.4. In the chlorinator room sample line #7 can be connected to either the CT inlet or the CT out chlorine analyzer. Just change the tubing around to make this connection to sample line #7.

5.4.5. Verify that the pilot filter pump suction line is connected to the on-line rapid mix tank.

5.4.6. Close the discharge valve to the pilot filter system.

5.4.6.1. This valve is located upstairs in the polymer room on the wall by the polymer aging tank.

5.4.7. Start pilot filter supply pump.

5.4.8. Switch soda ash feed from the CT effluent line to the plant clearwell.

5.4.8.1.Open valve SA0-9, above door into garage

5.4.8.2.Close valve SA0-10, located in garage on west wall.

5.4.9. Sample pump #10 will be used to supply a sample for treated chlorine residual and pH from the clearwell. Operate the following valves:

5.4.9.1.Close sample line #9 valve in chlorinator room under chlorine analyzers.

5.4.9.2.Open sample line #10 valve in chlorinator room connects sample pump #10 to treated chlorine analyzer.

5.4.9.3.Close sample line #9 valve in Polymer room under pH meters.

5.4.9.4.Open sample line #10 valve in polymer room connects sample pump #10 to treated pH meter.

5.4.10. The water treatment plant is now ready to be started up without the CT reservoir. Follow water plant startup procedures in this manual.

6. Daily CT value determination

6.1. While the water plant is in operation without the CT reservoir the daily CT values for the plant must be determined every day.

6.2. The daily CT value will consist of two segments:

6.2.1. The first segment will be the plant influent detention time at peak flow of the day multiplied by the pre-chlorine residual into the plant. (See detention time chart for plant influent)

6.2.1.1.The peak flow for the day will be the plant influent flow rate from the SCADA report.

6.2.2. The second segment will be the plant clearwell detention time at peak flow of the day multiplied by the chlorine residual in the clearwell. (See detention time chart for plant clearwell)

6.2.2.1.The peak flow each day will be the treated water flow rate from the SCADA report.

6.2.3. The sum of the two segments will be the CT value for the day. The CT value for each segment and the daily sum must be reported to DOH with the regular monthly report.

6.2.3.1.A form for this purpose is provided at the end of this section.

7. CT Reservoir on-line

7.1. Ensure that everything is removed from inside the reservoir and that it has been disinfected if required.

7.2. Close reservoir drain valve V83283-33.

7.3. The reservoir will be slowly filled by opening the inlet valve and adjusting it for a flow equal to one additional filter production rate at the plant.

7.3.1. The increased flow rate for the plant can not exceed 14 mgd.

7.3.2. Open valve V83283-15 and adjust for the flow rate above.

7.4. While the reservoir is filling, the water distribution system will be supplied by the plant through the bypass pipe.

7.5. When the CT reservoir level is equal to the other gravity reservoirs, then the reservoir can be placed on-line.

7.5.1. Open valve V83283-15 all the way.

7.5.2. Open valve V83283-17, 60-inch effluent pipe to distribution.

7.6. The CT reservoir is now on-line with the water plant in bypass mode.

8. Change Plant Operation from Bypass Mode to CT mode

8.1. Switch distribution piping to route all water from the plant to the CT reservoir.

8.1.1. Close valve V13008

8.2. Change the configuration at the water plant to normal operation by following the steps below:

8.2.1. Shut off pilot filter sample pump

8.2.2. Decrease pre-chlorine to .25 PPM residual.

8.2.3. Decrease chlorine residual in clearwell to .40 mg/l

8.2.4. The piping for sample pump #7 will need to be reconnected back to the CT reservoir. The piping and valves for this configuration are located in the ceiling of the garage above the pilot filter pump.

8.2.4.1.Once the piping is back to original configuration then turn on sample pump #7 to flush out the remaining raw water that may be in the pipe to the chlorinator room.

8.2.5. In the chlorinator room, change sample tubing back to original configuration.

8.2.5.1. Sample line #7 not used.

8.2.5.2. Reconnect sample line #8 tubing back to the CT outlet chlorine analyzer.

8.2.5.3. Open sample line #9 valve under chlorine analyzers.

8.2.5.4. Close sample line #10 valve, shuts off sample pump #10 to treated chlorine analyzer.

8.2.5.5. The CT inlet chlorine analyzer tubing should be reconnected to sample line #10 from the clearwell.

8.2.6. Open the discharge valve to pilot filter system.

8.2.6.1. This valve is located upstairs in the polymer room on the wall by the polymer aging tank.

8.2.7. Switch soda ash feed from the clearwell back to the CT effluent line.

8.2.7.1. Close valve SA0-9, above door into garage

8.2.7.2. Open valve SA0-10, located in garage on west wall.

8.2.8. Switch pH sample lines in the polymer room back to normal. Operate the following valves:

8.2.8.1. Open sample line #9 valve in Polymer room under pH meters.

8.2.8.2. Close sample line #10 valve in polymer room connects sample pump #10 to treated pH meter.

8.2.9. Startup sample pump #9 in Dakin/Yew station.

8.2.10. Startup sample pump #8 in Chlorine manifold vault (CMV)

8.2.11. Setup the trim chlorine feed system

8.2.11.1. Startup the trim chlorine injector.

8.2.11.2. Send a remote feed set point of zero (0) through SCADA.

8.2.11.3. Open trim chlorinator gas valve CLG-1

8.2.12. Set up the soda ash feed system

8.2.12.1. Send a remote feed set point of zero through SCADA.

8.2.12.2. Turn on the feeder by setting control to remote position.

8.2.13. The water treatment plant is now back to normal CT mode configuration.

8.2.14. When the chlorine residual coming out of the CT reservoir starts to drop below .6 mg/l then increase the chlorine feed set point to the trim chlorinator.

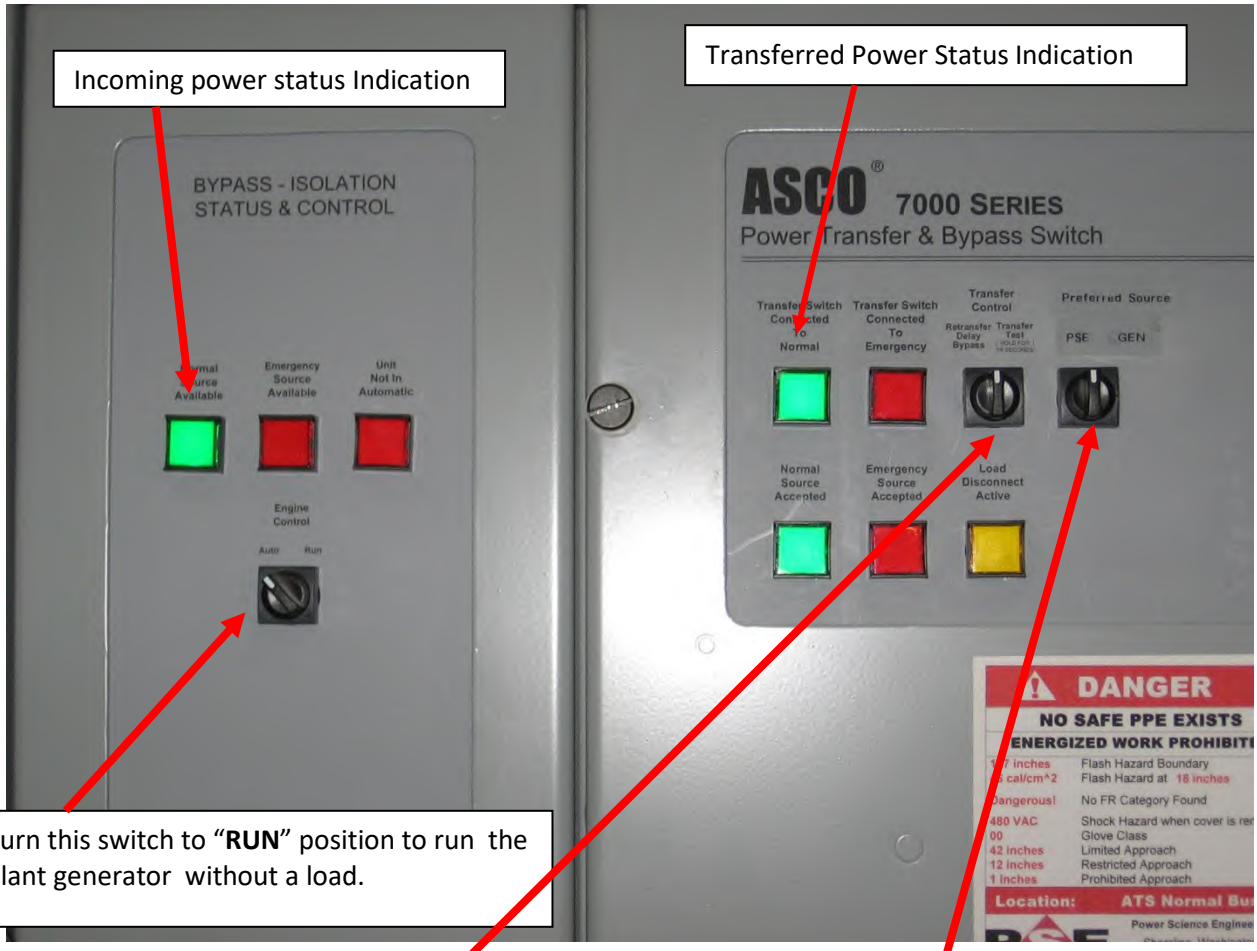
8.2.15. When the pH coming out of the CT reservoir starts to drop below a pH of 8.0 then increase soda ash feed set point on SCADA.

3.13 Automatic Transfer Switch (ATS)

WATER TREATMENT PLANT

AUTOMATIC TRANSFER SWITCH

(ATS)



Turn this switch to "**RUN**" position to run the plant generator without a load.

Turn this switch towards "**Transfer Test**" position and hold for 40 seconds until the generator comes on-line and the ATS transfers the load.

The Generator will run with no- load condition for 30 minutes then shut down. The time frame and load/noload is adjustable thru the HMI controller HMI. Its currently set for 30 minutes with no-load.

The **Preferred Source** switch determines which electrical source is used to provide power for the plant. The switch in the "PSE" position is the normal utility power source. If the switch is moved to "GEN" position. The plant generator is the preferred source and the generator will come on-line and provide power for the plant until the switch is placed back in PSE position.

CHAPTER 4

SCADA SYSTEM (future chapter)

4.1 DESCRIPTION AND PURPOSE

4.2 MAJOR COMPONENTS

Figure 4.2-1: SCADA System Schematic (11 x 17)

4.2.1 Main Compute

4.2.2 RTUs

4.2.3 Communication System

4.2.4 Backup Components

4.3 METHOD OF OPERATION

4.3.1 Polling Frequency

4.3.2 Report Generation

4.3.3 Control of Facilities

4.3.4 RTUs

4.3.5 Dial-up-mode

APPENDIX W

WATER OPERATIONS STAFF CERTIFICATIONS

WATER DISTRIBUTION - PROMOTIONS & CERTIFICATIONS LIST

Name	Cert. #	STATE CERTS
Alvarado, Ralph	9426	WDM 3
Bossert, Evan	16179	WDM1,CCS
Boucher, Adam	14865	WDM2, CCS
Buss, Tyler	15533	WDM2, CCS
Cruz, Fred	10123	WDM 3, CCS
Hayes Brent	11595	WDM 3, CCS
Lee, Mike	7661	WDM 2, BAT,CCS,
Lunde, Aaron	14407	WDM2, CCS
Patrick, Rick		WDM-1
Patrick, Tanner	14996	WDM2, CCS
Rouse, Tyler	13594	WDM 2, CCS, BAT
Sullivan, Dallas	14383	WDM 2, CCS
VanDiest Scott	10075	WDM2, CCS, BAT

UW I, II, III PROMOTIONS EXPERIENCE & TRAINING REQUIREMENTS:

Utility Worker II:

High School Diploma, or equivalent. AND

-**Two (2) years' experience as Utility Worker I,** OR three years equivalent experience performing manual labor in the construction, maintenance, and service work of public facilities, **AND**

-Possess and maintain the following certifications, based on the requirements of the unit to which assigned:

o Streets and Stormwater Collection Units:

Certified Erosion and Sediment Control Lead (CESCL) with in one (1) year of promotion, transfer, or placement to Utility Worker II.

o Wastewater Collection Unit:

Washington Wastewater Collection Personnel Association (WWCPA – 1) with in one (1) year of promotion, transfer, or placement to Utility Worker II.

Water Distribution Unit:

Washington State Certification as Water Distribution Manager I within one (1) year of promotion, transfer, or placement to Utility Worker II.

Utility Worker III:

High School Diploma, or equivalent, AND

Two years of experience in Public Works Operations Utility Worker I and 2 years of experience in the Utility Worker II classification, OR five years equivalent experience performing manual and semi-skilled labor in the construction, maintenance, and service work of all public facilities, **AND**

Possess and maintain the following certifications, based on the requirements of the unit to which assigned:

Street and Stormwater Collection Units:

Certified Erosion and Sediment Control Lead (CESCL)

Within one (1) year of promotion, transfer, or placement to Utility Worker III.

APPENDIX X

EMERGENCY RESPONSE PLAN

City of Bellingham WASHINGTON

Water System

EMERGENCY RESPONSE PLAN

City of Bellingham, Washington

June 11, 2021

Prepared by
Jacobs
1100 112th Ave NE, Suite 500
Bellevue, WA 98004

Handling Instructions

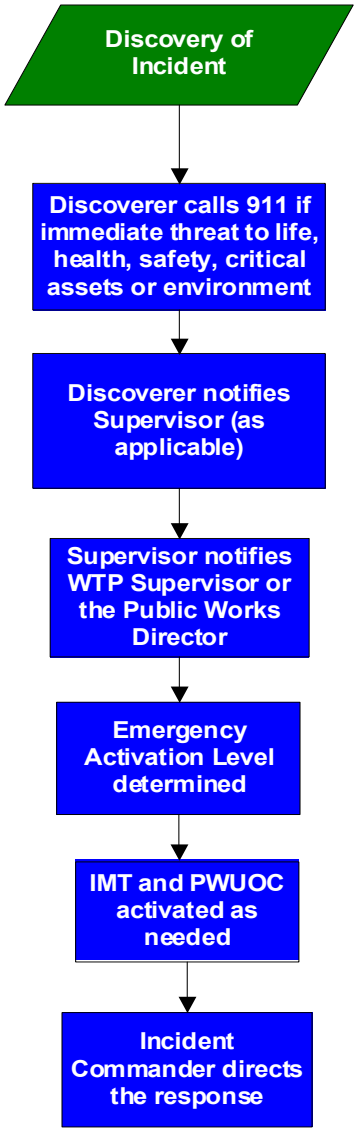
This Emergency Response Plan (ERP) is available to key City of Bellingham Water System (Water System) personnel who have roles and responsibilities in implementing the ERP. This ERP is also issued to entities whose familiarity with the ERP is essential to its implementation. This ERP contains potentially sensitive information that identifies critical utility assets. Therefore, this document is maintained by the Water System and controlled distribution is made available only to those persons and organizations that have roles and responsibilities when implementing the ERP (at the discretion of the Water Treatment Plant Supervisor).

WARNING

This document is **FOR OFFICIAL USE ONLY (FOUO)**. It contains information that is sensitive, but unclassified, and is exempt from public release under the Freedom of Information Act [5 U.S. Code (USC) 552, Exemption 2]. It is to be controlled, stored, handled, transmitted, distributed, and disposed of in accordance with local government policies relating to FOUO information; it is not to be released to the public or other personnel who do not have a valid "need-to-know" without prior approval of an authorized government official.

Source: Freedom of Information Act (FOIA)

Generalized Initial Response Actions



GENERAL PROCEDURE DETAILS FOR ANY RESPONSE INCIDENT

Discovery

Any person who discovers an emergency or incident is termed the "Discoverer." The Discoverer is in charge of the incident until relieved by their supervisor (as applicable).

The Discoverer will call 9-1-1 if there is an immediate medical emergency or threat to life, health, safety, critical assets, or the environment. They will then notify their supervisor who will notify the Water Treatment Plant Supervisor or Public Works (PW) Director.

Notification of Offsite Emergency Responders

The Discoverer will provide the following information:

- Facility name, address, location, and phone number
- Name of person reporting the incident
- Date, time, and type of incident
- Whether it is a threat or actual event
- If systems have been interrupted or shut down
- If a water outage is imminent
- If Hazardous Material (HAZMAT) was released or involved
- Estimated quantity of HAZMAT released if any
- For a HAZMAT release that requires evacuation, location where utility staff will meet emergency responders

Activation of the Incident Management Team and Emergency Operations Center

The Public Works Director will determine when to activate the Public Works Utility Operations Center (PW Department UOC) and whether the Incident Management Team (IMT) requires activation. The Incident Commander will direct the response. The Emergency Activation Levels and response actions are as follows:

Activation Levels	Response Actions
Non-Emergency	Handled by PW staff in accordance with standard operating procedures. No PW Department UOC activation.
Level 1 – Emergency	Notify PW Incident Commander. Consider PW Department UOC activation.
Level 2 – Emergency	Notify PW Incident Commander and PW Incident Management Team. Activate PW Department UOC. Consider City of Bellingham and/or Whatcom County EOC activation.
Level 3 – Emergency	Notify PW Incident Commander and PW Incident Management Team. Activate PW Department UOC. Activate City of Bellingham and/or Whatcom County EOC.

Water System General Information

System Owner and Operator:	City of Bellingham Water System
System ID Permit Number:	056003
System Address:	3201 Arbor Court Bellingham, WA
Population Served:	88,764 (2019)
Water System Description:	The Bellingham water system consists of a diversion dam, Lake Whatcom, screenhouse, Lake Whatcom Control Dam, 15 storage reservoirs for a total of 29 million gallons, 12 pump stations, and 400 miles of distribution piping. Drinking water is provided by an in-line filtration plant that employs alum for coagulation, 6 dual media filters, chlorine for disinfection, and soda ash for pH control.
Number of Service Connections:	23,500
Primary Emergency Contact:	Water Plant Chief Plant Operator (360) 778-7890
Alternate Emergency Contact:	Plant Supervisor, Wastewater Plant (360) 778-7858
After-Hours:	(360) 778-7850
Bellingham Fire Department:	9-1-1, Non-Emergency: (360) 778-8400
Bellingham Police Department:	9-1-1, Non-Emergency: (360) 778-8800
Whatcom County Sheriff's Office **Division of Emergency Management:**	Public Safety Building 311 Grand Avenue Bellingham, WA 98225 (360) 676-6681
Whatcom County Emergency Operations Center:	3888 Sound Way, Bellingham, WA 98226 (360) 738-2518
Washington State Department of Health:	(800) 521-0323
After Hours Emergency Hotline:	(877) 481-4901
State of Washington, Department of Ecology:	(425) 649-7000 nwroerts@ecy.wa.gov
National Response Center:	(800) 424-8802
Washington Emergency Management Division:	(800) 258-5990
State Emergency Response Commission:	(800) 258-5990

Distribution Log

No	Organization	Organization/Title	Number and Type of Copies
1	Water System	Water Treatment Plant	1 hard copy and 1 electronic copy
2		PW Department UOC/EOC	1 hard copy and 1 electronic copy
3		WTP Supervisor	1 hard copy and 1 electronic copy
4		Plant Maintenance Supervisor	1 hard copy and 1 electronic copy
5		Utility Worker 5	1 hard copy and 1 electronic copy
6		Superintendent of Maintenance	1 hard copy and 1 electronic copy
7		Superintendent of Plants	1 hard copy and 1 electronic copy
8		Development Manager	1 hard copy and 1 electronic copy
9		Maintenance Lead	1 hard copy and 1 electronic copy
10		Plant Operator	1 hard copy and 1 electronic copy
11		Safety Specialist	1 hard copy and 1 electronic copy
12		Utility Operations Engineer	1 hard copy and 1 electronic copy
13	Public Works	Public Works Director	1 Electronic copy
14		Assistant Public Works Director/Operations	1 Electronic copy
15		Environmental Education Coordinator	1 Electronic copy
16		Public Works Operations Water Distribution Supervisor	1 Electronic copy
17		Purchasing Manager	1 Electronic copy
18		Financial Services Manager	1 Electronic copy
19		Superintendent of Purchasing and Financial Services	1 Electronic copy
20		PW Communications and Outreach Coordinator	1 Electronic copy
21	City of Bellingham	Fire Department	1 Electronic copy
22		Police Department	1 Electronic copy
23	Whatcom County	Division of Emergency Management	1 Electronic copy
Electronic Copies			
1	M:\Data\Plants\Water Filtration Plant\Bellingham ERP May 2004, Revised Feb 2010		
2	M:\Data\Plants\Water Filtration Plant\Bellingham ERP\Nov-2012		

This ERP was developed, in part, using the results of the Risk and Resilience Assessment as required in Section 2013 of the America's Water Infrastructure Act. This ERP contains potentially sensitive information that identifies critical water assets. As such, this ERP is maintained by the Water Treatment Plant Supervisor or designee who controls distribution only to those persons and organizations that have roles and responsibilities in the implementation of the ERP.

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Acronyms and Abbreviations

AAR/IP	After-Action Report/Improvement Plan
AED	Automated External Defibrillator
AWIA	America's Water Infrastructure Act
AWWA	American Water Works Association
CBRNE	Chemical, Biological, Radiological, Nuclear, and (high yield) Explosives
CDC	Centers for Disease Control and Prevention
CFR	Code of Federal Regulations
COVID-19	Coronavirus Disease 2019
CPR	Cardiopulmonary Resuscitation
DAT	Damage Assessment Team
DHS	U.S. Department of Homeland Security
DPC	Discreet Process Control
EAL	Emergency Activation Level
EAP	Emergency Action Plan
EOC	Emergency Operations Center
ERP	Emergency Response Plan
FBI	Federal Bureau of Investigation
FEMA	Federal Emergency Management Agency
HAZMAT	Hazardous Materials
HSEEP	Homeland Security Evaluation and Exercise Program
HSPD	Homeland Security Presidential Directive
IAP	Incident Action Plan
IC	Incident Commander
ICS	Incident Command System
IED	Improvised Explosive Device
IMT	Incident Management Team
JIC	Joint Information Center
LEPC	Local Emergency Planning Committee
MG	Million Gallons
MGD	Million Gallons per Day
MHz	MegaHertz
NICC	National Infrastructure Coordination Center
NIMS	National Incident Management System
NRF	National Response Framework

NTAS	National Terrorism Advisory System
pH	Potential of Hydrogen
PLC	Programmable Logic Controller
PIO	Public Information Officer
PW	Public Works
PW Department UOC	Public Works Department Utility Operations Center
RPTB	Response Protocol Toolbox
RRA	Risk and Resilience Assessment
SCADA	Supervisory Control and Data Acquisition
SDS	Safety Data Sheet
SOP	Standard Operating Procedures
TLO	Terrorism Liaison Officer
UC	Unified Command
UHF	Ultra-High Frequency
UOC	Utility Operations Center
USC	U.S. Code
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
VHF	Very High Frequency
Water District #10	Lake Whatcom Water and Sewer District
Water System	City of Bellingham Water System
WAWARN	Washington Water/Wastewater Agency Response Network
WaterISAC	Water Information Sharing and Analysis Center
WTP	Water Treatment Plant

1 Emergency Response Plan Introduction and Background

1.1 Purpose and Mission Statement

The purpose of the City of Bellingham Water System (Water System) Emergency Response Plan (ERP) is to maintain quantity and quality of water, protect employees, minimize disruption to the public, and preserve property. This ERP is to be used when an event is of a level that requires the Water System to use the Incident Command System (ICS) or when an incident escalates beyond its capabilities. This ERP is to be used for emergencies that will be managed primarily by the Water System and describes situations where it will provide support to and cooperation with other agencies (The Bellingham Public Works [PW] Department, City of Bellingham; Whatcom County; and state, federal, and private sector supporting agencies) during large-scale emergencies.

The Water System ERP is an all-hazards plan that provides a basis for the coordinated planning and management of the types of incidents most likely to occur at the City of Bellingham Water System facilities. This ERP delineates emergency response procedures and incident management roles and responsibilities for reacting to major disasters or emergencies. This ERP complies with the Drinking Water Security and Safety Amendments to the Safe Drinking Water Act, which were required by the Public Health Security and Bioterrorism Preparedness and Response Act of 2002 and in accordance with America's Water Infrastructure Act of 2018 (AWIA) Section 2013.

AWIA Section 2013, Part (B), Emergency Response Plan, requires Emergency Response Plans to incorporate the findings of the Water System's Risk and Resilience Assessment (RRA). The AWIA requirements for a new or updated ERP also include the bulleted list below. The location in this ERP of text that fulfills each AWIA requirement is further described in Section 3 and in Appendix J.

- Strategies and resources to improve the resilience of the system
- Plans and procedures that can be implemented
- Identification of equipment
- Actions, procedures, and equipment that can obviate or significantly lessen the impact
- Strategies
- Coordination with local emergency planning committees

It is important to note that several of these requirements are typically and most effectively addressed not in an ERP, but in another document or manner. Specifically,

- It is industry-standard to address "strategies and resources to improve…the physical and cybersecurity of the system" in a security master plan, RRA, or similar document, not in an ERP, which should be an action plan focused on preparedness and response during an emergency.
- It is industry-standard to address "development of alternative source water options, relocation of water intakes, and construction of flood protection barriers" in an RRA.
- It is industry-standard to address "strategies that can be used to aid in the detection of malevolent acts or natural hazards that threaten the security or resilience of the system" in a security master plan, RRA, or similar document, not in an ERP, which should be an action plan focused on preparedness and response during an emergency.

The Water System recognizes the intent of all of the above requirements and addresses them as most appropriate in the RRA, as applicable. This ERP is used for immediate response actions by the Water System. The purpose of this plan is to provide staff with the information necessary to respond to an emergency situation whether it involves the water treatment plant, operations, offices and buildings, or staff. Using the results of the RRA, Table 1-1 shows where the risks and the action measures and responses that mitigate the threats identified as defined in the 2020 RRA are addressed in this ERP.

Table 1-1. Water System Risks from the RRA that are Addressed in this ERP

RRA Threat/Hazard	ERP Section (if applicable)	Annual Risk (%)
Malevolent Threats		
Physical Process Sabotage	Page iii – Generalized Initial Response Actions Flowchart Appendix C, Checklist #18 – Diversion of Theft Physical Insider/Outsider Checklist	43%
Cyber Process Sabotage	Page iii – Generalized Initial Response Actions Flowchart Appendix C, Checklist #29 – Supervisory Control and Data Acquisition (SCADA) Attack/Electronic and Checklist #30, SCADA Attack/Physical	7%
Physical Diversion or Theft	Page iii – Generalized Initial Response Actions Flowchart Appendix C, Checklist #18 – Diversion of Theft Physical Insider/Outsider Checklist	4%
Airplane Attack/Accident	Appendix C, Checklist #22 – Terrorist/Hostile Attack Aircraft Used as a Weapon	<1%
Armed Assailant(s)	Page iii – Generalized Initial Response Actions Flowchart Appendix C, Checklist #25 – Unauthorized Entry, Checklist #26 – Workplace Violence, Checklist #27 – Civil Disorder/ Terrorism	<1%
Contamination of Product	Section 4 – Threat Characterization Appendix C, Checklist #12 – Contamination Threat to the Water System, Checklist #13 – Identified Contamination in the Water System, and Water Contamination Procedures	<1%
Drone Attack	Appendix C, Checklist #22 – Terrorist/Hostile Attack Aircraft Used as a Weapon	<1%
Land Vehicle Accident	Appendix C, Checklist #23 –Terrorist/Hostile Attack Vehicle-Borne Improvised Explosive Device (IED) Car Bomb	<1%
Natural Hazards		
Earthquake	Appendix C, Checklist #10 – Earthquake	28%
Dependency Hazards		
Loss of Utilities (Power)	Section 6 – Equipment Appendix C, Checklist #6 – Power Failure	16%
Loss of Key Employees	Section 2.5 – Summary of Threats and Hazards (Disease Outbreak or Pandemic) Appendix C, Checklist #28 – Pandemic Response	<1%
Loss of Chemical Supplier	Appendix C, Checklist #9 – Chemical or Fuel Shortage	<1%
Proximity Hazards		
Proximity to Pipeline	N/A	<1%

This ERP was developed following the AWIA guidance that "Community Water Systems shall, to the extent possible, coordinate with existing local emergency planning committees established pursuant to the Emergency Planning Committee Right-to-Know Act of 1986 (42 U.S.C. 11001 et seq.) when preparing or revising an assessment or emergency response plan." External agencies such as the City of Bellingham Office of Emergency Management and Bellingham Fire Department contributed to the contents of this document, which follows their response actions accordingly.

1.2 Authority and References

This ERP fulfills the requirements of ERP development under the authority of the U.S. Environmental Protection Agency (USEPA) and as required under Section 2013 of the AWIA with regard to developing or updating Water System ERPs. Other requirements considered for development of this ERP include, but are not limited to, the following:

- National Fire Protection Association Standards 1600, Disaster/Emergency Management and Business Continuity Programs and 1620, Pre-Incident Planning
- 49 Code of Federal Regulations (CFR) Part 172, Subpart G, Emergency Response Information
- 40 CFR Part 265 Subpart C, Preparedness and Prevention and Subpart D, Contingency Plan and Emergency Procedures
- 40 CFR Part 355, Emergency Planning and Notification
- 40 CFR Part 141, Subpart Q, National Primary Drinking Water Regulations, Public Notification of Drinking Water Violations (Section 141.201 – General Public Notification Requirements)

Guidance used to develop this ERP includes the following:

- American Water Works Association (AWWA)/Federal Emergency Management Agency (FEMA) Water Sector Resource Typing Guidance November 5, 2019
- FEMA Incident Management Handbook 2017
- USEPA, Response Protocol Toolbox Planning for and Responding to Contamination Threats to Drinking Water Systems
- USEPA, Flood Resilience: A Basic Guide for Water and Wastewater Utilities, EPA 817-B-14-006, September 2014
- USEPA, Drought Response and Recovery, A Basic Guide for Water Utilities, EPA 810-B-16-001, March 2016
- AWIA Section 2013 requirements when developing or updating Water System Emergency Response Plans
- AWIA, America's Water Infrastructure Act of 2018, USEPA, Office of Water, *Community Water System Emergency Reponses Plan*, Template and Instructions, July 2019
- AWWA, *Security Practices for Operation and Management*, G430-14
- AWWA, Management Standard, Emergency Preparedness Practices, G440-17
- AWWA, M19, *Emergency Planning for Water and Wastewater Utilities*, Fifth Edition, Manual of Water Supply Practices, 2018
- AWWA, Utilities Helping Utilities: An Action Plan for Mutual Aid and Assistance Networks for Water and Wastewater Utilities, Water and Wastewater Agency Response Network 2006
- Water Environment Research Foundation, Emergency Response Plan Guidance for Wastewater Systems, 2004
- FEMA, National Incident Management System (NIMS): NIMS, *FEMA Plan*, *National Preparedness Report*, and *National Response Frameworks*
  - FEMA, Local Mitigation Planning Handbook
  - FEMA, Comprehensive Preparedness Guide 101
  - FEMA, Guidelines for Emergency Action Planning for Dams (FEMA Publication No. P-64)
  - FEMA, Incident Command System
- U.S. Department of Homeland Security (DHS): National Infrastructure Protection Plan

- U.S. Coast Guard (USCG), Incident Management Handbook, May 2014, (refer to Appendix A for references)
- Washington Water/Wastewater Agency Response Network (WAWARN)
- U.S. Environmental Protection Agency
- Training and Exercises:
  - Homeland Security Exercise and Evaluation Program (HSEEP), Volume 1, *Federal Emergency Management Agency*, April 2013
  - NIMS Training Program, DHS, May 2020

1.3 Relationship to Other Plans or Regulations

Effective emergency response and planning must include coordination with other city, county, and state response plans. Plans relevant to the ERP primarily include those listed in Table 1-2.

Table 1-2. Relationship of Other Plans to the Water System

Other Documents	Relationship to the Water System ERP	Document Location
City Plans		
City of Bellingham, Risk and Resilience Assessment, December 2020	RRA used the AWWA methodology entitled J100-10, Risk and Resilience Management of Water and Wastewater Systems, which is the current AWWA water and wastewater industry standard for RRAs. The results of the RRA in Table 1-1 of this ERP were used to develop staff emergency procedures or actions to take if an incident were to occur as identified in Table 1-1.	City of Bellingham Water System
City of Bellingham, Comprehensive Emergency Management Plan, 2018	Provides a guideline for the management of the immediate actions and operations required to respond to an emergency or disaster.	Bellingham Office of Emergency Management
Evacuation Plan for Bellingham City Hall, September 2006	To help ensure the safety of employees and the public, the City establishes evacuation procedures for all City buildings.	City of Bellingham
State and County		
Whatcom County Hazard Identification and Vulnerability Analysis, August 2010	To provide information concerning natural and technological hazards that have the potential to disrupt large areas or populations within Whatcom County.	Whatcom Unified Emergency Management
Whatcom County Natural Hazards Mitigation Plan, 2021	The plan identifies the types of natural hazards that impact a jurisdiction, assess each jurisdiction's vulnerability to those hazards, and to formulate mitigation strategies that will lessen the severity of natural disasters by protecting human life and property.	Whatcom County Sheriff Office's Division of Emergency Management

1.4 Water System Description

The City of Bellingham's water system serves approximately 90,000 customers. The water system stores and treats raw water, stores and distributes potable water, maintains the City's water lines, and tests to meet all applicable water quality standards.

The Water System includes pipes and constructed conveyances, barriers, source water, water collection and intake, pretreatment, treatment, storage, and distribution facilities.

The City's water supply is Lake Whatcom, a 5,095-acre water body fed by two separate watersheds: the area directly surrounding the lake and the area that surrounds the Middle Fork of the Nooksack River. The water supply from the lake and river is sufficiently clean that pretreatment is not required; however, the contributing watersheds are not protected. They provide recreational opportunities, home sites, commercial/industrial use, timber harvesting, and farming. The river water is delivered to Lake Whatcom via a diversion dam and pipeline. After diversion from the Middle Fork Nooksack, the water travels via tunnel for two miles under the north side of Bowman Mountain. The water then travels ten miles in a 40-inch pipeline that discharges into Mirror Lake approximately one-quarter mile upstream from Anderson Creek. The water flows through Anderson Creek and into Lake Whatcom.

Water is withdrawn from Lake Whatcom through a 1,225-foot-long wood stave intake that was installed in 1939 along with the other primary water supply system assets, including the gate house, Lake Whatcom Tunnel, and the Screen House. Raw water in conveyed through these facilities and screened (at the Screen House) prior to treatment at the Whatcom Falls Water Treatment Plant (WTP).

The WTP includes multi-media filtration (installed in 1968) preceded by Dissolved Air Flotation that was installed in 2018. The Dissolved Air Flotation system removes particles, including algae, upstream of filtration and helps to mitigate adverse impact of algae on WTP capacity.

The water system includes 17 pump stations and 14 distribution system reservoirs. The distribution system consists mostly of 6- to 12-inch diameter water mains, with some larger-diameter mains providing transmission capacity. The City has interties (supply connections enabling the City to supply smaller water systems) with eight neighboring systems. Several pressure-reducing valves exist throughout the system that enable water to flow from higher-pressure zones to lower-pressure zones within the City.

The City's intake is 1,200 feet from the shore of Lake Whatcom in the second basin in the northern portion of the water body. Water then travels underground, through a tunnel, from the Geneva Gate House to the Screen House in Whatcom Falls Park where fish and debris are screened, and chlorine is added.

The WTP, located in Whatcom Falls Park, is capable of producing 24 MGD. Prior to filtration, alum and polymer are added to the water for coagulation. The pH is adjusted with soda ash and chlorine is added before the water enters the distribution system. Appendix B contains facility maps and presents a general site plan for the WTP.

1.5 Plan Review and Update

This ERP is a controlled document that is distributed those listed in the Distribution Log on page vii. The Water Treatment Plant Supervisor or designee is responsible for the maintenance, revision, and distribution of the ERP. The ERP is required to be reviewed and updated every 5 years based on the recommendations made by AWWA *Emergency Preparedness Practices G440-17* and ERP requirements within the framework of the AWIA. Additional updates and revisions also can be triggered by the following events:

- After each incident that requires activation of the ERP
- After each evaluated exercise that tests the effectiveness of the ERP and corresponding After-Action Report/ Improvement Plan (AAR/IP) (see Section 8)
- Changes to contact and other information contained in the ERP, including:
  - Internal and external contact data (Appendix A)
  - Water System facility maps (Appendix B)
  - Roles or responsibilities of Water System personnel
  - Facility construction, operation, maintenance, or other circumstances that alter the hazards or methods of response to an incident
  - Hazardous material (HAZMAT) used or stored at system facilities
- Changes in applicable laws and regulations
- Changes to the NIMS/ICS incident response and management policies
- Changes to the HSEEP exercise planning guidelines

- Changes to the City of Bellingham or Office of Emergency Management that directly conflict with this ERP as to interagency collaboration, notification, and response

2 Concept of Operations

2.1 National Incident Management System and Incident Command System Framework

This ERP has been developed in accordance with NIMS, which was established in 2003 by Homeland Security Presidential Directive (HSPD)-5, Management of Domestic Incidents. NIMS is applicable at all jurisdictional levels and across functional disciplines. The intent of NIMS is to provide a response structure that is applicable across a full spectrum of potential incidents and hazard scenarios.

NIMS provides a consistent, nationwide approach for federal, state, local, and tribal governments to work effectively and efficiently together to prepare for, prevent, respond to, and recover from domestic incidents, regardless of cause, size, or complexity. HSPD-5 required adoption of the NIMS by state, local, and tribal governments by September 30, 2006 as a condition for federal preparedness assistance. NIMS was revised in December 2008 to clarify concepts and principles and refine processes and terminology. It was further reviewed and revised again in 2018.

This ERP uses the NIMS approach to emergency planning, response, and recovery. The approach relies on pre-incident planning, establishes command and communication hierarchies, and encourages the use of checklists and procedures to provide for efficient emergency response. NIMS incorporates the six functions of the ICS—Command, Operations, Planning, Intelligence, Logistics, and Finance/Administration—to collectively manage the emergency.

NIMS standard incident management structures are based on three key organizational systems:

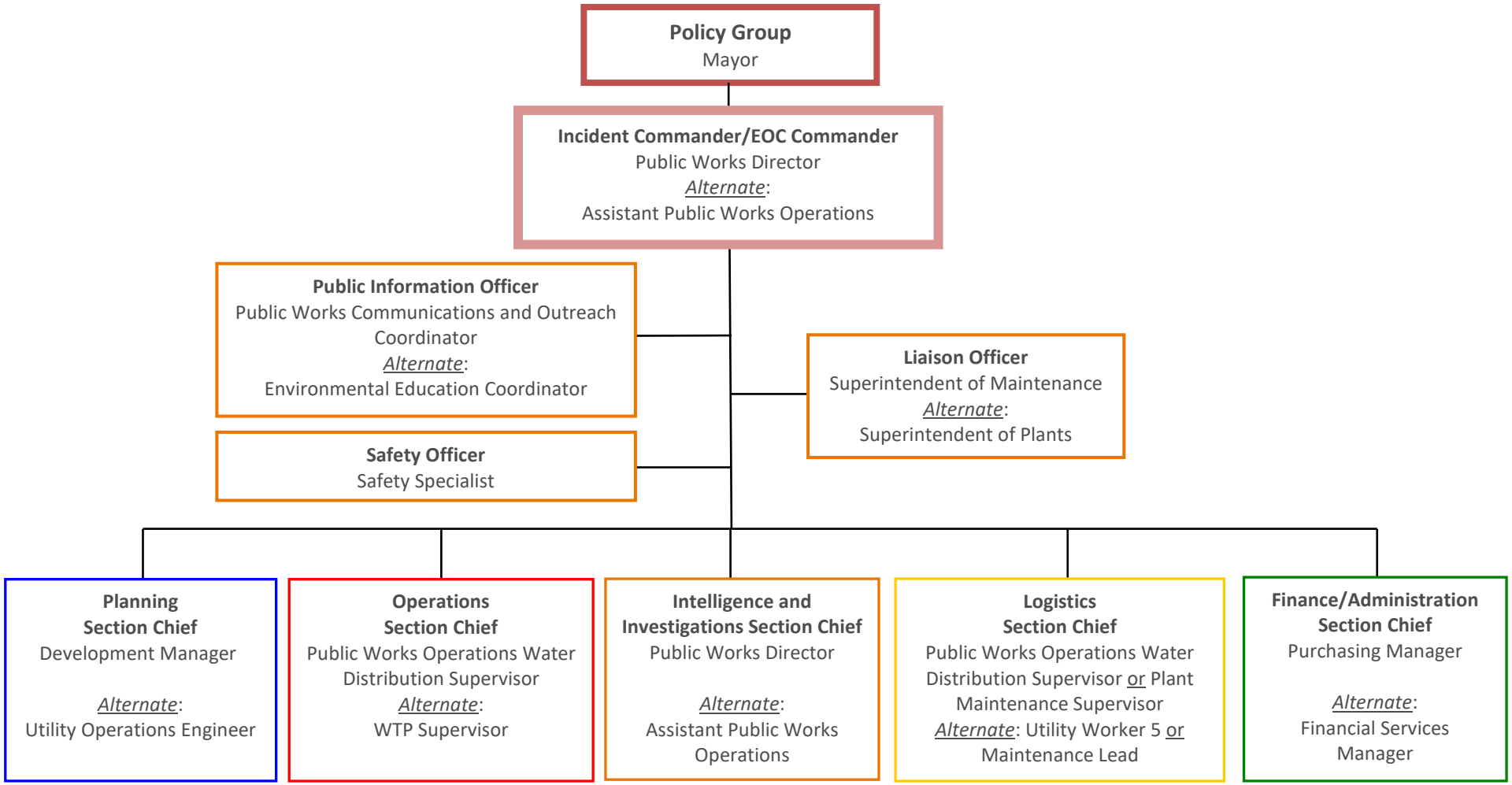
- ICS, which defines the operating characteristics, management components, and structure of incident management organizations throughout the lifecycle of an incident
- Multiagency Coordination Systems, which define the operating characteristics, management components, and organizational structure of supporting entities
- Public Information Systems, which include the processes, procedures, and systems for communicating timely and accurate information to the public during emergencies

NIMS prescribes use of the ICS, which provides a common framework for emergency response and a standardized means to command, control, and coordinate the use of resources and on-scene personnel. ICS is a standard, on-scene, all-hazard incident management concept that is interdisciplinary and organizationally flexible to meet the needs of incidents of any kind, size, or level of complexity. Using ICS, Water System personnel and external entities can integrate rapidly into a common management structure.

2.2 Water System Incident Management Team

The Water System has established a water system Incident Management Team (IMT) based on the ICS Command Staff positions consisting of Incident Commander, Public Information Officer (PIO), Liaison Officer, and Safety Officer and General Staff positions of Planning, Operations, Intelligence and Investigations, Logistics, and Finance/ Administration Section Chiefs. Through its staffing, the IMT can determine the severity of an event, identify the needed resources to respond, and maintain flexibility to expand response staffing if needed. Staff titles with designated IMT positions are provided in Figure 2-1. IMT contact list details are provided in Appendix A.

Figure 2-1. Incident Management Team Organization



A Policy Group will coordinate with the IMT Incident Commander (IC) regarding critical emergency response decisions and public or media crisis communication.

Should the severity of the event require sustained operations greater than a single operational period (12-hour shift), the IMT IC will determine staffing levels required to maintain expanded shift coverage and continue response to the event. Sustained operations may require recall of personnel for incident management and response purposes. The ICS has considerable internal flexibility and can expand to meet different needs. For example, if an emergency involves only the water system, the IMT likely will have sole incident management responsibility. However, in the event of a broader emergency, the IMT can expect to integrate into the Unified Command (UC) ICS structure staffed with multiple agencies such as local, county, state, and/or federal response personnel.

UC is a process often used in multi-agency or multi-jurisdiction incidents. It involves establishing a common set of objectives and a common strategy for an incident without the loss of Unity of Command, which includes agency or jurisdictional authority, responsibility, or accountability. The ICS in a UC will share command responsibility and represent their respective agency or jurisdictional needs.

Position staffing for the IMT depends on the severity and type of the emergency event. Position roles and responsibilities have been identified for the IMT; some events that could occur at the water systems will not require individual staffing for each position. One or two key personnel may assume responsibility for accomplishing required roles and responsibilities.

For example, the IMT IC may be solely responsible for managing incidents that occur within a building, are localized to a small area, and do not involve external emergency response agencies. Other emergencies, such as large main breaks, may involve additional IMT members and activation of the Emergency Operations Center. Large-scale emergency events, such as a major fire, explosion, suspected water contamination, or terrorist attack, will involve all IMT members and multiple external emergency response agencies. In these cases, the Water System will provide support and resources to the IC, or the event may require relocating the IC to the City of Bellingham Emergency Operations Center and appointing a Deputy Incident Commander to run the Water System Emergency Operations Center.

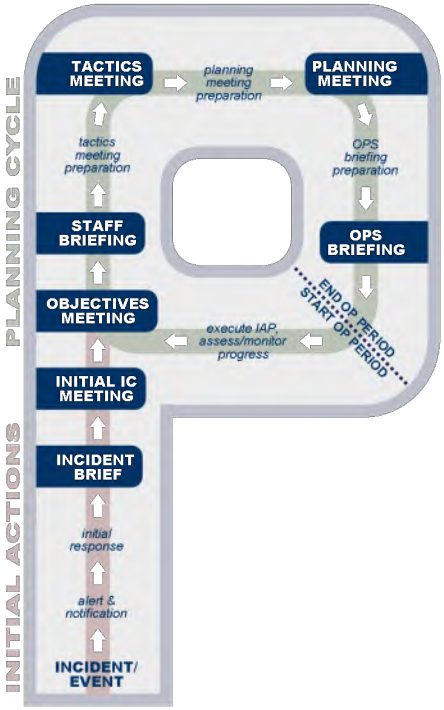
2.3 Planning "P" Introduction

The ICS structure provides an organizational framework for managing response operations. The Planning "P" (as shown in Figure 2-2) is a common emergency management image that illustrates the model incident management process for one operational period. The USCG states that the incident management planning process should be built on the following phases:

1. Identify and process the potential incidents and effects.
2. Establish incident objectives.
3. Develop the plan to counteract the effects.
4. Prepare, disseminate, and exercise the plan.
5. Execute, evaluate, and revise the plan.

The Planning "P" provides a functional and operational framework for interaction among IMT members and management of operational periods during response operations. The stem of the "P" represents initial response and mobilization, while the circular portion of the "P" represents ongoing operational management based on ICS principles. The boxes around the "P" in role-specific Planning P graphics (see Appendix D) indicate basic responsibilities at each stage of the response for members of the IMT or Command and General Staffs.

Figure 2-2. Planning P



Decision-makers should utilize the Planning "P" as a guide for developing Incident Action Plans (see Section 5.2 for detailed information), identifying tactical responses necessary to meet objectives, and planning essential meetings throughout the incident.

The primary components of the Planning "P" are as follows:

1. Initial Response, Objectives, and Briefing: The leg of the "P" describes the initial response activation period for the IMT and the Emergency Operations Center (EOC). The initial response activities should include the following:

- Conduct initial assessment.
- Develop a plan of action.
- Complete ICS-201 form (located in Appendix G). ICS 201 provides the Incident command team with information about the situation and the resources allocated to the incident. This form serves as a permanent record of the initial response to the incident and can be used for transfer of command.
- Prepare for command briefing:
  - Identify UC representatives.
  - Brief Command on initial response activities.
  - Agree on organization structure.
  - Clarify issues and concerns.
  - Identify Command Post and support facilities.
  - Discuss planned operations and directions.
  - Identify incident escalation potential.
- Identify Command Post and support facilities.
- Order appropriate staffing.

Tactical discussions should include alternative response strategies, potentially for each incident objective. On smaller incidents with minimal impact, the task of developing incident objectives and strategies may be the sole responsibility of the Incident Commander. On larger incidents, members of the IMT and EOC, and other key company personnel may contribute to this process.

2. Assessment Meetings to Define Objectives for an Operational Period

- Prior to meeting, Incident Command/UC should develop and update the following:
  - Response emphasis and priorities
  - Response objectives
  - Common operating policy, procedures, and guidelines
- Command and General Staff Meeting Briefing:
  - Meet and brief Command and General Staff on command direction, objectives, and priorities
  - Assign work tasks
  - Resolve problems
  - Clarify staff roles and responsibilities

3. Planning Meeting

- Update charts and maps, as necessary.
- Draft ICS-215, Operational Planning Worksheet.
- Identify operational requirements, strategies, and tactics for next operational period to meet priorities and objectives.
- Get tactical approval from Incident Command on planned actions.
- EOC and IMT review updated planned actions.
- Operations and Planning Sections discuss and document strategies, tactics, and contingencies.

4. Incident Action Plan (IAP) Preparation and Approval Meeting: ICS forms and supporting documents should convey the Incident Commander's intent and the Operations Section plan for the current operational period.

- Finalize information to be incorporated into the IAP.
- Complete all documentation associated with the IAP.
- Command approves IAP.
- Distribute plan to Section Chiefs and other required personnel.
- Provide briefing to Operation Section personnel.
- Ensure support and resources are in place for current and next operational period.
- Execute plan and assess progress:
  - Monitor ongoing operations and adjust tactical processes as necessary.
  - Measure and ensure progress against stated objectives.
  - Debrief resources coming off shift.
  - Prepare to brief UC/Planning on accomplishments.

At this point, a new operational period begins if the incident is not resolved. The cycle (the circular section of the "P") continues with execution of an adjusted plan. Progress evaluations and adjustments should continue until the incident is terminated. Additional information on preparing an IAP is provided in Section 5.2.

5. Response Termination

- Brief command on activities.
- Establish demobilization priorities.
- Identify surplus resources and probable resource release times (only the On-Scene Incident Commander should authorize the release or demobilization of response resources).
- Verify decontamination procedures and disposal plan, as necessary.
- Plan for equipment repair and maintenance services, as necessary.
- Identify Lessons Learned and apply to associated response plans.

2.4 Incident Management Team Roles and Responsibilities

In the ICS, the organizational structure includes an IC who leads the Command and General Staff (Officers and Section Chiefs). The ICS is effective as it assigns a single person to be in charge of and accountable for actions taken at the incident site. The IC is responsible for all aspects of the response.

The Policy or Executive Group provides policy guidance on priorities and objectives based on situational needs and the Emergency Plan. This group oversees resource coordination and provides support to the on-scene command from the EOC.

Command Staff members include the IC, PIO, Safety Officer, and Liaison Officer; their responsibilities are as follows:

- The PIO oversees development of messages to the public and manages press inquiries. If the incident expands to UC, the PIO will work in concert with other assisting agency PIOs within a Joint Information Center (JIC).
- The Safety Officer monitors conditions and adjusts safety procedures as needed to protect responders in the field.
- The Liaison Officer serves as the interface between the Utility and external agencies.

Appendix D contains the Command Staff, General Staff members include the Operations, Planning, Logistics, and Finance/ Administration Section Chiefs.

In general, a Water System staff member who first discovers a problem should immediately call 9-1-1 if there is a medical emergency or threat to life, health, or safety. They should then notify their supervisor immediately.

The supervisor will then notify the Water Treatment Plant Supervisor or Public Works Director (as applicable) and serve as the initial IC to coordinate response activities until the appropriate Utility person arrives to assume the role of IC per the IMT organizational chart.

If local emergency response agencies are called to perform rescue, fire, chemical release, or security assistance, the IC responsibilities are turned over to the lead fire or law enforcement official upon arrival on-scene and after the IC conducts a thorough briefing. The IMT will coordinate with the emergency response agency IC.

2.5 Summary of Threats and Hazards

Potential threats and hazards to the Water System were identified based on the results of the RRA along with historical data of events that have affected the utility and other events applicable to the Water System and the surrounding area. Worst-reasonable-case scenarios were developed for each threat identified below. Threats and hazards that may be applicable to the water facilities and/or services as identified in the 2020 Water Risk and Resilience Assessment include the following:

- Malevolent Threats
  - Contamination of Product. Intentional contamination of water in system by adversary with chemical, pathogenic, or other health concerning agents.
  - Physical Process Sabotage. Damaging, disabling, or destroying asset by physical/manual means by employee or other person, with the primary intent to sabotage system operations.
  - Cyber Process Sabotage. Damaging, disabling, or destroying asset by electronic/hacking means by employee or other person, with the primary intent to sabotage business enterprise.
  - Diversion or Theft. Physical theft or diversion of information, equipment, or valuable resources by employee or other person with inside knowledge and/or access. Example: Network hardware
  - Airplane Attack/Accident. Airplane crashes into facility. All function of site is lost and facility has to be reconstructed.
  - Armed Assailant(s). Attack by single armed individual (e.g., disgruntled employee, ex-spouse), with the primary intent to threaten and/or kill a utility staff member.
  - Land Vehicle Accident. Accidental crash of a vehicle into a facility
  - Drone Attack. Drone drops explosive onto reservoir. Reconstruction of reservoir is required.
- Natural Hazards
  - Earthquakes. Earthquakes are a concern as the District is located in a zone of high seismic hazard.
- Dependency Hazards
  - Loss of Utilities (Power). Unable to provide service for the number of days set as the organizational resilience standard
  - Loss of Chemical Supplier. Chemical supplier for aluminum sulfate based in Canada. Supply is disrupted. City has to search for new supplier and create emergency contract.
  - Loss of Employees. Key employees go on strike or leave, resulting in major service disruption until adequate employee support to keep the system components functioning can be restored.
- Proximity Hazards
  - Pipeline (oil and gas). Pipeline explosion occurs and damages the facility. Repairs are needed.

Appendix C contains Emergency Action Checklists and Emergency Action Plans (EAPs) for Water System response actions for incidents that may occur during different types of emergencies. The risks represented by these threats/hazards to critical assets, based on their likelihood, consequences, and the assets' vulnerabilities, are discussed in the RRA.

A disease outbreak, such as the ongoing Coronavirus Disease 2019 (COVID-19) pandemic, can affect a utility through staff shortages due to absenteeism, supply chain disruption (chemicals, materials, personal protective

equipment), and inability to maintain all operations. State and local public health officials in Washington monitor such public health situations closely. When implementing pandemic or influenza response plans, the Water System will coordinate with local health departments and state agencies to avoid conflict with other regional and state plans. The Water System approach to pandemic planning will follow guidance from the Centers for Disease Control and Prevention (CDC) and the World Health Organization. Examples of guidance can include the following:

- Staffing; non-essential vs. essential staff
- Employee screening to determine if they are well enough to work onsite
- Use of pandemic testing kits and required training
- Contact information for external emergency response partners, including maps and locations of temporary testing sites
- PPE guidelines
- Locations of pandemic equipment onsite

2.6 Emergency Activation Levels and Emergency Response Plan Activation

Depending on the nature and extent of the emergency, the Water System General Manager, Director of the Water System, or their designees will determine when the EOC and ERP are activated. The IC or designee has the authority to establish whether the EOC is activated or not. This activation may range from minimal IMT involvement to a full activation of the IMT. The Water System Emergency Activation Levels (EALs) are provided in Table 2-1 and include potential indicators and guidance criteria for each level. The City of Bellingham PW Department UOC uses the levels of "Non-Emergency, Level 1 - Emergency, Level 2 - Emergency, and Level 3 – Emergency." If required, a Water System representative would report to the Whatcom County EOC during a Level 3 Emergency Activation.

2.7 Notification Requirements

The Water Treatment Plant Supervisor or the Public Works Director or their designee is responsible for notifying employees, offsite emergency response personnel, applicable regulatory agencies, and support organizations such as vendors, contractors, and mutual aid entities, as well as providing regulatory-required notifications and advisories. (Communication information regarding customers, the public, and the media is included in Section 7.) In coordination with the IC, the entities initially notified will determine whether there are any additional entities that should be notified. The extent of the expanded notification will be commensurate with the certainty and severity level of the emergency.

2.8 Protective Actions and Site Security

The DHS issues National Terrorism Advisory System (NTAS) alerts for the United States. NTAS alerts may be issued for the nation, a region, state, or other geographic area and/or specific target types (such as a public utility). NTAS alerts include the following:

- Elevated Alert: Warns of a credible terrorism threat against the United States
- Imminent Alert: Warns of a credible, specific, and impending terrorism threat against the United States

Water utilities are considered a critical infrastructure and, overall, associated facilities are secured during normal and emergency conditions. Additional protection measures will be undertaken by Water System staff at facilities and assets depending on the nature of the threat or incident and/or NTAS alert level. Protective actions and site security will be coordinated with the City of Bellingham police department as the incident dictates. Notifications or alerts can be disseminated to the Water System through multiple sources including the City of Bellingham Police Department or the Office of Emergency Management.

Table 2-1. City of Bellingham Water System ERP Emergency Activation Levels

Emergency Activation Levels	Emergency Response Organization Action	Example(s)	Guidance Criteria
Non-Emergency	• Handled by PW staff in accordance with standard operating procedures • No PW Department UOC activation	• Pump outage • Small main break	• Potential problem identified • No external impacts
Level 1 - Emergency	• Notify PW Incident Commander • Consider PW Department UOC activation	• Transmission main break • Unauthorized entry at a treatment plant or reservoir • Chlorine leak	• Insignificant threat to health, property, or the environment • Handled by the routine response agency
Level 2 - Emergency	• Notify PW Incident Commander and PW Incident Management Team • Activate PW Department UOC • Consider City of Bellingham and/or Whatcom County EOC activation	• Contamination in a single zone of the distribution system	• Actual or potentially significant threat to health, property, or the environment • Requires some help from additional responders or outside resources
Level 3 - Emergency	• Notify PW Incident Commander and PW Incident Management Team • Activate PW Department UOC • Activate City of Bellingham and/or Whatcom County EOC	• Long-term loss of power to water treatment plant	• Immediate or widespread threat to health, property, or the environment • Requires the assistance of a full complement of responders and outside resources

2.9 Emergency Operations Centers

An EOC is a designated facility that serves as the command center to coordinate response and provide support in an emergency. Initial and sustained operations would take place in the field and at the scene of the incident. The EOCs are primarily staffed by resource providers and agency representatives. The locations of the City of Bellingham Public Works Utility Operations Center (PW Department UOC) and the Whatcom County EOC are provided below. Specific activities to be performed by personnel in the PW Department UOC during an emergency are as follows:

- Set priorities and develop and execute IAP forms (refer to Appendix G).
- Coordinate and support all field-level incident activities.
- Gather, process, and report information to other involved agencies regarding magnitude and potential impact of the event, specific damages, and planned response and recovery actions.
- Coordinate with local governments, response entities, operational areas, or other EOCs as appropriate.
- Request resources from external sources, if necessary, consistent with procedures within the National Response Framework (NRF).

- Provide food, water, and other emergency supplies for field personnel who are not able to leave their posts during an emergency.

2.9.1 City of Bellingham Public Works Utility Operations Center

The PW Department UOC is located as follows:

PW Department UOC: 2221 Pacific Street, Bellingham, WA 98229

Primary Points of Contact: Water Treatment Plant Supervisor

The alternate PW Department UOC, which will be used if the primary PW Department UOC is unavailable or rendered unusable during an emergency, is located as follows:

Alternate EOC: Federal Building, 104 W. Magnolia Street, Bellingham, WA 98225

Standard general supplies that can be included inside the PW Department UOC are listed in Table 2-2. These supplies should be replenished after use. It is the responsibility of the Planning and Logistics Section Chiefs to arrange for and maintain PW Department UOC supplies.

Table 2-2. Standard PW Department UOC Supplies

General Supplies	Communications Equipment
• Water System ERP, City of Bellingham Comprehensive Emergency Management Plan, and applicable related documents • Emergency lighting and flashlights • Spare batteries for flashlights or rechargeable batteries • Logbook of events for each IMT position, including standard emergency forms, contact information, and emergency response checklists • Photocopier and printer • Laundry machines • Notepads, pens, calculator, and clock • Whiteboard, flip charts, and markers for incident charting • Tables and chairs • Fuel for backup generators • Sleeping cots (6 or more) • Food and water supplies for 18 to 20 people for 5 to 7 days	• Computers • Cell phones • Radios or satellite phones (if available) • Landlines and speaker phones • Internet connection • Power Over Ethernet • Televisions • Facsimile machine • List of contact information/cell phones for all personnel • Backup generators
Reference Materials	**Emergency Personnel Safety Equipment**
• Major water system as-built drawings including, but not limited to, wells, tanks/reservoirs, booster stations, lift stations, and other assets • Electronic and hard-copy system maps • Plans and procedures • Operating procedures and system descriptions including backup systems and interconnections with other systems • Geographic Information System ability or printed maps • U.S. Geological Survey 7.5 quadrangle maps of entire City and surrounding county • City road maps, including the surrounding county	• Disposable laboratory coats • Splash-resistant goggles • Safety boots • Air quality meters • Face shields • Safety glasses • Respirators • Automated External Defibrillator (AED) • Self-Contained Breathing Apparatus • Disposable Gloves • Disposable Shoe Covers

2.9.2 Whatcom County Emergency Operations Center

The Whatcom County Office of Emergency Management is the lead agency for planning, activation, and emergency actions/response associated with the City of Bellingham area. The EOC retains command of any incident unless it is relinquished to another authority depending on the type and complexity of emergency. Public Works has a specific place/desk at the City EOC for coordination of notifications, advisories, messaging, resource needs, and situation briefings impacting the utility.

The City of Bellingham and/or Whatcom County EOCs may be activated in conjunction with the PW Department UOC for emergency events that require assistance from multiple agencies and/or significant interaction with the public and news media.

Whatcom County EOC: Whatcom County Emergency Management, 3888 Sound Way, Bellingham, WA 98226

Depending on the geographical area, size, and nature of the emergency, the City of Bellingham PW Department UOC would be activated under the ICS and adhere to NIMS concepts. In the event the PW Department UOC resources are exhausted, the Whatcom County EOC would provide resources based on requests made consistent with the NRF. Incidents with multi-jurisdictional or multi-agency involvement will be organized within the UC structure.

3 Risk and Resilience Assessment Results and AWIA Requirements

This section describes additional AWIA requirements that must be met to certify this ERP as compliant with Section 2013. Emergency Action Plans or checklists were developed as a result of the RRA requirements. Appendix J tables represent a summary of the additional AWIA requirements.

The below list describes the procedures, checklists or processes that can obviate or significantly lessen the impact of a malevolent act or natural hazard on public health, safety, and water supply.

Based on the results from the RRA, if the Water System were to act on one of the top threats identified, emergency response actions would be put into place. The Standard Operating Procedures (SOPs) and Emergency Action Checklists referenced here are included in Appendix C.

No.	Document Title
1	Activating the PW Department Utility Operations Center
2	Deactivating the PW Department Utility Operations Center
3	Evacuation (for Non-Chemical Release)
4	Shelter-in-Place (for Chemical Release)
5	Medical Emergency
6	Power Failure
7	Severe Weather
8	Water Shortage
9	Chemical or Fuel Shortage
10	Earthquake
11	Fire/Explosion
12	Contamination Threat in the Water System
13	Identified Contamination in the Water System
13.a	Water Contamination Procedures
14	Aluminum Sulfate Spill at Water Treatment Plant
15	Diesel Fuel Spill at Water Treatment Plant
16	Soda Ash Spill at Water Treatment Plant
17	Polymer Spill at Water Treatment Plant
18	Diversion or Theft of Physical Insider/Outsider Checklist
19	Water Treatment Plant Destruction/Failure
20	Distribution System Destruction/Failure
21	Dam Failure
22	Terrorist/Hostile Attack Aircraft Used as a Weapon
23	Terrorist/Hostile Attack Vehicle-Borne IED Car Bomb
24	Bomb Threat
25	Unauthorized Entry
26	Workplace Violence
27	Civil Disorder/Terrorism
28	Pandemic Response
29	SCADA Attack/Electronic
30	SCADA Attack/Physical

4 Threat Characterization

4.1 Threat Notification

A "threat warning" is the initial occurrence or discovery that triggers an evaluation of whether to activate this ERP. These warnings must be thoroughly evaluated to avoid false alarms. Descriptions of possible threat warnings that may be encountered are as follows (if any of these conditions are met, the WTP Supervisor will issue a threat warning):

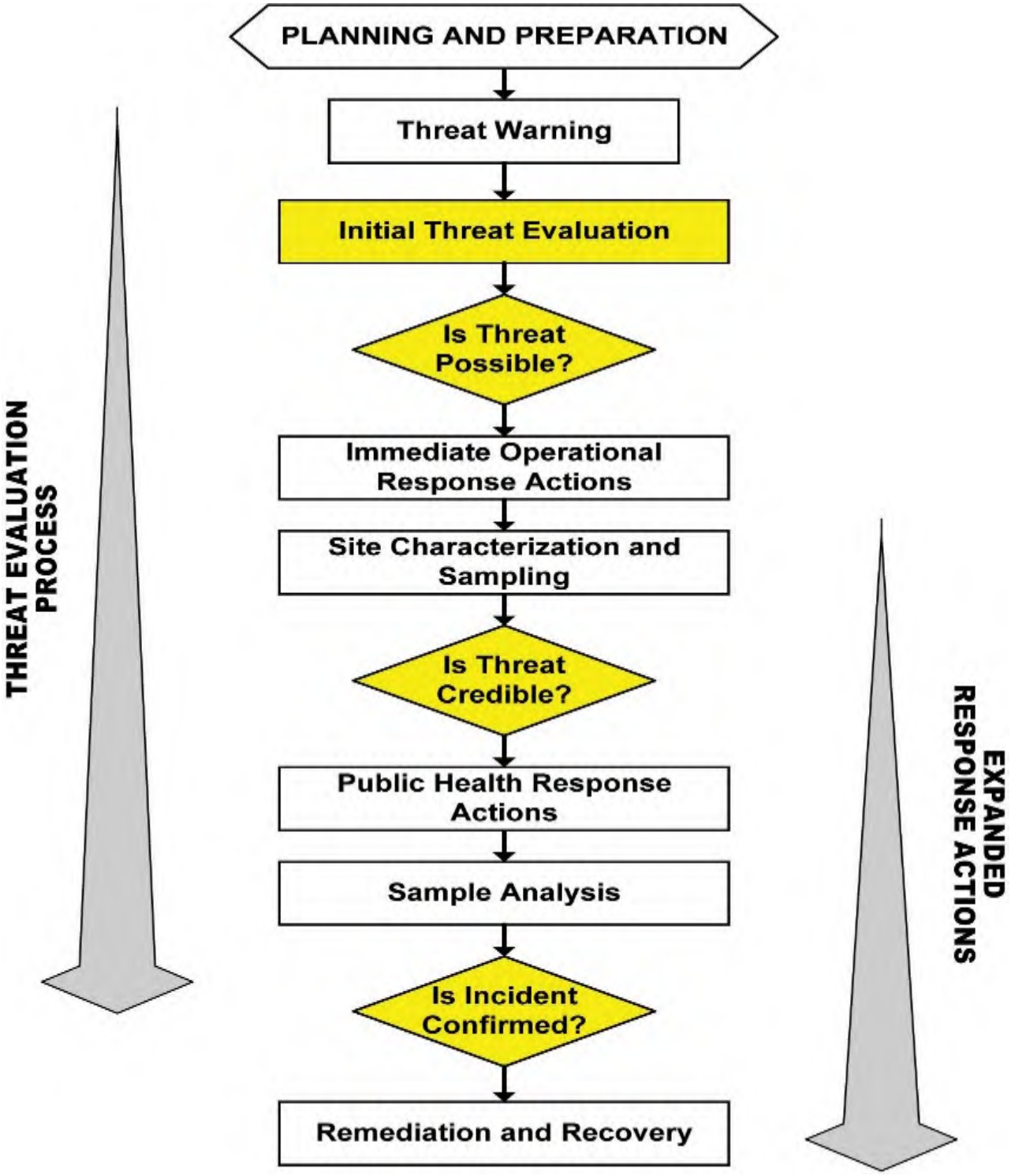
1. **Security Breach.** Physical security breaches through secured doors or gates/fences, or criminal acts such as trespassing, are the most common threat warnings.
2. **Witness Account.** Employees or neighbors may see suspicious activity, such as trespassing, breaking and entering, or other types of tampering that they report to local law enforcement.
3. **Notification by Perpetrator.** A threat may be made directly to Water System personnel, either verbally or in writing. A Security Incident Report Form on which to record the threat details is provided in Appendix G.
4. **Notification by Law Enforcement.** Public Works may receive notification about a threat directly from emergency management, the police department, Fusion Center, Terrorism Liaison Officers (TLOs), or other government agencies. This type of threat may be the result of a report of suspicious activity or data gathered by intelligence personnel.
5. **Notification by News Media.** A threat to damage Water System property or contaminate drinking water may be delivered to the news media or the media may discover such a threat. These threats are immediately reported to law enforcement, who would immediately contact Public Works.
6. **Unusual Water Characteristics**. Unusual changes in water characteristics (for example, taste, appearance, color, odor, laboratory results, or alarms) are reported and investigated by the Water Treatment Plant Supervisor.

4.2 Threat Decision Process

The threat decision process begins immediately after a threat warning is received. The threat decision process is managed in three successive stages: possible, credible, and confirmed. As the situation escalates through these three stages, actions that might be considered also change. Potential threats must be reported to appropriate Water System personnel and/or local law enforcement, as appropriate. Threat communications with employees, critical customers, and/or external agencies or organizations are conducted by Water System Supervisors or designees.

The USEPA Response Protocol Toolbox for Planning and Responding to Drinking Water Threats and Incidents action decision tree is shown in Figure 4-1.

Figure 4-1. Response Protocol Toolbox: Planning for and Responding to Drinking Water Contamination Threats and Incidents



Source: USEPA Response Protocol Toolbox Response Guidelines, 2004

4.3 Threat Stages

Stage 1 – Possible. Is the threat possible? When the water system is faced with a threat, the Water System will first evaluate available data to determine whether the threat is possible (could something happen based on the warning and staff's knowledge of the facility?). When the threat is determined to be possible, precautionary response actions are implemented.

Stage 2 – Credible. Is threat credible? There must be information or evidence to corroborate the threat for it to be considered credible.

If a threat is deemed to be credible, the ERP may be activated, including initiating internal and external advisories, conducting sampling and analysis, or considering isolation of part of the system. At this point, personnel are not certain whether a major threat event has occurred, but they are preparing to respond should the threat lead to a confirmed event. SCADA system and other alarms are in place for potential issues such as power outage, equipment failure, or security breach.

Stage 3 – Confirmed. Has the incident been confirmed? Confirmation implies that definitive evidence and information have been collected to establish that the threat or incident has occurred. Some threats are obviously confirmed, such as structural damage to system assets, in which case Stages 1 and 2 are omitted. Upon confirmation of the incident, the utility would fully implement the ERP. The ERP contains emergency guidelines (Appendix C) to be implemented immediately when a threat or incident is confirmed.

5 Incident Management and Incident Action Plans

5.1 Incident Management

5.1.1 Health and Safety Considerations

Protecting the health and safety of Water System personnel and the surrounding area is a key priority during both normal operations and emergency response. Safety hazards include those related to confined spaces, excavation and trenching, ladders, traffic control, falls, chemical handling, machinery and equipment operation, electrical safety, and others. Water System staff responding to an emergency must be trained to do so and follow required health and safety policies and procedures.

5.1.1.1 Evacuation and Shelter-in-Place

The WTP Supervisor (as applicable) must decide early in the response whether to evacuate personnel to an established offsite assembly area or shelter onsite from the dangers of the event. The location of evacuation assembly area depends on accessibility and the severity of the event. If required to shelter in place, the designated shelter-in-place location for the WTP is in the Laboratory. Personnel may be relocated to a designated area onsite or relocated offsite if the onsite areas are inaccessible (if it is safe to do so). Offsite evacuation assembly areas are used when there is sufficient time for offsite evacuation and vehicles are available to evacuate Water System personnel.

Evacuation exit signs for all Water System facilities are located throughout the facility or building. The evacuation gathering site for all staff is located at the WTP front gate. Facility evacuation maps are located in Appendix F.

Medical surveillance of emergency responders is required for those who may encounter HAZMAT or other hazards. Medical assistance will be provided by local emergency medical services, if required. Trained Water System personnel can provide cardiopulmonary resuscitation (CPR) and first aid to responders using the supplies available in the first-aid kits located throughout facilities. AEDs are centrally located at all main facilities (WTP, Post Point, PW Department Operations, Federal Building, and City Hall).

5.1.1.2 Hazardous Materials

Water System staff should review and follow the Safety Data Sheets (SDSs) for the materials being handled. The SDS identifies hazards and chemical properties of a substance and outlines procedures for workers and emergency personnel to follow for handling the specified substance in a safe manner. The SDS also includes information such as physical data (for example, melting point, boiling point, and flash point), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill-handling procedures. SDSs are readily available at the WTP front gate and in the Lead Operator's Office.

Multiple chemical systems are used at the WTP to provide treatment and corrosion control for the distribution system. The chemicals are as follows:

- Aluminum sulfate
- Polymer
- Sodium hypochlorite
- Soda ash

5.1.2 Operational Planning Cycle

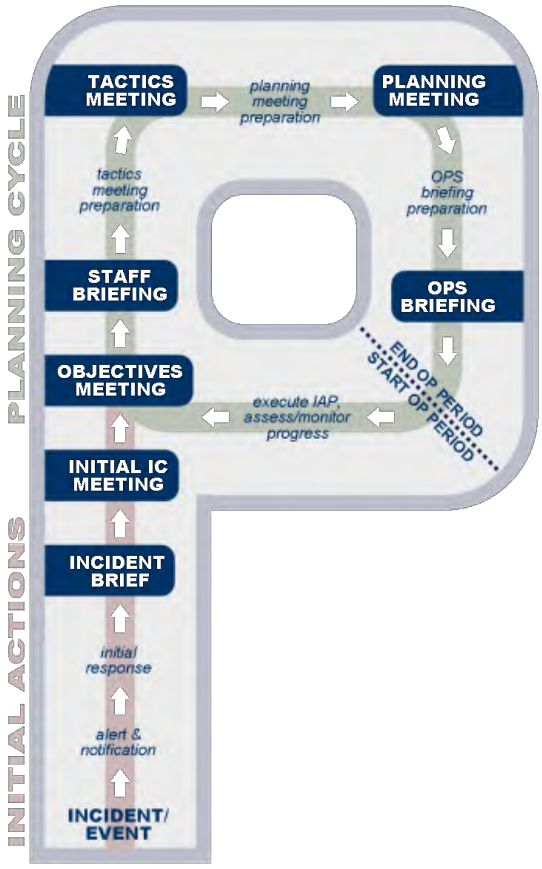
To support the phases of the IAP development, the Planning "P" (from the USCG Incident Management Handbook) shown in Figure 5-1 provides a visual representation of the Operational Planning Cycle. The Operational Planning Cycle is repeated for each operational period of an incident and results in the IAP for that operational period.

As depicted in the Planning "P" (introduced in Section 2.3), the operational period is divided into eleven distinct periods characterized by briefings, meetings, and working periods:

1. Incident Brief
2. Initial IC Meeting
3. Objectives Meeting
4. Staff Briefing
5. Preparing for the Tactics Meeting
6. Tactics Meeting
7. Preparing for the Planning Meeting
8. Planning Meeting
9. IAP Preparation and Approval
10. Operational Briefing
11. Execute Plan and Assess Progress

Each of these periods, including schedules, meeting descriptions, assignments, and other important information, is characterized in the IMT Position Guides provided in Appendix D.

Figure 5-1. Planning P



5.2 Incident Action Plans

A planning process has been developed as part of the ICS to facilitate development of an IAP in an orderly and systematic manner. This section explains the planning process required to develop an IAP. Following these planning steps enables expedited development of an IAP.

IAP development involves four major phases, as briefly described below:

- Response Phase
- Recovery Phase
- Damage Assessment and Incident Investigation Phase
- Termination Phase

5.2.1 Response Phase

Response activities are intended to reduce injuries, ensure employee safety, minimize facility damage, and facilitate recovery. Response activities include warning, isolating, and controlling the incident; assessing damage; establishing temporary service; and other operations. Response may include the following:

1. Initiating response activities.
2. Activating the PW Department UOC and this ERP, as necessary.
3. Coordinating operations through the PW Department UOC and Whatcom County EOC.
4. Releasing information to customers by the PIO or through a JIC.
5. Establishing staging areas for applicable facilities. These areas, such as schools, community centers, and/or church parking lots, would be pre-determined in coordination with Whatcom County EOC.

5.2.1.1 Initial Operations

As discussed in Section 2, if a discoverer finds an immediate threat to life, health, safety, or critical assets or a HAZMAT release, the discoverer should call 9-1-1 and then notify their supervisor as quickly as possible. The Supervisor will then notify the Water Treatment Plant Supervisor. The Public Works Director or designee will determine if the IMT and the ERP should be activated.

The following information should be provided to 9-1-1 dispatch and/or outside response agencies/organizations notified of the incident:

- Facility name, address, location, and telephone number
- Name of person reporting the incident
- Date, time, and type of incident
- Whether the problem is a threat or actual event
- Whether water systems have been interrupted or shut down
- Whether a water outage is imminent
- Whether HAZMAT has been released or involved
- Type and quantity (if known) of HAZMAT released
- For HAZMAT releases that require evacuation, the location where Water System staff will meet emergency responders

The Supervisor will notify the Water Treatment Plant Supervisor or the Public Works Director, as applicable, and serve as the initial IC to coordinate response activities until the appropriate employee arrives to manage the emergency at the scene (that is to take on the role of the IC) and the IMT is activated. If other local response agencies are summoned, in most cases they will take over command of the scene if outside assistance is required. IC requirements for initial response may include the following:

- Directing staff and other persons who may be affected by the emergency to evacuate, shelter-in-place, or take other protective actions.
- Requesting emergency assistance from local emergency response agencies (fire, police, and medical).
- Notifying staff and regulatory agencies of policies and procedures.

If local emergency response agencies are called to perform rescue, fire, chemical release, and/or security assistance, IC responsibilities must be turned over to the lead fire or law enforcement official upon arrival. The IMT will coordinate with the emergency response agency IC. The initial emergency response will be accomplished by Water System personnel fulfilling their roles and responsibilities. Depending on the nature and extent of the emergency, Water System personnel may be located at the incident scene, the PW Department UOC, and/or be on-call.

In the event of large-scale incidents, resourcing is very important for emergency response and recovery. As set forth in the NRF, resource requests and support should be coordinated at the local level first, followed by requests for state-level resources and, finally, federal resources once state resources are exhausted. The full range of resource availability is characterized in order below:

1. Water System resources are utilized to support response.
2. As resources are exhausted, mutual aid agreements can be used to support response.
3. The Water System can request resources through the Office of Emergency Management at the Whatcom County EOC (as long as it is open and activated) once internal and mutual aid resources are exhausted.
4. Once City and County resources are exhausted, the next step is to request resources through the Washington Emergency Management Division.

In the event of a disaster declared by the State of Washington, the State will utilize state-to-state mutual aid agreements such as Emergency Management Assistance Compacts as state resources are exhausted. In addition, the Intrastate Mutual Aid System can provide support in the event of a Washington-declared disaster. The Governor has the authority to request a State declaration of disaster as needed.

As a final method of resourcing, the State of Washington can request federal support through FEMA if state and mutual aid resources are exhausted in the event the President of the United States declares a disaster based on the Governor's request. Washington is part of FEMA Region 10.

The PW Department UOC and local responders (for example, the Bellingham Fire Department) can provide the Water System with requested resources in support of utility response operations. If the PW Department UOC is activated, a PW Department representative may be requested to coordinate utility response actions and resource requests from the Whatcom County EOC rather than the PW Department UOC. The Water System IC is responsible for selecting a Public Works representative that would relocate to the Whatcom County upon request. Typically, the representative selected is the IMT's primary Liaison Officer; however, the IC can select any member of the IMT to serve as the representative. The alternate IMT member chosen as the Public Works representative would then become the primary IMT Liaison Officer at the PW Department UOC.

5.2.1.2 Emergency Action Plans and Checklists

EAPs and SOPs are useful for responding to potential emergencies that may occur for specific events and at certain locations as the result of an intentional, accidental, or natural event. EAPs and checklists are provided in Appendix C.

To support sustained operations (i.e., those greater than a single operational period of 12 hours), the ICS emphasizes orderly and systematic planning using an IAP. The IAP is the central tool for planning emergency response operations during an operational period. The IAP is prepared by the Planning Section Chief with input from appropriate sections and units of the IMT. It should be written at the outset of the response and revised continually throughout the response. Copies of ICS Forms that, when compiled, become the IAP are provided in Appendix G. These forms are also available at https://training.fema.gov/icsresource/icsforms.aspx.

Incidents vary in their kind, complexity, size, and requirements for detailed and written plans. In an initial response for an incident that is readily controlled, a written plan may not be necessary. Larger, more complex incidents require an IAP to coordinate activities. The level of detail required in an IAP also will vary according to the size and complexity of the response.

5.2.1.3 Incident Operational Planning

Incident operational planning includes setting objectives and conducting tactics and planning meetings.

Incident Objectives

Objectives are set by the IC and are not limited to a single operational period but consider the total incident. The IC establishes the general strategy to be used and states major policy, legal, or fiscal constraints in accomplishing the objectives and appropriate contingency considerations. Before finalizing the incident goals and objectives, the IC should provide a draft copy of the IAP to the Operations Section Chief. The Operations Section Chief should ensure that the incident goals and objectives are understood and are realistic. After discussion, the incident goals and objectives are recorded using ICS Form-202 (Appendix G) and delivered to the Operations Section Chief, Planning Section Chief, PIO, and Liaison Officer to communicate the strategy for the subsequent operational period. The Planning Section Chief then prepares for the Tactics Meeting.

Setting or reaffirming goals and objectives at the beginning of each shift is a top priority of the IC. The following three important guidelines are to be considered:

1. Goals and objectives must be clearly stated and measurable so the IMT can determine how much was accomplished during the current operational period (shift) and track progress.
2. Goals and objectives must be attainable given the people, equipment, and supplies available during the shift.
3. Goals and objectives must be broad and flexible enough for the Operations Section Chief to achieve them in the best way possible under variable conditions.

Tactics Meeting

The IAP is reviewed by the Planning Section Chief, Operations Section Chief, IC, and other appropriate IMT members. The IC will update the initial objectives if warranted. Upon review, the Planning Section Chief will provide alternatives and strategies that will be necessary before the Tactics Meeting begins. The Tactics Meeting is scheduled and conducted by the Planning Section Chief. The length of the meeting should be 15 to 20 minutes.

The Operations Section Chief directs how resources will be deployed to meet response objectives. This blueprint of tactical deployment for the next operational shift will be developed and revised before the Planning Meeting where formal deployment of resources and work assignments will be determined. The Operations Section Chief normally determines control line locations and establishes Branch or Unit boundaries for geographical assignments for the next operational period. These lines will be plotted on the incident map. After determining divisional boundaries, specific work assignments for each division/group will be developed for the next operational period.

Tactics must be specific and within the boundaries set by the IC's general control objectives (strategies). Following the Tactics Meeting, the Operations Section Chief completes the Operational Planning Worksheet (ICS Form-215, Appendix G) with assistance from the Resource Status Unit Leader. This form should be completed at least 1 hour prior to the planning meeting.

At this time, the Operations Section Chief may consider the need for alternative or backup tactics and note these on the Incident Objectives (ICS Form-202, Appendix G) and Branch/Unit Assignment List (ICS Form-204, Appendix G).

Planning Meeting

Prepare for the Planning Meeting. The Planning Section Chief will:

- Establish the operational planning period with the IC.
- Determine planning meeting participants with the IC. Only key personnel should attend the planning meeting to facilitate an orderly and brief exchange of information. Final determination of participants is made by the IC.
- Establish and post the location and time for the planning meeting. The meeting area should be free from distractions and in a secure, private area.
- Ensure that planning maps (Supervisors, Operators, and/or Locators have access to electronic and hard-copy water system maps), forms, and resource and situation status are available and up-to-date:
  - Use large sketch maps or charts for planning and briefing.
  - Display the Planning Matrix (ICS Form-215, Appendix G).
  - Direct the Resource Status Unit to prepare a current resource inventory.
  - Direct the Situation Status Unit to update displays and summarize current intelligence.

Conduct the Planning Meeting. The Planning Section Chief is responsible for conducting the Planning Meeting and ensuring that the flow of information is brief and to the point. Most of the groundwork for the IAP should have been done by all parties involved prior to the meeting. This prevents the group from diverging from the subject at hand. The Planning Section Chief or Resources and Situation Unit Leaders will accomplish the following:

- Provide a briefing on the current situation and resource status. Information for this briefing may come from any or all the following sources:
  - Initial response IC
  - Incident Briefing Form (ICS Form-201, Appendix G)
  - Field observations
  - Operations reporting
  - Resource Unit and Situation Unit reports

- Specify resources needed by Divisions-Groups:
  - The Operations Section Chief, after specifying tactics for each division or group and in conjunction with the Planning Section Chief, will determine resource needs by group to accomplish work assignments. Resource needs will be recorded on the Planning Matrix. Resource needs should be considered on basis of the type of resource required to do the job.
- Specify operations facilities and reporting facilities:
  - The Operations Section Chief, in conjunction with the Logistics Section Chief and the Planning Section Chief, will specify any facility locations needed to accomplish the work assignments. These will normally be staging areas, shelters, or other types of areas.
- Place resource and personnel orders:
  - The Planning Section Chief should identify resource needs based on the needs provided by the Operations Section Chief and resource data available from the Resource Status Unit. Using the Planning Matrix (ICS Form-215, Appendix G), it will be possible to determine how many of the resources required for the next operational period are already available at the incident or in route.
  - By matching resource needs with those resources available for the operational period, the resources that must be ordered can be determined. With this new assessment, new resource orders can be put together and shown to the IC for approval, and then ordered through normal dispatch channels by the Logistics Section.
  - Make sure that a system of confirming resource orders and their expected arrival time(s) are established with the Logistics Section to enable the Resource Status Unit to complete the Branch-Unit Assignment Lists. Note: branches and units will be activated only if the incident becomes very large in complexity and is sustained for several operational periods.
- Consider communications, medical, safety, and transportation plan requirements:
  - The IAP will normally consist of the Incident Objectives (ICS Form-202), Division/Group Assignment List (ICS Form-204), Organizational Assignment List (ICS Form-203), an Incident Map, Communications Plan (ICS Form-205), a Medical Plan (ICS Form-206), a Transportation Plan, a Safety Message (ICS Form-208), and an Environmental Plan if appropriate. These forms are provided in Appendix G.
- The Planning Section Chief must determine the need for these attachments to any written IAP and ensure that they are prepared by the appropriate units.

5.2.1.4 Finalize, Approve, and Implement Incident Action Plan

- The Planning Section Chief is responsible for seeing that the IAP is complete and accurate. The following sequence of steps to accomplish this are these:
  - Set a time when IAP attachments are required to be completed.
  - Obtain plan attachments and review for completeness and approvals.
  - Obtain IC approval of the complete plan package.
  - Prepare for subsequent operations shift briefing.
- This is a period in which the Planning Section Chief and staff finish last-minute matters and prepare for the operations shift briefing:
  - Arrange for Documentation Unit to reproduce the plan.
  - Review the IAP to ensure it is up to date and complete prior to the operation briefing and distribution of the IAP.
- Select the operational period briefing location (at the pre-designated report-in for shift duty area):
  - Choose a location large enough to accommodate personnel.
  - Select a quiet place.
  - Set up the display map.

- Attend the operational period briefing:
  - Hand out the IAP to all pertinent personnel.
  - Provide a brief on the incident as of current time and orient to the display map.
  - Read and explain the current weather report.
  - The Planning Section Chief may finalize the briefing with any missing data and ask/answer questions.
- Finalize operational plans and prepare agency-specific reports:
  - Document any changes to the IAP made during the briefing.
  - Revise the Incident Status Summary (ICS Form-209) and prepare agency-specific forms and reports.
  - Set up a procedure to debrief operational personnel.
  - Revise the resource status board to show current shift status.
  - Submit all forms, reports, plans, and miscellaneous written information to Documentation Manager for filing.

5.2.2 Recovery Phase

The recovery phase occurs after emergency response actions are complete. Recovery, which is intended to return the affected facility or area to normal operations, is both a short-term and long-term process. Short-term operations seek to restore water services to the community. Long-term recovery focuses on restoring the system to its normal, or improved, state. The recovery period is also an opportune time to institute mitigation measures, particularly those related to the recent emergency. Examples of recovery actions include completing repairs, replacing heavily damaged equipment, and reviewing emergency response actions. The types of activities that could be conducted during the recovery phase include damage assessment, environmental consequence assessment, long-term protective action determinations, facility and/or environmental restoration, and dissemination of information.

Coordination of recovery activities with Emergency Management may involve utility service restoration recovery activities that require utility personnel representation at a designated Disaster Recovery Center.

5.2.2.1 Recovery Team

During emergency response operations, the Water System IC appoints a Recovery Manager. The Recovery Manager is responsible for selecting a recovery team and developing a recovery strategy prior to emergency termination. The Recovery Manager should be a senior operations representative familiar with the systems that may be affected by the emergency. This person should have the responsibility and authority to coordinate recovery planning; authorize recovery activities; protect the health and safety of workers and the public; and initiate, change, or recommend protective actions. Additional responsibilities include the following:

- Facilitate the transition from emergency to recovery operations.
- Develop, implement, and maintain the Recovery Plan.
- Coordinate all vendor and contractor activities that occur onsite.
- Ensure that the appropriate safety inspections have been completed.
- Coordinate the completion of emergency repairs and schedule permanent repairs.
- Notify key agencies of emergency repair status and the scheduled completion of system repairs.
- Complete permanent repair and/or replacement of system facilities.
- Review press releases prior to distribution. The Water System will work with the PW Department Communications and Outreach Coordinator to develop and coordinate the press releases.
- Release repaired facilities and equipment for normal use.
- Replace, or authorize the replacement of, materials and supplies used in the emergency.
- Document all recovery activities.

The Recovery Manager determines the needed expertise and selects the personnel necessary for the recovery organization. In general, the composition of the recovery organization is based on the nature and extent of the emergency and includes the following:

- Technical advisors to the Recovery Manager, which may include external experts such as industrial hygienists or fire protection specialists.
- Water system personnel with the technical expertise to direct post-incident assessment activities and analyze the results. Maintenance, operations, and engineering staff would be expected to fill these positions.
- The PW Communications and Outreach Coordinator to respond to inquiries or concerns from employees, the public, the news media, and outside agencies. The PW Department Communications and Outreach Coordinator should be prepared to provide information regarding the results of the incident investigation, the extent of onsite and offsite impacts, and the status of recovery operations.

Although the transition from response to recovery is not well defined, response efforts may be considered complete when the emergency is alleviated and hazardous conditions no longer exist. Effects of an emergency event often create secondary emergencies or hazards that also require response. Although one aspect of an event may transition into recovery, other aspects may remain in a response phase.

The following example activities might be executed by the recovery team:

- Install warning signs and barriers.
- Begin repair activities, including preparing designs and bids for contractor services.
- Execute agreements with vendors for equipment, materials, and services.
- Remove and dispose of debris.
- Collect cost account information needed for insurance claims and a request for emergency disaster funds.
- Obtain inspections and/or certifications that may be required before facilities can be returned to service.
- If necessary, initiate incident investigation procedures.

As the event is winding down and the utility is ramping back up, another agency may become involved to assume some of the operations from their home facility. This process is referred to as Devolution. Devolution occurs when the affected utility is severely damaged and a specific operation within its core mission needs to be delegated to another agency or another utility until such time that the primary facility is repaired and restored to normal operation within that core function.

5.2.2.2 Recovery Plan

The purpose of a Recovery Plan is to define the steps necessary to restore the systems to normal operations. Recovery planning is accomplished during the emergency response phase so that recovery can commence as soon as possible. The plan is not implemented, however, until it has been approved by the IC. Recovery planning must also be coordinated with the appropriate external regulatory and response agencies. The Planning and Logistics Section Chiefs are responsible for developing the Recovery Plan. Recovery Plan contents may include:

- Cover Page
- Incident Assessment and Investigation
  - Provide a summary of the emergency incident.
  - Outline provisions for controlling HAZMAT releases and exposure to persons affected.
  - Determine and document the extent of damage to equipment, facilities, and water system assets.
  - Coordinate with the incident investigation team and local, state, and/or federal agencies and organizations, as necessary, to document the root cause of the event.
- Recovery Planning and Schedule
  - Determine if impacted equipment, facilities, and water system assets can continue to operate.
  - Address worker health and safety during recovery activities and protection of workers and the public from hazardous situations and/or HAZMAT exposure, such as installation of temporary warning signs, barriers, and/or shielding.

  - Identify and mitigate other potential impacts that would hinder emergency response and recovery, i.e., inaccessibility of assembly areas and/or inoperative emergency or safety equipment).
  - Assign utility staff to implement and/or monitor implementation of assigned recovery tasks, including developing work packages, scheduling activities, and estimating costs for repair and recovery.
  - Restrict work activities at impacted equipment, facilities, and water system assets until the area(s) have been inspected and sufficient controls established to prevent further harm to personnel or the water system.
  - Define and prioritize the specific repair and restoration work required and organize according to functional area or process.
  - Address planning needs for handling and disposal of hazardous waste generated from the emergency and during recovery activities.
  - Establish methods of decontamination for system assets.
  - Address planning needs for control, treatment, decontamination, and disposal of potentially contaminated water resulting from emergency response and/or recovery activities in accordance with regulatory and environmental compliance requirements.
  - Determine how emergency equipment and consumable materials will be replenished, decontaminated, repaired, and/or replaced.
  - Determine long-term sustained damage to critical assets and whether this function can be done by another agency until repairs or replacement are complete.
- Resumption of Normal Operations
  - Determine what inspections, certifications, and requirements are necessary to return the system to normal operations. These may include the following:
    - Technical specifications, safety requirements, health and safety regulations, environmental regulations, and compliance documents
    - Federal, state, and local organizations and entities to be consulted prior to resuming system operations and termination of recovery activities
  - Identify changes that may occur because of repair, restoration, replacement activities, and/or accident investigation findings.
  - Determine records that need to be collected and provided to the IC and/or external agencies.

Often, recovery operations require the support of vendors, contractors, and specialized equipment. Many of these support agencies can be pre-identified. Priority requests for assistance that may be anticipated should be established by formal documentation with an agreement for providing this priority assistance.

5.3 Damage Assessment and Incident Investigation Phase

5.3.1 Damage Assessment

Damage assessment is used to determine the extent of loss, estimate repair or replacement costs, and identify the resources needed to return the damaged system to full operation. This assessment is begun during the emergency response phase of the event and continues through the recovery phase.

The IC or designee is the individual responsible for establishing and managing Damage Assessment Teams (DAT). Each DAT is composed of three to four personnel such as an operations or maintenance supervisor, electrician, engineer, Intelligence and Investigations Section Chief, and purchasing manager. Team composition may vary depending upon the nature and extent of the emergency. DATs, comprising persons that have knowledge of operational needs and the incident, will be deployed to affected sites to perform site surveys. The DAT will first ensure that a safety/structural inspection/assessment is completed in conjunction with the PW Department UOC. This activity will likely be completed with building inspectors and the Fire Department. Once determined safe on a prioritized facility or building basis, the damage assessment is initiated.

Damage assessment procedures follow the guidelines established for system operability checks and determination of operability/serviceability. At a minimum, the DAT will complete the following activities:

- Conduct an initial analysis of the extent of damage to the system or facility.
- Preserve evidence if the damage is criminal in nature.
- Estimate the repairs to restore the system or asset; the estimate will consider supplies, equipment, rental of specialized equipment (for example, cranes, pumps), and additional staffing needs.
- Identify vendors/contractors who have contracts with the Water System to perform these repairs and services including sole-source vendors for new equipment purchases.
- Provide this estimate to the procurement specialist to prepare a cost estimate to conduct repairs.

A damage assessment form for utility systems that can be used for recording data collected during a damage assessment is located at http://water.epa.gov/infrastructure/watersecurity/funding/fedfunds/disaster.cfm and provided in Appendix G.

5.3.2 Incident Investigation

Initial investigative activities begin immediately following an incident to preserve evidence and document the scene. However, emergency response actions take precedence over initial investigative actions. The purpose of incident investigation is to identify the underlying causes of an incident and implement corrective actions that would prevent the incident from recurring.

The IC, in coordination with the IMT including the Intelligence and Investigations Section Chief, is responsible for assigning roles and responsibilities to personnel during the incident investigation process. Once emergency responders assess the scene(s) for danger and determine that the incident has been safely mitigated, the following considerations are addressed:

1. Were personnel injured?
2. What caused the accident?
3. Is there property damage?
4. What systems or operations were affected?
5. What mitigation actions were completed and when?

The IC or designee establishes an Incident Investigation Team. Contract employees are included as part of the Incident Investigation Team whenever the incident involves the work of the contractor. Other individuals with appropriate knowledge may participate, if required, to investigate an incident (for example, other employees, engineer, equipment supplier, vendor, consultant).

The incident scene will be secured by the Incident Investigation Team to preserve evidence. Any items (for example, damaged equipment) that might explain what happened should be left untouched. Local law enforcement or the Federal Bureau of Investigation (FBI) will secure the scene if the incident is determined to be caused by a malevolent act. The FBI is normally not a first responder agency, whereas local law enforcement will secure the scene and determine the organization that has jurisdiction over the incident. The Incident Investigation Team will develop a report that documents the results of the investigation. The report should consist of the following sections, at a minimum:

- Report cover
- Witness identification
- Witness account
- Witness certification
- Incident description
- Safety recommendations
- Conclusions
- Incident Investigation Team certification
- Additional instructions

The Incident Investigation Team will coordinate with and defer to local law enforcement, the FBI, and/or fire investigators before collecting evidence. Disturbing the scene of a law enforcement or fire investigation may be a criminal offense. The Incident Investigation Team will photograph and/or videotape the area based upon the nature of the incident and the requirements of outside investigation agencies. The date and time must be noted on all photographs. The Incident Investigation Team will collect evidence that may have contributed to the cause of the incident and that may be subject to change (for example, dust) and document where the evidence was found. The team will then record (for example, photograph and take notes) relative locations of people, parts, and materials (for example, note the positions of valves, switches, and any controls). If appropriate, the Incident Investigation Team examines fire-extinguishing equipment to see if it has been activated. Finally, the team will collect any written documents that may aid the investigation, such as written instructions, container labels, operator logs, and training records. Local law enforcement or the FBI will collect and preserve evidence.

The Incident Investigation Team will record (and/or obtain from the FBI or law enforcement as appropriate) statements from operators, persons near the accident, witnesses, and emergency response personnel. Questions may relate to the events leading up to the accident including time of day, weather conditions, what happened, why it happened, and any suggestive corrective actions that should be taken to prevent reoccurrence. The date and time of all interviews must be recorded in interview notes.

After completing initial interviews, the Incident Investigation Team will review and analyze all evidence to determine the root cause(s) of the incident. Following the incident analysis phase, the Incident Investigation Team will summarize safety recommendations resulting from the investigation. Safety recommendations are then assigned by the IC or designee to the appropriate staff (for example, operations, maintenance, or engineering personnel) for prompt follow-up. Safety recommendations often require additional evaluation to determine whether they are technically and/or economically feasible; therefore, the list of recommendations should include a target evaluation date, resolution, and resolution date for each recommendation. Whenever a safety recommendation is not implemented, a written explanation of its exclusion will be documented. The Incident Investigation Report is not considered complete until all safety recommendations are resolved and documented.

5.4 Termination Phase

The recovery phase will be officially terminated when normal operations are resumed at facilities affected by the emergency. Upon terminating the recovery phase, personnel perform the following activities:

- Debrief staff and document lessons learned. Update training programs, the ERP, EAPs, and SOPs, as needed, based upon "lessons learned" during the emergency response and recovery phases of the event.
- Identify operational changes that have occurred because of repair, restoration, or incident investigation.
- Document the recovery phase and compile applicable records for permanent storage.

5.5 Incident Documentation and Forms

Each group involved in an emergency incident will maintain a Unit Log (Appendix G) to track activities, resources, and other actions relevant to the incident. Other forms and resources that may be utilized during emergency response phases are provided in Appendix G and include the following:

- Unit Log
- Situational Briefing Form
- ICS Forms
- Damage Assessment Form

Should the Water System be adversely impacted by a Presidentially declared disaster, the Financial and Administration Section Chief would work with the PW Department UOC and Finance Department and coordinate with the County's assigned state and FEMA Public Assistance Coordinator regarding eligible disaster reimbursement funds. FEMA Public Assistance program information (http://www.fema.gov/public-assistance-resources-and-tools) and 2018 Public Assistance Program and Policy Guide (http://www.fema.gov/public-

assistance-policy-and-guidance) provide current information on how the utility would be required to track information and costs, and apply for potential reimbursement.

FEMA Public Assistance Project Worksheets can be downloaded at https://www.fema.gov/media-library/assets/documents/26103. FEMA Public Assistance worksheet information can be collected using these forms; however, submittal of documentation and other information must be completed online using the Emergency Management Mission Integrated Environment system. Note: FEMA forms are modified on a regular basis, and a complete set of forms should be downloaded for use each time they are needed.

5.6 Records Preservation

FEMA reimbursement depends on maintaining accurate incident documentation, therefore, organizing this documentation and controlling its chain of custody is critical. Multiple records will be generated during the response and recovery phases of an emergency event. These records may include the following:

- Unit Logs
- Forms
- Logbooks and other emergency response action notes
- Records documenting the purchase of emergency services, equipment, and supplies
- Copies of press releases and other public information distributed by the PW Communications and Outreach Coordinator
- Photographs and/or video footage of response and recovery operations, including damage to facilities and equipment

The Planning and Logistics Section Chiefs are responsible for compiling records associated with an emergency incident and arranging for record storage. Important paper and electronic records should be kept in a carefully selected location to facilitate prompt retrieval and ensure security. It is recommended that all operating records be kept in a minimum of two locations, including an offsite facility. Computer backup systems should be kept up to date and reflect the information necessary to continue and track the provision of services.

The following guidelines are recommended for preservation of essential records:

- Protection of essential local records is vital to resume utility operations after a major catastrophe or national emergency.
- Essential records and documents that require safeguarding fall into three general categories:
  - Records that protect the rights and interests of individuals
  - Records required for effective emergency operations: plans, procedures, resource inventories, lists of succession, maps, memorandums of understanding, agreements, and lists of regular and auxiliary personnel
  - Records required to re-establish normal governmental functions and protect the rights and interests of the government, rules and regulations, official proceedings, and financial and court records
- The selection of records for preservation is the responsibility of the official rendering the service involved or with the record custodians.
- These decisions should be made in concert with the organization's overall plan for determination of value, protection, and disposal of records.

6 Emergency Resources

6.1 Equipment

The Water System owns and maintains various types of equipment and spare parts that can be used to respond to an emergency such as equipment, tools, spare pumps, piping, crew truck stock items, and other general spare parts/equipment inventories. Emergency field equipment consists of all available PW Department vehicles, equipment, tools, personal protective equipment, and sampling kits that may be used to respond to a threat or emergency at the Water System. The M:/ drive contains the listing of vehicles and equipment that would be readily accessible to PW Department staff in an emergency. This information is also maintained in an electronic database (City Works). During an emergency, this database should be used to obtain the current list of equipment and/or to search for specific equipment needs. Table 6-1 contains safety equipment items, their purpose, location, and quantity.

Table 6-1. Safety Equipment

Item	Purpose	Location	Number
Chemical splash goggles	Chemical spills	WTP laboratory	1
First aid kit	General first aid	WTP laboratory	1
Confined space retrieval system	Confined space entry and retrieval	Post Point Plant & WTP	2
Lockout/tagout	Hazardous energy control	WTP pump room	1

Additional equipment may be available from other City departments or neighboring water utilities. All requests for additional resources should be made to the Logistics Section Chief, who will coordinate with the IC and request assistance from the Bellingham and/or Whatcom County EOC, as needed.

Two-way radios, cellular telephones, and pagers will be used to maintain communication among the PW Department UOC, field personnel, and external agencies. Appendix E lists the communications equipment that is currently assigned to the PW Department Operations Division.

Emergency or unusual circumstances may also require rapid purchasing procedures. The Financial Section Chief, assisted by the Planning Section Chief and Logistics Section Chief, will implement these procedures. Water System generators are maintained and tested under load during regular inspection schedules to ensure they are in good operating condition. Generator fuel is supplied by a commercial company as needed. The Public Works Department also maintains a fuel management system for fuel services as well as fuel lock agreements to be used in the event of an emergency.

6.2 Personnel

During normal operations or in an emergency, operators can provide adequate shift coverage. Water System maintenance personnel can repair equipment, pump stations, lift stations, and other assets depending on the nature and magnitude of repair required. Depending on the emergency, staff members can be expected to be at the PW Department UOC in support of the water system.

In the event that the severity of an incident requires sustained operations greater than a single operational period (12-hours), the IC determines the staffing levels required to maintain expanded operational period coverage and continue incident response. Sustained operations may require a recall of personnel to fill positions needed for monitoring and controlling the event scene. Key positions of the IMT have assigned staffing of a primary and alternate person.

6.3 Alternative Water Sources

The Water System maintains an interconnected distribution system. See Appendix J for interconnections and alternative source water options. In an area-wide, prolonged water supply loss, potable and non-potable water could also be provided by external entities through requests and coordination with the PW Department UOC and Whatcom County EOC.

The PW Department UOC would determine the number and location of dispensing sites or points of distribution such as shelter facility parking lots if bottled water distribution is needed. The current planning factor for drinking water is 3 gallons per person per day according to FEMA. This planning factor does not include water use for purposes other than drinking water.

6.4 Vendors and Contractors

Resources such as laboratories, interdependent service providers for power, internet providers, cellular telephone providers, chemical vendors, vendors and contractors for parts and other services are maintained, as needed, by individual groups within the Water System or inside the Public Works Department. Contact lists are located in Appendix A of this ERP.

6.5 Coordination with External Organizations

It is possible that Water System will not have all the personnel, equipment, and materials needed to cope with a major water system emergency or disaster. Necessary additional assistance and resources may be rendered from non-impacted, inter-jurisdictional agencies and/or other organizations. The following external organizations have been identified for potential response support during a water system emergency:

- The FBI operates the National Infrastructure Protection Center and has established Infra-Guard to provide notification and information on terrorist threats to critical infrastructure. The Center additionally has response and investigation responsibilities.
- The USEPA maintains an Emergency Response Program for biological/chemical incidents. For the Utility Operations Division, this applies to contamination of the water system. USEPA may provide assistance when the responding agency is in a situation beyond available resources of the local responders. USEPA is not a first responder and cannot respond onsite to every spill, but can always offer technical assistance. USEPA Region 10 can be accessed 24 hours per day at 1-800-424-4372.
- The Coast Guard's National Strike Force is also available for biological/chemical support 24 hours a day.
- Chem-trac is operated out of their National Response Center and has the ability to identify unknown chemicals. They can be contacted at 1-800-424-8802.
- FEMA provides emergency response and recovery aid once a disaster has been Presidentially declared for the region. The City Manager would contact FEMA to request assistance based on direction from the IC at the City EOC during the emergency response to the incident.

6.6 Mutual Aid Agreements

Mutual aid agreements and memoranda of understanding are established to define the relationship between two or more agencies for response assistance. The IC is responsible for activating these agreements during an emergency. If the PW Department UOC is activated and Whatcom County resources are exhausted, the Washington State Emergency Management Division would tap into other local, county, state, and federal resources.

The City of Bellingham Public Works is a member of WAWARN, which is a voluntary program with the goal of establishing a statewide voluntary network that assists member water utilities to help other member utilities respond to an emergency. The main concept of WAWARN is "utilities helping utilities." The network will facilitate moving personnel, equipment, and materials to a system requesting assistance. The WAWARN website information is located at https://wawarn.org/. A copy of Mutual Aid agreements is located in Appendix I.

Mutual aid agreements are established to define the relationship between two or more agencies for response assistance. The agencies listed below provide routine services to the Water System and may be required to assist the department in an emergency or crisis situation. Additionally, the suppliers listed below may provide emergency response support or equipment.

- Alternate water suppliers
- Utilities
- Chemical suppliers
- Equipment suppliers
- Contractors and consultants

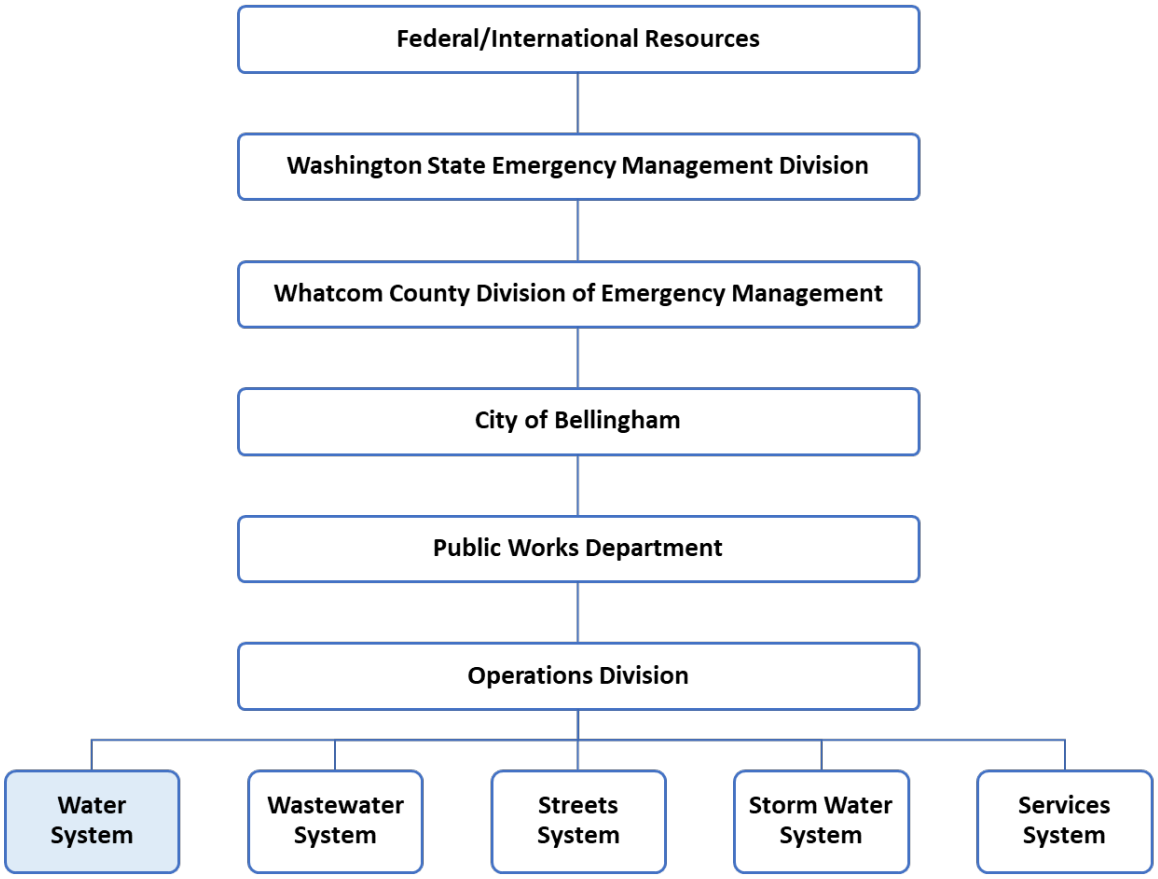
The following agencies may provide support to the Water System in an emergency or crisis situation:

- City of Bellingham Police Department
- City of Bellingham Fire Department
- Whatcom County Sheriff's Office
- Whatcom County Health Department
- Whatcom County Division of Emergency Management, which will obtain support from state and federal agencies as needed

Appendix A contains contact information for the agencies, organizations, and suppliers listed above.

Appendix I lists intergovernmental cooperative purchasing agreements, interlocal agreements, and non-conforming agreements that the City of Bellingham maintains with other agencies and organizations. The Financial Section Chief is responsible for activating and using these agreements during an emergency. Figure 6-1 presents the relationships among Public Work Departments, the City of Bellingham, Whatcom County, and state and federal emergency management agencies.

Figure 6-1. Emergency Management Flow Chart



Only the Water System is included in this ERP.

6.7 Emergency Procurement

Emergency circumstances may require immediate purchasing actions. An emergency purchase is defined as an unforeseen or unanticipated urgent and immediate need for equipment, supplies, or services where there exists a threat to public health, safety or welfare or the preservation of public properties would not be possible using normal purchasing procedures. The Water System Finance/Administration Section Chief, assisted by the Planning Section Chief and Logistics Section Chief, implements these activities in an emergency. Emergency procurement of resources and services can be obtained by Water System personnel through the Finance Department if deemed necessary to maintain production and service to customers.

Whenever practical, before any purchase controlled by this section is made, the requesting department will contact the Purchasing Manager for concurrence, explain the nature of the emergency, and provide a written certification of the emergency. If the item or service cannot be obtained from a vendor with an existing Public Works contract, the requesting department will request a Purchase Order, which will be incorporated into an Integrated Financial System for electronic tracking. The requesting department will be responsible for obtaining the necessary affidavits, insurance certificates, proof of proper licenses, trade certificates, permits, etc. from the contracted vendor as the emergency work may require.

During normal business hours, the Water System will notify the Purchasing Manager of the emergency situation and request verbal/email approval to proceed with the emergency purchase. The Water System will provide the following information:

- The nature of the emergency
- The estimated cost of the services/goods required
- The recommended vendor to receive the order

Documentation of all receipts and correspondence is required. For services purchased, a certificate of insurance must be provided if not already on file. As soon as practicable, the requesting department will submit the following documentation to the Purchasing Manager:

- Justification and/or explanation of circumstances for an emergency purchase that includes a clear definition of the products and/or services sought and how and where they will be used
- Any other supporting documentation as may be applicable

Following stabilization of the emergency situation, the IC must forward the purchase order to the Purchasing Manager. The Financial Services Manager can also approve emergency purchases or contracts.

For procurements of this type, the following procedures apply:

1. The Requesting Department will first attempt to contract with vendors who already have Public Works contracts for the goods or services needed.
2. The Purchasing Manager may make, or authorize others to make, emergency procurements of supplies, services, or construction items when there exists a threat to public health, welfare, or safety provided that such emergency procurements will be made with such competition as is practicable under the circumstances.
3. All disaster purchases that are acquired without full and open competition or that are not under an existing contract must be subsequently reviewed and approved by the Purchasing Manager as appropriate. A written determination of the basis for the emergency and for the selection of the particular contractor will be included.
4. If an emergency disaster declaration is made by the federal government, contact the Finance Department before the acquisition of any goods or services.

7 Crisis Communication

7.1 Crisis Communication Team

Timely accurate communication is essential in an emergency situation. Communication channels are on many levels and communication plans address communication to external and internal stakeholders, regulatory agencies, and the public. During a crisis, clear and timely communication is critical in preserving life, property, and customer confidence.

The purpose of formalizing crisis communications is to accomplish the following:

- Establish a Crisis Communication Team.
- Outline clear and easy-to-follow procedures for communicating with staff, outside agencies (response and regulatory), vendors and contractors, customers, the public, the media, and other stakeholders during a crisis.
- Provide tools for use during a crisis to facilitate timely, accurate communication with identified groups.

The Crisis Communication Team is responsible for making notifications and advisories, including providing information to various stakeholders during the response and recovery phases of an emergency event. The Crisis Communication Team consists of IMT members led by the PW Department Communications and Outreach Coordinator and including contacts listed in Appendix A-3, Crisis Communication Stakeholder Contact List. The PW Department Communications and Outreach Coordinator communicates directly with the Water System with regard to crisis communications. The crisis communication procedures are specific to the type of crisis. Once the incident expands to a large crisis category, the Crisis Communication Team is activated. Contact lists for the Crisis Communication Team are located in Appendix A of this ERP. Additional public communication process and templates are located in Appendix H.

7.2 Public Information Officer Responsibilities

The PW Department Communications and Outreach Coordinator is responsible for communicating with the public, media, and/or coordinating with other agencies, as necessary, with incident-related information requirements. The Communications and Outreach Coordinator is also responsible for developing and releasing information about the incident to the news media, incident personnel, and other appropriate agencies and organizations. The Communications and Outreach Coordinator will coordinate all information releases with final approval given by the IC. Refer to Appendix D of this ERP for the PIO Position Guide. The Communications and Outreach Coordinator should also monitor the media coverage of the incident to ensure that accurate and timely information is provided to Bellingham residents on potential and actual emergency incidents, and major emergencies/disasters and is not misreported by the media.

7.3 Internal and External Communications

During an emergency that affects a significant portion of the water service area, pertinent information and instructions should be updated hourly during the first day and every 3 hours thereafter until the crisis is resolved. If computer services are disrupted, then information and updates can be printed on letterhead or other approved format and distributed to Crisis Communication Team personnel.

The Water System maintains current contact information for all personnel on the M:/ drive. Communications regarding threat warnings and emergency status briefings with staff are coordinated by the PW Department Communications and Outreach Coordinator so that key information distributed can be managed and tracked. Contact information for the IMT and external agencies and organizations are provided in Appendix A.

Staff involved in emergency response will receive information and directions from their immediate supervisor. In the event of injuries or casualties, the PW Department Director will be responsible for the notification.

In general, information is disseminated from the PW Communications and Outreach Coordinator using the following communications tactics and channels: news release, social media (Facebook, NextDoor, Twitter, Instagram), intranet, and internet, and AlertSense.

Communications among facilities, field personnel, and the PW Department UOC will be conducted by telephone (landline or cellular phone), email, or text. Cellular service and landlines cannot always be relied upon during emergencies. However, phone texting can be used as an alternative means of communication.

7.4 Staff Family Communications

During a crisis, staff members who are concerned about their family members or who know their families will be concerned about them are not as focused on immediate responsibilities. Distraught family members seeking information can also become an obstacle during a crisis by jamming communications and inadvertently spreading misinformation. In an emergency that requires a voluntary and/or mandatory evacuation of staff and staff family members would be coordinated with the PW Department UOC and Whatcom County EOC regarding the location of designated public shelters. Essential personnel who are not included in a mandatory evacuation would be located at the Water System for an extended period to work on a rotating operational period, which is usually 12 hours in duration.

A list of employees and family emergency contact information is maintained by Human Resources personnel. The Crisis Communication Team will establish communication protocols for notification of families and other employees if a medical or other life-threatening emergency occurs. The chain of command for staff and family notifications begins with the PW Director down through supervisor heads and then on to staff levels.

7.5 Onsite Vendors, Contractors, and Visitors

Onsite vendors, contractors, and visitors are included in protective and/or preventive actions, including sheltering in place and evacuation. Supervisors, as applicable, are responsible for their vendors, contractors, and visitors at Water System facilities during normal operations and in the event of an emergency. If non-staff persons are injured, the Water Treatment Plant Supervisor will contact the PW Director, who will initiate contact with the appropriate company and follow the notification protocol as appropriate.

7.6 External Notifications and Reporting

The IC is responsible for evaluating the emergency and requesting assistance from local emergency response agencies, as required. Notifications should not be unduly delayed or withheld for a lack of information. In addition, the notification of and/or reporting to external agencies and organizations of an incident must follow applicable regulatory requirements.

The Logistics Section Chief, in coordination with the IC, is responsible for coordinating the notification of and/or directly notifying external agencies and organizations in an emergency or a situation that may affect their response capabilities. For example, the Fire Department should be notified of significant pressure loss within the distribution system. Basic event information regarding operations should be collected in advance to facilitate rapid communication during an emergency event.

For drinking water quality issues, communication with County and State regulatory agencies is coordinated by the Water Quality Laboratory Supervisor or the certified Operator in Charge in consultation with the Natural Resources Director and the PW Department Director.

In the event of suspected or actual criminal activity, TLOs, Police Department, and the Office of Emergency Management should be notified. Notification of law enforcement agencies should be conducted at a supervisory level. Any employee can call 9-1-1 when there is an immediate threat to life, safety, or the environment. A Threat Documentation Form, located in Appendix G, should be provided to the Police Department and TLOs to assist with tracking threats. This information may be used to identify trends in coordination with the Fusion Center if applicable.

The DHS and FBI also encourage reporting suspicious or criminal activity to the local FBI Joint Terrorism Task Force. The number for the FBI Seattle Field Office is (206) 622-0460. Additional notification can be made to the Homeland Security Operations Center or National Infrastructure Coordination Center. All cybersecurity incidents must be reported to the National Infrastructure Coordination Center (NICC). Contact information for these agencies is also located in Appendix A of this ERP.

7.7 Customer, Public, and Media Communications

The IMT is responsible for the preparation and release of information to the PW Department Communications and Outreach Coordinator. The Communications and Outreach Coordinator will disseminate all information to the public during the response and recovery phases of an emergency event. Communication with the media and the public, including customers, regarding service interruption, impacts to the public, and actions taken by the Water System to restore service is vital, especially during an emergency response effort.

Note: Water System staff should refer all media inquiries to the Communications and Outreach Coordinator during an emergency.

In the event the PW Department UOC and Whatcom County EOC are activated at the same time, the Communications and Outreach Coordinator would be located at Whatcom County EOC and an Alternate may be located at the PW Department UOC. A PIO designee may also be located on scene and may take video footage of the incident as needed and appropriate. During a large-scale emergency, the Communications and Outreach Coordinator would coordinate through a coordination center, or a JIC may be established to facilitate coordination activities.

7.7.1 Customer Communications

The PW Department Communications and Outreach Coordinator coordinates with the IMT to conduct customer advisories of water quality, quantity, or other situations that may interrupt, delay, or stop drinking water. This may include dissemination of a "Boil Water Advisory," "Do Not Drink Advisory," or "Do Not Use Advisory." Communication templates are provided in Appendix H.

A Drinking Water Advisory Communication Toolbox (2016) was developed by the CDC, the Public Health Service, the U.S. Department of Health and Human Services, and the AWWA to assist with customer communications (https://www.cdc.gov/healthywater/emergency/dwa-comm-toolbox/index.html). The Drinking Water Advisory Communication Toolbox provides information on how to plan for, develop, implement, and evaluate communication activities with the public and stakeholders during drinking water notifications and advisories.

7.7.2 Public Releases

The PW Department Communications and Outreach Coordinator is responsible for notifying the public through contact with appropriate media outlets, including social media. News (press) conferences, press releases, media briefings, web postings, social media, and other methods are used to provide emergency information, frequent updates, and customer communications. The PW Department Director or Communications and Outreach Coordinator serves as the Water System designated spokesperson.

Public information will be released at a single location, preferably at the PW Department UOC. It is desirable that the public information representatives from other involved agencies join the PW Communications and Outreach Coordinator in releasing information through a single coordination point.

USEPA provides tools that the Water System could use to enhance its crisis communication efforts. These tools are available as part of USEPA's *Public Awareness Kit for Water Utilities* available online at http://www.epa.gov/communitywaterresilience/water-utility-public-awareness-kit.

7.8 Crisis Communication Tools

The news media are among the first to seek information when a crisis strikes. It is crucial that accurate and complete information be conveyed to the news media and the public. Key messages include themes that apply to the Water System and the community, regardless of the crisis. Themes or messages that are appropriate for use during a crisis include (as appropriate):

1. An explanation and/or apology to impacted parties.
2. A statement of responsibility for the event or responsibility for follow-up after an event and a commitment to mitigate the impacts stemming from the event as soon as possible.
3. A commitment stating that the goal of the utility is that this type of crisis never occurs again in the future.

These themes can be crafted in advance and modified as needed when an actual crisis arises. It is important that these themes be discussed with, and endorsed by, the Crisis Communication Team well in advance of an actual emergency. Specific emergency public communication processes are in Appendix H of this ERP.

Rumor control is a major aspect of delivering messages to reduce the flow of erroneous and misleading information to the public. When public officials are communicating with the public via the media, the following information should be disseminated and updated regularly:

- Nature, location, and time of disaster
- Number of injuries and/or other casualties
- Agencies involved in response
- Scope of agency involvement
- Nature and severity of injuries
- Condition of casualties

It is important to keep Health Insurance Portability and Accountability Act (HIPPA) regulations in mind whenever providing health and/or injury information to the public. Do not provide personal information about a victim or the location of the hospital at which a victim is located. General tips for messing to the media could include:

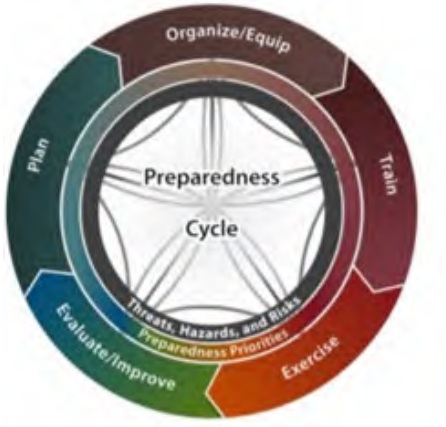
- Be truthful and upfront about local water quality issues.
- Answer questions as well as possible, but do not be afraid to indicate more time is needed to provide an accurate response. Once the correct information is available, quickly report.
- Keep in mind that reporters are not familiar with state or federal requirements for safe drinking water; thus, avoid technical terminology and use customary terms.
- Provide additional sources of information, for instance, referrals to state contacts or USEPA fact sheets.
- Be sensitive to the fact that reporters may be working on tight deadlines.
- Provide a list of the elements that are yet to be addressed but are in planning.
- Be prepared for an article to vary from how the utility anticipated it would be. If a significant piece of information is missing or wrong, request the information be re-presented with the accurate information included.
- Do not become defensive when answering questions.

8 Training and Exercises

8.1 Overview

The NIMS defines the integrated preparedness cycle (shown in Figure 8-1), as planning, equipping, training, exercising, evaluating, and taking corrective action to mitigate preparedness issues. To ensure smooth and expedient ERP implementation during an incident, a training and exercise program is recommended to be instituted to develop competencies and maintain awareness among staff regarding responsibilities under the ERP.

Figure 8-1. Integrated Preparedness Cycle



To ensure that this ERP can be implemented successfully, it must be tested periodically to identify areas for improvement and maintain staff familiarity with ERP contents. Testing the ERP will likely minimize flaws and mistakes that might not otherwise become known until an actual emergency. Testing this ERP, with the participation of outside agencies or organizations that will be involved in a crisis, is advised.

8.2 Training

This section summarizes the types of training that should be provided to Water System employees who may be involved in an emergency. Training methods may include lectures, discussions, slide or videotape presentations, computer demonstrations, and/or guest speakers.

8.2.1 Incident Command System Training

The USEPA recommends a core curriculum of ICS training for utilities and other support agencies. ICS training is offered through FEMA's Emergency Management Institute and includes a variety of online independent study courses and classroom training as outlined in *National Incident Management System Training Program, Department of Homeland Security, September 2011* (http://www.fema.gov/pdf/emergency/nims/nims_training_program.pdf) and listed and available online at https://training.fema.gov/is/crslist.aspx?all=true. Students must first obtain a FEMA Student Identification at https://cdp.dhs.gov/femasid.

Recommended NIMS/ICS curriculum and audiences are as follows:

- IS-100: Introduction to Incident Command System, ICS 100. This course describes the history, features, and principles of ICS, as well as the relationship of ICS to NIMS and is recommended for all Utility staff. This course is offered online.
- IS-120: An Introduction to Exercises. This course is recommended for Utility personnel who may be charged with exercise duties. This course is offered online.
- IS-200: Basic Incident Command System for Initial Response. This course enables supervisory personnel to operate efficiently within the ICS, and explains ICS roles, responsibilities, and protocols. This course is offered online.
- IS-201: Forms Used for the Development of the Incident Action Plan. This course provides training on using ICS forms to compile an IAP over an operational period and is recommended for IMT members. This course is offered online.
- ICS-300: Intermediate ICS for Expanding Incidents. This course describes how the NIMS command and management components support managing expanding incidents and developing an IAP for a simulated incident. This is a classroom course of approximately 18 hours in duration and recommended for IMT members.

- ICS-400: Advanced ICS. This course describes how major incidents engender special management challenges, describes the circumstances in which an area command is established, and the circumstances in which multiagency coordination systems are established. This is a classroom course of approximately 14 hours in duration and recommended for IMT members.
- IS-552: The Public Works Role in Emergency Management. This course describes the role of a Water System during a large incident involving the community. This course is offered online and recommended for IMT members.
- IS-554: Emergency Planning for Public Works. This course is offered online and recommended for IMT members.
- IS-556: Damage Assessment for Public Works. This course is offered online and recommended for IMT members.
- IS-558: Public Works and Disaster Recovery. This course is offered online and recommended for IMT members.
- IS-559 Damage Assessment Training for Water and Wastewater Utilities. This course is offered online and recommended for IMT members.
- IS-700: An Introduction to the National Incident Management Systems. This course explains the principles and structure of NIMS, discusses ICS as a response model for NIMS, and discusses the applicability of NIMS in wider-scope, multi-jurisdictional incidents. This course is offered online and recommended for all Utility staff.
- IS-800: An Introduction to the National Response Framework. This course describes how the federal government will work with state, local, and tribal entities in responding to national emergencies. This course is offered online and recommended for IMT members.
- IS-907: Active Shooter: What You Can Do. This course is offered online and is recommended for all Utility staff.
- IS-915: Protecting Critical Infrastructure Against Insider Threats: This course is offered online and is recommended for all Utility staff.

NIMS and IS/ICS courses are available online through FEMA or in coordination with Emergency Management. IS/ICS courses should be completed every 3 to 5 years by Water System personnel. A standard emergency training and exercise schedule matrix for Water System staff is provided in Table 8-1.

Table 8-1. Emergency Response Plan Training and Exercise Matrix Schedule

Training	Participants	Frequency
IS-100: Introduction to Incident Command System for Public Works (ICS 100)	IMT Team Members	Updates every 3 to 5 years
IS-700: National Incident Management Systems, an Introduction	IMT Team Members	Updates every 3 to 5 years
IS-200: ICS for Single Resources and Initial Action Incidents	IMT Team Members	Updates every 3 to 5 years
IS-800: National Response Framework (NRF), an Introduction	IMT Team Members	Updates every 3 to 5 years
Fire Extinguisher	Designated Water System staff	Annually
HAZMAT training	Designated Operators and Maintenance staff	Annually and/or per Risk Management Plan requirements
CPR/First Aid/AED	Designated Water System staff	Every 2 years
Drills	Varies	Varies
Tabletop Exercises	IMT Team Members	At least once every 2 years
Full-Scale Exercises	IMT Team Members LEPC and other emergency response and regulatory agencies	At least once every 3 years

Note: Drills may be used to supplement employee awareness training, tabletop exercises, and functional exercises. Therefore, participants and training frequency may vary. Actual emergency response incidents can also provide documentation for drills and exercises.

Coordination with the Whatcom EOC regarding training and exercises potentially provided by Emergency Management should be coordinated with the Water System as an active participant or observer. The Water System should continue involvement with the Whatcom County Sheriff's Office Division of Emergency Management when they conduct training and exercises. In addition, coordination with the LEPC is encouraged for emergency preparedness and threat response action.

8.2.2 Emergency Preparedness Training

The Water System and other City staff have participated in classroom emergency management training and online courses. Recommended emergency preparedness training for personnel includes the following:

- Emergency response and security awareness training is recommended annually and should be incorporated into current health and safety briefings and new employee orientation.
- HAZMAT-related training and refresher for operations and maintenance staff.
- Site evacuation training for all Water System staff.
- Select ICS training courses recommended as described above.
- Active Shooter Training is recommended for all Water System staff.
- USEPA Water/Wastewater All-Hazards Boot Camp Training (http://www.epa.gov/waterresiliencetraining/waterwastewater-utility-all-hazards-bootcamp-training) is available online and recommended for staff responsible for emergency preparedness, response, and management.

- Don't Get Soaked Video (https://www.youtube.com/watch?v=kPK9j2S5TwE), which is an online video recommended to be watched by utility senior management, Board of Directors members, and local government officials, as appropriate.

8.3 Exercises

Successful implementation of the ERP is achieved through discussion-based and operational exercises as described in this section. Training and exercises allow staff members to face hypothetical situations that are outside of normal daily operations. To meet challenges associated with emergency response and business continuity, effective training and exercise programs provide helpful forums for integrating response procedures with external partners.

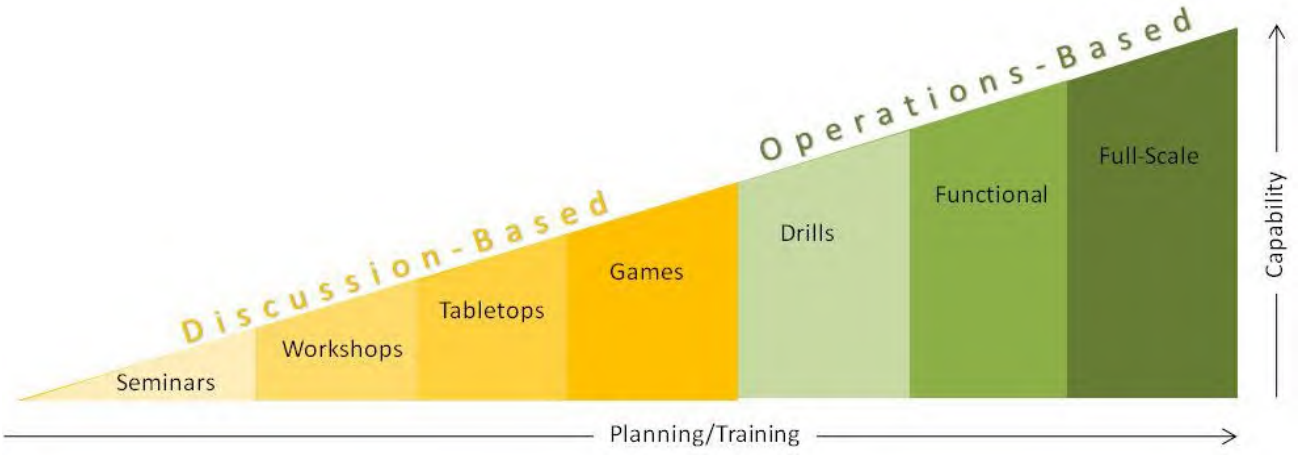
The HSEEP, administered by the DHS, provides a nationally recognized and systematic methodology to conduct training and exercises to support emergency preparedness. HSEEP includes consistent terminology that can be used by all exercise planners, regardless of the nature and composition of their sponsoring agency or organization. HSEEP also provides tools to help exercise planners conduct and evaluate exercises to improve overall preparedness. HSEEP reflects lessons learned and best practices of existing exercise programs and can be adapted to a variety of scenarios and incidents (for example, natural disasters, terrorism, and technological disasters).

Seven types or levels of exercises are utilized per the HSEEP guidelines to test response plans and provide Water System staff with relevant experience. These exercises are divided into two types: discussion-based exercises and operations-based exercises.

- **Discussion-based exercises.** Discussion-based exercises familiarize participants with current plans, policies, agreements, and procedures, or may be used to develop new plans, policies, agreements, and procedures. These types of exercises usually consist of workshops/seminars, tabletop exercises, and games.
- **Operational exercises.** Operations-based exercises validate plans, policies, agreements, and procedures; clarify roles and responsibilities; and identify resource gaps in an operational environment. These types of exercises usually consist of drills, functional exercises, and full-scale exercises.

HSEEP uses a building-block approach to ensure that exercise participants progress at a logical pace. Figure 8-2 depicts the building-block approach including both discussion-based and operations-based exercises. Each level builds on the proceeding levels in realism, exercise play, stress, number of participants and agencies involved, time, and cost.

Figure 8-2. Homeland Security Exercise and Evaluation Program Building Block Approach



Some exercises, such as seminars, workshops, or games, are not evaluated but rather serve as teaching environments to present policies and procedures and provide a method of testing knowledge. Tabletop exercises, drills, functional exercises, and full-scale exercises are evaluated exercises for which an AAR/IP is developed. Other forms of exercise evaluations can be used to analyze drills or exercises. For instance, a facility evacuation drill can use other approved formats to document lessons learned.

It is recommended that exercises be conducted annually for Water System staff. HSEEP-compliant drills and an HSEEP-compliant tabletop exercise should be conducted annually. HSEEP functional exercises should be conducted at least once every 2 to 3 years. HSEEP full-scale exercises should be conducted at least once every 5 years. Invitations to participate for, and coordination with, the Office of Emergency Management, regional, state, and federal response partners are encouraged, as appropriate. The IMT can assist in conducting annual drills and exercises for the Water System.

8.4 Documentation

Training activities should be documented and kept on file in accordance with standard Water System practices. Training documentation includes class rosters, course notes or syllabus, exams, evaluation checklists, sign-in sheets, and copies of certificates. Exercise documentation includes a list of participating personnel along with a written description of potential deficiencies identified based on the exercise. Exercises that follow HSEEP format are evaluated exercises that include an AAR/IP. Following an exercise, this ERP should be reviewed and revised to improve response procedures, tools, and resources that are currently provided in this document.

Appendix A
Incident Management Team Contact Lists and Internal and External Contact Information

APPENDIX A – INTERNAL AND EXTERNAL CONTACT INFORMATION

NO.	CONTENTS
A-1	Incident Management Team Contact List
A-2	Contact List of Supervisors
A-3	Crisis Communication Stakeholder Contact List
A-4	Government Agencies Contact Information
A-5	Laboratories Available for Service on Weekends or Holidays
NOTE: Appendix A should be updated on a regular basis or as points of contacts and contact details change.	

Table A-1. Incident Management Team Contact List

IMT Title	COB Title	Name	Contact Details
Executive/Policy Group	Mayor	Seth Fleetwood	(360) 778-8000
Incident Commander/ EOC Commander	Public Works Director	Eric Johnston	(360) 778-7900 (X7710) (360) 201-3713 pw@cob.org 2221 Pacific Street Bellingham, WA 98225
Incident Commander/ EOC Commander (Alternate)	Assistant Public Works Director	Mike Olinger	(360) 778-7700 2221 Pacific Street Bellingham, WA 98229
Public Information Officer (PIO)	PW Communications and Outreach Coordinator	Amy Cloud	(360) 778-7912 accloud@cob.org 104 West Magnolia Street, Suite 109 Bellingham, WA 98225
Public Information Officer (Alternate)	Environmental Education Coordinator	Riley Grant	(360) 778-7732 ragrant@cob.org 2221 Pacific St. Bellingham, WA 98229
Public Information Officer (Tertiary)	COB Communications Director	Janice Keller	(360) 778-8100 jkeller@cob.org
Safety Officer	Safety Specialist	Paul Grayston	
Liaison Officer	Superintendent of Maintenance	Steve Bradshaw	(360) 778-7700 2221 Pacific Street Bellingham, WA 98229
Liaison Officer (Alternate)	Superintendent of Plants	Rob Johnson	
Planning Section Chief	Development Manager	Brent Baldwin	(360) 778-7900 104 West Magnolia Street, Suite 109 Bellingham, WA 98225
Planning Section Chief (Alternate)	Utility Operations Engineer	Jim Bergner	
Operations Section Chief	Public Works Operations Water Distribution Supervisor	Fred Cruz / Marty Gray	
Operations Section Chief (Alternate)	WTP Supervisor(s)		

Table A-1. Incident Management Team Contact List

IMT Title	COB Title	Name	Contact Details
Intelligence and Investigations Section Chief	Public Works Director	Eric Johnston	(360) 778-7900 pw@cob.org 2221 Pacific Street Bellingham, WA 98225
Intelligence and Investigations Section Chief (Alternate)	Assistant Public Works Operations	Mike Olinger	(360) 778-7700 2221 Pacific Street Bellingham, WA 98229
Logistics Section Chief	Public Works Operations Water Distribution Supervisor	Fred Cruz / Marty Gray	
Logistics Section Chief	Plant Maintenance Supervisor	Mark Schorr	
Logistics Section Chief (Alternate)	Utility Worker V	Brent Hayes Tyler Rouse	
Logistics Section Chief (Alternate)	Maintenance Lead	Shannon Franks / Tobin Hull	
Finance/Administration Section Chief	Purchasing Manager	Connie Allen	
Finance/Administration Section Chief (Alternate)	Financial Services Manager	Karla Buckingham	
IT Department	COB IT	Marty Mulholland	via x8088 (for Steven Niedermeyer, sniedermeyer@cob.org)

Table A-2. Contact List of Supervisors

Name/Address	Work Phone	Home Phone	Cellular Phone
Superintendent, Operations Steve Bradshaw Stanwood, WA	(360) 778-7892	--	(360) 778-9003
Superintendent, Plants Rob Johnson Bellingham, WA	(360) 778-7735	--	(360) 223-0036
Chief Operator, Water Treatment *<Currently Vacant>*			
Water Division Supervisor Marty Gray Bellingham, WA	(360) 778-7733	--	(360) 510-5417
Water Division Supervisor Fred Cruz Lynden, WA	(360) 778-7712	--	(360) 201-4026
Chief Operator, Wastewater Shayla Francis Mt. Vernon, WA	(360) 778-7858	--	(360) 220-4003
Maintenance Supervisor Mark Schorr Bellingham, WA	(360) 778-7885	--	(360) 510-6250
Laboratory Supervisor Peg Wending Bellingham, WA	(360) 778-7872	(360) 733-9178	(360) 303-3300
Safety Specialist Paul Grayston Bellingham, WA	(360) 778-7741	-	(360) 739-3835

Table A-3. Crisis Communication Stakeholder Contact List

Organization	Position	Name	Contact Details
City of Bellingham	Deputy Administrator Communications Director Police PIO Emergency Manager	Brian Heinrich Janice Keller Lt. Claudia Murphy Liz Coogan	(360) 778-8117 bmheinrich@cob.org (360) 778-8100 jkeller@cob.org (360) 778-8834 cmurphy@cob.org (360) 778-8444 ecoogan@cob.org
Whatcom Unified Emergency Management (ECC)	PIO group	Riley Sweeney Chalice Dew-Johnson	rileysweeney@cityofferndale.org cdjohnso@co.whatcom.wa.us pio@whatcomready.org
Whatcom County	Deputy Executive	Tyler Schroeder	(360) 778-5207
Port of Bellingham	PIO	Mike Hogan	mikeh@portofbellingham.com
Western Washington University	 Chief of Police Safety Manager PIO	 Darin Rasmussen Holly Woll-Salkeld Paul Cocke	(360) 650-3000 Darin.Rasmussen@wwu.edu holly.woll-salkeld@wwu.edu Paul.Cocke@wwu.edu
Bellingham Technical College	PIO	Marni Saling Mayer	msmayer@btc.edu
Whatcom Community College	PIO	Marissa Ellis	pio@whatcom.ctc.edu
Bellingham School District	PIO	Jacqueline Brawley	Jacqueline.Brawley@bellingham schools.org
PeaceHealth St. Joseph Medical Center	PIO/Communications Director	Bev Mayhew	BMayhew@peacehealth.org
Whatcom County Health Department	PIO Backup PIO	Melissa Morin Mark Raaka	(360) 594-2504 (cell) mmorin@co.whatcom.wa.us Mraaka@co.whatcom.wa.us
Whatcom Transportation Authority	PIO	Maureen McCarthy	maureenm@ridewta.com

Table A-4. Government Agencies Contact Information

Name	Contact
City of Bellingham	
Bellingham Police Department	9-1-1 or (360) 778-8800
Bellingham Fire Department	9-1-1 or (360) 778-8400 or fire@cob.org
Office of Emergency Management	(360) 778-8440 or oem@cob.org
Public Works Operation Assistant Director	(360) 778-7700 2221 Pacific St. Bellingham, WA 98229
Post Point Wastewater Treatment Plant	(360) 778-7850 200 McKenzie Avenue Bellingham, WA 98225
Water Treatment Plant Operator	(360) 778-7890
Puget Sound Energy	(888) 225-5773
Whatcom County	
Emergency Services (What-Comm Dispatch Center)	9-1-1
Whatcom County Prosecuting Attorney's Office	(360) 778-5710
Whatcom County Sheriff's Office	(360) 778-6600
Whatcom County Sheriff's Office Division of Emergency Management	(360) 676-6681
Whatcom Unified Emergency Operations Center	3888 Sound Way Bellingham, WA 98226
Local Emergency Planning Committee (LEPC)	(360) 676-6681
Whatcom County Environmental Health	(360) 778-6000 EnvironmentalHealth@whatcomcounty.us 509 Girard Street Bellingham, WA 98225
State of Washington	
Emergency Management Division	(253) 512-7000
Washington State Department of Ecology Northwest Regional Office	(425) 649-7000
Report a spill to water	(800) OILS-911 (1-800-645-7911)
Washington State Patrol	(360) 596-4000
Office of the Governor	(360) 902-4111 TTY/TDD call 711 or (800) 833-6384
Department of Natural Resources	(360) 902-1000
Washington Water/Wastewater Emergency Response Network (WAWARN)	Statewide Committee Chair – David Brown (509) 575-6154

Table A-4. Government Agencies Contact Information

Name	Contact
	david.brown@yakimawa.gov Northwestern Chair – Ned Worchester (206) 684-8311 ned.worcester@seattle.gov
Washington State Department of Health	Main Office: (800) 521-0323 After-Hours Emergency Hotline (for water systems and operators) (877) 481-4901 Northwest Regional Office (Whatcom County): (253) 395-6750
Washington State Department of Labor & Industries	(360) 902-5800
Federal	
Local FBI Field Office (Covers the entire state of Washington)	(206) 622-0460 seattle.fbi.gov
National Response Center	(800) 424-8802
National Infrastructure Protection Center (physical)	(800) 282-0870
National Infrastructure Protection Center (cyber)	(202) 323-3204
EPA Region 10 Emergency Response (Serving Alaska, Idaho, Oregon, Washington, and 271 Tribal Nations)	(206) 553-1200 (800) 424-4372 epa-seattle@epa.gov
Local Special Agent in Charge of the EPA CID	Phone: (208) 378-6518 Fax: (208) 378-5770
FEMA Region 10	(425) 487-4600
Bureau of Land Management	National Office Phone: (202) 208-3801 Fax: (970) 256-4997 TTY/Federal Relay System: (970) 256-4900 Oregon/Washington State Office Phone: (503) 808-6001 Fax: (503) 808-6422 TTY/Federal Relay System: (800) 877-8339 blm_or_so_land_office_mail@blm.gov
Center for Disease Control and Prevention	(800) 232-4636 (888) 232-6348
Regional Poison Control Centers	(800) 222-1222
National Infrastructure Coordination Center *All Cybersecurity Incidents Must Be Reported to NICC	(202) 282-9201 NICC@hq.dhs.gov
WaterISAC	(866) H2O-ISAC

Table A-4. Government Agencies Contact Information

Name	Contact
	(202) 331-0479 analyst@waterisac.org https://www.waterisac.org/report-incident
24/7 Emergency Hazmat Response	
CHEMTREC	(800) 262-8200 (within the U.S.) chemtrec@chemtrec.com Monday – Friday, 8:00 a.m. to 5:30 p.m. EST, USA and Canada. * *Emergency response call center is open 24/7.

Table A-5. Laboratories Available for Service on Weekends or Holidays

Lab Name and Address	Contact Person(s)	Contact Number(s)	Open Saturdays	Open Sundays	Open Holidays	Analyses	Comments
Accurate Testing Labs, LLC. 7950 Meadowlark Way Coeur d'Alene, ID 83815	Walter Mueller Jim McMaster	(208) 762-8378 (O) (208) 661-1101 (C) (208) 661-5833 (C)	Variable (TBA)	Variable (TBA)	Variable (TBA)	Coliforms Nitrate	Call cellphone numbers during off-hours for service arrangements
Addy Lab of Southwest Washington P.O. Box 719 Vancouver, WA 98666	Tom Newman Carl Addy	(360) 263-4396 (H) (360) 750-0055 (O) (360) 771-7345 (C) (360) 699-6415 (H) (360) 771-5789 (C)	Variable (TBA)	Variable (TBA)	Variable (TBA)	Coliforms Nitrate	Call Friday to arrange time, if possible. Call home numbers otherwise
Alliance Analytical Laboratories 401 E. "S" Street Yakima, WA 98901	Joyce Carr Bill Rice Angela Peters	(509) 469-2400 (O) (509) 452-7119 (H) (509) 697-6031 (H) (509) 574-5246 (H)	8:00 am to 4:00 pm	8:00 am to 12:00 n	8:00 am to 12:00 n	Coliforms Nitrate	Call as soon as possible to make arrangements for the testing.
AmTest Inc.-Redmond 14603 N.E. 87th Street Redmond, WA 98052-6552	Kathy Fugiel	(425) 885-1664 (O) (425) 770-7037 (H)	Variable (TBA)	Variable (TBA)	Variable (TBA)	Coliforms Nitrate	Call only for emergencies.
Anatek Labs, Inc.-Spokane E. 504 Sprague Avenue, Suite D Spokane, WA 99216	Kathleen Sattler	(509) 838-3999 (O) (509) 926-4701 (H) (509) 979-0370 (C)	Variable (TBA)	Variable (TBA)	Variable (TBA)	Coliforms Nitrate	Call to make arrangements anytime emergency samples needed.
Anatek Labs, Incorporated 1282 Alturas Drive Moscow, ID 83843	Scott Finch	(208) 883-2839 (O)	Variable (TBA)	Variable (TBA)	Variable (TBA)	Coliforms Nitrate	Call to make arrangements.
AV Labs, Inc. 64 North Broadway Avenue Othello, WA 99344	Alma Barajas Joan Garva	(208) 488-2468 (O)	Variable (TBA)	Variable (TBA)	Variable (TBA)	Coliforms Nitrate	Call as soon as informed of the need for off-hours analyses.

Table A-5. Laboratories Available for Service on Weekends or Holidays

Lab Name and Address	Contact Person(s)	Contact Number(s)	Open Saturdays	Open Sundays	Open Holidays	Analyses	Comments
Avocet Environmental Testing 1500 North State Street, Suite 200 Bellingham, WA 98225	Madell Briggs Carol Bissell	(360) 734-9033 (?) (800) 227-9427 (O)	Variable (TBA)	Only in extreme cases	Not open	Coliforms	Call the day before during normal hours to make arrangements.
Bellingham Water Filtration Plant Lab 2221 Pacific Street Bellingham, WA 98226	Peg Wendling	(360) 676-7689 (O)	Variable (TBA)	Variable (TBA)	Variable (TBA)	Coliforms	Only open for emergencies. Call beforehand during normal working hours.
Benton-Franklin Health District Lab 471 Williams Boulevard Richland, WA 99352	David E. Miller Sherry Dengate	(509) 943-2614 (O) (509) 546-9909 (H) (509) 586-1375 (H)	Variable (TBA)	Variable (TBA)	Variable (TBA)	Coliforms Nitrate	Emergencies only. Call during normal working hours to make arrangements.
Cascade Analytical, Inc. 3019 GS Center Road Wenatchee, WA 98801	Laura Mrachek	(509) 662-1888 (O)	Variable (TBA)	Variable (TBA)	Variable (TBA)	Coliforms Nitrate	Call to arrange. Service preference is only for larger, municipal water systems.
Chelan-Douglas Health District 200 Valley Mall Parkway East Wenatchee, WA 98802	Linda Conard	(509) 886-6400 (O)	Variable (TBA)	Variable (TBA)	Variable (TBA)	Coliforms	Call only during normal hours to see what arrangements can be made.
CWU Dept. of Biological Sciences MS 7837 Ellensburg, WA 98926	Arlene Carter Jody Scheffelmair	(509) 963-3013 (O) (509) 962-6528 (H) (509) 925-4413 (H)	Variable (TBA)	Variable (TBA)	Variable (TBA)	Coliforms	Call whenever emergency sample are needed.
Edge Analytical, Incorporated 11525 Knudson Road Burlington, WA 98233	Dr. Lawrence Henderson	(800) 755-9295 (O)	Variable (TBA)	Variable (TBA)	Variable (TBA)	Nitrate	Call during normal working hours to make arrangements.
Environmental Health Labs 110 South Hill Street South Bend, IN 46617	Dale Piechocki	(574) 233-4777 (O)	NO	NO	NO	N/A	Open only for security-related emergency response testing.

Table A-5. Laboratories Available for Service on Weekends or Holidays

Lab Name and Address	Contact Person(s)	Contact Number(s)	Open Saturdays	Open Sundays	Open Holidays	Analyses	Comments
Grays Harbor County Water Testing Lab 310 West Spruce Street Montesano, WA 98563	Jeff Nelson	(360) 249-4413 (O)	Variable (TBA)	Variable (TBA)	NO	Coliforms	Call to arrange for weekend analyses by 5:00 pm Friday
Lab/Cor, Inc. 7619 6th Avenue, N.W. Seattle, WA 98117	John Harris Richard Schatz	(206) 781-0155 (O)	Variable (TBA)	Variable (TBA)	Variable (TBA)	Coliforms	Call the day before emergency sample to be collected.
LOTT Water Quality Laboratory 500 Adams Street, N.E. Olympia, WA 98501	John Damitio Mike Gruber	(360) 753-8167 (O)	8:00 am to 3:30 pm	8:00 am to 3:30 pm	8:00 am to 3:30 pm	Coliforms Nitrate	Open year round.
Philip Analytical Services (BC) (a.k.a. PSC Analytical Labs) 8577 Commerce Court Burnaby, B.C. V5A 4N5	Dr. Thomas Zhu Rob Gilbert	(604) 444-4808 (O) (604) 444-4808 (O) ext. 249 (O)	9:00 am to 5:00 pm	Not open	Not open	Coliforms Nitrate	Call Friday by 5:00 pm to make arrangements.
Seattle Public Utility Water Quality Lab 800 South Stacy Street Seattle, WA 98134	Microbiology Lab	(206) 615-1363 (O)	7:00 am to 3:30 pm	7:00 am to 3:30 pm	7:00 am to 3:30 pm	Coliforms	Call during normal service hours at number shown.
Thurston County Health Dept. Lab 2000 Lakeridge Dr., S.W. Olympia, WA 98502	Mike Clark	(360) 786-5465 (O)	Variable (TBA)	Variable (TBA)	Variable (TBA)	Coliforms Nitrate	Call the day before service is needed.
Twiss Analytical Laboratories, Inc. 26280 Twelve Trees Lane, Suite C Poulsbo, WA 98370	Steve Twiss Chris Shaeffer	(360) 779-5141 (O)	Variable (TBA)	Variable (TBA)	Variable (TBA)	Coliforms	Call to make arrangements.

Table A-5. Laboratories Available for Service on Weekends or Holidays

Lab Name and Address	Contact Person(s)	Contact Number(s)	Open Saturdays	Open Sundays	Open Holidays	Analyses	Comments
Udder Health Systems. Inc. 6401 Old Guide Road Bellingham, WA 98226	Kent Oostra	(360) 398-1360 (O) (360) 354-0934 (H) (360) 220-5318 ©	8:00 am to 4:00 pm	8:00 am to 4:00 pm	8:00 am to 4:00 pm	Coliforms	Open every day of the year.
Walla Walla County-City Health Dept. P.O. Box 1753 Walla Walla, WA 99362-1753	Jeanette Lightfoot Dave Eaton	(509) 527-3290 (O) (509) 529-5039 (H)	Variable (TBA)	Variable (TBA)	Variable (TBA)	Coliforms Nitrate	Call for emergencies only.
Water Management Laboratories, Inc. 1515 80th Street, E. Tacoma, WA 98404-3315	H. Chris Mueller	(253) 531-3121 (O) (253) 841-0732 (H)	9:00 am to 5:00 pm	9:00 am to 12:00 n	9:00 am to 12:00 n	Coliforms Nitrate	Call ahead of time to arrange. After hours calls can be made to: (253) 841-0732 (H)
Wenatchee Wastewater Treatment Plant Laboratory P.O. Box 519 Wenatchee, WA 98807-0519	General Lab Tom Hardie Don Files	(509) 664-3387 (O) (509) 664-3382 (O) (509) 664-3384 (O)	7:30 am to 4:00 pm	7:30 am to 4:00 pm	7:30 am to 4:00 pm	Coliforms	Call for emergencies only.

Note: (O) = Office phone; (H) = Home phone; (C) = Cell phone; TBA = To be arranged

Appendix B
Facility Maps

APPENDIX B – FACILITY MAPS

NO.	CONTENTS
1	Public Works Facilities
2	Site Plan for the Water Treatment Plant
3	Water Distribution System

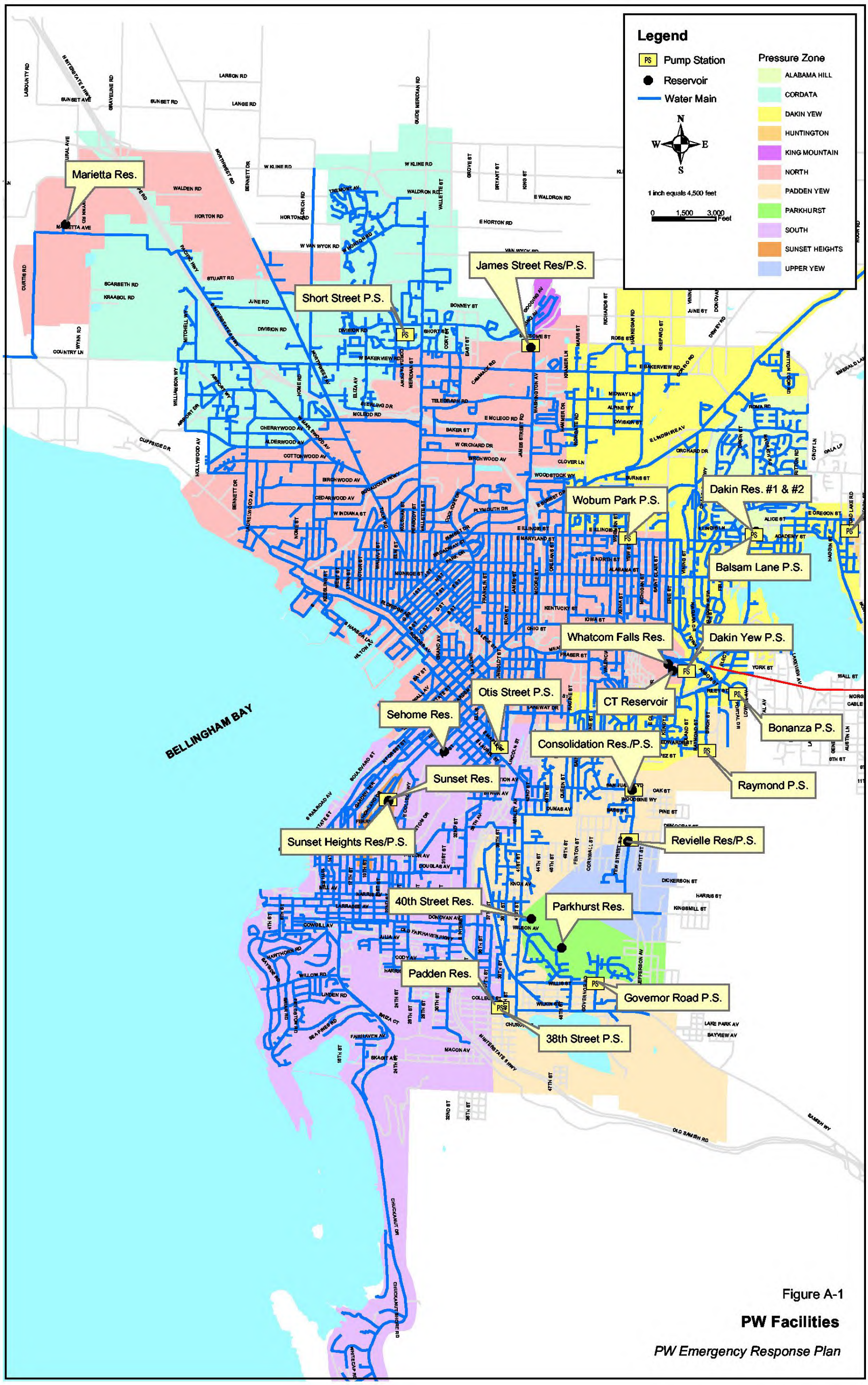


Figure A-1

PW Facilities

PW Emergency Response Plan



Figure A-2

Site Plan for Water Treatment Plant

PW Emergency Response Plan

Site Plan.cdr

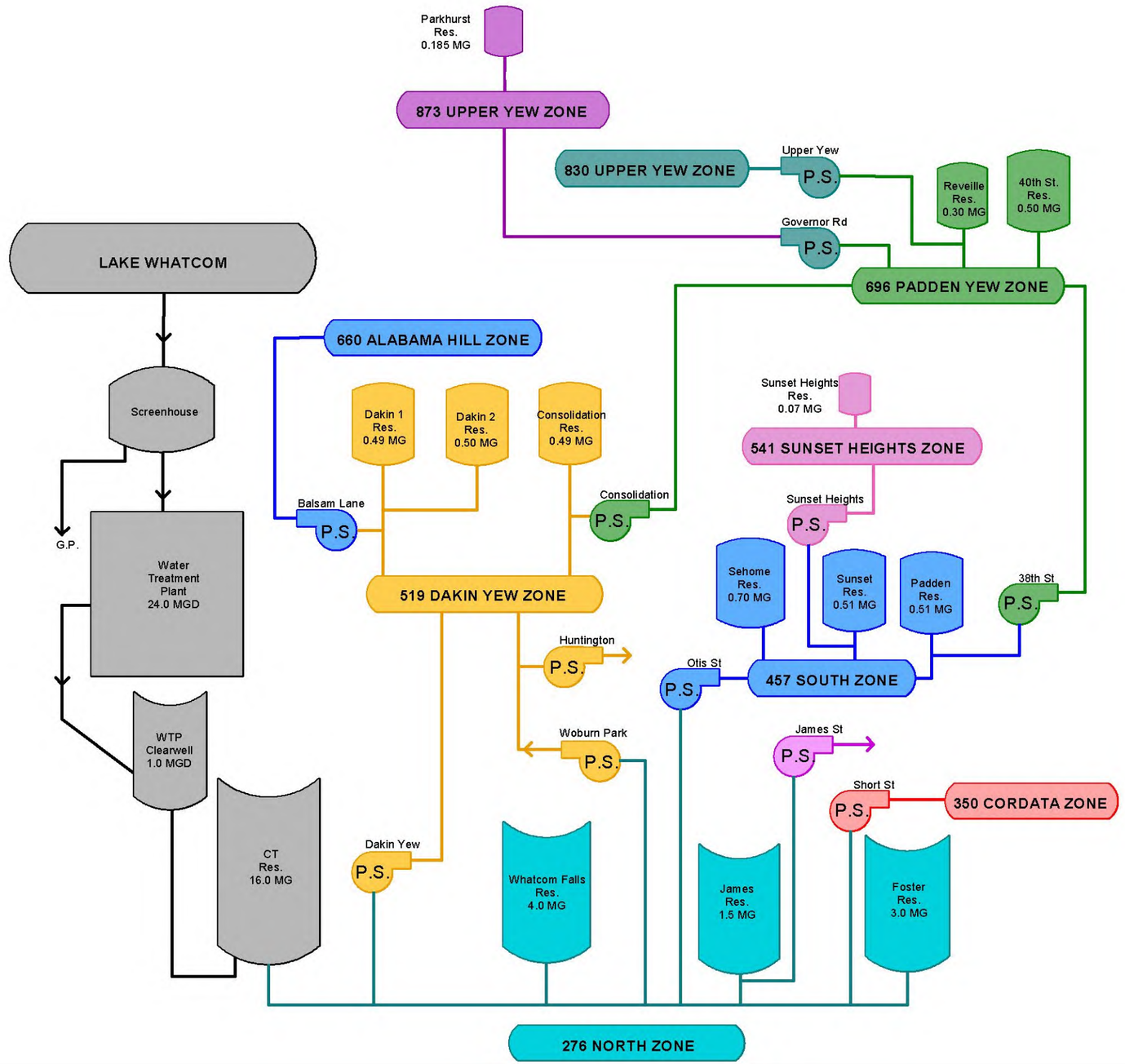


Figure A-3

Water Distribution System

PW Emergency Response Plan

Appendix C
Emergency Action Checklists and Emergency Action Plans

APPENDIX C – EMERGENCY ACTION CHECKLIST AND EMERGENCY ACTION PLANS

NO.	CONTENTS
1	Activating the PW Department Utility Operations Center
2	Deactivating the PW Department Utility Operations Center
3	Evacuation (for Non-Chemical Release)
4	Shelter-in-Place (for Chemical Release)
5	Medical Emergency
6	Power Failure
7	Severe Weather
8	Water Shortage
9	Chemical or Fuel Shortage
10	Earthquake
11	Fire/Explosion
12	Contamination Threat to the Water System
13	Identified Contamination in the Water System
13.a	Water Contamination Procedures
14	Aluminum Sulfate Spill at Water Treatment Plant
15	Diesel Fuel Spill at Water Treatment Plant
16	Soda Ash Spill at Water Treatment Plant
17	Polymer Spill at Water Treatment Plant
18	Diversion or Theft Physical Insider/Outsider Checklist
19	Water Treatment Plant Destruction/Failure
20	Distribution System Destruction/Failure
21	Dam Failure
22	Terrorist/Hostile Attack Aircraft Used as a Weapon
23	Terrorist/Hostile Attack Vehicle-Borne IED Car Bomb
24	Bomb Threat
25	Unauthorized Entry
26	Workplace Violence
27	Civil Disorder/Terrorism
28	Pandemic Response
29	SCADA Attack/Electronic
30	SCADA Attack/Physical

CHECKLIST 1

ACTIVATING THE PW DEPARTMENT UTILITY OPERATIONS CENTER		
✓	**LINE#**	**TASK**
	1	Select the location that will be used for the PW Utility Operations Center (PW Department UOC). An alternate UOC should be used if the primary UOC is unavailable or may be rendered unusable by the emergency event.
	2	Identify the Incident Management Team members that may be needed to provide assistance during the emergency. See IMT Org chart in Section 2.2
	3	Contact, or direct someone to contact, the identified Incident Management Team members with instructions to report to the PW Department UOC or the incident scene.
	4	Set up the PW Department UOC (connect computers, activate dedicated phone lines, etc.). See list in Table 2-2.
	5	Establish primary and alternate means of communication among the PW Department UOC, PW Department personnel at the incident scene, and external response agencies.
	6	If electrical power may fail during the emergency event, ensure that emergency power is available.
	7	Inform the City's Emergency Operations Center (EOC) that the PW Department UOC has been activated.
	8	During local or regional threats or emergencies, provide support to the City of Bellingham EOC and/or the Whatcom County EOC.
	9	If the severity of an emergency event requires sustained operations, determine the staff and resources needed to maintain operations and continue emergency response.
	10	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 2

DEACTIVATING THE PW DEPARTMENT UTILITY OPERATIONS CENTER		
✓	**LINE#**	**TASK**
	1	Notify Incident Management Team members and other Water System staff to return to their regular assignments and schedules.
	2	Inform the City's Emergency Operations Center that the PW Department UOC has been deactivated.
	3	Decommission the PW Department UOC (store emergency equipment, deactivate dedicated phone lines, etc.).
	4	Ensure that the records relating to the emergency event are complete and stored appropriately.
	5	Repair or replace PW Department UOC equipment and supplies, as needed.
	6	Evaluate the emergency response. If necessary, modify the Water System Emergency Response Plan, standard operating procedures, EAPs, checklists, or training program to include "lessons learned" during the response.
	7	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place “N/A” in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 3

EVACUATION (FOR NON-CHEMICAL RELEASE)

✓	LINE#	TASK
	1	If you notice fire, smoke, or other unusual circumstance(s), activate the local emergency notification system.
	2	Assign one person to call 9-1-1 from a safe location and report the problem.
	3	Direct a quick and orderly evacuation of the area.
	4	Quickly and thoroughly search your area to make sure all employees and visitors are out of the building.
	5	Report to the designated evacuation site.
	6	Notify Command Center (PW Department UOC or Fire Department) if any employee(s) cannot be immediately located.
	7	Direct employees to an alternate census site if the designated site becomes unsafe because of the path of the plume, other dangers associated with the emergency, or inclement weather.
	8	Do not attempt to re-enter the building without the approval of the Incident Commander.
	9	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name	Signature	Date/Time

CHECKLIST 4

SHELTER-IN-PLACE (FOR CHEMICAL RELEASE)		
✓	**LINE#**	**TASK**
	1	Notify employees to shelter in the designated location, or as directed by facility announcements. The designated shelter-in-place location for the Water Treatment Plant is the Laboratory.
	2	Ensure that all windows and doors are closed. If applicable, ensure that all openings have been sealed so that they are airtight.
	3	If required by the nature of the emergency, ensure that all ventilation systems are configured to minimize air intake and/or recycle internal air.
	4	Identify a single door for entry into the building and post a door monitor.
	5	Do not allow personnel to leave the building unless approved by the Incident Commander.
	6	Maintain a list of all personnel in the building.
	7	Isolate personnel who may be contaminated. If personnel may be injured, follow the instructions in Checklist #5 – Medical Emergency.
	8	If sheltering is the result of a hazardous materials release, do not allow employees to smoke, eat, drink, apply cosmetics, or chew tobacco or gum.
	9	Follow instructions from the appropriate authority.
	10	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 5

MEDICAL EMERGENCY		
✓	**LINE#**	**TASK**
	1	Check the scene for safety before providing emergency assistance.
		a) Consider conditions (traffic, spilled chemicals, downed power lines, etc.) that may affect the safety of potential responders and others at the scene.
		b) Remove, shut down, or minimize any hazards that you can safely control.
	2	Call 9-1-1 to report the illness or injury.
	3	If available, ensure the following information is relayed to the 9-1-1 Call Center:
		a) Name of individual reporting
		b) Type of emergency
		c) Number of people needing medical care
		d) Location (room, floor, building) of patient(s)
		e) Hazards that may be encountered
		f) Whether first aid/CPR is being provided
		g) Gender, age, and medical history of patient(s)
		h) Symptom(s) of patient(s)
	4	Ensure that trained staff members provide first aid/CPR until emergency response personnel arrive.
	5	Arrange for someone to meet emergency response personnel at the facility entrance and escort them to the patient's location.
	6	Assist local emergency responders, as requested.
	7	Notify the employee's family or emergency contact.
	8	If injury appears to be the result of an intentional act, provide support to the Bellingham Police Department and other law enforcement agencies (preserve evidence, interview witnesses, etc.).
	9	In the event of serious injury or death, notify the City of Bellingham.
	10	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name	Signature	Date/Time

CHECKLIST 6

POWER FAILURE		
✓	**LINE#**	**TASK**
	1	Activate/check status of emergency power supply.
	2	Notify Puget Sound Energy. If applicable, request periodic status updates.
	3	If power failure is due to local equipment failure, develop and implement recovery plan.
	4	If power failure appears to be the result of an intentional act, provide support to the Bellingham Police Department and other law enforcement agencies (preserve evidence, interview witnesses, etc.).
	5	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 7

SEVERE WEATHER

✓	LINE#	TASK
	1	Monitor weather using a NOAA radio, local news media, or Internet weather sites.
	2	During periods of icy or snowy weather, ensure the following actions are taken:
		a) Clear snow and ice from roads.
		b) Ensure emergency power supply is available.
		c) Prepare equipment and vehicles (fill fuel tanks, check oil and tire pressure, etc.).
		d) Consider releasing non-essential personnel from their duties until the weather improves.
		e) Arrange alternate transportation to work for essential personnel, if necessary.
	3	During a tornado, severe thunderstorm, or other severe weather watch, ensure the following actions are taken:
		a) Move loose outdoor items into buildings, if possible.
		b) Allow employees to perform *only* essential outdoor activities.
		c) Instruct employees to move to permanent structures and prepare for sheltering.
		d) Listen to weather reports for further announcements and direction.
	4	During a tornado, severe thunderstorm, or other severe weather warning, ensure the following actions are taken:
		a) Have employees move to designated shelters, or to the interiors of buildings away from doors and windows.
		b) Direct personnel to get under desks, tables, or other sturdy objects (tornado warning only).
		c) Monitor weather reports to determine when employees can return to their normal assignments.
		d) If a tornado, severe thunderstorm, or windstorm damages the facility, follow other applicable emergency response checklists.
		e) After the emergency is over, follow damage assessment and recovery procedures.
	5	During a flood watch, ensure the following actions are taken:
		a) Monitor gauges, as appropriate.
		b) Prepare to activate PW Department UOC, if necessary.
		c) Check inventory of equipment, chemicals, and supplies.
	6	During a flood warning, ensure the following actions are taken:
		a) If flooding affects the facility, notify the Incident Commander.
		b) Follow other applicable emergency response checklists.
		c) Assess electrocution or grounding hazards in flooded or water-damaged areas and secure those areas.
		d) Initiate public warning for water contamination, if necessary.
		e) Coordinate the emergency provision of potable water, if necessary.
	7	Maintain unit log of events (Appendix G) for weather-related emergencies that affect Water System employees or damage PW Department facilities and/or equipment. Forward this log to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 8

WATER SHORTAGE		
✓	**LINE#**	**TASK**
	1	Notify Operations Section Chief.
	2	Determine the effect of the crisis on the ability of the water system to produce potable water at adequate flows and pressures.
	3	Determine if alternate sources of water can be used in the distribution system to maintain pressure and flow.
	4	Notify the PW Communications and Outreach Coordinator and decide whether, when, and how to notify customers and the news media.
	5	If water supply crisis is caused by drought conditions:
		a. Comply with emergency water conservation measures issued by the City of Bellingham and/or other agencies.
		b. Promote water conservation through public outreach campaigns.
	6	Maintain log of actions and forward to the Incident Commander at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 9

CHEMICAL OR FUEL SHORTAGE

Chemical or fuel shortages may be caused by inclement weather, transportation accidents, or deliberate acts of violence. Plans should be in place to have additional supplies, when possible, when bad weather is predicted, or homeland threat levels are elevated to orange or red. In addition, pre-negotiated agreements to supply critical chemicals should be in place with alternate vendors.

✓	LINE#	TASK
		CHEMICAL OR FUEL SHORTAGE
		GENERAL STAFF RESPONSE TASKS
	1	Maintain chemical supplies at a seven-day level.
	2	When chemical supplies drop below a seven-day level and/or other potential delivery problems occur, contact the Operations Section Chief.
		OPERATIONS SECTION CHIEF (or Designee) RESPONSE TASKS
	3	Review current chemical inventory.
	4	Contact chemical supplier(s):
		a. If possible, resolve the delivery problem.
		b. If the supplier is not able to deliver within a reasonable period of time, contact alternate vendors.
	5	Maintain log of actions and forward to the Incident Commander at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 10

EARTHQUAKE		
✓	**LINE#**	**TASK**
	1	When the shaking begins:
		a) If you are indoors, move to the nearest safe place under a sturdy table or desk or against an inside wall where nothing can fall on you. Stay indoors until the shaking stops and it is safe to exit. Stay away from windows.
		b) If you are outdoors, find a clear spot away from buildings, trees, and power lines. Drop to the ground.
		c) If you are in a vehicle, slow down and drive to a safe place. Stay in the vehicle until the shaking stops.
	2	Check yourself and others in the area for injuries. If applicable, follow the instructions in Checklist #5 – Medical Emergency.
	3	Look for and extinguish small fires. If the fire cannot be controlled with a fire extinguisher:
		a) Call 9-1-1 to report the emergency.
		b) Follow the instructions in Checklist #11 – Fire/Explosion.
	4	Assess damage in the immediate area. Consider utilities (gas pipelines, power lines, etc.) and other structural issues.
	5	Provide status report to the Incident Commander.
	6	If local emergency response assistance is required, call 9-1-1. Arrange for someone to escort local emergency responders to the scene of the emergency.
	7	Follow other applicable emergency response checklists.
	8	Provide technical support and resources to local emergency response personnel, the City of Bellingham EOC, and/or the Whatcom County EOC, as requested.
	9	Assemble team of operations, maintenance, engineering, and other PW staff (as needed) to assess damage to Water System facilities.
	10	If facilities have been damaged, follow recovery procedures.
	11	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 11

FIRE/EXPLOSION

✓	LINE#	TASK
	1	When smoke or flames are visible, the fire alarm sounds, or an explosion occurs, call 9-1-1 to report the emergency.
	2	Look for and extinguish small fires. If the fire cannot be safely controlled, go to Step #3.
	3	Evacuate the building or facility in accordance with the procedures in Checklist #3 – Evacuation (non-chemical).
	4	Ensure that local emergency response personnel are directed to the emergency area. Keep them informed of casualty and building conditions.
	5	Account for all personnel and visitors at the evacuation staging area.
	6	Follow other applicable emergency response checklists.
	7	Notify Incident Commander of the emergency event, response actions, and current status.
	8	Provide technical support and resources to local emergency response personnel, as requested.
	9	Direct personnel to an alternate census site if the designated site becomes unsafe because of the path of the plume, other dangers associated with the emergency, or inclement weather.
	10	If fire/explosion appears to be the result of an intentional act:
		a) Provide support to the Bellingham Police Department and other law enforcement agencies (preserve evidence, interview witnesses, etc.).
		b) Consider the possibility of secondary fires/explosions.
	11	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 12

CONTAMINATION THREAT TO THE WATER SYSTEM		
✓	LINE#	TASK
	1	PW Department or Water System employee becomes aware that the water system may be contaminated through any means, including:
		a) Security breach
		b) Notification by the news media
		c) Witness account
		d) Unusual water quality
		e) Notification by the perpetrator (verbal or written)
		f) Consumer complaints
		g) Notification by law enforcement officials
		h) Notification by public health agencies
	2	Notify the Incident Commander.
	3	Complete the appropriate form (Appendix G) to document the threat.
	4	Evaluate the threat to determine if the threat is possible.
		a) If the threat is possible, go to Step #5.
		b) If the threat is not possible, go to Step #12.
	5	Notify local emergency responders (9-1-1), the Bellingham FBI, the Whatcom County Division of Emergency Management, and the Washington Department of Health.
	6	Evaluate the spread of potential contamination and its impact on public health and select the appropriate operational response. Responses may include:
		a) Closing water supply intake
		b) Containment or isolation of potentially contaminated water
		c) Elevating residual disinfectant levels
		d) Discharge of potentially contaminated water
	7	Characterize the suspected contamination site. The characterization may include:
		a) General site information
		b) Physical evidence of potential contamination (such as discarded equipment or supplies)
		c) Environmental indicators (such as dead animals or vegetation, unusual odors, discoloration, etc.)
		d) Field safety screening results
		e) Results from field testing of water
	8	Collect water samples for laboratory analysis.

CONTAMINATION THREAT TO THE WATER SYSTEM

✓	LINE#	TASK
	9	Using the information collected during the threat evaluation and the site characterization, determine if the threat is credible.
		a) If the threat is credible, send samples for laboratory analysis, continue site characterization activities, and implement measures to protect public health.
		b) Coordinate public notification in accordance with the guidance in Appendix G.
		c) If the threat is not credible, go to Step #12.
	10	If contamination is found, follow the steps in Checklist #13.
	11	If contamination is not found, determine if the threat is still credible.
		a) If the threat is credible, revise sampling and analysis plans and collect additional samples.
		b) If the threat is not credible, go to Step #12.
	12	Close the investigation and return to normal operations.
	13	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name	Signature	Date/Time

CHECKLIST 13

IDENTIFIED CONTAMINATION IN THE WATER SYSTEM		
✓	LINE#	TASK
	1	Contamination in the water system is confirmed through water quality monitoring or other methods.
	2	Determine the area affected.
	3	Contain or isolate the affected source.
	4	Contact the Washington Department of Health, for assistance in identifying the contaminant(s) and determining an appropriate response.
	5	Coordinate public notification in accordance with the guidance in Appendix G.
	6	Contact the following personnel and/or agencies, as applicable:
		a) Local emergency response agencies (9-1-1)
		b) Whatcom County Division of Emergency Management
		c) Whatcom County Health Department
		d) Washington Department of Health
		e) Washington Department of Ecology
		f) Federal Bureau of Investigation, Bellingham Office
		g) EPA's National Response Center
		h) Post Point Pollution Control Plant
		i) Water districts that purchase water from the affected system
	7	If necessary, coordinate the purchase and distribution of emergency water supplies.
	8	Flush system based on the water quality monitoring results. Consider the effects of flushing on the wastewater collection system and/or the environment.
	9	Sample appropriate system elements (such as storage tanks, filters, and sediment basins) to determine if residual contamination exists.
	10	Assess the need to decontaminate or replace system elements.
	11	Plan for the appropriate disposition of equipment and materials, including personal protective equipment, used during the emergency.
	12	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

WATER CONTAMINATION PROCEDURES

There are many potential threats to the water system. Water contamination is when a hazardous material of any kind is polluting a source of water. This water contamination procedure and resources provides information to assist in managing a distribution system contamination incident. This procedure includes threat stages for potential water contamination incidents, notification protocols, and Federal resources provided by the USEPA.

Threat Stages

Possible Stage

Site characterization and immediate operational response are two actions that should be implemented within an hour of a possible water contamination threat. Initial site characterization includes identification of physical evidence (for example, discarded containers, indication of tampering) and environmental indicators (for example, dead animals or vegetation, unusual odors) from the site. In addition, field safety screening for hazardous contaminants in the atmosphere and on surfaces, rapid field testing, and sample collection should be conducted by external contracted laboratory personnel in coordination with the Bellingham Fire Department HAZMAT Team.

The Water Quality laboratory is located at the WTP. Specific laboratory analysis for water quality parameters can be conducted at this laboratory. Additional laboratories with expanded capabilities are available for service; a list of these laboratories is located in Appendix A.

Water System employees should call 9-1-1 and take photographs so that police and fire personnel can respond and collect evidence. Implementing immediate operational response will minimize exposure to customers. As a preventive measure, isolation, increased disinfection, and/or system flushing can be considered. When these measures cannot be implemented, customer notification should be considered.

Credible Stage

In determining the credibility of a threat, information from the site characterization will be useful, and the site characterization will be continued. Additionally, sources such as the Water Information Sharing and Analysis Center (WaterISAC) program, intelligence personnel, and the public health department, as well as unusual water characteristics, will be vital in supplying information for the credibility evaluation.

Upon determination of credibility, response actions that may be conducted by the Water System to include public advisories, such as “Boil Water,” “Do Not Drink,” or “Do Not Use” advisories that are coordinated through the PW Department Communications and Outreach Coordinator. Communication templates are located in Appendix H. Additionally, customer exposure can be minimized through isolation, increased disinfection, and/or system flushing. Investigation and sampling would continue.

Confirmed Stage

Confirmation of contamination requires definitive evidence and contaminant identification so that remediation can begin. The duration of this stage would last less than 24 hours. Information to consult during the Confirmed Stage includes analytical results and additional site characterization data. Additionally, information from external entities may help to provide confirmation of contamination when analytical data are not available.

Once confirmed, a full response mode must be implemented. Customer advisories must be reviewed, revised if necessary, and disseminated; full characterization of the contaminated area must be completed; remediation and recovery planning are required; and an alternate zone/water source must be identified for use if necessary.

Contamination Notification

During customer notification of contamination, essential information to provide includes the following:

1. Location of the contamination – where it is and where it is not

2. Description of how the Utility and other agencies are responding
3. Description of advisory actions customers must take (for example, do not drink, do not use, boil water, etc.)
4. Assurance that customers and the public will be kept informed

Public notification procedures under the National Primary Drinking Water Regulations, federal Public Notification Rule (Tier 1, 40 CFR 141.202) include the following:

- Notify the public as soon as practical, but no later than 24 hours after a potential water quality violation and/or credible contamination threat is identified.
- Discuss the threat with the local health department and, as soon as practical but no later than 24 hours after potential water quality violation and/or credible contamination threat is identified, determine whether additional customer and public notifications are required in coordination with the PW Department Communications and Outreach Coordinator. Examples of additional advisories could include repeat advisories, directions regarding how long the advisories are in effect, how often to issue, the form and timing of customer and public advisories, and other actions to reach water system users.

Contamination Procedures

The Water System maintains procedures for reporting water quality violations and potential impacts resulting from the release of water containing hazardous material into the environment (refer to the "Identified Contamination in the Water System" [Checklists above #12 and #13]). Reporting procedures for a drinking water quality violation include steps to take for responding, reporting, and notifying the State of Washington, Department of Ecology. In addition, potential environmental issues associated with impacts from contaminated water, such as release of contaminated water to the soil or waterbodies during flushing activities, would also be coordinated with the state.

In the event of potential water system contamination, Water System staff would coordinate with the Public Works IMT, and the Fire Department as warranted, for threat management decision-making, site characterization, and sampling processes. If a hazardous substance has been introduced into the water system, Water Quality Laboratory personnel would conduct initial response actions such as water sample screening for potential contaminants of concern and follow Checklist #13, "Identified Contamination in the Water System".

In the event of a major water contamination event, the Water System, in coordination with appropriate outside entities, would assist in determining initial response actions such as isolation of potentially contaminated areas, water sampling and analysis, and remediation and recovery activities. Depending on the potential contaminants identified through field screening, the appropriate laboratory analysis required would be decided in coordination with regulatory agencies.

If the WTP onsite water quality laboratory was not able to conduct the sampling and analysis and/or unable to analyze for Chemical, Biological, Radiological, Nuclear, and (high yield) Explosives (CBRNE)-type contamination, an external contracted laboratory may be used. Additional accredited laboratories are available; a contact list is located in Appendix A.

Federal Resources

Laboratories

Federal laboratories such as the CDC and other CBRNE-specialty federal laboratories are available in the case of a major contamination event. The CDC maintains a laboratory response network that can respond quickly to CBRNE and other high-priority public health emergencies with rapid testing, timely notification, and secure messaging of laboratory results.

The Integrated Consortium of Laboratory Networks (www.icln.org) coordinates federally sponsored analytical laboratory services for CBRNE incidents. In addition, the National Environmental Laboratory Accreditation Program management system maintains a database of certified laboratories (https://lams.nelac-institute.org/).

The Water Laboratory Alliance provides the water sector with access to an integrated nationwide network of laboratories. This network offers the capabilities and capacity to analyze water samples in the event of natural, intentional, or unintentional water contamination involving CBRNE contaminants and includes Environmental Response Laboratory Network members. The USEPA maintains this information at https://www.epa.gov/waterlabnetwork.

Drinking Water System Response Protocol Toolbox

The USEPA has developed the Water Response Protocol Toolbox: Planning for and Responding to Contamination Threats to Drinking Water Systems (https://www.epa.gov/waterutilityresponse#pp8) that contains the following modules:

- Planning for and Responding to Drinking Water Contamination Threats and Incidents: Overview and Application
- Module 1: Water System Planning Guide
- Module 2: Contamination Threat Management Guide
- Module 3: Site Characterization and Sampling Guide
- Module 4: Analytical Guide
- Module 5: Public Health Response Guide
- Module 6: Remediation and Recovery Guide

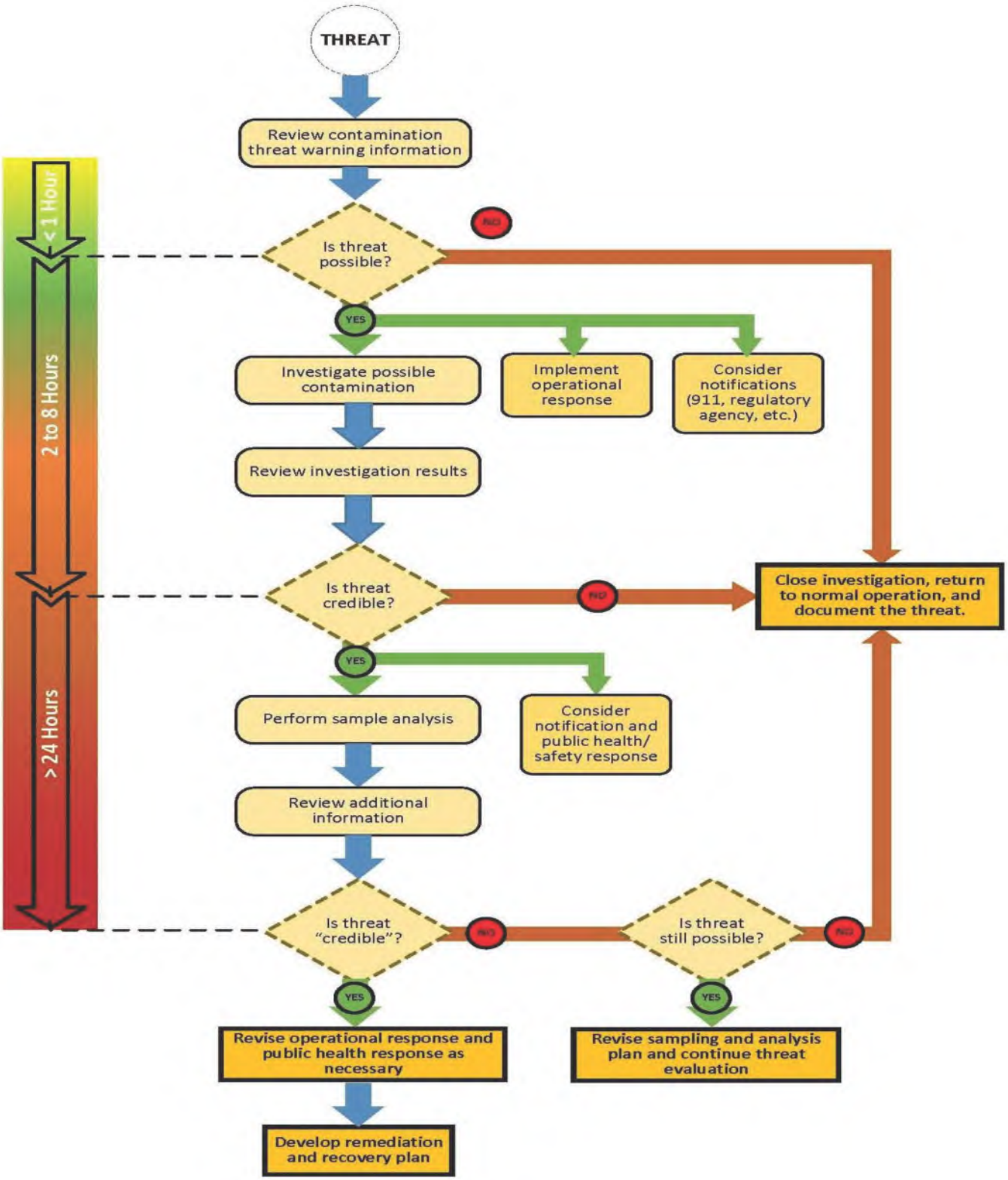
Response Protocol Toolbox (RPTB): Response Guidelines compile RPTB forms that may be helpful during an incident response. A Water Security Handbook: Planning for and Responding to Drinking Water Contamination Threats and Incidents is a shorter version of the RPTB and companion to the Response Guidelines.

These modules are an important resource for water system contamination threats or incidents that may occur. In addition, the USEPA's Water Contaminant Information Tool is a secure online database that provides information on chemical, biological, and radiological contaminants of concern for water security. Utilities can use this tool in the event of a water system contamination threat or incident. Access to the tool is granted to water and wastewater utilities through the USEPA website link above using the Central Data Exchange system.

The below figures provide USEPA's contamination threat management decision tree and site characterization and sampling process, respectively.

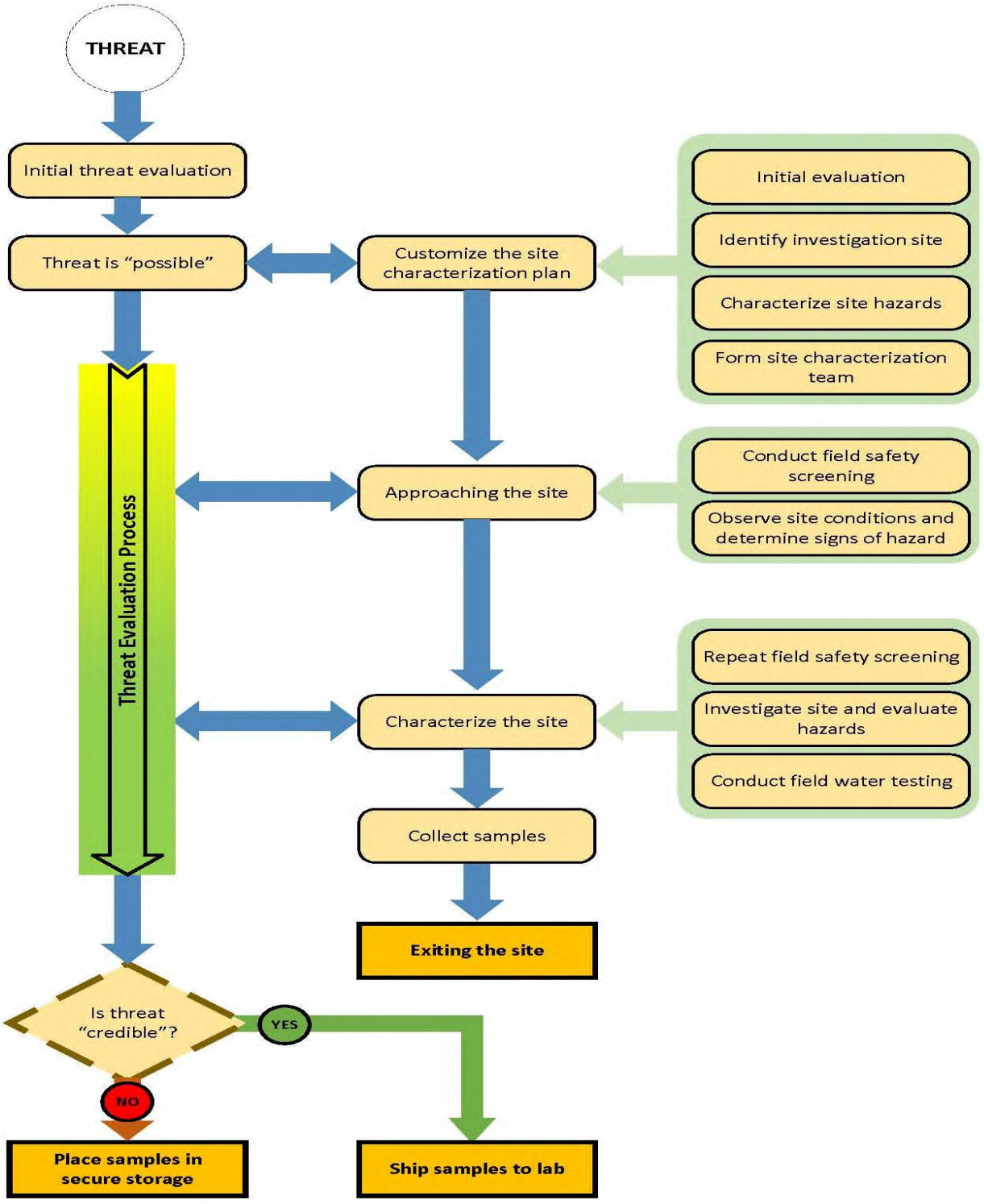
Contamination Threat Management Decision Tree

Source: USEPA Response Protocol Toolbox Module 2: Contamination Threat Management Guide



Site Characterization and Sampling Process

Source: USEPA Response Protocol Toolbox Module 3: Site Characterization and Sampling Guide



Contamination Response and Decontamination Guidance

Response and remediation actions may include collection, transport, and disposal of contaminated water. Information regarding decontamination of water systems is provided by the USEPA. In addition, specific information regarding containment, treatment, disposal, storage, and transportation of contaminated water is contained in the USEPA's *Containment and Disposal of Large Amounts of Contaminated Water: A Support Guide for Water Utilities*, EPA 817-B-12-002, September 2012.

The below figure provides a flowchart to assist the Water System with decontamination and disposal decisions based on USEPA guidance. Implementation of this guidance would occur in coordination with the appropriate regulatory agencies. It is also recommended that the Water System maintain a copy of this guidance at its UOC to assist in determining a remediation and recovery strategy.

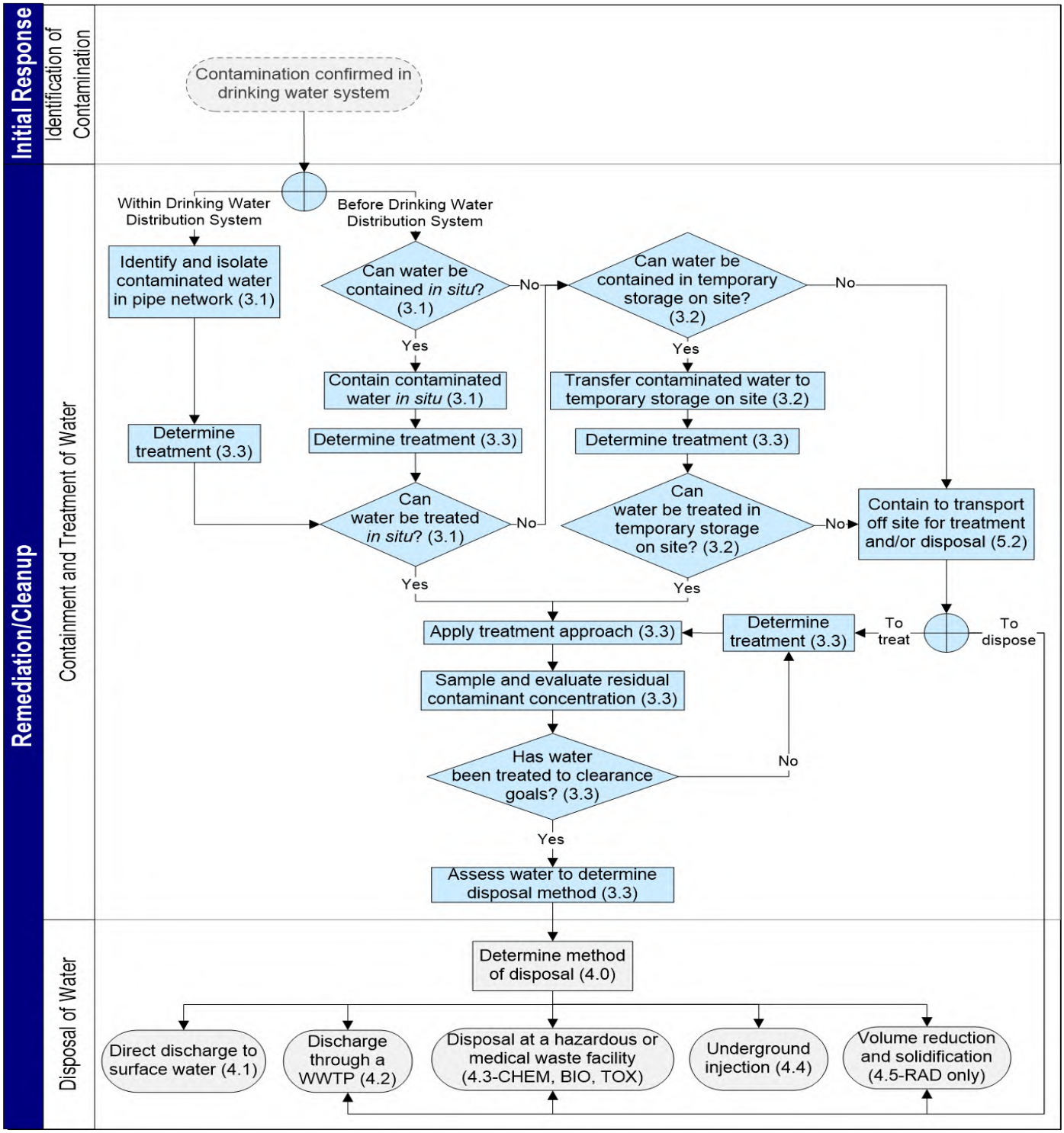
Additional USEPA resources and tools available to assist the Water System in the event of an actual or potential water contamination event include the following:

- USEPA *Water Quality Surveillance and Response Systems* for distribution system monitoring and management primers (guidance and technical resources)
- USEPA Decontamination and Recovery Planning – Water and Wastewater System Case Study (EPA 817-F-08-004, September 2008)
- USEPA Containment and Disposal of Large Amounts of Contaminated Water (EPA 817-B-12-002, September 2012)

USEPA is currently in the process of developing additional tools as part of its ongoing Decontamination Preparedness and Assessment Tool initiative.

General Decontamination Guidance Flowchart

Source: USEPA, Containment and Disposal of Large Amounts of Contaminated Water: A Support Guide for Water Utilities. EPA 817-B-12-002. September 2012.



CHECKLIST 14

ALUMINUM SULFATE SPILL AT WATER TREATMENT PLANT		
✓	LINE#	TASK
	1	Notify all plant personnel.
	2	If the chemical feed pumps must be shut down, follow the standard operating procedure for WTP shut down.
	3	If the spill is due to overfilling, stop filling operation.
	4	Call 9-1-1 and the Incident Commander.
	5	Notify federal, state, and local agencies as required.
	6	Control access to the affected area.
	7	Don protective clothing and repair damage or stop leak in storage tank site.
	8	Initiate confinement using a dike across all entrances to the garage area of the plant. Allow chemical to run into floor drain of the garage.
	9	If chemical overflows the dike and runs onto the blacktop, place dike around the storm drain in the parking lot.
	10	Ensure that the Bellingham Fire Department is escorted to the emergency area.
	11	Dilute and wash down spill area with large amounts of water.
	12	Put system back into operation only after approval by the Incident Commander.
	13	Investigate cause or causes of spill. Recommend changes in procedures, as needed.
	14	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 15

DIESEL FUEL SPILL AT WATER TREATMENT PLANT		
✓	LINE#	TASK
	1	Notify all plant personnel.
	2	Call 9-1-1 and the Incident Commander.
	3	Notify federal, state, and local agencies as required.
	4	Control access to the affected area.
	5	Stop refueling operation and shut off tanker truck valve.
	6	If diesel fuel leak is in the day tank, isolate the leak by shutting down the supply line valve.
	7	Initiate confinement with adsorbent material. Construct dikes to prevent fuel from entering the daylight drain system.
	8	Ensure that the Bellingham Fire Department is escorted to the emergency area.
	9	Repair damage to tank and/or piping.
	10	Contact diesel fuel supplier to clean up the spill.
	11	Investigate cause or causes of spill. Recommend changes in procedures, as needed.
	12	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 16

SODA ASH SPILL AT WATER TREATMENT PLANT		
✓	**LINE#**	**TASK**
	1	Notify all plant personnel and the Incident Commander.
	2	Don the appropriate personal protective equipment.
	3	If spill is due to overfilling, stop the filling operation.
	4	If spill is due to transfer from delivery trucks to the silos, clean up the spillage using shovels, brooms, or vacuums. Avoid dust generation.
	5	Place spillage in the appropriate container for disposal.
	6	Flush the area with water; do not flush the material to any storm drains or waterways.
	7	Investigate cause or causes of spill. Recommend changes in procedures, as needed.
	8	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name	Signature	Date/Time

CHECKLIST 17

POLYMER SPILL AT WATER TREATMENT PLANT		
✓	**LINE#**	**TASK**
	1	Notify all plant personnel and the Incident Commander.
	2	Don the appropriate personal protective equipment.
	3	Absorb spilled material into a non-reactive material and place in the appropriate container for disposal.
	4	Scrub the area to remove any residual and thoroughly flush with water. Do not flush the material to any storm drains or waterways.
	5	Investigate cause or causes of spill. Recommend changes in procedures, as needed.
	6	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name	Signature	Date/Time

CHECKLIST 18

DIVERSION OR THEFT PHYSICAL INSIDER/OUTSIDER CHECKLIST

Unauthorized entry or criminal activity may occur at any facility. The criminal activity may range from employee diversions or thefts as a result of insider/outsider collaboration.

✓	LINE#	TASK
		GENERAL STAFF RESPONSE TASKS
	1	If unauthorized entry and theft is observed, immediately call 9-1-1 and report the emergency.
	2	Contact the Water Treatment Plant Supervisor and report activity.
	3	Follow the instructions provided by security staff.
	4	Try to ensure that the person or persons do not leave until security and police arrive to interview them. If they do attempt to leave, record a description of each intruder and the vehicle make, model, color, and license number.
		INCIDENT COMMANDER (or Designee) RESPONSE TASKS
	5	Direct employees to check their immediate work areas for any suspicious items or damage.
	6	Instruct employees *not* to disturb any suspicious items.
	7	If applicable, evacuate the building or facility. Account for all personnel at the designated assembly area.
	8	Report any suspicious items to the local emergency response agency's Incident Commander.
	9	Provide technical support and resources to local emergency response agencies, as requested.
	10	Determine whether there are any impacts or potential impacts to the operation of water supply, treatment, and/or distribution facilities.
	11	Follow other applicable emergency response checklists.
	12	Ensure that the Washington Department of Health has been notified within two hours of the event. Also ensure that other federal, state, and local agencies have been notified as applicable.
	13	Coordinate building re-entry with the Incident Commander.
	14	Maintain log of actions and forward to the Safety Officer at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 19

WATER TREATMENT PLANT DESTRUCTION/FAILURE

✓	LINE#	TASK
	1	Call 9-1-1 and report the event. Also notify the Water Treatment Plant Supervisor (360) 778-7890.
	2	Notify WTP Chief Operator. If WTP Chief Operator is not available, notify the Operations Supervisor.
	3	Determine if the WTP needs to be shut down due to contamination or hydraulic failure.
	4	If the emergency is due to a hazardous materials spill:
		a) Ensure control of spill event.
		b) Determine scope of contamination.
		c) Sample and analyze for degree of contamination.
		d) Obtain expert guidance regarding decontamination procedures.
		e) Initiate action to decontaminate the WTP.
		f) Coordinate with PW Wastewater System.
		g) Decontaminate WTP, as necessary.
		h) Go to Step #8.
	5	If the emergency is due to a sewage spill:
		a) Ensure control of spill event.
		b) Determine scope of contamination.
		c) Sample and analyze for degree of contamination.
		d) Flush plant piping and backwash filters.
		e) Disinfect plant piping and filters.
		f) Disinfect WTP, as necessary.
		g) Sample and analyze water quality.
		h) Go to Step #8.
	6	If the emergency is due to hydraulic failure:
		a) Isolate WTP from the distribution system.
		b) Shut down the WTP.
		c) Issue order to public regarding water conservation. If the anticipated down time may exceed the available supply, go to Step #7.
		d) Lockout/tagout electrical equipment, pumps, and valves, as needed.
		e) Dewater flooded interior areas.
		f) Replace damaged sections of pipe.
		g) Initiate temporary repair of damaged concrete structures.

WATER TREATMENT PLANT DESTRUCTION/FAILURE

✓	LINE#	TASK
		h) Flush and disinfect hydraulic systems.
		i) Sample and analyze water quality.
		j) Perform engineering and permanent repair of hydraulic systems.
		k) Go to Step #8.
	7	If the anticipated down time may exceed the available supply:
		a) Issue order to public to restrict water usage.
		b) Coordinate emergency water purchase.
		c) Supply water via tank trucks.
		d) Ensure uninterrupted water supply to priority customers.
	8	Restore system to normal operation.
	9	Investigate cause or causes of destruction/failure. Recommend changes in procedures, as needed.
	10	Notify Washington State Department of Health, before the end of the next business day. See Table A-4 in Appendix A for contact information.
	11	Notify Whatcom County Health Department. See Table A-4 in Appendix A for contact information.
	12	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 20

DISTRIBUTION SYSTEM DESTRUCTION/FAILURE

✓	LINE#	TASK
	1	For a hydraulic failure in a discharge pressure or gravity main:
		a) Call 9-1-1 and report the event.
		b) Close valves upstream and downstream of the break.
		c) For small outages, provide bottled water to affected customers.
		d) Issue notice to public regarding water quality and low water pressure.
		e) Replace damaged sections of pipe.
		f) Decontaminate the distribution system, if needed.
		g) Restore system to normal operation.
	2	If hydraulic failure is due to multiple general main breaks:
		a) Call 9-1-1 and report the event.
		b) Close valves upstream and downstream of the breaks.
		c) Open valves between affected zone and adjacent zone in operation.
		d) Issue notice to public regarding water quality and low water pressure.
		e) Truck water to areas without service.
		f) Centralize water distribution.
		g) Replace damaged sections of pipe.
		h) Decontaminate the distribution system, if needed.
		i) Restore system to normal operation.
	3	If pump station failure is due to physical destruction:
		a) Call 9-1-1 and report the event.
		b) Close intake and discharge valves.
		c) Open valve(s) on bypass line, if provided.
		d) Open valves between affected zone and adjacent zone in operation.
		e) Issue notice to public regarding water quality and low water pressure.
		f) Truck water to areas without service.
		g) Centralize water distribution.
		h) Repair damaged equipment and structures.
		i) Restore system to normal operation.

DISTRIBUTION SYSTEM DESTRUCTION/FAILURE		
✓	**LINE#**	**TASK**
	4	If the anticipated down time may exceed the available supply:
		a) Issue order to public to restrict water usage.
		b) Coordinate emergency water purchase.
		c) Supply water via tank trucks.
		d) Ensure uninterrupted water supply to priority customers.
	5	Investigate cause or causes of destruction/failure. Recommend changes in procedures, as needed.
	6	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

CHECKLIST 21

DAM FAILURE		
✓	**LINE#**	**TASK**
	1	If monitoring or inspection results indicate that there is a potential or actual failure at the dam, call 9-1-1 and the Incident Commander.
	2	Follow the instructions in the site-specific Emergency Action Plan. Emergency Action Plans for the following structures are located in the primary and alternate PW Department UOCs:
		a) Lake Whatcom Dam
	3	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 22

TERRORIST/HOSTILE ATTACK AIRCRAFT USED AS A WEAPON

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column. Note time of task completion. Record any notes on the following page.

✓	LINE#	TASK
		First on Scene
	1	Call 9-1-1 and report the incident.
	2	Notify the Water Treatment Plant Supervisor or designee.
	3	Notify the PW Department Director.
	4	Comply with law enforcement instructions upon arrival.
	5	Comply with site-wide announcements and law enforcement directions.
	6	Assist Protective Force personnel with building-specific requests, e.g., location of equipment and materials, location of specific personnel, etc.
		a. During situations involving violence/gunfire/hand grenade blasts, etc.:
		b. Direct employees in immediate area of terrorist activities to hide under furniture and hold badges near their face when approached by responding law enforcement.
	7	Direct employees outside immediate area to follow law enforcement instructions and stay indoors, lock doors and keep away from windows.
	8	Direct employees to report any suspicious activity or person to 9-1-1.
	9	Restore building to normal operations when it is safe to do so, and Incident Commander provides authorization.
	10	Maintain log of actions and forward to the Incident Commander upon completion.
	11	Provide technical support and resources to local emergency response agencies, as requested.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 23

TERRORIST/HOSTILE ATTACK VEHICLE-BORNE IED CAR BOMB

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column. Note time of task completion. Record any notes on the following page.

✓	LINE#	TASK
		First on Scene
	1	Direct employees to report any suspicious activity or person to 9-1-1.
	2	Call 9-1-1 and report the incident.
	3	Notify the Water Treatment Plant Supervisor or designee.
	4	Notify the PW Director.
	5	Comply with law enforcement instructions upon arrival.
	6	Comply with site-wide announcements and law enforcement directions.
	7	Assist Protective Force personnel with building-specific requests, e.g., location of equipment and materials, location of specific personnel, etc.
	8	During situations involving violence/gunfire/hand grenade blasts, etc., direct employees in immediate area of terrorist activities to hide under furniture and hold badges near their face when approached by responding law enforcement.
	9	Direct employees outside immediate area to follow law enforcement instructions and stay indoors, lock doors and keep away from windows.
	10	Restore building to normal operations when it is safe to do so, and Incident Commander provides authorization.
	11	Maintain log of actions and forward to the Incident Commander upon completion.
	12	Provide technical support and resources to local emergency response agencies, as requested.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 24

BOMB THREAT

✓	LINE#	TASK
	1	When a bomb threat is received, obtain as much information as possible from the caller. Use the attached form to document the information.
	2	Call 9-1-1 to report the event and notify your supervisor.
	3	Determine if a partial or full evacuation should occur.
	4	***Do not use radio transmitters or receivers, and do not activate building alarms.***
	5	Remove all personal items (coats, purses, packages, etc.) you brought to work that day.
	6	Look for (but do not move or touch) any suspicious items. Report such items to your supervisor after you reach the census site.
	7	Do not smoke or permit smoking in the immediate vicinity.
	8	Report to your evacuation site, as instructed. Return to the facility only after receiving the "all clear" message from the Bellingham Police Department.
	9	Make a quick check of assigned areas, restrooms, and nearby public meeting rooms to confirm that all employees have left the building.
	10	Instruct others, including the general public, to leave the building and wait at the census site.
	11	Confirm that all assigned employees are present. Immediately report any missing employees to the Bellingham Police Department.
	12	Report any unclaimed and/or suspicious packages or items to the Bellingham Police Department.
	13	Provide technical assistance and support to the Bellingham Police Department, as requested.
	14	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place “N/A” in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name	Signature	Date/Time

BOMB DATA CARD

QUESTIONS TO ASK:

1. When is bomb going to explode?
2. Where is it right now?
3. What does it look like?
4. What kind of bomb is it?
5. What will cause it to explode?
6. Did you place the bomb?
7. Why?
8. What is your address?
9. What is your name?
10. Where are you calling from?

EXACT WORDING OF THE THREAT:

_____
_____
_____
_____
_____

Sex of Caller: _____ Race: _____

Age: _____Length of Call: _____

Number at which call is received:

_____

CALLER'S VOICE:

_____ Calm	_____ Nasal
_____ Angry	_____ Stutter
_____ Excited	_____ Lisp
_____ Slow	_____ Raspy
_____ Rapid	_____ Deep
_____ Soft	_____ Ragged
_____ Loud	_____ Clearing Throat
_____ Laughter	_____ Deep Breathing
_____ Crying	_____ Cracking Voice
_____ Normal	_____ Disguised
_____ Distinct	_____ Accent
_____ Slurred	_____ Familiar

If voice is familiar, who did it sound like?

_____
_____
_____
_____

BACKGROUND SOUNDS/NOISE:

_____ Street	_____ Animal Noises
_____ Clear	_____ Factory Machinery
_____ Crockery	_____ Static
_____ Voices	_____ Local
_____ PA System	_____ Long Distance
_____ Music	_____ Office Machines
_____ House Noises	
_____ Motor	
_____ Booth	

Other:

_____

THREAT LANGUAGE:

_____ Well Spoken (educated)	_____ Message Read by Threat Maker
_____ Foul	_____ Incoherent
_____ Irrational	_____ Taped

REPORT CALL IMMEDIATELY TO:

9-911

Mayor's Office: (360) 778-8100

Date: _____/_____/_____

Name: _____

Position: _____

Phone Number: _____

CHECKLIST 25

UNAUTHORIZED ENTRY		
✓	**LINE#**	**TASK**
	1	If unauthorized entry is observed, immediately call 9-1-1.
	2	If possible, record a description of each intruder and the make, model, color, and license number of any vehicle involved. Do not put yourself in danger by confronting the intruder(s).
	3	Direct employees to check their immediate work areas for any suspicious items or damage.
	4	Instruct employees not to disturb any suspicious items.
	5	If applicable, evacuate the building or facility. Follow the instructions in Checklist #3 – Evacuation (for non-chemical).
	6	Report any suspicious items to the Bellingham Police Department.
	7	Provide technical support and resources to the Bellingham Police Department and other emergency response agencies, as requested.
	8	Determine whether there are any impacts or potential impacts to facility operations. Report any such impacts to the Incident Commander.
	9	Follow other applicable emergency response checklists.
	10	Ensure that other federal, state, and local agencies have been notified, as applicable.
	11	Coordinate building or facility re-entry with the Bellingham Police Department.
	12	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 26

WORKPLACE VIOLENCE		
✓	**LINE#**	**TASK**
	1	Call 9-1-1 to report the emergency.
	2	Comply with facility announcements and law enforcement instructions.
	3	Notify the Incident Commander of the emergency event, response actions, and current status.
	4	Provide technical support and resources to local emergency response agencies, as requested.
	5	During situations involving violence, gunfire, etc.:
		a. Direct employees in the immediate area to hide under furniture and hold badges near their faces when approached by emergency responders.
		b. Direct employees outside the immediate area to stay indoors, lock doors, keep away from windows, and follow law enforcement instructions.
	6	Direct employees to report any suspicious activity or person to the Bellingham Police Department.
	7	Follow other applicable emergency response checklists.
	8	Restore the building or facility to normal operations as approved by the Bellingham Police Department.
	9	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 27

CIVIL DISORDER/TERRORISM		
✓	**LINE#**	**TASK**
	1	Call 9-1-1 to report the emergency. Report any suspicious activity or person to the Bellingham Police Department.
	2	Comply with facility announcements and law enforcement instructions.
	3	Notify the Incident Commander of the emergency event, response actions, and current status.
	4	Provide technical support and resources to local emergency response agencies, as requested.
	5	During situations involving violence, gunfire, hand grenade blasts, etc.:
		a. Direct employees in the immediate area to hide under furniture and hold badges near their faces when approached by emergency responders.
		b. Direct employees outside the immediate area to stay indoors, lock doors, keep away from windows, and follow law enforcement instructions.
	6	Coordinate public notification of the event, as required. See Appendix G for additional information.
	7	Follow other applicable emergency response checklists.
	8	Restore the building or facility to normal operations as approved by the Bellingham Police Department.
	9	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 28

PANDEMIC RESPONSE

The risk of transmission of COVID-19 via drinking water is low. However, pandemics can have other impacts to utilities such as staffing shortages, supply chain disruptions, field operations interruptions and inability to maintain all operations.

✓	LINE#	TASK
	1	Preparation for Pandemic:
		a. Identify emergency contacts with local health department and Emergency Management Agency
		b. Assess Information Technology capability to ensure it can accommodate remote work arrangements without compromising security
		c. Coordinate with local law enforcement to ensure water sector staff are considered staff are considered first responders
		d. Identify critical positions, functions, customers and minimum staff required to maintain operations
		e. Ensure availability of adequate proper personal protective equipment, infection control and cleaning supplies
		f. Establish policy for screening employees for symptoms, extended sick leave, telework and social distancing within facilities
		g. Ensure redundancy in laboratory personnel
		h. Develop inventory of critical materials, chemicals, and supplies
	2	Response to a Pandemic:
		a. Establish contact with local health department and Emergency Management Agency
		b. Inform all staff on CDC recommendations to limit transmission
		c. Close all offices to public and limit contact where possible (i.e., suspend any in-home, non-sampling appointments)
		d. Limit or cease all in-person meetings and travel
		e. Increase frequency of cleaning and disinfecting all surfaces and equipment (control rooms, vehicles, computers, break rooms)
		f. Implement telework for staff where feasible to maintain critical operations
		g. Make preparations to house critical staff on site and contact WAWARN for potential assistance
		h. Communicate with customers regarding drinking water supply safety based on EPA, CDC guidance
		i. Contact supplies for critical equipment, materials and treatment chemicals to ensure adequate supplies and delivery timelines
		j. Remind staff of potential cybersecurity threats and back up critical files

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 29

SCADA ATTACK/ELECTRONIC

✓	LINE#	TASK
	1	Place all affected or potentially affected equipment in LOCAL/MANUAL and configure as required using last known good process values. Institute tight access control to local plant and equipment to avoid physical attack.
	2	Notify the Incident Commander, who will coordinate the notification of federal, state, and local agencies (when applicable).
	3	Coordinate with the Bellingham Police Department and other law enforcement agencies to preserve evidence, interview witnesses, etc.
	4	Physically disconnect links of the affected and other potentially affected control systems from local business networks and dial-up modem connections.
	5	Save all event logs, alarm logs, and historical data files to removable media and place in a secure location for later analysis.
	6	Save all SCADA application and database files to removable media and place in a secure location for later analysis.
	7	Remove SCADA servers from the control system for later analysis. If possible, do not interrupt the power supply to the servers.
	8	Install spare SCADA server, loaded with latest archived configuration files. Change all passwords. Do not restart SCADA application until PLCs or Discreet Process Control (DPCs) have been reconfigured.
	9	Upload all affected or potentially affected PLC or DPC programs and configurations to removable media and place in a secure location for later analysis.
	10	Completely purge the memory from all affected or potentially affected PLC or DPCs, and download latest archived configuration and program (if unaffected by the attack).
	11	Save all configuration files from network switches, hubs, and servers to removable media.
	12	Completely purge the memory from all network switches, hubs, servers, and modems. Download latest archived configuration files. Change all passwords. Inspect and validate all archived routing tables.
	13	Restart reconfigured SCADA server application. Verify that the application is current. If not, install any service packs or updates installed since the last backup.
	14	Restart PLC or DPCs on a system-by-system basis, verifying proper operation. Return equipment to AUTOMATIC control on a system-by-system basis, verifying proper operation.
	15	Analyze all archived network device configuration files to determine the cyber-attack entry point and attack method. Reconfigure and enhance systems as required to prevent subsequent successful attacks.
	16	Reestablish links from the enhanced control system, as required, to local business networks and dial-up modem connections.
	17	Maintain unit log of events (Appendix G) and forward to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name / Signature / Date/Time

CHECKLIST 30

SCADA ATTACK/PHYSICAL		
✓	LINE#	TASK
	1	Place all affected equipment in MANUAL and configure as required using last known good process values.
	2	Notify Incident Commander, who will coordinate the notification of federal, state, and local agencies (when applicable).
	3	Coordinate with the Bellingham Police Department and other law enforcement agencies to preserve evidence, interview witnesses, etc.
	4	Refer to vulnerability assessment ranking of the relative importance of the various facilities. Assign evaluation and repair teams and resources based on the relative importance of the affected installations.
	5	Physically examine and/or run electronic diagnostic tests of all affected, or potentially affected, systems to determine which components have been damaged.
	6	Obtain and install replacement components. Maintain records of all newly installed component model numbers, serial numbers, and source of supply. Restart, test, and certify repaired systems.
	7	Return certified systems to AUTOMATIC control mode of operation.
	8	Keep records of all newly installed components for restocking of spare supplies and financial settlement with suppliers.
	9	Forward records to the Planning Section Chief at the conclusion of the emergency event.

Check box when an item was completed or, if an item was not applicable, place "N/A" in the column.

The tasks listed above are general guidelines for responding to each type of emergency; specific response actions may vary depending upon the nature and extent of the emergency event.

Comments:

Printed Name	Signature	Date/Time

Appendix D
Incident Management Team Position Guides

Incident Commander/Unified Command Position Guide

Position Description

The Incident Commander/Unified Command is responsible to provide coherent, strategic-level direction to support operational response and development of objectives to facilitate business continuity and resumption of normal operations.

Response Actions

RESPONSE ACTIONS – INITIAL RESPONSE	✓
Activate the ERP, Public Works Utility Operations Center (PW Department UOC), and ICS structure (IMT).	❑
Assess the situation and/or obtain an incident briefing for from the prior Incident Commander.	❑
Determine incident objectives and strategy (ICS Form 202) and establish immediate priorities.	❑
Define provisional operational objectives and parameters.	❑
Establish an Incident Command Post as needed.	❑
Establish an appropriate organization and resources to manage the incident.	❑
Ensure planning meetings are scheduled as required.	❑
Approve and authorize implementation of an Incident Action Plan.	❑
Ensure that adequate safety and personnel accountability measures are in place.	❑
Coordinate activity for Command Staff.	❑
Approve requests for additional resources or for release of resources.	❑
Keep Executive Group (response agencies, local EOC, and council members, commissioners, other local politicians, etc.) informed of incident status as needed.	❑
Authorize release of information to the news media.	❑
Ensure that Incident Status Summary (ICS Form 209) is completed and disseminated.	❑
Identify key resource and capability concerns.	❑
Establish liaison with City of Bellingham/Whatcom County/state emergency management as needed.	❑
Initiate processes for tracking resources and cost accounting.	❑
Notify external response partners of necessary assistance.	❑

RESPONSE ACTIONS - GENERAL TASKS	WHEN
Provide overall management of the incident.	As needed
Participate in meetings as requested (refer to the PIO Planning "P" job aid).	As needed
Discuss field response information and prepare or update situational awareness as needed.	As needed
Address financial, operational, and other issues.	As needed
Monitor and oversee response activities via situation reports, meetings, and briefings with the Planning Section, and ad hoc requests for information.	Throughout
Maintain liaison with external response partners as needed.	Throughout

RESPONSE ACTIONS – DEMOBILIZATION	✓
Ensure that the Demobilization Form (ICS-221) is prepared.	❑
Return to normal operations.	❑
Provide policy and strategic-level input to the after-action report/improvement planning process.	❑

Coordination with Others

COORDINATE WITH	WHEN	INCIDENT COMMANDER PROVIDES	INCIDENT COMMANDER OBTAINS
General Staff	As needed	Direction	Feedback
Command Staff	As needed	Direction	Feedback
Planning Section	As Needed	Direction/guidance and meeting/ briefing facilitation	Situation status and action planning
Boards of Commissioners	As needed	Situation updates	Feedback
Senior Leaders of External Entities	Routinely	Public outreach, resources, strategic-level ops coordination	Feedback and guidance
PIO	Routinely	Guidance to develop and implement public messaging if needed	Feedback and guidance

Incident Commander – Planning P[1]

ATTEND TACTICS MEETING
- Work with Command and General Staffs to validate strategies and tactics for the next operational period.
- Provide guidance and clarification regarding objectives.

TACTICS MEETING PREPARATION
- Work with Operations and Planning Sections to develop strategy and tactics for the next operational period.
- Discuss/document strategies, tactics, and contingencies; ensure time to draft the IAP.

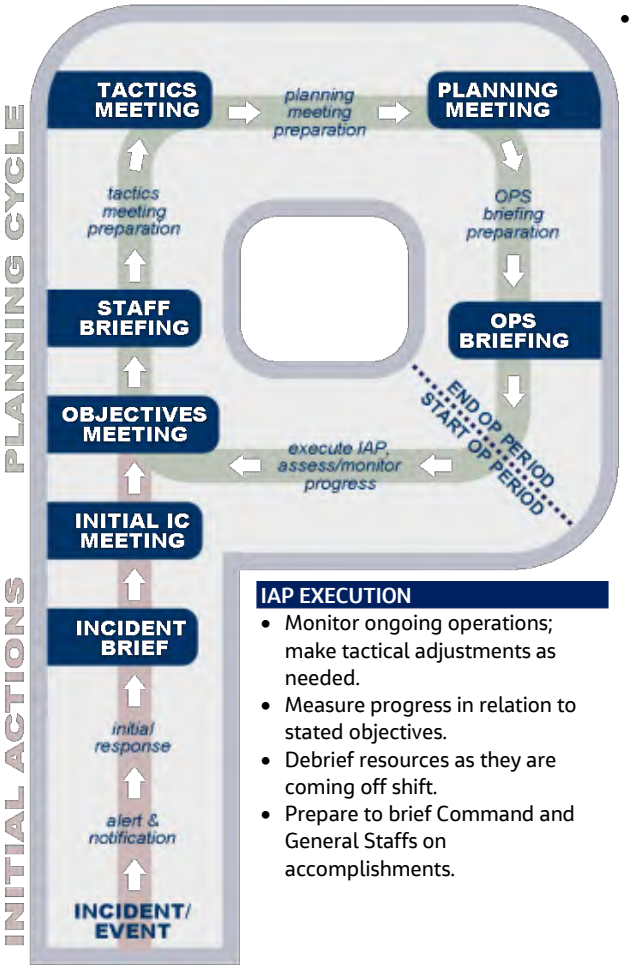
ATTEND STAFF BRIEFING
- Receive situation status briefing.
- Discuss established goals, operational period objectives, priorities, assignments, and progress.

ATTEND OBJECTIVES MEETING IF INVITED
- Objects identified/ reviewed and prioritized for next operational period.

ATTEND INITIAL IC MEETING IF INVITED
- Response scope and priorities are established.
- Command/General Staffs assigned.
- Cost-sharing procedures are agreed upon.
- Incident and support facilities are established.

ATTEND INCIDENT BRIEF
- Brief Command and General Staffs on initial response activities.
- Clarify issues and concerns.
- Discuss planned operations and provide overall direction.

PLANNING MEETING PREPARATION
- Ensure a block of time is set aside for Command and General Staffs to prepare for the Planning Meeting by updating charts, maps, resource estimates, Safety Plan, etc.



IAP EXECUTION
- Monitor ongoing operations; make tactical adjustments as needed.
- Measure progress in relation to stated objectives.
- Debrief resources as they are coming off shift.
- Prepare to brief Command and General Staffs on accomplishments.

INITIAL RESPONSE
- Report to the PW Department UOC.
- Meet with the IMT Command and General Staffs as they arrive.
- Manage initial response activities.
- Conduct Initial Assessment.
- Develop an initial plan of action.
- Prepare for the incident brief with Command and General Staffs.

ATTEND PLANNING MEETING
- Meet with Command and General Staffs.
- Review planned actions.
- Finalize information in the IAP.
- Obtain approval of the IAP from the Command and General Staff.

OPS BRIEFING PREPARATION
- Ensure that time is set aside to complete all IAP documentation.
- Ensure final approval of the IAP.
- Prepare duplicate IAPs for dissemination.

ATTEND OPS BRIEFING
- Provide operations briefing to all personnel for each response area.
- Ensure that Operations is afforded all necessary support to execute the IAP.
- Deploy next operating period resources.

[1] Adapted from the United States Coast Guard Incident Management Handbook, August 2006.

Safety Officer Position Guide

Position Description

The Safety Officer's primary responsibility is to oversee worker health and safety for activities associated with any relevant response activities. While all field responders are responsible for operating safely, the Safety Officer monitors overarching hazards and changing conditions, such as weather, to modify safety practices as needed and provide appropriate equipment.

Response Actions

RESPONSE ACTIONS – INITIAL RESPONSE	✓
Report to the PW Department UOC or Incident Command Post.	❑
Commence actions to ensure responder/worker safety.	❑
Support the Incident Brief. Receive current situation status, resources, incident potential, and safety conditions, and prepare initial Site Safety Plan (ICS-208).	❑

RESPONSE ACTIONS – SEQUENCE FOR EACH OPERATIONAL PERIOD	✓
Staff Briefing – Receive situation status briefing and discuss established overall goals, operational period objectives, priorities, assignments, etc. ❑ Prepare the Incident Action Plan Safety Analysis (ICS 215a). ❑ Ensure that the Medical Plan (ICS-206) is broadly communicated.	❑
Tactics Meeting – Develop response organization, operational assignments, and resources aligned with operational period objectives. Identify and resolve critical safety and security issues.	❑
Planning Meeting – Receive situation update, assist with approval/revision of plan, and obtain responsibilities/deadlines for open actions, tasks, and IAP assignments.	❑
Operations Briefing Preparation – Assist with Site Safety Plan and with IAP.	❑
Operations Briefing – Review IAP changes, receive Situation Briefing, and address safety and security issues.	❑
IAP Execution and Progress Assessment - Assist as needed.	❑

RESPONSE ACTIONS - GENERAL TASKS	WHEN
Ensure worker safety during all tasks associated with response activities.	Continually
Oversee contractor safety (if employed) and ensure compliance with city and county policies.	Continually
Ensure all applicable safety regulations are followed.	Continually
Ensure plans and policies are consistent across all sites and activities.	Continually
Ensure readiness of standby emergency and rescue equipment.	Continually
Ensure hazard communications materials are accessible and legible.	Continually
Ensure proper use and fit of personal protective equipment.	Routinely
Oversee personnel accountability systems.	Routinely
Monitor workers for exposure to safety or health hazardous conditions.	Routinely
Identify and correct occupational safety and health hazards.	As needed
Alter, suspend, evacuate, or terminate activities that may pose an imminent safety or health risk to workers.	As needed
Take action to mitigate/eliminate unsafe conditions, operations, or hazards.	As needed
Make notifications to local fire, rescue, and emergency management resources.	As needed
Arrange for standby rescue teams.	As needed

RESPONSE ACTIONS - GENERAL TASKS	WHEN
Provide training and safety/health information.	As needed
Perform assessment of engineering controls and personal protective equipment.	As needed
Document safe and unsafe acts, corrective actions taken on the scene, accidents/ injuries, best practices, ways to improve safety/future incidents.	As needed
Ensure prompt submittal of accident reports.	As needed
Review IAP for safety implications.	As needed
Exercise emergency authority to stop and prevent unsafe acts.	As needed
Prepare and/or maintain Site Safety and Health Plan (ICS-208).	As needed

RESPONSE ACTIONS – DEMOBILIZATION	✓
Assist in preparation of the Demobilization Form (ICS-221).	❑
Resume normal agency operations upon incident termination.	❑
Participate in the AAR/IP development process.	❑

Coordination with Others

COORDINATE W/OTHERS	WHEN	SAFETY OFFICER PROVIDES	SAFETY OFFICER OBTAINS
Incident Commander	Routinely	Health and safety guidance and situation updates	Feedback and guidance
Operations Staff	Routinely	Health and safety guidance and situation updates	Feedback and guidance
Command Staff	Routinely	Health and safety guidance and situation updates	Feedback and guidance
Fire, rescue, and emergency management resources	As needed	Notifications	Feedback, guidance, and response, if needed

Safety Officer – Planning P

ATTEND TACTICS MEETING
- Desired outcomes include response organization, operational assignments, and resources aligned with operational period objectives.
- Identify and resolve any critical safety issues.

TACTICS MEETING PREPARATION
NO PREP NECESSARY
- Incident Commander, Operations/Planning Sections prepare for Tactics Meeting.

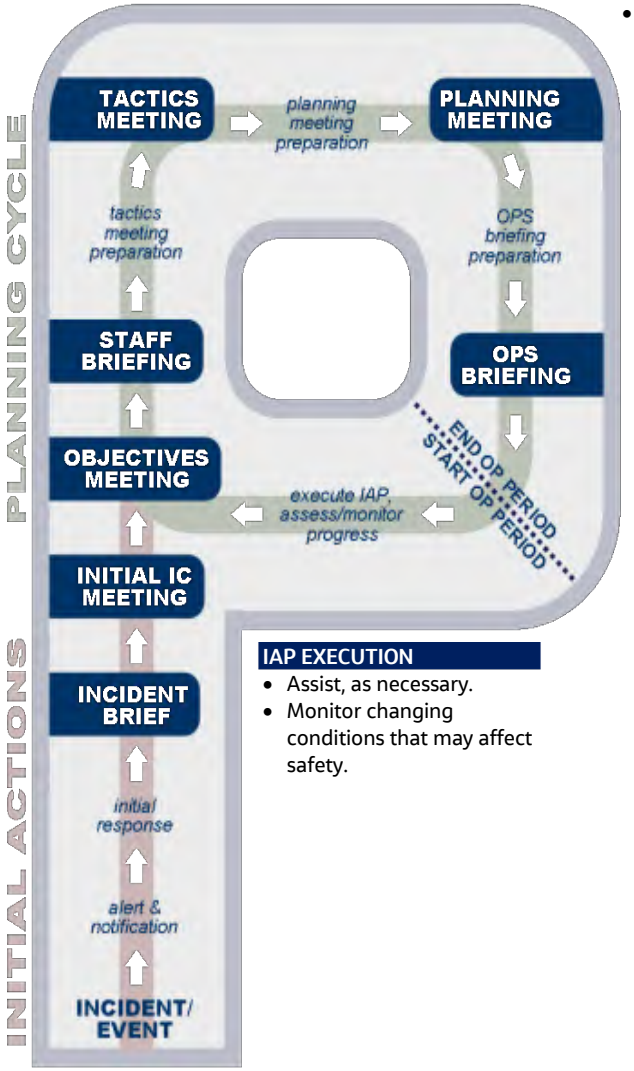
ATTEND STAFF BRIEFING
- Receive situation status briefing.
- Discuss established goals, operational period objectives, priorities, assignments, etc.
- Prepare ICS-203 and 204.

ATTEND OBJECTIVES MEETING IF INVITED
- Objects identified/ reviewed and prioritized for next operational period.

ATTEND INITIAL IC MEETING IF INVITED
- Response scope and priorities are established.
- Command/General Staff assigned.
- Safety and security matters are addressed.

ATTEND INCIDENT BRIEF
- Receive current situation status, resource assignments, resources en-route/ordered, facilities established, incident potential, etc.

PLANNING MEETING PREPARATION
- No action necessary unless requested.



INITIAL RESPONSE
- Report to PW Department UOC as requested.

IAP EXECUTION
- Assist, as necessary.
- Monitor changing conditions that may affect safety.

ATTEND PLANNING MEETING
- Receive situation update.
- Assist with approval/revision of plan.
- Obtain responsibilities and deadlines for open actions, tasks and IAP assignments.

OPS BRIEFING PREPARATION
- Assist with the Site Safety Plan(s) and IAP as necessary.

ATTEND OPS BRIEFING
- Review IAP changes.
- Receive Situation Briefing.
- Address safety and security issues.

Liaison Officer Position Guide

Position Description

The Liaison Officer coordinates with external response partners and serves as the Water System single point of contact for all entities (public, non-public, and private) not directly involved in response operations. The Liaison Officer is responsible for routing contacts from external organizations to the appropriate destination(s) within the utility.

Response Actions

RESPONSE ACTIONS – INITIAL RESPONSE	✓
Report to the PW Department UOC or Incident Command Post.	❑
Report to Incident Commander when ready to commence operations.	❑
Obtain initial briefing.	❑
Augment staff as needed to address existing needs; delegate staff responsibilities as appropriate.	❑
Ensure all required supplies and equipment are in place.	❑
Notify Planning Section of resources activated including names and locations of assigned personnel.	❑

RESPONSE ACTIONS – GENERAL TASKS	WHEN
Participate in meetings as requested (refer to the PIO Planning "P" job aid).	As needed
Receive, assess, route, and address contacts/communications from cooperating and/or assisting entities not directly involved in response.	As needed
Advise the Incident Commander on matters concerning external coordination.	As needed
Prepare and maintain a Unit Log (ICS-214) and/or General Message (ICS-213) as needed.	As needed
Respond to Incident Commander's strategic and tactical direction as needed.	As needed
Appoint deputies to ensure 24/7 coordination with all pertinent external entities as needed.	As needed
Maintain situational awareness with the Incident Commander.	Routinely

RESPONSE ACTIONS – DEMOBILIZATION	✓
Assist in preparation of the Demobilization Form (ICS-221).	❑
Receive, assess, route, and address contacts/communications from cooperating and/or assisting entities not directly involved in response.	❑
Release staff according to Demobilization Plan at termination of incident or on an ad hoc basis.	❑
Return to normal responsibilities upon incident termination.	❑
Participate in the AAR/IP development process.	❑

Coordination with Others

COORDINATE W/OTHERS	WHEN	LIAISON OFFICER PROVIDES	LIAISON OFFICER OBTAINS
Planning Section	Resources are in place	Notification of resources activated	Requests for resources
Operations Section(s)	As needed	Coordination support	Requests for resources
PIO	As needed	Message content	Outreach support
Incident Commander	Routinely	Situation updates	Situation status updates

Liaison Officer – Planning P

ATTEND TACTICS MEETING
- Desired outcomes include response organization, operational assignments, and resources aligned with operational period objectives.

TACTICS MEETING PREPARATION

NO PREP NECESSARY
- Incident Commander, Operations/Planning Sections prepare for Tactics Meeting.

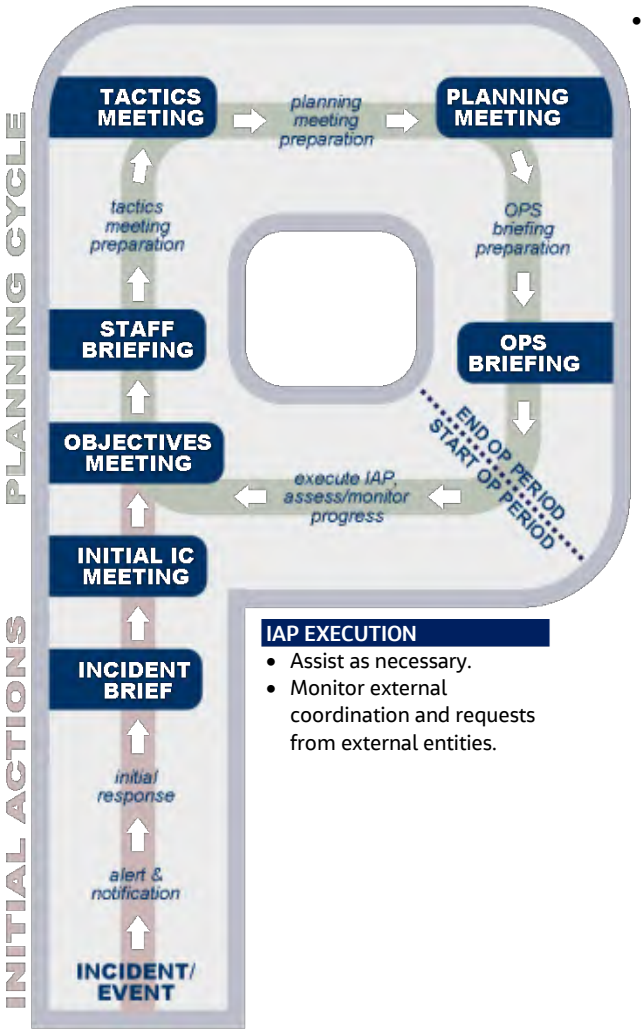
ATTEND STAFF BRIEFING
- Receive situation status briefing.
- Discuss established goals, operational period objectives, priorities, assignments, etc.

ATTEND OBJECTIVES MEETING IF INVITED
- Objects identified/ reviewed and prioritized for next operational period.

ATTEND INITIAL IC MEETING IF INVITED
- Response scope and priorities are established.
- Command/General Staff assigned.
- Resource ordering procedures agreed upon.

ATTEND INCIDENT BRIEF
- Receive current situation status, resource assignments, resources en-route/ordered, facilities established, incident potential, etc.

PLANNING MEETING PREPARATION
- No action necessary unless requested.



IAP EXECUTION
- Assist as necessary.
- Monitor external coordination and requests from external entities.

INITIAL RESPONSE
- Report to PW Department UOC as requested.

ATTEND PLANNING MEETING
- Receive situation update.
- Assist with approval/revision of plan.
- Obtain responsibilities and deadlines for open actions, tasks and IAP assignments.

OPS BRIEFING PREPARATION
- Assist with IAP as necessary.

ATTEND OPS BRIEFING
- Review IAP changes.
- Receive Situation Briefing.
- Provide update of external coordination and jurisdictional issues.

Public Information Officer Position Guide

Position Description

The PIO is responsible for generating and disseminating message content to the public during a contamination incident or event. If other local, county, or state agencies are activated to respond to an incident, the PIO may function independently and/or in conjunction with a JIC with other agency PIOs. Public communication requirements may include providing routine situation updates, responding to media inquiries, monitoring media content, and research to support public communications.

Response Actions

RESPONSE ACTIONS – INITIAL RESPONSE	✓
Report to the PW Department UOC or the Incident Command Post.	❑
Define processes to address these possible assignments: 1) media relations and monitoring, 2) research and writing, and 3) public Inquiries.	❑
If activated and assigned, work in the JIC with other PIOs to develop appropriate public messaging and support message dissemination.	❑
Coordinate messaging with the Incident Commander.	❑

RESPONSE ACTIONS – GENERAL TASKS	WHEN
Participate in meetings as requested (refer to the PIO Planning "P" job aid).	As needed
Request briefings regarding situation status; collect and verify third-party information from news channels, weather reports, etc.	As needed
Provide situation updates to the Command and General Staffs.	Routinely
Develop press releases, scripts, and other content for public consumption.	As needed
Assist in developing press releases as needed.	As needed
Address translation needs and communication with those with special needs.	As needed
Monitor the tone and content of news media coverage to suppress rumors and to identify and correct misinformation.	Ongoing
Coordinate water conservation campaign content as needed.	Ongoing
Maintain a Unit Log (ICS-214) and/or General Message (ICS-213) as needed.	Routinely

RESPONSE ACTIONS – DEMOBILIZATION	✓
Assist in preparation of the Demobilization Form (ICS-221).	❑
Return to responsibilities upon incident termination.	❑
Participate in the AAR/IP development process.	❑

Coordination with Others

COORDINATE W/OTHERS	WHEN	PIO PROVIDES	PIO OBTAINS
Command and General Staffs	As needed	Coordination Efforts	Coordination Efforts
JIC	As needed	Situation Updates	Message dissemination support; assistance with translating and communication with those with special needs
Incident Commander	As needed	Coordination of press release content	Coordination of press release content

Incident Commander and Operations	As needed	Information outlining what information may/may not be discussed with the media	Information outlining what information may/may not be discussed with the media

Public Information Officer – Planning P

ATTEND TACTICS MEETING
- Desired outcomes include response organization, operational assignments, and resources aligned with operational period objectives.

TACTICS MEETING PREPARATION
NO PREP NECESSARY
- Incident Commander, Operations/Planning Sections prepare for Tactics Meeting.

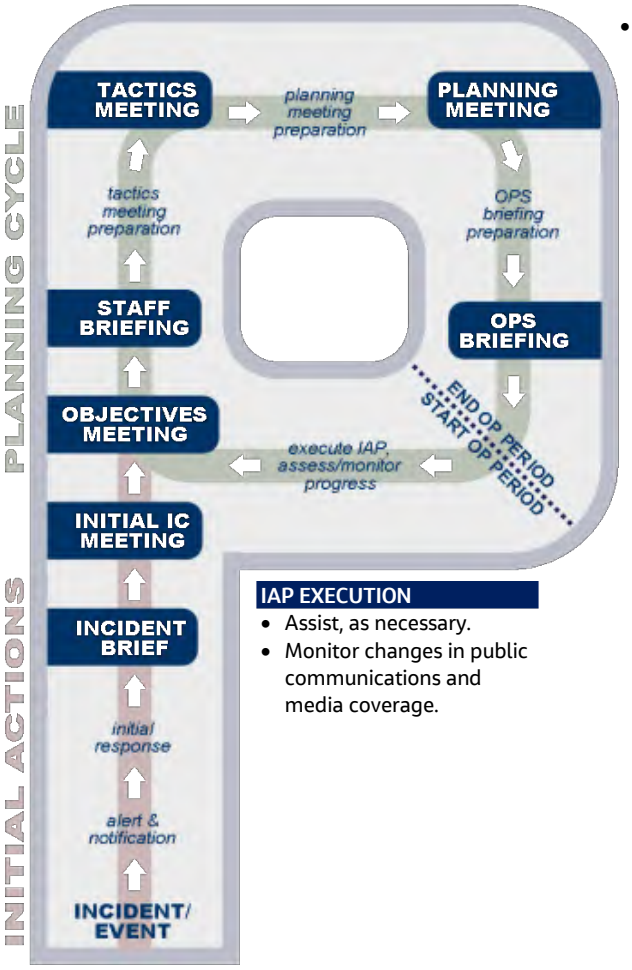
ATTEND STAFF BRIEFING
- Receive situation status briefing.
- Discuss established goals, operational period objectives, priorities, assignments, etc.

ATTEND OBJECTIVES MEETING IF INVITED
- Objects identified/reviewed and prioritized for next operational period.

ATTEND INITIAL IC MEETING IF INVITED
- Response scope and priorities are established.
- Command/General Staff assigned.
- Resource ordering procedures agreed upon.

ATTEND INCIDENT BRIEF
- Receive current situation status, resource assignments, resources en-route/ordered, facilities established, incident potential, etc.

PLANNING MEETING PREPARATION
- No action necessary unless requested.



IAP EXECUTION
- Assist, as necessary.
- Monitor changes in public communications and media coverage.

INITIAL RESPONSE
- Report to PW Department UOC as requested.

ATTEND PLANNING MEETING
- Receive situation update.
- Assist with approval/ revision of plan.
- Obtain responsibilities and deadlines for open actions, tasks and IAP assignments.

OPS BRIEFING PREPARATION
- Assist with IAP as necessary.

ATTEND OPS BRIEFING
- Review IAP changes.
- Receive Situation Briefing.
- Provide update of public communication and jurisdictional issues.

Operations Section Chief Position Guide

Position Description

The Operations Section Chief is responsible for operational activities associated with the response needs specific to the incident or event. The Operations Section Chief directs all field response activities and implements tactics to achieve incident objectives during each operational period.

Response Actions

RESPONSE ACTIONS – INITIAL RESPONSE	✓
Report to the PW Department UOC and/or Incident Command Post when ready to commence operations.	❑
Maintain situational awareness with Command and General Staffs, particularly in relation to conditions and status of operations in the field.	❑
Receive briefing(s) from the Incident Commander (initially) and/or the prior shift On-Scene Commander.	❑
Conduct detailed analyses of available alternatives and select preferred remediation actions in consultation with Command and General Staffs.	❑

RESPONSE ACTIONS – GENERAL TASKS	WHEN
Participate in and assist with various meetings to support situational awareness, resourcing, and mitigation of safety issues. Refer to Planning "P" job aid for more detailed information.	As needed
Assign specific tasks to operational units.	As needed
Anticipate and resolve resource and logistical requirements.	As needed
Work with the Incident Commander and Planning Section to prepare the Operational Planning Worksheet (ICS-215) outlining work assignments and resources.	Each operational period
Ensure that operational units have a copy of the IAP.	As needed
Support the Incident Commander in development of operational plans, reports, etc.	As needed
Complete the Unit Log (ICS 214) as needed.	Staff Briefing
Perform internal and external notifications as needed.	As needed
Recruit runners/assistants.	As needed
Conduct investigations at fixed facilities to estimate damages and response needs.	Ongoing

RESPONSE ACTIONS – DEMOBILIZATION	✓
Assist in preparation of the Demobilization Checklist (ICS-221).	❑
Return operations to normal upon incident termination.	❑
Participate in the AAR/IP development process.	❑

Coordination with Others

COORDINATE W/OTHERS	WHEN	OPERATIONS SECTION CHIEF PROVIDES	OPERATIONS SECTION CHIEF OBTAINS
Incident Commander	Routinely	Situation updates	Support and Information
Incident Commander and Planning Section	Each operational period Tactics Meeting	Preparation of ICS-215	Preparation of ICS-215
Logistics Section	Routinely	Situation Updates	Strategic Direction

Operations Section Chief – Planning P

ATTEND TACTICS MEETING
- Work with the Incident Commander to develop strategy and tactics for the next operational period.
- Provide guidance, clarification, and proposed objectives.

TACTICS MEETING PREPARATION
- Work with Planning Section for resource and status information.
- Discuss and document strategies, tactics, and contingencies.
- Ensure time to draft IAP.

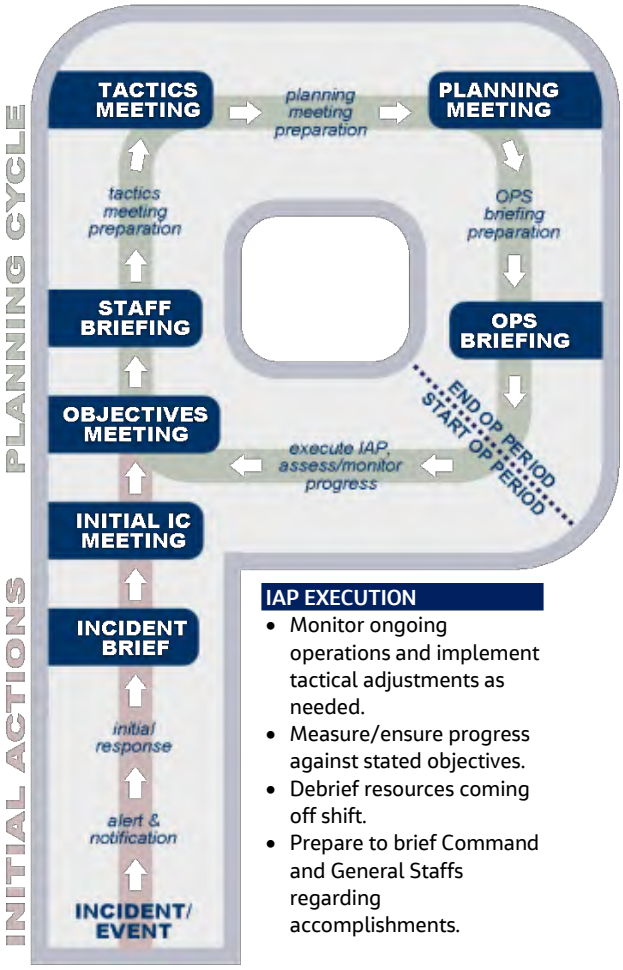
ATTEND STAFF BRIEFING
- Receive situation status briefing.
- Discuss established goals, operational period objectives, priorities, assignments, etc.

ATTEND OBJECTIVES MEETING IF INVITED
- Objects identified/ reviewed and prioritized for next operational period.

ATTEND INITIAL IC MEETING IF INVITED
- Response scope and priorities are established.
- Command/General Staffs assigned.
- Incident and support facilities are established.

ATTEND INCIDENT BRIEF
- Brief Command and General Staffs on initial response activities.
- Clarify any issues and concerns.
- Discuss planned operations and direction.

PLANNING MEETING PREPARATION
- Ensure a block of time is set aside for Command and General Staffs to prepare for the Planning Meeting (update charts, maps, Safety Plan, etc.).



IAP EXECUTION
- Monitor ongoing operations and implement tactical adjustments as needed.
- Measure/ensure progress against stated objectives.
- Debrief resources coming off shift.
- Prepare to brief Command and General Staffs regarding accomplishments.

INITIAL RESPONSE
- Report to the PW Department UOC.
- Meet with Command and General Staffs.
- Conduct initial assessment.
- Manage initial response activities.
- Develop plan of action.
- Prepare for command briefing.

ATTEND PLANNING MEETING
- Meet with Command General Staffs.
- Review planned actions.
- Finalize information to populate the IAP.
- Obtain approval for tactics in relation to planned actions.

OPS BRIEFING PREPARATION
- Ensure time is set aside to complete all documentation for inclusion in the IAP.
- Ensure Command and General Staffs approve the IAP.
- Ensure duplicate IAPs are distributed.

ATTEND OPS BRIEFING
- Provide a briefing to Operations personnel for each response area.
- Ensure necessary operational support is in place.
- Deploy next operating period resources.

Intelligence and Investigations Section Chief Position Guide

Position Description

The Intelligence and Investigations Section Chief is responsible to ensure that all intelligence and or investigations operations and activities are properly managed, coordinated and directed.

Response Actions

RESPONSE ACTIONS – INITIAL RESPONSE	✓
Report to the PW Department UOC and/or Incident Command Post when ready to commence operations.	❑
Maintain situational awareness with Command and General Staffs, particularly in relation to conditions and status of intelligence and investigation coordination with external agencies as needed	❑
Receive briefing(s) from the Incident Commander (initially) and/or the prior shift On-Scene Commander.	❑
Conduct detailed analyses of available alternatives and select preferred remediation actions in consultation with Command and General Staffs.	❑

RESPONSE ACTIONS – GENERAL TASKS	WHEN
Participate in and assist with various meetings to support situational awareness, resourcing, and mitigation of intelligence and investigations functions	As needed
Assign specific tasks to the Intelligence and Investigations staff	As needed
Prevent/Deter potential unlawful activity, incidents, or attacks	As needed
Collect, process, analyze, secure, and appropriately disseminate information and intelligence	As needed
Identify, document, process, collect, create a chain of custody for, safeguard, examine, analyze, and store probative evidence	As needed
Conduct a thorough and comprehensive investigation that leads to the identification, apprehension and prosecution of perpetrators working with external law enforcement agencies	As needed
Serve as a conduit at the direction of the Incident Commander to provide situational awareness pertaining to a Water System incident	As needed
Inform and support life safety operations, including the safety and security of all response personnel	Ongoing
Work with the Incident Commander and Planning Section to prepare the Operational Planning Worksheet (ICS-215) outlining work assignments and resources.	Each operational period
Ensure that operational units have a copy of the IAP.	As needed
Support the Incident Commander in development of operational plans, reports, etc.	As needed
Complete the Unit Log (ICS 214) as needed.	Staff Briefing
Perform internal and external notifications as needed.	As needed
Recruit runners/assistants.	As needed
Conduct investigations at fixed facilities to estimate damages and response needs.	Ongoing

RESPONSE ACTIONS – DEMOBILIZATION	✓
Assist in preparation of the Demobilization Checklist (ICS-221).	❑
Return operations to normal upon incident termination.	❑
Participate in the AAR/IP development process.	❑

Coordination with Others

COORDINATE W/OTHERS	WHEN	OPERATIONS SECTION CHIEF PROVIDES	OPERATIONS SECTION CHIEF OBTAINS
Incident Commander	Routinely	Situation updates	Support and Information
Incident Commander and Planning Section	Each operational period Tactics Meeting	Preparation of ICS-215	Preparation of ICS-215
Logistics Section	Routinely	Situation Updates	Strategic Direction

Intelligence and Investigations Section Chief – Planning P

ATTEND TACTICS MEETING
- Work with the Incident Commander to develop strategy and tactics for the next operational period.
- Provide guidance, clarification, and proposed objectives.

TACTICS MEETING PREPARATION
- Work with Planning Section for resource and status information.
- Discuss and document strategies, tactics, and contingencies.

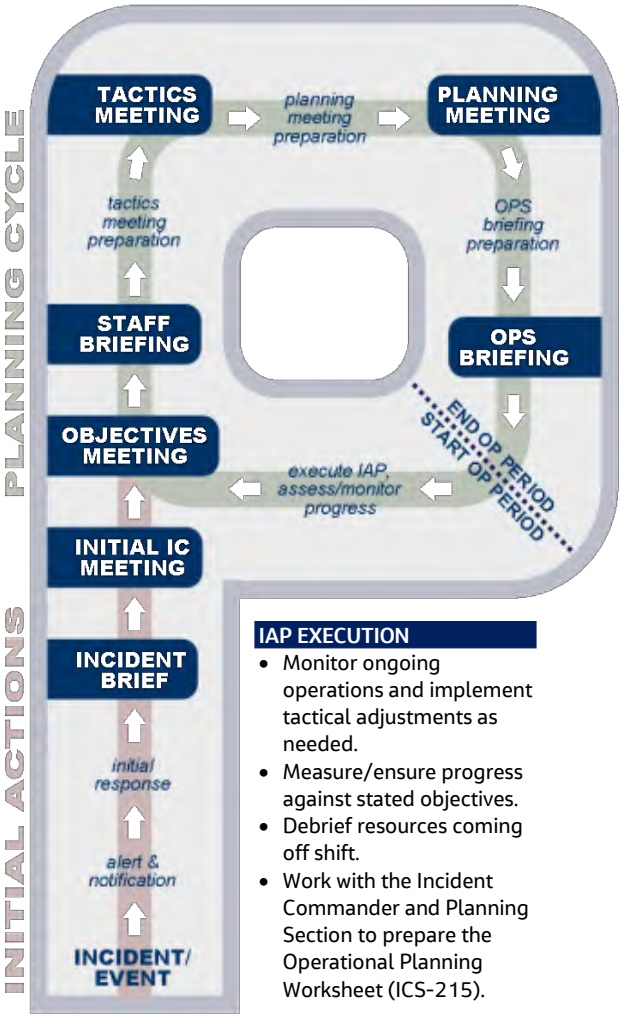
ATTEND STAFF BRIEFING
- Receive situation status briefing.
- Discuss affected assets and results of investigations.
- Complete Unit Log (ICS 214).

ATTEND OBJECTIVES MEETING IF INVITED
- Objects identified/reviewed and prioritized for next operational period.

ATTEND INITIAL IC MEETING IF INVITED
- Response scope and priorities are established.
- Command/General Staffs assigned.
- Incident and support facilities are established.

ATTEND INCIDENT BRIEF
- Brief Command and General Staffs on initial response activities.
- Clarify any issues and concerns.
- Discuss planned operations and direction.

PLANNING MEETING PREPARATION
- Ensure a block of time is set aside for Command and General Staffs to prepare for the Planning Meeting (update charts, maps, Safety Plan, etc.).



IAP EXECUTION
- Monitor ongoing operations and implement tactical adjustments as needed.
- Measure/ensure progress against stated objectives.
- Debrief resources coming off shift.
- Work with the Incident Commander and Planning Section to prepare the Operational Planning Worksheet (ICS-215).

INITIAL RESPONSE
- Report to the PW Department UOC as requested.
- Meet with Command and General Staffs.
- Conduct initial assessment of affected assets.
- Develop plan of action.
- Prepare for command briefing.

ATTEND PLANNING MEETING
- Meet with Command General Staff.
- Review planned actions.
- Finalize information to populate the IAP.
- Obtain approval for tactics in relation to planned actions.

OPS BRIEFING PREPARATION
- Ensure time is set aside to complete all documentation for inclusion in the IAP.
- Ensure Command and General Staffs approve the IAP.
- Ensure duplicate IAPs are distributed.

ATTEND OPS BRIEFING
- Provide a briefing to Operations personnel for each response area.
- Ensure necessary operational support is in place.
- Deploy next operating period resources.
- Determine if incident is criminal or terrorism related.
- If so, adjust operational decisions accordingly.
- Maximize efforts to prevent additional terrorism and other criminal activity.
- Protect evidence and crime scene (if applicable).

Planning Section Chief Position Guide

Position Description

The Planning Section Chief coordinates all planning activities including conducting meetings and assimilation of data to develop the IAP. Incident planning occurs on a cyclical pattern (as depicted in the Planning "P") and repeats during each operational period. The primary output of operational planning is the IAP. Planning information may also be disseminated via briefings, reports, maps and status boards, and other means.

Response Actions

RESPONSE ACTIONS – INITIAL RESPONSE	✓
Report to the PW Department UOC or Incident Command Post.	❑
Receive an incident status briefing	❑
Activate Planning Section personnel as needed. Organize and brief subordinates. Develop a planning organization, assign work locations, and assign preliminary work tasks to personnel.	❑
Acquire work materials and ensure the workspace is ready for Planning Section operations.	❑
Incident Brief ❑ Facilitate the Incident Brief that describes the current incident status. ❑ Assist the Incident Commander in preparing the Incident Briefing (ICS-201).	❑
Initial IC Meeting ❑ Set up the meeting room. ❑ Facilitate the Initial IC meeting. ❑ Provide a recorder to document the meeting.	❑

RESPONSE ACTIONS – SEQUENCE FOR EACH OPERATIONAL PERIOD	✓
Objectives Meeting ❑ Facilitate the Objectives Meeting. ❑ Provide a recorder to document decisions. ❑ Distribute and post decisions. ❑ Prepare Incident Objectives (ICS-202).	❑
Staff Briefing ❑ Facilitate the meeting. ❑ Provide a Situation Briefing. ❑ Receive work tasks and assignments. ❑ Resolve conflicts and clarify roles and responsibilities. ❑ Prepare ICS-203 and ICS-204 forms.	❑
Tactics Meeting Preparation ❑ Meet with Incident Commander to determine strategies, tactics, and resource requirements. ❑ Notify meeting participants of the scheduled meeting. ❑ Set up the meeting room.	❑
Tactics Meeting ❑ Facilitate the meeting. ❑ Provide a Situation Briefing. ❑ Review proposed strategy, tactics, and resource requirements, and identify resource shortfalls. ❑ Ensure strategy and tactics comply with incident objectives. ❑ Mitigate logistics and safety issues (with assistance from the Safety Officer as needed). ❑ Prepare the Operational Planning Worksheet (ICS-215) in coordination with the Incident Commander and/or Operations Section Chief.	❑

RESPONSE ACTIONS – SEQUENCE FOR EACH OPERATIONAL PERIOD	✓
Planning Meeting Preparation ❑ Revise the ICS-215 form and make hard copies for attendees. ❑ Notify participants of meeting location and time. ❑ Set up the meeting room.	❑
Planning Meeting ❑ Facilitate the meeting. ❑ Provide a Situation Briefing. ❑ Confirm availability of resources. ❑ Verify support for proposed IAP. ❑ Document decisions and assigned actions.	❑
Operations Briefing Preparation ❑ Develop components of IAP. ❑ Review the completed IAP for correctness. ❑ Provide the IAP to Command Staff for review and approval. ❑ Make copies of the IAP for distribution.	❑
Operations Briefing ❑ Set up the briefing area. ❑ Facilitate the briefing and provide a Situation Briefing. ❑ Distribute copies of the IAP. ❑ Make adjustments to IAP as necessary.	❑
IAP Execution and Progress Assessment ❑ Monitor progress regarding IAP implementation. ❑ Measure/ensure progress against stated objectives. ❑ Maintain situation and resource status. ❑ Debrief resources coming off shift. ❑ Maintain interaction with Incident Commander and other Command staff as necessary.	❑

RESPONSE ACTIONS – GENERAL TASKS	WHEN
Ensure general welfare and safety of Planning Section personnel.	Continually
Establish an ICS planning cycle and process.	Each operational period
Provide input to and review the Communications Plan (ICS-205), Medical Plan (ICS-206), and Traffic Plan.	Each operational period
Oversee preparation of the IAP.	Each operational period
Ensure that the Check-in List (ICS-211) and Unit Logs (ICS-214) are prepared.	As needed
Estimate service and support requirements for planned and expected operations.	As needed
Provide the Incident Commander with response objective recommendations for the upcoming operational period.	As needed

RESPONSE ACTIONS – DEMOBILIZATION	✓
Prepare the Demobilization Checkout (ICS-221) with input from Command and General Staffs.	❑
Provide support as needed to coordinate information exchange to support accountability and cost recovery.	❑
Ensure ICS forms and operations records are completed and filed for future reference and inclusion in the After-Action Report.	❑
Return to normal responsibilities upon incident termination.	❑
Participate in the AAR/IP development process.	❑

Coordination with Others

COORDINATE W/OTHERS	WHEN	PLANNING SECTION CHIEF PROVIDES	PLANNING SECTION CHIEF OBTAINS
Operations	As needed	Direct response characterization	Support
Operations and the Incident Commander	As needed	Evaluate risk reduction in immediate operational response actions; establish preliminary and final remediation goals	Guidance
Incident Commander	As needed	Response objective recommendations for the upcoming operational period	Guidance
Operations, Logistics, and Finance/ Administration Sections	As needed		Operational information to develop common operating picture

Planning Section Chief – Planning P

ATTEND TACTICS MEETING
- Facilitate Tactics Meeting.
- Provide Situation Briefing.
- Review proposed strategy, tactics & resource requirements.
- Identify resource shortfalls.
- Assure the strategy & tactics comply with incident objectives.

TACTICS MEETING PREPARATION
- Meet with Incident Commander to determine strategies, tactics & resource requirements.
- Notify meeting participants of scheduled meeting.

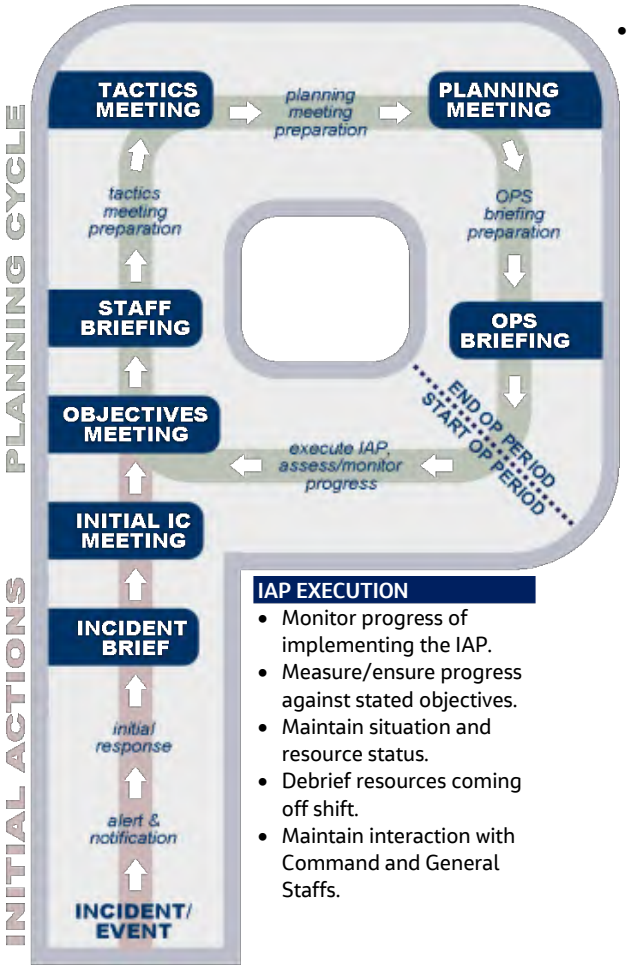
ATTEND STAFF BRIEFING
- Set up meeting room.
- Facilitate Staff Briefing.
- Provide Situation Briefing.
- Receive work tasks and assignments.
- Resolve conflicts and clarify roles/ responsibilities.

ATTEND OBJECTIVES MEETING
- Set up meeting room.
- Facilitate Objectives Meeting.
- Provide recorder to document decisions.
- Distribute and post decisions.

ATTEND INITIAL IC
- Set up meeting room.
- Facilitate initial IC Meeting.

ATTEND INCIDENT BRIEF
- Facilitate Incident Brief.

PLANNING MEETING PREPARATION
- Revise ICS-215; make hard copies for attendees.
- Notify participants of meeting location and time.
- Set up meeting room.



IAP EXECUTION
- Monitor progress of implementing the IAP.
- Measure/ensure progress against stated objectives.
- Maintain situation and resource status.
- Debrief resources coming off shift.
- Maintain interaction with Command and General Staffs.

INITIAL RESPONSE
- Report to PW Department UOC as requested.
- Receive situation status briefing.
- Activate Planning Section as needed.
- Organize and brief subordinates.
- Acquire work materials.

ATTEND PLANNING MEETING
- Facilitate Planning Meeting.
- Provide Situation Briefing.
- Confirm availability of resources.
- Verify support for the proposed plan.
- Document decisions and assigned actions.

OPS BRIEFING PREPARATION
- Develop components of the IAP.
- Review completed IAP for correctness.
- Provide IAP to IC for review and approval.
- Make copies of IAP for distribution.

ATTEND OPS BRIEFING
- Facilitate Ops Briefing.
- Provide Situation Briefing.
- Distribute copies of IAP.
- Adjust IAP, if necessary.

Logistics Section Chief Position Guide

Position Description

The Logistics Section Chief is responsible for coordinating resource management activities and overseeing all activities from ordering through to demobilization. The Logistics Section Chief should be copied on all requests, orders, and disposition reports.

Response Actions

RESPONSE ACTIONS – INITIAL RESPONSE	✓
Report to the PW Department UOC or Incident Command Post.	❑
Develop logistics responsibilities and delegate as needed. Identify work locations across the Logistics Section. Logistics functions that may require personnel support include supply, distribution, facilities, ground support (transportation), communications, and food.	❑
Assemble and brief personnel on status of logistics needs and requests.	❑
Coordinate with Planning Section and Incident Commander to ascertain the number of personnel in need of food and lodging.	❑
Notify the Planning Section of the Logistics Section units activated, including names and locations of assigned personnel.	❑
Initiate coordination with Finance/Administration Section Chief to ensure coordination and visibility with regard to resource acquisition, usage, tracking, and disposition.	❑
Conduct a needs assessment to identify and prioritize unmet resource needs.	❑
For resources not on hand, consult with the Incident Commander to determine availability of funds and most appropriate, time sensitive, and cost-effective methods of procuring the resources.	❑

RESPONSE ACTIONS – SEQUENCE FOR EACH OPERATIONAL PERIOD	✓
Staff Briefing ❑ Receive situation status briefing. ❑ Discuss established goals, operational period objectives, priorities, assignments, etc. ❑ Assist in preparing ICS-203 and ICS-204.	❑
Tactics Meeting ❑ Receive current situation update. ❑ Participate and contribute logistics information as necessary. ❑ Identify and resolve major logistical issues. ❑ Determine tactics and control operations and the resources to be assigned. ❑ Verify support requirements.	❑
Planning Meeting Preparation ❑ Verify support requirements. ❑ Develop information regarding resource availability.	❑
Planning Meeting ❑ Receive situation update (including resources at risk). ❑ Assist with approval/revision of the IAP. ❑ Support Operations in making tactical resource assignments and determining Operations facilities and reporting locations. ❑ Develop resources, support, and overhead order with Planning Section. ❑ Assist with implementing the IAP once approved. ❑ Provide briefing regarding logistical support and resource ordering status. ❑ Obtain responsibilities and deadlines for open actions, tasks, and IAP assignments.	❑

RESPONSE ACTIONS – SEQUENCE FOR EACH OPERATIONAL PERIOD	✓
Operations Briefing Preparation ❑ Develop logistics information pertinent to the IAP. ❑ Verify resources ordered.	❑
Operations Briefing ❑ Review IAP changes. ❑ Receive Situation Briefing. ❑ Provide transport, communication, and supply update.	❑
IAP Execution and Progress Assessment ❑ Verify and maintain status of resources and resolve logistical problems.	❑

RESPONSE ACTIONS – GENERAL TASKS	WHEN
Ensure general welfare and safety of Logistics Section personnel.	Continually
Monitor status of resources currently in use.	Routinely
Receive resource requests and submit request for fulfillment.	As needed
Identify service and support requirements for planned and expected operations.	As needed
Coordinate, process, and track requests for additional resources via asset management system.	As needed
Advise IC on current service and support capabilities.	As needed
Assist in preparing the Check-in List (ICS-211).	As needed
Prepare a Unit Log (ICS-214).	As needed

RESPONSE ACTIONS – DEMOBILIZATION	✓
Assist in preparing the Demobilization Checkout (ICS-221).	❑
Demobilize or redeploy resources that are no longer needed. ❑ Return loaned and rented resources. ❑ Dispose of, sell, or warehouse excess resources. ❑ Document disposition. ❑ Conduct financial settlement with suppliers (in coordination with Finance/Administration Section). ❑ Send thank you notes to suppliers and donors.	❑
Receive Incident Demobilization Plan from Planning Section when incident is nearing termination.	❑
Recommend release of Unit resources in conformity with Incident Demobilization Plan.	❑
Collect resource tracking worksheets from participating business units upon incident termination.	❑
Present resource tracking worksheets to the Finance/Administration Section for accountability and cost recovery.	❑
Return to normal logistical activities.	❑
Participate in the AAR/IP development process.	❑

Coordination with Others

COORDINATE W/OTHERS	WHEN	LOGISTICS SECTION CHIEF PROVIDES	LOGISTICS SECTION CHIEF OBTAINS
Incident Commander	Routinely	Situation updates	Feedback
Planning Section and Incident Commander	After Logistics units are assigned	Number of personnel in need of food and lodging	Number of personnel in need of food and lodging
Planning Section	After Logistics units are assigned	Identification of logistics units activated (including names and locations)	Feedback and Guidance
Finance/Administration Section Chief	As needed	1. Coordination and visibility with regard to resource acquisition, usage, tracking, and disposition 2. Determination of fund availability and most appropriate, time sensitive, and cost-effective method of procuring resources	1. Coordination and visibility with regard to resource acquisition, usage, tracking, and disposition 2. Determination of fund availability and most appropriate, time sensitive, and cost-effective method of procuring resources

Logistics Section Chief – Planning P

ATTEND TACTICS MEETING
- Receive current situation update.
- Participate and contribute logistics information as necessary.
- Identify and resolve major logistical issues.
- Determine tactics and control operations and what resources will be assigned. Verify support requirements.

TACTICS MEETING PREPARATION
NO PREP NECESSARY
- Operations/Planning Sections prepare for Tactics Meeting.

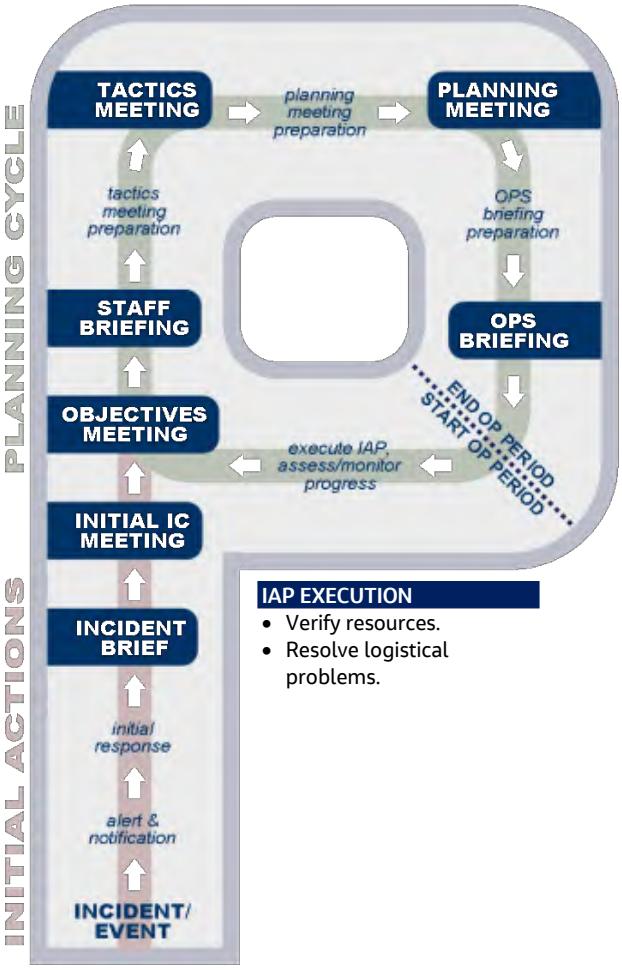
ATTEND STAFF BRIEFING
- Receive situation status briefing.
- Discuss established goals, operational period objectives, priorities, assignments, etc.

ATTEND OBJECTIVES MEETING IF INVITED
- Objects identified/ reviewed and prioritized for next operational period.

ATTEND INITIAL IC MEETING IF INVITED
- Response scope and priorities are established.
- Command/General Staff assigned.
- Resource ordering procedures agreed upon.

ATTEND INCIDENT BRIEF
- Order staff as needed if/when activated.
- Receive current situation status, resource assignments, resources en-route/ordered, facilities established, incident potential, etc.

PLANNING MEETING PREPARATION
- Verify support requirements.
- Know resource availability.



IAP EXECUTION
- Verify resources.
- Resolve logistical problems.

INITIAL RESPONSE
- Report to PW Department UOC as requested.

ATTEND PLANNING MEETING
- Receive situation update.
- Assist with approval/revision of plan.
- Support Operations in making tactical resource assignments and determining reporting locations.
- Obtain responsibilities and deadlines for open actions, tasks and IAP assignments.
- Support resource ordering with Planning Section.
- Assist with implementing plan once approved.
- Provide briefing on logistical support and resource ordering.
- Obtain deadlines for open actions, tasks and IAP.

OPS BRIEFING PREPARATION
PREP NECESSARY
- Provide logistical input to IAP.
- Verify resources ordered.

ATTEND OPS BRIEFING
- Review IAP changes.
- Receive Situation Briefing.
- Provide transport, communication, and supply update.

Finance/Administration Section Chief Position Guide

Position Descriptions

The Finance/Administration Section Chief provides financial management for all business units involved with the incident and works directly with the Logistics Section Chief Finance/Administration Section Chief to expedite and track procurement requests.

Response Actions

RESPONSE ACTIONS – INITIAL RESPONSE	✓
Report to the PW Department UOC or Incident Command Post.	❑
Work with Incident Commander to confirm need and scope of declared emergency.	❑
Support emergency procurement based on resource and logistics needs.	❑
Initiate an emergency procurement tracking system.	❑
Incident Brief ❑ Order staff as needed if/when activated ❑ Receive overview of current situation status, resource assignment, resources en-route/ordered, facilities established, incident potential, etc.	❑

RESPONSE ACTIONS – SEQUENCE FOR EACH OPERATIONAL PERIOD	✓
Staff Briefing ❑ Receive situation status briefing. ❑ Discuss established goals, operational period objectives, priorities, assignments, etc. ❑ Assist in preparing Assignment Lists (ICS Form-203 and 204).	❑
Planning Meeting Preparation ❑ Verify financial and administrative requirements.	❑
Planning Meeting ❑ Receive situation summary. ❑ Provide briefing on administrative and financial status/projections, etc. ❑ Assist with approval/revision of plan. ❑ Receive responsibilities/deadlines for open actions/tasks and IAP assignments. ❑ Assist with implementing plan once approved.	❑
Operations Briefing Preparation ❑ Verify financial and administrative requirements for IAP.	❑
Operations Briefing ❑ Review IAP changes. ❑ Receive Situation Briefing. ❑ Provide information on fiscal issues, time reporting, etc.	❑
IAP Execution and Progress Assessment ❑ Facilitate smooth administrative and financial reporting.	❑

RESPONSE ACTIONS – GENERAL TASKS	WHEN
Provide status report summarizing procurement requests and their statuses.	Upon request from Incident Commander or EOC Director
Develop feasibility studies.	As needed
Assist in preparing the Check-in List (ICS-211).	As needed
Prepare a Unit Log (ICS-214).	As needed

RESPONSE ACTION - DEMOBILIZATION	✓
Assist in preparing the Demobilization Checkout (ICS-221).	❑
Return to normal finance and administration responsibilities upon incident termination.	❑
Participate in the AAR/IP development process.	❑

Coordination with Others

COORDINATE W/OTHERS:	WHEN:	FINANCE AND ADMINISTRATION SECTION CHIEF PROVIDES:	FINANCE AND ADMINISTRATION SECTION CHIEF OBTAINS:
Incident Commander	Routinely	Situation updates	Support and Information
Logistics Section Chief (if activated separately)	As needed	Coordination of procurement requests	Coordination of procurement requests

Finance/Administration Section Chief – Planning P

ATTEND TACTICS MEETING
- Receive current situation update.
- Participate and contribute financial information as necessary; resolve major financial issues.
- Determine tactics and control operations and what resources will be assigned.
- Verify support requirements.

TACTICS MEETING PREPARATION
NO PREP NECESSARY
- Operations/Planning Sections prepare for Tactics Meeting.

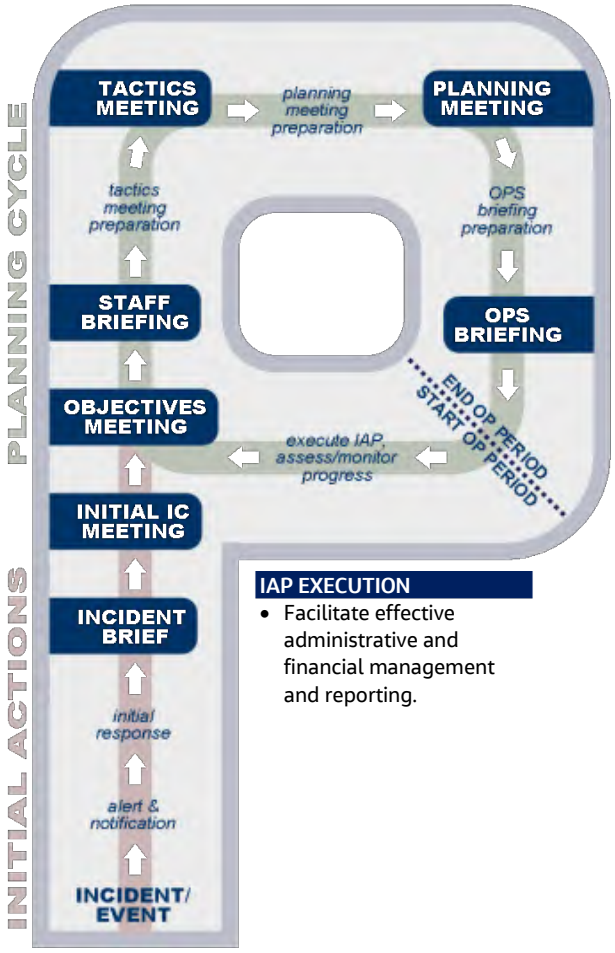
ATTEND STAFF BRIEFING
- Receive situation status briefing.
- Discuss established goals, operational period objectives, priorities, assignments, etc.

ATTEND OBJECTIVES MEETING IF INVITED
- Objects identified/ reviewed and prioritized for next operational period.

ATTEND INITIAL IC MEETING IF INVITED
- Response scope and priorities are established.
- Command/General Staff assigned.
- Cost-sharing procedures are agreed upon.

ATTEND INCIDENT BRIEF
- Order staff as needed if/when activated.
- Receive current situation status, resource assignments, resources en-route/ordered, facilities established, incident potential, etc.

PLANNING MEETING PREPARATION
- Verify financial and administrative requirements.



IAP EXECUTION
- Facilitate effective administrative and financial management and reporting.

INITIAL RESPONSE
- Report to PW Department UOC as requested.

ATTEND PLANNING MEETING
- Receive situation update.
- Provide briefing on administrative and financial status/projections.
- Assist with approval/revision of the IAP.
- Receive responsibilities and deadlines for open actions, tasks, and IAP assignments.
- Assist in implementing the IAP once approved.

OPS BRIEFING PREPARATION
PREP NECESSARY
- Verify administrative and financial requirements for the IAP.

ATTEND OPS BRIEFING
- Review IAP changes.
- Receive Situation Briefing.
- Provide information on fiscal issues, time reporting, and other administrative needs.

Appendix E
Equipment Lists

APPENDIX E – EQUIPMENT LISTS

NO.	CONTENTS
1	Emergency Field Equipment
2	Communications Equipment

Table E-2. Communications Equipment List

Division	Radios	Cell Phones
Water	(9) 800 (MegaHertz) MHz radios, (4) Ultra High Frequency (UHF) radios	3
Sewer	(4) UHF radios	6
Wastewater	(7) 800 MHz radios, (7) UHF radios	0
Streets	(1) 800 MHz radio, (4) UHF radios	3
Administration	None	8
Traffic	(13) 800 MHz radios, (36) UHF radios, (1) Very High Frequency (VHF) radio PW K Ops, (8) 800 MHz radios, (47) UHF radios	0

DEPARTMENT OF PUBLIC WORKS

HANSEN IMS v7 SYSTEM

Print Date: 5/20/2004

Emergency Response Plan

Vehicle & Equipment Availability List

Grouped by Vehicle/Equipment Type
Sorted by Vehicle/Equipment Type, Description, User/Customer, Budget #

UNIT ID	YEAR	MAKE / MODEL	DESCRIPTION	LICENSE	SERIAL/VIN #	USER/CUSTOMER	BUDGET #
1 TON DUMP BED							
211	1990	FORD / F250	DUMP BED TRUCK	08067D	2FTHF25HXLCB08084	PARKS	001-5422231
362	1993	FORD / F SUPER DUTY	DUMP BED TRUCK	28215D	2FDLF47MXPCA25918	PARKS	456-5425211
214A	1991	FORD / F250	DUMP BED TRUCK - RENTAL	09861D	1FTHF25H1MKA88448	FLEET	001-5422241
1 TON FLATBED							
355	1989	DODGE / D350	FLATBED TRUCK	08036D	1B6ME3657LS628254	TRAFFIC	111-5662222
1 TON SERVICE BODY							
3012	2003	FORD / F450XL	SERVICE TRUCK	36459D	1FDXX46S33ED42927	PARKS	001-5423251
227	1991	GMC / SIERRA	SERVICE TRUCK	12201D	1GDJC34K9ME537446	PARKS	001-5423251
229	1994	GMC / SIERRA	SERVICE TRUCK	15466D	1GDHK34K8RE561505	POST POINT	410-5632212
268	1993	CHEVROLET / C3500	SERVICE TRUCK	15419D	1GBHC34K1PE229134	POST POINT	420-5632222
3006	2001	FORD / F350	SERVICE TRUCK	33096D	1FDSF34LX1ED17233	TRAFFIC	111-5662222
224	1994	CHEVROLET / CC31003	SERVICE TRUCK	15467D	1GBGC34K8RE303129	TRAFFIC	111-5662222
230	1994	GMC / SIERRA	SERVICE TRUCK	15465D	1GDHK34K9RE560766	WATER	410-5634221
3011	2003	CHEVROLET / SILVERADO	SERVICE TRUCK			WATER	410-5634221
3003	2001	DODGE / 3500 RAM	SERVICE TRUCK	30400D	3B6MC36591M550703	WATER	410-5634221
3000	2001	DODGE / 3500 RAM	SERVICE TRUCK	30390D	3B6MC36541M550706	WATER	410-5634222
3004	2001	DODGE / 3500 RAM	SERVICE TRUCK	30399D	3B6MC36571M550702	WATER	410-5634222
3002	2001	DODGE / 3500 RAM	SERVICE TRUCK	30392D	3B6MC36501M550704	WATER	410-5634222
3001	2001	DODGE / 3500 RAM	SERVICE TRUCK	30396D	3B6MC36521M550705	WATER	410-5634222
1 TON SERVICE BODY W/HOIST							
349	1993	CHEVROLET / HD3500	SERVICE TRUCK	15429D	1GBKC34F6PJ108888	POST POINT	420-5632222

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1 TON SERVICE BODY W/HOIST							
353	1999	CHEVROLET / HD3500	SERVICE TRUCK	20252D	1GBKC34FOXO39845	TRAFFIC	111-5662211
1/2 TON 4 X 4 TRUCK							
2009	2002	CHEVROLET / K1500 SILVERADO	1/2 TON PICK-UP 4 X 4		1GCEK14T12Z267804	PARKS	456-5425211
2001	2001	GMC / SONOMA	1/2T TRUCK 4X4	30375D	1GTD19W618212250	ENGINEERING	111-5661311
2002	2001	GMC / SONOMA	1/2T TRUCK 4X4	30374D	1GTD19W118212415	ENGINEERING	111-5661311
2000	2001	GMC / SONOMA	1/2T TRUCK 4X4	30378D	1GTD19W718213861	ENGINEERING	111-5661311
279	2001	FORD / F150	1/2T TRUCK 4X4	30316D	1FTRW08W91KE04743	POST POINT	420-5632222
2008	2002	FORD / RANGER	1/2T TRUCK 4X4 EXT CAB	33658D	1FTYR45EX2PA82074	ENGINEERING	430-5667311
1/2 TON TRUCK							
2024	2004	CHEVROLET / COLORADO	1/2 TON EXT CAB PICKUP 4X2	36469D	1GCCS196448152486	SURFACE AND STORM WATER	430-5636211
2025	2004	CHEVROLET / COLORADO	1/2 TON EXT CAB PICKUP 4X2	36474D	1GCCS196248152857	SURFACE AND STORM WATER	430-5636211
2010	2002	GMC / SONOMA	1/2 TON PICK-UP EXT CAB 4 X 2	33652D	1GTCS19W428185792	WATER	410-5634222
2016	2003	CHEVROLET / S-10	1/2T TRUCK	36413D	1GCCS19X738203308	ENGINEERING	111-5661311
292	1992	FORD / RANGER	1/2T TRUCK	12274D	1FTCR14U3NPA75750	PARKING SERVICES	465-5524321
261	1989	CHEVROLET / S10	1/2T TRUCK	06502D	1GCBS14EOK2245550	PARKS	001-5421111
2004	2001	DODGE / DAKOTA	1/2T TRUCK	30384D	1B7GL22N51S280935	PARKS	001-5422211
291	1991	FORD / RANGER	1/2T TRUCK	09870D	1FTCR14U0MPA84159	PARKS	001-5422221
252	1991	TOYOTA / 8100	1/2T TRUCK	12233D	JT4RN81PXM5125597	PARKS	001-5422231
280	1995	FORD / RANGER	1/2T TRUCK	1548D	1FTCR14U7SPA82180	PARKS	001-5422241
2003	2001	DODGE / DAKOTA	1/2T TRUCK	30383D	1B7GL22N71S280936	PARKS	001-5423271
281	1995	FORD / RANGER	1/2T TRUCK	15484D	1FTCR10A0SPA73753	PARKS	001-5423281
282	1995	FORD / RANGER	1/2T TRUCK	15485D	1FTCR10A9SPA73752	PARKS	001-5423281
287	1991	TOYOTA / 8100	1/2T TRUCK	12228D	JT4RN81P2M5127411	PARKS	001-5423281
289	1991	TOYOTA / 8100	1/2T TRUCK	12229D	JT4RN81P9M5125851	PARKS	001-5423281
286	1991	TOYOTA / 8100	1/2T TRUCK	12232D	JT4RN81P4M5127538	PARKS	001-5423281
277	2000	GMC / SONOMA SLS	1/2T TRUCK	28217D	1GTCS19W6Y8176021	PARKS	001-5471111
272	1993	FORD / RANGER	1/2T TRUCK	15402D	1FTCR10X9PPB08849	POST POINT	420-5632221
273	1993	FORD / RANGER	1/2T TRUCK	15408D	1FTCR10X5PPB08850	POST POINT	420-5632222

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1/2 TON TRUCK							
212	1990	DODGE / D150	1/2T TRUCK	08063D	1B7GE16Y4LS768205	POST POINT	420-5632222
278	2000	GMC / SONOMA	1/2T TRUCK	30308D	1GTCS14W6YK227334	SOLID WASTE	440-5636241
270	1993	GMC / SONOMA	1/2T TRUCK	15409D	1GTCS19Z6PO524343	STREET	111-5636231
285	1991	FORD / RANGER	1/2T TRUCK	09871D	1FTCR14U9MTA33895	SURFACE AND STORM WATER	430-5636211
275	1993	DODGE / D250	1/2T TRUCK	14693D	1B7KE26Z9PS256034	TRAFFIC	111-5662221
2017	2003	CHEVROLET / S-10	1/2T TRUCK	36416D	1GCCS19X438214900	WATER	410-5634221
265A	1991	FORD / RANGER	1/2T TRUCK - RENTAL	09872D	1FTCR14U4MTA33898	FLEET	001-5253212
267A	1992	FORD / RANGER	1/2T TRUCK - RENTAL	12273D	1FTCR14X4NPA75749	FLEET	111-5644221
253	1986	TOYOTA / 8235	1/2T TRUCK - RENTAL	D28248	JT4RN55D3G0187357	PARKING SERVICES	465-5524312
246	1991	DODGE / D150	1/2T TRUCK - RENTAL	12223D	1BYHE16YOMS367546	PARKS	001-5422221
240	1991	DODGE / D150	1/2T TRUCK - RENTAL	12221D	1B7HE16YXMS338796	PARKS	001-5422241
231	1991	DODGE / D150	1/2T TRUCK - RENTAL	12218D	1B7HE16Y4MS338793	PARKS	001-5423281
2005	2001	GMC / SONOMA	1/2T TRUCK 4X2	30388D	1GTCS19W418227456	PARKS	001-5423281
2018	2003	CHEVROLET / S10	1/2T TRUCK 4X2	36434D	1GCCS19X938270850	PARKS	001-5423281
2011	2002	GMC / SONOMA	1/2TON PICK-UP EXT CAB 4 X 2	33653D	1GTCS19W528189138	FACILITIES	530-5646312
15 PASSENGER VAN							
408	1999	FORD / F350	PASSENGER VAN	28209D	1FBSS31LXXHC14829	PARKS	001-5431111
3/4 TON TRUCK							
208	1986	GMC / C2500	3/4 TON TRUCK - RENTAL	D33395	1GTEC24H4GJ520893	PARKS	001-5422241
2030	2004	FORD / F250XL	3/4 TON TRUCK EXT CAB	36486D	1FTNX20L54ED03873	PARKS	001-5422211
226	1994	CHEVROLET / C2500	3/4T TRUCK	14685D	1GCFC24K7RE311630	PARKS	001-5422211
255	1989	CHEVROLET / C2500	3/4T TRUCK	06297D	1GCFC24HOKE236294	PARKS	001-5422211
222	1991	CHEVROLET / CHEYENNE	3/4T TRUCK	09856D	1GCFC24K7ME185598	PARKS	001-5422231
244	1996	FORD / F250	3/4T TRUCK	20214D	2FTHF25H7TCA53479	PARKS	001-5423261
204	1996	FORD / F250	3/4T TRUCK	20213D	1FTHX25H2TEB17627	SEWER	420-5634231
210	1990	CHEVROLET / C2500	3/4T TRUCK	08069D	1GCFC24H5LZ260682	TRAFFIC	111-5662221
223	1992	DODGE / D250	3/4T TRUCK	14675D	1B7JE26ZXPS233468	WATER	410-5634221
209	1990	CHEVROLET / C2500	3/4T TRUCK	08070D	1GCFC24HOLZ254837	WATER	410-5634222

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3/4 TON TRUCK							
221A	1991	CHEVROLET / CHEYENNE 2500	3/4T TRUCK - RENTAL	09857D	1GCFC24KOME186222	FLEET	001-5422241
254	1989	CHEVROLET / C20	3/4T TRUCK - RENTAL	06296D	1GCFC24H3KE238721	TRAFFIC	111-5662222
6 PASSENGER VAN							
420	1990	DODGE / CARAVAN	PASSENGER VAN	08064D	2B4FK2533LR772650	DATA SERVICES	111-5644221
425	1998	FORD / WINDSTAR	PASSENGER VAN	20257D	2FMDA51U7WBB36206	PARKS	001-5431111
446	1993	GMC / SAFARI	PASSENGER VAN	14672D	1GKDM19Z6PB526021	TRAFFIC	111-5662311
448	1993	FORD / AEROSTAR	PASSENGER VAN	14671D	1FMCA11U4PZB10472	WATER	410-5634222
4006	2003	DODGE / CARAVAN	PASSENGER VAN	36420D	1D8GP24383B271876	WATER TREATMENT PLANT	410-5632211
406	1985	GMC / SAFARI	PASSENGER VAN - RENTAL	D22282	1G5DM15NXFB515625	FLEET	001-5723411
7 PASSENGER VAN							
4000	2001	DODGE / CARAVAN	PASSENGER VAN	30381D	2B8GP44381R337444	TRAFFIC	111-5662311
8 PASSENGER VAN							
423	1995	GMC / SAFARI	PASSENGER VAN	15497D	1GKDM19W1SB550922	ENGINEERING	430-5667311
AIR COMPRESSOR							
10-23	1987	SULLAIR / 185DPQ/87	AIR COMPRESSOR		004-93481-702281	SURFACE AND STORM WATER	430-5636211
1096	1995	SANBORN / 500A60/95	AIR COMPRESSOR		5145018	TRAFFIC	111-5662221
10-16	1983	SPEEDAIR / 32408D/83	AIR COMPRESSOR		02163H780285	TRAFFIC	111-5662221
11-87	1989	INGERSOL / 10CGT/89	AIR COMPRESSOR		30T660549	TRAFFIC	111-5662222
10-24	1987	SULLAIR / 185DPQ/87	AIR COMPRESSOR		004-93480-702282	WATER	410-5634222
BACK PACK BLOWER							
15-181	2004	SHINDAIWA / EB630	BACK PACK BLOWER		3097960	PARKS	001-5422211
15-155	2002	JOHN DEE / BR40	BACK PACK BLOWER		JT1510188	PARKS	001-5422211
15-110	1999	STIHL / BG75	BACK PACK BLOWER		41846486	PARKS	001-5422221
15-70		J DEERE / 5E/94	BACK PACK BLOWER		M0005EX128226	PARKS	001-5422231
15-121	1999	J DEERE / BP40	BACK PACK BLOWER		JT1760065	PARKS	001-5422231
15-105	1999	J DEERE / BP40	BACK PACK BLOWER		JT1500112	PARKS	001-5422231

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BACK PACK BLOWER							
15-159	2002	STIHL / BR 420C	BACK PACK BLOWER		254711649	PARKS	001-5422241
15-111	1999	J DEERE / BP40	BACK PACK BLOWER		JT1870350	PARKS	001-5423281
15-67	1994	J DEERE / 5E/94	BACK PACK BLOWER		128228	PARKS	001-5423281
15-137	2001	SHINDAIWA / EB630	BACK PACK BLOWER		0031562	PARKS	001-5423281
15-150	2001	SHINDAIWA / EB630	BACK PACK BLOWER		0031510	PARKS	001-5423281
17-51	1995	BP4500 / JDEERE/95	BACK PACK BLOWER		M045BPX011838	PARKS	001-5423281
15-136	2001	SHINDAIWA / EB630	BACK PACK BLOWER		0042184	PARKS	001-5423281
15-31	1994	ECHO / BP4600/94	BACK PACK BLOWER		052939	PARKS	456-5425211
15-123	2000	ECHO / BP-60HT	BACK PACK BLOWER		002869	STREET	111-5636231
15-133	2000	SHINDAIWA / EB 630	BACKPACK BLOWER		0031661	PARKS	001-5423281
15-132	2000	SHINDAIWA / EB 630	BACKPACK BLOWER			PARKS	001-5423281
BITUMAN APPLICATOR							
11-73	1998	CRAFCO / BAX250	BITUMAN APPLICATOR		9713X18	TRAFFIC	111-5662221
BRUSH CUTTER							
15-138	2001	SHINDAIWA / C-350	BRUSH CUTTER		9104300	PARKS	001-5422241
CABLE TRAILER							
10-51	2001		CABLE TRAILER		1M9DF1A551L160596	STREET	111-5662222
459		KOAT / 25	CABLE TRAILER		56364	TRAFFIC	111-5662221
CARGO MAXI PANEL							
401A	1997	FORD / HD E250	CARGO VAN	20237D	1FTFS24L4VHA53863	PARKS	001-5423261
CARGO MAXI WINDOW							
453	2001	CHEVROLET / EXPRESS	CARGO VAN	30355D	1GCGG29R611188994	WATER	410-5634221
449A	1993	GMC / VANDURA	CARGO VAN - RENTAL	15401D	1GTEG25K2PF518027	FLEET	001-5422221
CARGO MAXI WINDOW LIFTGATE							
4003	2003	FORD / ECONOLINE	CARGO VAN	36415D		PURCHASING	520-5642212

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CARGO MINI PANEL							
418	1991	FORD / AEROSTAR	CARGO VAN	12224D	1FTDA14U3MZB27876	POST POINT	420-5632222
409	1990	DODGE / CARAVAN	CARGO VAN	08062D	2B7FK1136LR757014	POST POINT	420-5632222
419	1991	FORD / AEROSTAR	CARGO VAN	12225D	1FTDA15U7MZB27877	POST POINT	420-5632223
CARGO MINI WINDOW							
4004	2003	DODGE / RAM	CARGO VAN	36412D	2D7HB11X33K513525	ENGINEERING	111-5661311
444	1991	FORD / AEROSTAR	CARGO VAN	12226D	1FTDA15U9MZB27878	TRAFFIC	111-5662111
407	1995	CHEVROLET / GIOCARGO	CARGO VAN	15498D	1GTDM19W4SB551039	TRAFFIC	111-5662221
4005	2003	DODGE / RAM 1500	CARGO VAN	36419D	2D7HB11X73K515682	WATER	410-5634221
413	1990	DODGE / CARAVAN	CARGO VAN	08060D	2B7FK1138LR757015	WATER TREATMENT PLANT	410-5632212
430	1986	CHEVROLET / ASTRO	CARGO VAN - RENTAL	D29665	1GCDM15Z3GB170757	PARKS	001-5431111
437	1989	FORD / AEROSTAR	CARGO VAN - RENTAL	06282D	1FMCA11U7KZC13023	PARKS	456-5425211
4001	2001	CHEVROLET / ASTRO	MINI CARGO VAN	30389D	1GCDM19W81B147532	GIS SERVICES	111-5644311
CHAIN SAW							
11-131	2001	SHINDAIWA / 360	CHAIN SAW		0071227	PARKS	001-5422221
11-103	1996	HUSQVARNA / 36	CHAIN SAW		96204H100784	PARKS	001-5422221
11-106	1999	HUSQVARNA / 335XPT	CHAIN SAW		991800940	PARKS	001-5422221
11-107	1999	HUSQVARNA / 261	CHAIN SAW		993100524	PARKS	001-5422221
11-102	1999	HUSQVARNA / 36	CHAIN SAW		96284H100235	PARKS	001-5422221
11-105	1999	HUSQVARNA / 394XP	CHAIN SAW		992800064	PARKS	001-5422221
11-82	1986	HUSQVARNA / R61/86	CHAIN SAW		6203563	PARKS	001-5422221
11-121	2000	SHINDAIWA / 357	CHAIN SAW			PARKS	001-5422221
11-100	1998	SHINDAIWA / 577-20	CHAIN SAW		6039251	PARKS	001-5422221
11-122	2000	SHINDAIWA / SHINDAIWA 360	CHAIN SAW		0050524	PARKS	001-5422221
11-61	1991	SHINDAIWA / 695/90	CHAIN SAW		7043460	PARKS	001-5423261
11-132	2001	SHINDAIWA / 488	CHAIN SAW		1025549	PARKS	
11-133	2001	HUSQVARNA / 335 XPT	CHAIN SAW		01-1400173	PARKS	
11-108	1999	SHINDAIWA / 757	CHAIN SAW		715582	STREET	111-5636231
11-12	1992	SHINDAIWA / 757/92	CHAIN SAW		200172	STREET	111-5636231

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CHAIN SAW							
11-98	1993	SHINDAIWA / 757/93	CHAIN SAW		303919	WATER	410-5634221
11-09	1990	SHINDAIWA / 695/90	CHAIN SAW		6042001	WATER	410-5634222
11-101	1996	/ BYONIC BLAYDE	GRADER/PLANER			PARKS	001-5422241
CHIPPER							
10-57	1993	VERMEER / 1250	CHIPPER	15431D	1VRC14136P1004150	PARKS	001-5422221
10-58	1989	PROMARK / 310	CHIPPER	06274D	0658	PARKS	001-5422221
COMBOPLANE							
15-05	1986	METRO/CO / MT/783HD/86	COMBOPLANE		1479	PARKS	001-5422211
15-116	1999	METROTUR / 526 HD	COMBOPLANE		3844	PARKS	001-5422211
15-15	1992	METROTUR / 784-3160/92	COMBOPLANE		2832	PARKS	001-5422241
COMPACT SEDAN							
172	2001	TOYOTA / PRIUS	HYBRID SEDAN	30333D	JT2BK12U910013249	ENVIROMENTAL RESOURCES	111-5628111
COMPACTOR							
11-30	1995	BOMAG / BT5E/95	COMPACTOR		101540032224	SEWER	420-5634232
11-128	2001	BOMAG / BT 65	COMPACTOR		101540442390	SEWER	420-5634232
11-40	1996	BOMAG / BT58/96	COMPACTOR		101540041919	SURFACE AND STORM WATER	430-5636211
11-119		BOMAG / BT65	COMPACTOR			WATER	410-5634222
11-43	1994	ST6018 / 3433/94	COMPACTOR		A40389	WATER	410-5634222
CONCRETE GRINDER							
11-77	1998	HONDA / VA 25 S	CONCRETE GRINDER		644-9709007	TRAFFIC	111-5662221
11-22	1994	VON ARX / 94	CONCRETE GRINDER		625566	TRAFFIC	111-5662222
CONCRETE MIXER							
11-13	1998	/ CM9HMIXER	CONCRETE MIXER		GC04-3635972	PARKS	001-5423261
CONCRETE SAW							
11-11	1988	CONCUT / 730D/88	CONCRETE SAW		880331	SEWER	420-5634232

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CONCRETE TRAILER							
10-40	1992	MIXERSYS / TR125/92	CONCRETE TRAILER		2511-92	WATER	410-5634222
CULITVATING DISK							
15-20	1988	BUSH HOG / 86	CULITVATING DISK		1100166	PARKS	001-5422211
15-43	1988	J DEERE / 569/88	FIELD CULTIVATOR DISK		DE3778	PARKS	001-5422211
DEMOLITION TOOL							
10-53			DEMOLITION TOOL		2968	SEWER	420-5634232
10-52	1975		DEMOLITION TOOL		2937	SURFACE AND STORM WATER	430-5636211
10-65		/ 77	DEMOLITION TOOL		14307	SURFACE AND STORM WATER	430-5636211
DRAG BROOM							
15-75	1994	GANDY / SWEEP M/94	DRAG BROOM			PARKS	001-5422211
DUAL AXLE DUMP 10 YD							
338	1993	INTERNATIONAL / 2674	10YD DUMP TRUCK	14665D	1HTGLBAT1PH488187	STREET	111-5636231
339	1993	INTERNATIONAL / 2674	10YD DUMP TRUCK	14660D	1HTGLBAT3PH488188	SURFACE AND STORM WATER	430-5636211
ELECTRIC PUMP							
11-05	1959		ELECTRIC PUMP			SEWER	420-5634232
EQUIPMENT TRAILER							
10-10	1972	HOMEMADE / 72	EQUIPMENT TRAILER		WN72727405	SEWER	420-5634232
10-43	1993	FERROTEK / 93	EQUIPMENT TRAILER		WA92158168	WATER	410-5634222
10-50	2000	INTERSTATE / 24TDA	EQUIPMENT TRAILER			WATER	410-5634222
EVACUATION FAN							
11-17	1986	CUES / 86	EVACUATION FAN, MOUNTED BLOWER		4103B	SEWER	420-5634232
FIXED MOTORS							
960		/ 74	STATIONARY ENGINE			POST POINT	420-5632222

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FLEET TOOLS							
16-53	1986	MILLER / DIALARC/86	ARC WELDER		JF913535	FLEET	
16-55	1987	NILFISK / GS82/87	ASBESTOS VACUUM SYSTEM		1772717/1823712	FLEET	510-5645311
16-66		SUN / VAT40/83	BATTERY ANALYZER		13C40537	FLEET	
16-37	1983	ASSOCIAT / 6002/83	BATTERY CHARGER		600212434	FLEET	
16-65	1992	SCHAUER / J512/92	BATTERY CHARGER			FLEET	
16-57	1989	BEAR / 42-210/89	BATTERY/CHARGING SYSTEM TESTER			FLEET	
16-10		YALE / 55	CHAIN BLOCK HOIST			FLEET	
16-12	1978	BEEBE / 78	CHAIN BLOCK HOIST			FLEET	
16-56	1988	JET / 88	CUT OFF SAW		1494	FLEET	
16-35	1979	OWATONNA / 1770A/79	DOLLY		2464	FLEET	
16-06	1968	DELTA / 57	DRILL AND STAND			FLEET	
11-37	1990	BEREMA / COBRA148/90	DRILL/BREAKER		BR1-168611	TRAFFIC	111-5662221
16-76			EXCIDE JUMPER CART			FLEET	
16-73			FUEL ISLAND			FLEET	510-5645311
16-61	1990	HONDA / EG3500/90	GENERATOR		EA64047668	FLEET	
16-54	1987	WALKER / 93660/87	HYDRAULIC JACK		E660P08293	FLEET	
16-46		BLACKHAW / 67610	HYDRAULIC PRESS			FLEET	
16-02	1968	BLACKHAW / 62	JACK			FLEET	
16-59	1990	BETTRENG / 200HD/90	JET WASHER			FLEET	
16-63	1991	HOBART / BETA/91	PORTABLE WELDER		91WS02348	FLEET	
16-52	1986	DYNABLAS / 4204/86	PRESSURE WASHER		812305-823	FLEET	510-5645311
16-39		BEEBE / LH300/83	ROUSTABOUT HOIST			FLEET	
16-38	1983	BLACK&DK / 83	SHOP VAC		1004	FLEET	
16-60	1990	MONORAIL / TEMPEST2/90	VACUUM		7241	FLEET	510-5645311
16-09	1968	AIRCO / OXYCOT/55	WELDING OUTFIT			FLEET	
16-58	1989	DOYLE / 75A/88	WET/DRY VACUUM		5019	FLEET	
FRONT MOUNTED BLOWER MOWER							
14-81		/ BW240JD2	BLOWER, FRONT MOUNTED		18846	PARKS	001-5422211
14-70		AGRI METAL / BW 240 JD	FRONT MOUNTED BLOWER		9539	PARKS	001-5422211

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FRONT MOUNTED BLOWER MOWER							
14-71		AGRI METAL / BW 240 JD	FRONT MOUNTED BLOWER		9853	PARKS	001-5422211
14-73		AGRI METAL / BW240JD	FRONT MOUNTED BLOWER		12010	PARKS	456-5425211
14-72		AGRI METAL / BW240J	FRONT MOUNTED BLOWER		11992	PARKS	456-5425211
FULLSIZE SEDAN PROGRAM PATROL							
054A	1997	FORD / CROWN VIC	PATROL SEDAN - RENTAL	20248D	2FALP71W2VX139274	FLEET	001-5826321
HAND HELD BLOWER							
15-53	1994	SHINDAIWA / EB240/94	HAND HELD BLOWER		4001717	PARKS	001-5422211
15-102		SHINDAIWA / EB240	HAND HELD BLOWER		7050691	PARKS	001-5422211
15-140	2001	SHINDAIWA / EB240	HAND HELD BLOWER		1011974	PARKS	001-5422221
15-180		MARUYAMA / BLL 2600	HAND HELD BLOWER		021104	PARKS	001-5422231
HYDRAULIC COMPRESSOR							
10-39	1990	STANLEY / HP18304/90	HYDRAULIC COMPRESSOR		2282	WATER	410-5634221
JACK HAMMER							
10-59			JACK HAMMER			WATER	410-5634222
10-61			JACK HAMMER		14307	WATER	410-5634222
10-60			JACK HAMMER		5264	WATER	410-5634222
11-96	1993	STANLEY / MB-675/93	JACKHAMMER		675373	WATER	410-5634222
JACK HAMMER ATTACHEMENT							
11-69	1997	J DEERE / 8B/97	BACKHOE ATTACHMENT-JACKHAMMER		M0008BX150546	PARKS	001-5422241
723C	1995	ALLIED / 740/95	HYDRAULIC IMPACT HAMMER		2612	SURFACE AND STORM WATER	430-5636211
723B	1995	ALLIED / 740/95	HYDRAULIC IMPACT HAMMER		2612	SURFACE AND STORM WATER	430-5636211
JET VACUUM							
603A	1993	VACTOR / 2112C/93	CATCH BASIN/SEWER CLEANER		44771216	SURFACE AND STORM WATER	430-5636211
611A	1992	GUZZLER / JETTER/93	SEWER JET JETTER			SEWER	420-5634231
LAWN CARE EQUIPMENT							

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LAWN CARE EQUIPMENT							
15-83	1996	/ EB240/96	HAND HELD BLOWER		6011133	FACILITIES	530-5646312
MIDSIZE SEDAN							
114	1997	CHEVROLET / MALIBU L	MIDSIZE SEDAN	20283D	1G1NE52M6V6123660	DATA SERVICES	111-5644111
8000	2001	CHEVROLET / MALIBU	MIDSIZE SEDAN	30372D	1G1ND52J51M615465	ENGINEERING	111-5661311
141	1991	DODGE / SPIRIT	MIDSIZE SEDAN	09868D	1B3XA46K6MF683368	ENGINEERING	111-5661311
129	1995	PONTIAC / GRAND AM	MIDSIZE SEDAN	15486D	1G2NE55D1SM619092	ENVIROMENTAL RESOURCES	111-5628211
106	1992	FORD / TAURUS	MIDSIZE SEDAN	12289D	1FACP50U7NG233774	PARKS	001-5421111
113	1995	FORD / TAURUS	MIDSIZE SEDAN	15476D	1FALP52U0SG276118	PARKS	001-5471111
140	1991	DODGE / SPIRIT	MIDSIZE SEDAN	12208D	1B3XA463XMF679235	SAFETY	111-5612112
115	1997	CHEVROLET / MALIBU LS	MIDSIZE SEDAN	20285D	1G1NE52MSV6158528	STREET	111-5636111
162	1990	PONTIAC / 6000LE	MIDSIZE SEDAN	08077D	1G2AF54T2L6235171	WATER	410-5634222
102A	1992	FORD / TAURUS	MIDSIZE SEDAN-RENTAL	12286D	1FACP50U0NG233776	WATER	410-5634311
163A	1993	DODGE / DYNASTY	SEDAN - RENTAL	14694D	1B3XC463XPD214870	FLEET	001-5423281
MISCELLANEOUS							
11-92	1992	VERSALIF / VST4001/92	AERIAL PERSONNEL LIFT		79985	TRAFFIC	111-5662221
11-56	1997		AUTO CRANE			WATER	410-5634221
11-94	1992	UNIC / UR503/92	CRANE		A504753	WATER	410-5634222
601	1990	CATERPILLAR / VC-60D/89	FORKLIFT		2MC01504	FLEET	510-5645311
602	1993	CATERPILLAR / VC60D/92	FORKLIFT		2MC02539	POST POINT	420-5632221
621	1997	CATERPILLAR / GC/97	FORKLIFT		2EM03867	PURCHASING	520-5642212
11-39	1993	/ 93	HOIST		230DW1092	FLEET	
11-33	1993	AUTOCRAN / ECONOTON/93	HOIST		370400300233	SEWER	420-5634232
11-91		AUTOCRAN / ECONTON2/90	HOIST		370400300135DW0990	STREET	111-5636231
11-32	1993	AUTOCRAN / ECONOTON/93	HOIST		370400300231	STREET	111-5636231
11-38	1993	AUTOCRAN / ECONOTON/93	HOIST		230DW1092	SURFACE AND STORM WATER	430-5636211
11-42		AUTOCRAN / ECONTON2/90	HOIST		370400300134DW0990	WATER	410-5634222
353A			MANLIFT			TRAFFIC	111-5662211
15-34	1984	HONDA / BF100ESA/84	OUTBOARD MOTOR		1600615	PARKS	001-5423261

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MISCELLANEOUS							
11-31	1994	UPRIGHT / UL-24DC/94	PERSONNEL LIFT		011974	FACILITIES	530-5646312
11-115	2000	/ HG3510	POWER UNIT		FWK00126RH	WATER	410-5634222
981	1974	AIRCO / 74	WELDER		HD700122	FLEET	
MOUNTED GENERATOR							
983	1993	CUMMINGS / 2-TA/93	MOUNTED GENERATOR			POST POINT	420-5632222
961		ONAN / 81	TRAILER MOUNTED GENERATOR		F80575985	POST POINT	420-5632222
PACK TANK							
12-33	1986		PACK TANK		S831047	PARKS	001-5422221
PAINT SPRAYER/STRIPER							
11-66	1998	GRACO / 197C	PAINT STRIPER		BAG153	TRAFFIC	111-5662221
PASSENGER CART							
528	1992	GRUMMAN / S-10	PASSENGER CART	12268D	1GBCS10A6N2910032	DATA SERVICES	111-5644221
PIPE SAW							
11-04	1996	STIHL / TS350/96	PIPE SAW		131923892	PARKS	001-5423251
11-99	1998	STIHL / T5350	PIPE SAW		38154543	SURFACE AND STORM WATER	430-5636211
11-70	1999	STIHL / TS400	PIPE SAW		143574843	WATER	410-5634221
11-46	1994	STIHL / TS350/94	PIPE SAW		129948499	WATER	410-5634221
11-60	1999	/ TS400	PIPE SAW		143574810	WATER	410-5634222
11-52	1996	STIHL / TS-350/96	PIPE SAW		134723397	WATER	410-5634222
11-127	2000	STIHL / TS 400-14	PIPE SAW		148592870	WATER	410-5634222
11-118	2000	/ TS400	PIPE SAW		144636888	WATER	410-5634222
PLATE COMPACTOR							
11-114	2000	/ AP 2000	PLATE COMPACTOR		1578201	WATER	410-5634222
PORTABLE GENERATOR							
11-21	1990	HONDA / EG3500X/90	PORTABLE GENERATOR		EA6-4036687	PARKS	001-5423261

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PORTABLE GENERATOR							
11-81	1985	1-82 / EM2200X/85	PORTABLE GENERATOR		GX1401355199	PARKS	001-5423281
11-80	1985	HONDA / EM2200X/85	PORTABLE GENERATOR		GX1401355194	SEWER	420-5634232
11-48	1988	/ 11-51/87	PORTABLE GENERATOR		GC041091581	TRAFFIC	111-5662221
11-34	1989	HONDA / EG3500X/89	PORTABLE GENERATOR		4035165	WATER	410-5634222
POST HOLE DIGGER							
11-86	1987	FORD / 905/87	POST HOLE DIGGER		YJH0802	PARKS	001-5423261
PRESSURE WASHER							
18-04		EXCEL / EXHP2630	PRESSURE WASHER		2152115263	PARKS	001-5422231
11-75	1994	MI T M / CW30043/94	PRESSURE WASHER		208464	PARKS	001-5423281
11-76	1995	MIT M / CW3004/95	PRESSURE WASHER		MI-T-M-CW3004-3MGH	PARKS	001-5423281
11-79		EXCEL / 6600-GAS/86	PRESSURE WASHER		12854623	POST POINT	420-5632221
PUSH BLOWER							
15-130	2000	HONDA / LITTLE WONDER HO	HONDA PUSH BLOWER		1000602316	PARKS	001-5423281
PUSHER/PULLER							
11-03	1993	POWERAM / 1825/93	HYD PIPE PUSHER/PULLER		93-96/91-18-13	WATER	410-5634222
SANDER							
11-25	1996	MONROE / 1.8 YD/95	SANDER		8PV3250	STREET	111-5636233
11-55A	2002	SWENSON / 4.5SAND/96	SANDER		101 1003 009	STREET	111-5636233
11-58	1993	SWENSON / EV100-13/92	SANDER		62490	STREET	111-5636233
11-55	1996	SWENSON / 4.5SAND/96	SANDER		101 1003 009	STREET	111-5636233
11-57	1993	SWENSON / EV100-13/92	SANDER		62382	STREET	111-5636233
SEWER RODDER							
10-11	1991	SRECO / RSR516TR/90	SEWER RODDER		L901817	SEWER	420-5634231
SIGN CLEANER							
11-85	1986	HIWAYHND / TM60-G/86	SIGN CLEANER		8611-027	TRAFFIC	111-5662222

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SINGLE AXLE DUMP 1 YD							
3010	2003	ISUZU / NQR DIESEL	1 YD DUMP TRUCK	36437D		STREET	111-5636231
301	1991	FORD / F350	1YD DUMP TRUCK	08080D	1FDKF37H1MKA31204	PARKS	001-5422211
341	1993	FORD / F SUPER DUTY	1YD DUMP TRUCK	14667D	2FDLF47M1PCA25922	SEWER	420-5634231
340	1993	FORD / F SUPER DUTY	1YD DUMP TRUCK	14668D	2FDLF47M3PCA25923	STREET	111-5636231
337	1990	ISUZU / NPRFL	1YD DUMP TRUCK	08073D	JALB4B1H3L7007418	STREET	111-5636231
342	1993	FORD / F SUPER DUTY	1YD DUMP TRUCK	14681D	2FDLF47M1PCA25919	SURFACE AND STORM WATER	430-5636211
302	1995		1YD DUMP TRUCK	15500D	1GDKC34FXSJ522286	WATER	410-5634221
344	1993	FORD / F SUPER DUTY	1YD DUMP TRUCK	14683D	2FDLF47M8PCA25920	WATER	410-5634222
336	1991	FORD / F SUPER DUTY	1YD DUMP TRUCK	08079D	2FDLF47GXMCA12253	WATER	410-5634222
SINGLE AXLE DUMP 2 YD							
3013	2003	FORD / F550 XL	2YD DUMP TRUCK	36463D	1FDAF57P63ED42929	SURFACE AND STORM WATER	430-5636211
3014	2003	FORD / F550 XL	2YD DUMP TRUCK	36462D	1FDAF57P23ED42930	SURFACE AND STORM WATER	430-5636211
SINGLE AXLE DUMP 5 YD							
326	1992	INTERNATIONAL / 4900	5YD DUMP TRUCK	26509D	1HTSDN2R9NH442499	PARKS	001-5422221
327	1992	INTERNATIONAL / 4900	5YD DUMP TRUCK	13321D	1HTSDN2R1NH442500	PARKS	001-5423261
329	1992	INTERNATIONAL / 4900	5YD DUMP TRUCK	13322D	1HTSDN2N4NH443105	SEWER	420-5634232
345	1993	FREIGHTLINER / FL70	5YD DUMP TRUCK	15426D	1FV6HLBB9RL585986	SEWER	420-5634232
330	1992	INTERNATIONAL / 4900	5YD DUMP TRUCK	13323D	1HTSDN2N2NH443104	STREET	111-5636231
331	1996	INTERNATIONAL / 4900	5YD DUMP TRUCK	20205D	1HTSDAAR1TH301708	SURFACE AND STORM WATER	430-5636211
332	1996	INTERNATIONAL / 4900	5YD DUMP TRUCK	20204D	1HTSDADR5TH301707	WATER	410-5634222
328	1992	INTERNATIONAL / 4900	5YD DUMP TRUCK	12292D	1HTSDN2N6NH443106	WATER	410-5634222
SINGLE AXLE DUMP BED							
322	1999	CHEVROLET / 3500HD	DUMP BED TRUCK	28212D	1GBKC34J7XF092725	PARKS	001-5422211
351	1993	INTERNATIONAL / 4600LP	DUMP BED TRUCK	15451D	1HTSBZRM6PH493971	PARKS	001-5422221
324	1996	ISUZU / ZFI	DUMP BED TRUCK	20232D	JALC4B1K2T7002954	PARKS	001-5423261
3009	2001	FORD / F450 XL	TILT BED TRUCK	30397D	1FDXF47S01ED87225	PARKS	001-5422241

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SINGLE AXLE FLATBED W/ HOIST							
360	1992	INTERNATIONAL / NAV 4900	FLATBED TRUCK	12269D	1HTSDPPN4NH429287	WATER	410-5634222
SINGLE AXLE MANLIFT							
3005	2001	FORD / F450 XL	MANLIFT TRUCK	33095D	1FDXF46F21ED17214	PARKS	001-5422221
SINGLE AXLE SERVICE BODY							
298	1993	CHEVROLET / C3500	SERVICE TRUCK	15428D	1GBHC34F1PE218685	FLEET	510-5645311
SINGLE AXLE SERVICE BODY HOIST							
370	1993	FORD / F SUPER DUTY	SERVICE TRUCK	14680D	2FDLF47M8PCA25917	SEWER	420-5634232
350	1992	INTERNATIONAL / NAV 4900	SERVICE TRUCK	12270D	1HTSDPPN6NH429288	TRAFFIC	111-5662221
SNOW PLOW BLADE							
12-54	1997	/ MPP41R11-ISCT	SNOW PLOW BLADE		97-09-2553	STREET	111-5636233
12-55	1997	/ MPP41R11-ISCT	SNOW PLOW BLADE		97-09-2551	STREET	111-5636233
12-56	1997	/ MPP41R11-ISCT	SNOW PLOW BLADE		97-09-2552	STREET	111-5636233
SPORT UTILITY VEHICLE							
2022	2004	JEEP / LIBERTY	SUV	36454D	1J4GK48K84W234079	DATA SERVICES	111-5644221
2019	2004	JEEP / LIBERTY	SUV	36457D	1J4GK48K54W219331	WATER	410-5634222
520A	1991	GMC / S15 JIMMY	SUV - RENTAL	09866D	1GKDT13Z0M2554503	FLEET	111-5644221
2023	2004	JEEP / LIBERTY	SUV 4X2	36468D	1J4GK48K94W249125	SEWER	420-5634232
SPRAY TANK TRAILER							
12-20	1984	REARS / 84	SPRAY TANK/TRAILER		L84-1208	PARKS	001-5422211
STATION WAGON							
166	1993	OLDSMOBILE / CUTLASS CIERA	STATION WAGON	14698D	1G3AJ85NXP6424927	WATER TREATMENT PLANT	410-5632213
STATIONARY GENERATOR							
972	1992	ONAN / 125DGEA	GENERATOR SET		L910439901	FLEET	
980		WINCO / 84	STATIONARY GENERATOR		27512-G84	POST POINT	420-5632222

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STATIONARY GENERATOR							
984		ONAN / 400DFEB	STATIONARY GENERATOR		A950566130	PUBLIC WORKS OPERATIONS	111-5612111
962		KOHLER / 275ROZ71	STATIONARY GENERATOR		174002	WATER TREATMENT PLANT	410-5632212
966		CUMMINGS / KTA19-G2/87	STATIONARY GENERATOR		73114681	WATER TREATMENT PLANT	410-5632212
964		MAGNATON / MARATHON/86	STATIONARY GENERATOR		RH3222280	WATER TREATMENT PLANT	410-5632212
963		ONAN / 125/84	STATIONARY GENERATOR		L830690733	WATER TREATMENT PLANT	410-5632212
970		CATERPILLAR / 74	STATIONARY GENERATOR ENGINE			POST POINT	420-5632222
965		CUMMINGS / 74	STATIONARY GENERATOR ENGINE			POST POINT	420-5632222
975		MARATHON / 74	STATIONARY GENERATOR ENGINE			POST POINT	420-5632222
973	1994	ONAN / 200DFAA/94	STATIONARY GENERATOR ENGINE		L930528158	WATER TREATMENT PLANT	410-5632212
STEP PANEL VAN							
451	1994	FORD / F SUPER DUTY	SCAN VAN	15469D	3FCLF59M4RJB09426	SEWER	420-5634232
SWEEPER							
610A	1989	TYMCO / 600/88	SWEEPER		8912SNK67922	STREET	111-5636234
607A		TYMCO / 600 BAH	TYMCO SWEEPER (AUX)		200006SNM61950-BAH	STREET	111-5636234
TILT BED TRAILER							
10-34	1997	/ CAR	TILT BED TRAILER		1M9CF6B77VL160131	PARKS	001-5422211
10-33	1988	FERROTEK / 88	TILT BED TRAILER		WA78120330	PARKS	001-5422211
10-37	1989	FERROTEK / 89	TILT BED TRAILER		WA86130146	PARKS	001-5422211
10-38	1989	FERROTEK / 89	TILT BED TRAILER		WA86130486	PARKS	001-5422231
10-32	1985	JACOBSEN / 15064110/85	TILT BED TRAILER		1XJJT0114FFH05808	PARKS	001-5422241
10-31	1992	BUTLER / LT1014/92	TILT BED TRAILER		1BUD16207N2009950	PARKS	001-5422241
TRACTOR BCKHOE/LDR ARTICULATED							
7003	2004	CASE / 580MT 4X4	BACKHOE/LOADER	36451D	JJG0312322	SURFACE AND STORM WATER	430-5636211
TRACTOR BCKHOE/LDR IMPLEMENT							
718	1996	JCB / 214	BACKHOE/LOADER		SLP214TCTE0447262	PARKS	001-5423261
7000	2001	CASE / 580M 4WD EXTENDAHOE	BACKHOE/LOADER	30380D	JJG0307516	PARKS	456-5425211

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TRACTOR BCKHOE/LDR IMPLEMENT							
714	1994	CASE / 580/94	BACKHOE/LOADER	15461D	JJG0185114	SEWER	420-5634232
726	1999	KUBOTA / B-21	BACKHOE/LOADER		52075	WATER	410-5634221
711	1992	CASE / 580SK/92	BACKHOE/LOADER		JJGO173602	WATER	410-5634222
715	1994	CASE / 580/94	BACKHOE/LOADER	15460D	JJG0185127	WATER	410-5634222
710	1992	CASE / 580SK/92	BACKHOE/LOADER		JJG0173597	WATER	410-5634222
TRACTOR EXCAVATOR IMPLEMENT							
723	1995	GRADALL / GW-394/95	EXCAVATOR		0138335	SURFACE AND STORM WATER	430-5636211
7002	2003	VOLVO / EC140B	TRACKHOE/EXCAVATOR		EC140V10809	WATER	410-5634222
TRACTOR EXCAVATOR TREK							
7001	2001	JOHN DEE / 35ZTS	MINI EXCAVATOR			PARKS	001-5422241
TRACTOR LOADER ARTICULATED							
7004	2000	VOLVO / L70D	EXCAVATOR	36450D	4145	STREET	111-5636231
725A	1978		LOADER		41K8276	SURFACE AND STORM WATER	430-5636212
TRACTOR LOADER IMPLEMENT							
720	1996	J DEERE / 5400	LOADER	20215D		PARKS	001-5422211
713	1999	J DEERE / 5410	LOADER		LV5410S243483	PARKS	001-5422211
706	1996	J DEERE / 1070/96	LOADER		W00440X006460	PARKS	001-5422231
716	1999	J DEERE / 4300	LOADER		LV4300H330105	PARKS	001-5422241
705	1992	J DEERE / 870/92	LOADER		M00870B104974	PARKS	001-5422241
727	1999	J DEERE / 4500	LOADER		LV4500P151435	PARKS	456-5425211
TRASH PUMP							
12-24	1996	HONDA / WD20X/96	2" CENTRIFUGAL TRASH PUMP		2535728	WATER	410-5634222
12-28	1976	HOMELITE / 76	TRASH PUMP		48402343	SEWER	420-5634232
11-35	1990	DEISAMER / DPL403SD/90	TRASH PUMP		81979 (ENGINE)	SEWER	420-5634232
12-23	1996	HONDA / WT20X/96	TRASH PUMP		3722179	WATER	410-5634222
11-123		HONDA / WMP20X	TRASH PUMP		60040445	WATER	410-5634222

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TRASH PUMP							
12-07		HONDA / WH15X TRASH PUMP	TRASH PUMP		3350460	WATER	410-5634222
UTILITY CART							
5001	2003		UTILITY CART			PARKS	001-5422231
5000	2001	CARRYALL / TURF II	UTILITY CART		93274D-O	PARKS	001-5422231
529	1999	PUG / CHETECH	UTILITY CART		159079064	PARKS	001-5422241
557	1993	CUSHMAN / EDESIG	UTILITY CART		642206	POST POINT	420-5632221
558	1993	CUSHMAN / EDESIG	UTILITY CART		642386	POST POINT	420-5632221
559	1993	CUSHMAN / TITAN	UTILITY CART		93005087	POST POINT	420-5632222
UTILITY SEWER JET							
611	1992	INTERNATIONAL / NAV 4900	SEWER JET TRUCK	14666D	J2167J6515SHYDB93	SEWER	420-5634231
UTILITY SWEEPER							
6001	2003	TENNANT / 6650 XP	SWEEPER			PARKING SERVICES	465-5524311
607	2000	TYMCO / 600BAH	SWEEPER TRUCK	30323D	1FVAB3BV71HF84545	STREET	111-5636234
606	1995	SCHWARZE / AAPLEX	SWEEPER TRUCK	20202D	1FDXH81E1TVA10703	STREET	111-5636234
UTILITY TRAILER							
10-28		HOMEMADE / 76	UTILITY TRAILER		WA86130476	POST POINT	420-5632222
10-48	2000		UTILITY TRAILER		IM9CF3B54YL160220	STREET	111-5636231
10-18	1984	CALKINS / 83	UTILITY TRAILER		1CXBB1618DSBA2613	SURFACE AND STORM WATER	430-5636211
10-46	1999	SPECTRE / CUSTOM	UTILITY TRAILER		4W84F2224X1001379	WATER	410-5634221
10-27	1991	CORNEHL / 91	UTILITY TRAILER		GCT001393	WATER	410-5634222
10-26	1991	CORNEHL / 91	UTILITY TRAILER		001388	WATER	410-5634222
10-47	1999		UTILITY TRAILER		1M9CF2B52XL160063	WATER	410-5634222
UTILITY VACTOR							
603	1993	INTERNATIONAL / 8100	VACTOR	14677D	1HTHCA7TOPH484380	SURFACE AND STORM WATER	430-5636211
VACUUM SWEEPER							

Emergency Response Plan
Vehicle & Equipment Availability List

Grouped by Vehicle/Equipment Type
Sorted by Vehicle/Equipment Type, Description, User/Customer, Budget #

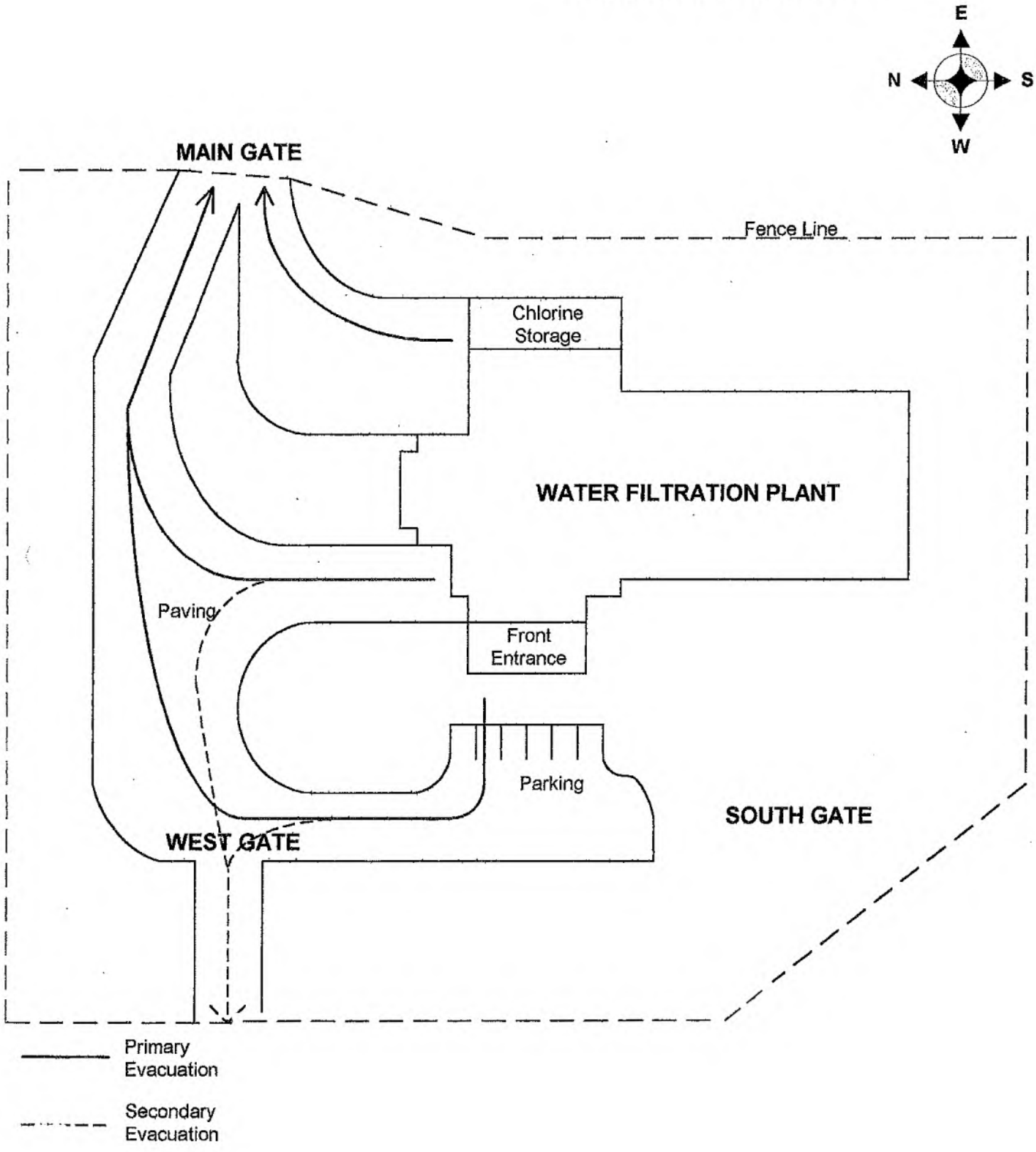
UNIT ID	YEAR	MAKE / MODEL	DESCRIPTION	LICENSE	SERIAL/VIN #	USER/CUSTOMER	BUDGET #
VACUUM SWEEPER							
15-97	1990	J DEERE / 152/90	VACUUM SWEEPER		E00152G828864	PARKS	001-5422211
15-73	1986	PARKER / PV8608K/86	VACUUM SWEEPER		096091	PARKS	001-5422231
15-179	2003	PARKER / PV00110BF	VACUUM SWEEPER		XP0110B0905	PARKS	001-5422231
WATER PUMP							
11-06	1992	HONDA / WH20X/92	WATER PUMP		WH20-3034467	DATA SERVICES	111-5644221
12-04	1991	HONDA / WT30X/91	WATER PUMP		1007304	POST POINT	420-5632221
12-05	1991	HONDA / WB30X/91	WATER PUMP		2669027	POST POINT	420-5632221
12-64	2004	HONDA / WB20X	WATER PUMP		WABT 1058981	SURFACE AND STORM WATER	430-5636211
12-65	2004	HONDA / WT30X	WATER PUMP		WABJ 1102244	SURFACE AND STORM WATER	430-5636211
12-63	2002	HONDA / WD 20X	WATER PUMP		GC01-3931149	WATER	410-5634221
11-51	1974	TRUETEST / 74	WATER PUMP		7620	WATER	410-5634222

Appendix F
Evacuation Maps

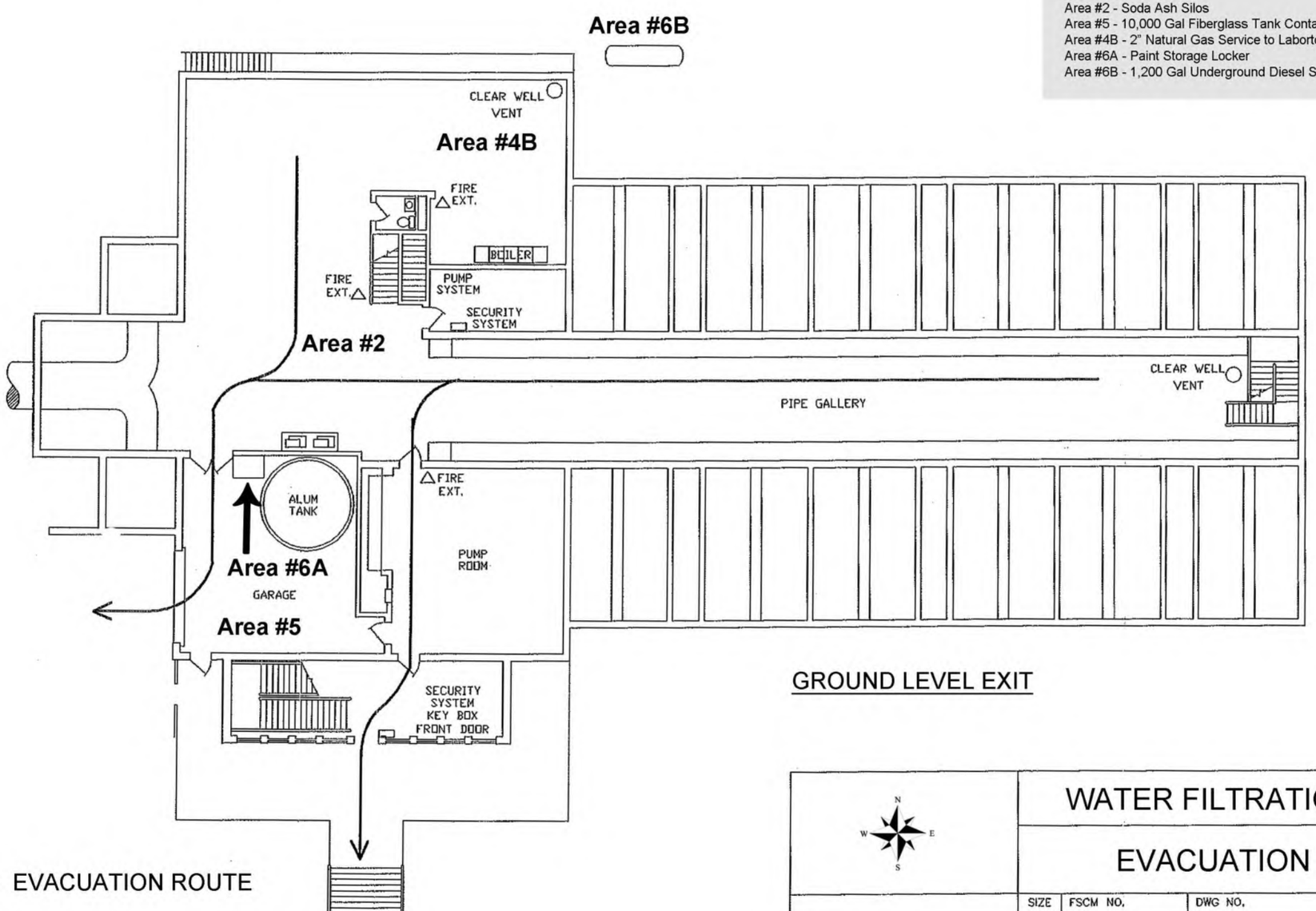
APPENDIX F – EVACUATION MAPS

NO.	CONTENTS
1	Water Filtration Plant Overall Evacuation Site Map
2	Water Filtration Plant Ground 2 Evacuation Map
3	Water Filtration Plant Up Stairs 2 Evacuation Map
4	Water Filtration Plant Ground 3 Evacuation Map
5	Water Filtration Plant Up Stairs 3 Evacuation Map

SITE MAP
EVACUATION ROUTES



LEGEND
Area #2 - Soda Ash Silos
Area #5 - 10,000 Gal Fiberglass Tank Containing Aluminum Sulfate
Area #4B - 2" Natural Gas Service to Labortory Counter
Area #6A - Paint Storage Locker
Area #6B - 1,200 Gal Underground Diesel Storage Tank and Generator



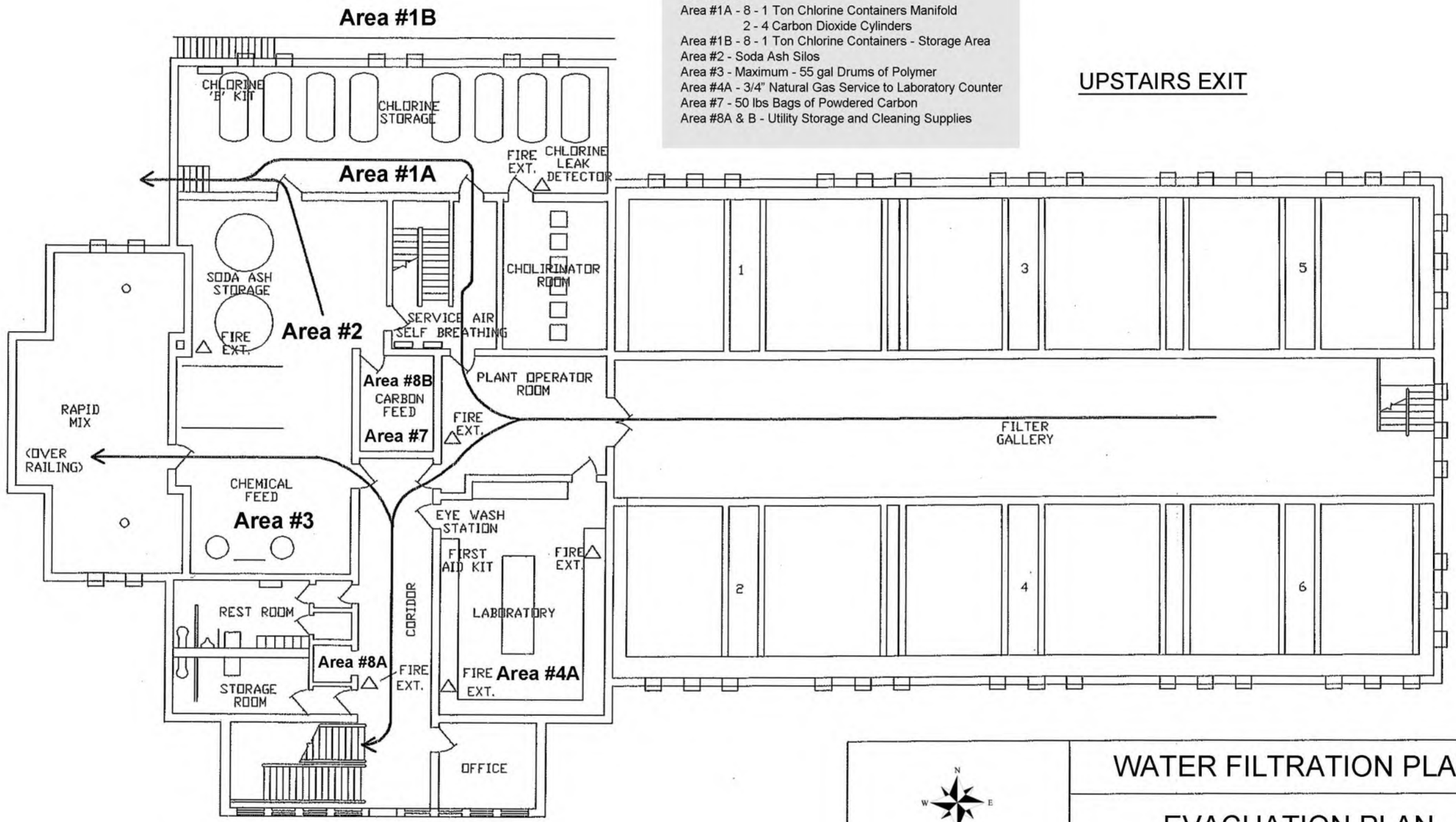
WATER FILTRATION PLANT

EVACUATION PLAN

SIZE	FSCM NO.	DWG NO.	REV
			A
SCALE		SHEET	

Last Revised: 4/11/2013

LEGEND
Area #1A - 8 - 1 Ton Chlorine Containers Manifold
2 - 4 Carbon Dioxide Cylinders
Area #1B - 8 - 1 Ton Chlorine Containers - Storage Area
Area #2 - Soda Ash Silos
Area #3 - Maximum - 55 gal Drums of Polymer
Area #4A - 3/4" Natural Gas Service to Laboratory Counter
Area #7 - 50 lbs Bags of Powdered Carbon
Area #8A & B - Utility Storage and Cleaning Supplies



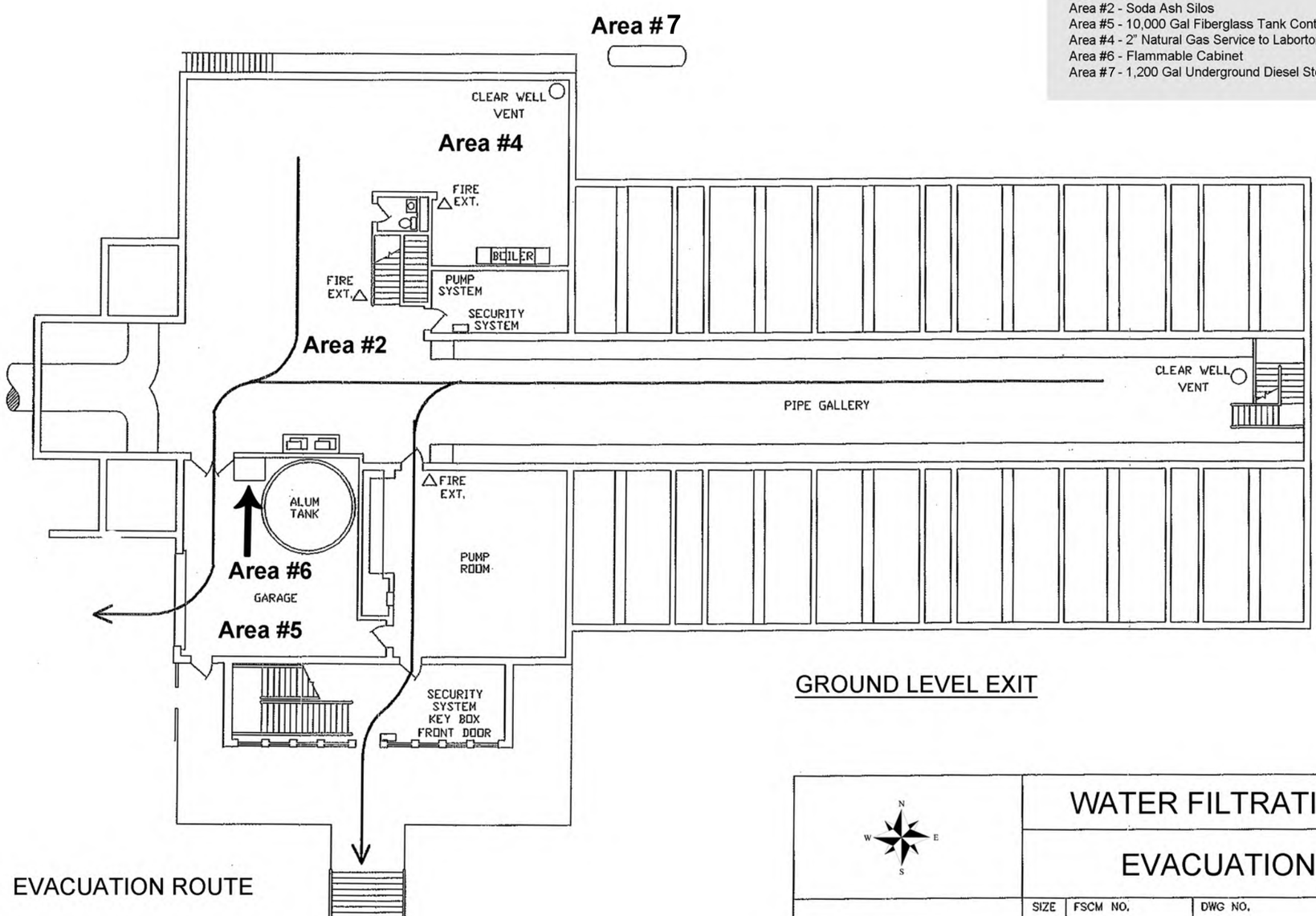
WATER FILTRATION PLANT

EVACUATION PLAN

SIZE	FSCM NO.	DWG NO.	REV
			A
SCALE			SHEET

Last Revised: 4/11/2013

LEGEND
Area #2 - Soda Ash Silos
Area #5 - 10,000 Gal Fiberglass Tank Containing Aluminum Sulfate
Area #4 - 2" Natural Gas Service to Labortory Counter
Area #6 - Flammable Cabinet
Area #7 - 1,200 Gal Underground Diesel Storage Tank and Generator



WATER FILTRATION PLANT

EVACUATION PLAN

SIZE	FSCM NO.	DWG NO.	REV
			A
SCALE			SHEET

Last Revised: 4/26/2016

LEGEND
Area #1A - 8 - 1 Ton Chlorine Containers Manifold
2 - 4 Carbon Dioxide Cylinders
Area #1B - 8 - 1 Ton Chlorine Containers - Storage Area
Area #2 - Soda Ash Silos
Area #3 - Maximum - 55 gal Drums of Polymer
Area #4 - 3/4" Natural Gas Service to Laboratory Counter
Area #8 & 9 - Utility Storage and Cleaning Supplies

UPSTAIRS EXIT

Area #1B
CHLORINE 'B' KIT
CHLORINE STORAGE
Area #1A
FIRE EXT.
CHLORINE LEAK DETECTOR
SODA ASH STORAGE
Area #2
FIRE EXT.
SERVICE AIR SELF BREATHING
CHOLIRINATOR ROOM
1
3
5
Area #8
CARBON FEED
PLANT OPERATOR ROOM
FIRE EXT.
FILTER GALLERY
RAPID MIX
(OVER RAILING)
CHEMICAL FEED
Area #3
EYE WASH STATION
FIRST AID KIT
FIRE EXT.
2
4
6
CORIDOR
LABORATORY
REST ROOM
Area #9
FIRE EXT.
FIRE EXT.
Area #4
STORAGE ROOM
OFFICE

EVACUATION ROUTE

WATER FILTRATION PLANT

EVACUATION PLAN

SIZE	FSCM NO.	DWG NO.	REV
			A
SCALE			SHEET

Last Revised: 4/26/2016

Appendix G
Incident Command System Forms

APPENDIX G. FEMA INCIDENT COMMAND SYSTEM FORMS

NO.	CONTENTS
ICS-201	Incident Briefing
ICS-202	Incident Objectives
ICS-203	Organization Assignment List
ICS-204	Assignment List
ICS-205	Incident Radio Communication Plan
ICS-206	Medical Plan
ICS-207	Incident Organization Chart
ICS-208	Safety Message/Plan
ICS-209	Incident Status Summary
ICS-210	Resource Status Change
ICS-211	Incident Check-in List
ICS-213	General Message
ICS-214	Activity Log
ICS-215	Operational Planning Worksheet
ICS-215A	Incident Action Plan Safety Analysis
ICS-218	Support Vehicle/Equipment Inventory
ICS-221	Demobilization Check-Out
DAT	Damage Assessment Team Form
WaterISAC	Tampering Threat & Incident Report - Water Quality Control Division

Unit Log

INCIDENT NAME:		DATE/TIME PREPARED:
Unit Name:	Unit Leader:	Operational Period:

Personnel Assigned		
Name	**ICS Position**	**Title**

TIME	MAJOR EVENTS

PREPARED BY (Name and Position):		Page 1 of 2
APPROVED BY (Name and Position):		

TIME	MAJOR EVENTS

INCIDENT BRIEFING (ICS 201)

1. Incident Name:	2. Incident Number:	3. Date/Time Initiated: Date: Time:

4. Map/Sketch (include sketch, showing the total area of operations, the incident site/area, impacted and threatened areas, overflight results, trajectories, impacted shorelines, or other graphics depicting situational status and resource assignment)**:**

5. Situation Summary and Health and Safety Briefing (for briefings or transfer of command)**:** Recognize potential incident Health and Safety Hazards and develop necessary measures (remove hazard, provide personal protective equipment, warn people of the hazard) to protect responders from those hazards.

6. Prepared by: Name: _____ Position/Title: _____ Signature: _____

Date/Time: _____

INCIDENT BRIEFING (ICS 201)

1. Incident Name:	2. Incident Number:	3. Date/Time Initiated: Date: Time:

7. Current and Planned Objectives:

8. Current and Planned Actions, Strategies, and Tactics:

Time:	Actions:

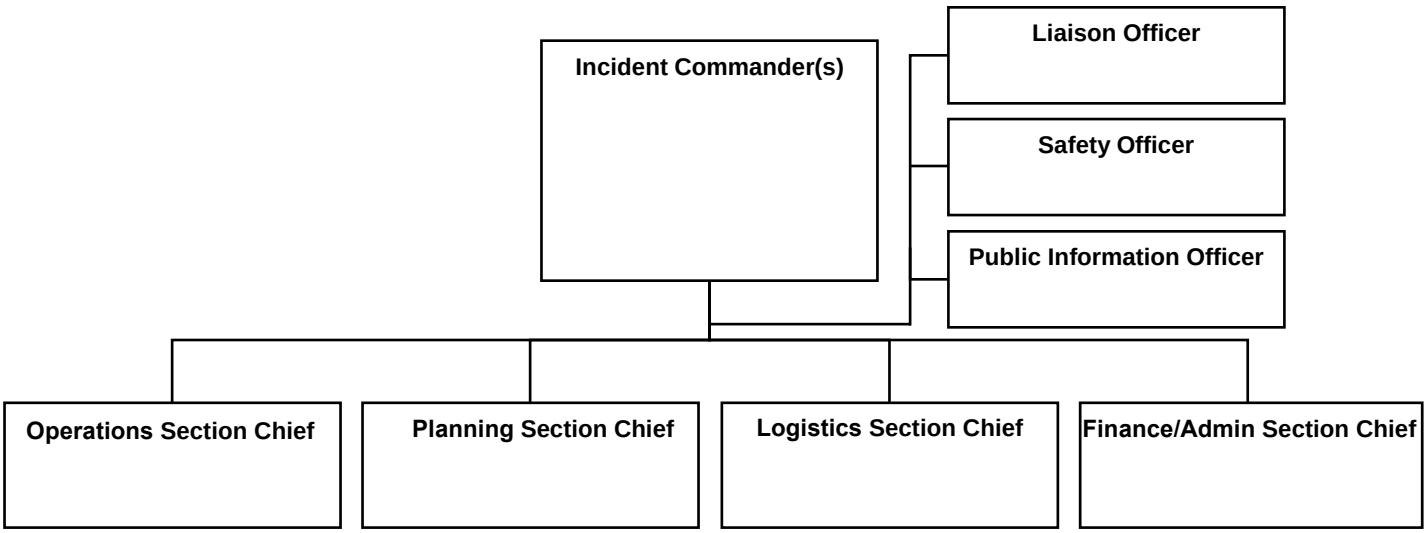
6. Prepared by: Name: _____ Position/Title: _____ Signature: _____

 Date/Time: _____

INCIDENT BRIEFING (ICS 201)

1. Incident Name:	2. Incident Number:	3. Date/Time Initiated: Date: Time:

9. Current Organization (fill in additional organization as appropriate)**:**



6. Prepared by: Name: _____ Position/Title: _____ Signature: _____

Date/Time: _____

INCIDENT BRIEFING (ICS 201)

1. Incident Name:	2. Incident Number:	3. Date/Time Initiated: Date: Time:

10. Resource Summary:

Resource	Resource Identifier	Date/Time Ordered	ETA	Arrived	Notes (location/assignment/status)
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	
				☐	

6. Prepared by: Name: _____ Position/Title: _____ Signature: _____

Date/Time: _____

ICS 201
Incident Briefing

Purpose. The Incident Briefing (ICS 201) provides the Incident Commander (and the Command and General Staffs) with basic information regarding the incident situation and the resources allocated to the incident. In addition to a briefing document, the ICS 201 also serves as an initial action worksheet. It serves as a permanent record of the initial response to the incident.

Preparation. The briefing form is prepared by the Incident Commander for presentation to the incoming Incident Commander along with a more detailed oral briefing.

Distribution. Ideally, the ICS 201 is duplicated and distributed before the initial briefing of the Command and General Staffs or other responders as appropriate. The "Map/Sketch" and "Current and Planned Actions, Strategies, and Tactics" sections (pages 1–2) of the briefing form are given to the Situation Unit, while the "Current Organization" and "Resource Summary" sections (pages 3–4) are given to the Resources Unit.

Notes:

- The ICS 201 can serve as part of the initial Incident Action Plan (IAP).
- If additional pages are needed for any form page, use a blank ICS 201 and repaginate as needed.

Block Number	Block Title	Instructions
1	**Incident Name**	Enter the name assigned to the incident.
2	**Incident Number**	Enter the number assigned to the incident.
3	**Date/Time Initiated** • Date, Time	Enter date initiated (month/day/year) and time initiated (using the 24-hour clock).
4	**Map/Sketch** (include sketch, showing the total area of operations, the incident site/area, impacted and threatened areas, overflight results, trajectories, impacted shorelines, or other graphics depicting situational status and resource assignment)	Show perimeter and other graphics depicting situational status, resource assignments, incident facilities, and other special information on a map/sketch or with attached maps. Utilize commonly accepted ICS map symbology. If specific geospatial reference points are needed about the incident's location or area outside the ICS organization at the incident, that information should be submitted on the Incident Status Summary (ICS 209). North should be at the top of page unless noted otherwise.
5	**Situation Summary and Health and Safety Briefing (**for briefings or transfer of command): Recognize potential incident Health and Safety Hazards and develop necessary measures (remove hazard, provide personal protective equipment, warn people of the hazard) to protect responders from those hazards.	Self-explanatory.
6	**Prepared by** • Name • Position/Title • Signature • Date/Time	Enter the name, ICS position/title, and signature of the person preparing the form. Enter date (month/day/year) and time prepared (24-hour clock).
7	**Current and Planned Objectives**	Enter the objectives used on the incident and note any specific problem areas.

Block Number	Block Title	Instructions
8	**Current and Planned Actions, Strategies, and Tactics** • Time • Actions	Enter the current and planned actions, strategies, and tactics and time they may or did occur to attain the objectives. If additional pages are needed, use a blank sheet or another ICS 201 (Page 2), and adjust page numbers accordingly.
9	**Current Organization** (fill in additional organization as appropriate) • Incident Commander(s) • Liaison Officer • Safety Officer • Public Information Officer • Planning Section Chief • Operations Section Chief • Finance/Administration Section Chief • Logistics Section Chief	• Enter on the organization chart the names of the individuals assigned to each position. • Modify the chart as necessary, and add any lines/spaces needed for Command Staff Assistants, Agency Representatives, and the organization of each of the General Staff Sections. • If Unified Command is being used, split the Incident Commander box. • Indicate agency for each of the Incident Commanders listed if Unified Command is being used.
10	**Resource Summary**	Enter the following information about the resources allocated to the incident. If additional pages are needed, use a blank sheet or another ICS 201 (Page 4), and adjust page numbers accordingly.
	• Resource	Enter the number and appropriate category, kind, or type of resource ordered.
	• Resource Identifier	Enter the relevant agency designator and/or resource designator (if any).
	• Date/Time Ordered	Enter the date (month/day/year) and time (24-hour clock) the resource was ordered.
	• ETA	Enter the estimated time of arrival (ETA) to the incident (use 24-hour clock).
	• Arrived	Enter an “X” or a checkmark upon arrival to the incident.
	• Notes (location/ assignment/status)	Enter notes such as the assigned location of the resource and/or the actual assignment and status.

INCIDENT OBJECTIVES (ICS 202)

1. Incident Name:	**2. Operational Period:** Date From: Date To: Time From: Time To:

3. Objective(s):

4. Operational Period Command Emphasis:

General Situational Awareness

5. Site Safety Plan Required? Yes ☐ No ☐

Approved Site Safety Plan(s) Located at:

6. Incident Action Plan (the items checked below are included in this Incident Action Plan)**:**

☐ ICS 203	☐ ICS 207	Other Attachments:
☐ ICS 204	☐ ICS 208	☐ _____
☐ ICS 205	☐ Map/Chart	☐ _____
☐ ICS 205A	☐ Weather Forecast/Tides/Currents	☐ _____
☐ ICS 206		☐ _____

7. Prepared by: Name: _____ Position/Title: _____ Signature: _____

8. Approved by Incident Commander: Name: _____ Signature: _____

ICS 202	**IAP Page** _____	Date/Time: _____

ICS 202
Incident Objectives

Purpose. The Incident Objectives (ICS 202) describes the basic incident strategy, incident objectives, command emphasis/priorities, and safety considerations for use during the next operational period.

Preparation. The ICS 202 is completed by the Planning Section following each Command and General Staff meeting conducted to prepare the Incident Action Plan (IAP). In case of a Unified Command, one Incident Commander (IC) may approve the ICS 202. If additional IC signatures are used, attach a blank page.

Distribution. The ICS 202 may be reproduced with the IAP and may be part of the IAP and given to all supervisory personnel at the Section, Branch, Division/Group, and Unit levels. All completed original forms must be given to the Documentation Unit.

Notes:

- The ICS 202 is part of the IAP and can be used as the opening or cover page.
- If additional pages are needed, use a blank ICS 202 and repaginate as needed.

Block Number	Block Title	Instructions
1	**Incident Name**	Enter the name assigned to the incident. If needed, an incident number can be added.
2	**Operational Period** • Date and Time From • Date and Time To	Enter the start date (month/day/year) and time (using the 24-hour clock) and end date and time for the operational period to which the form applies.
3	**Objective(s)**	Enter clear, concise statements of the objectives for managing the response. Ideally, these objectives will be listed in priority order. These objectives are for the incident response for this operational period as well as for the duration of the incident. Include alternative and/or specific tactical objectives as applicable. Objectives should follow the SMART model or a similar approach: **S**pecific – Is the wording precise and unambiguous? **M**easurable – How will achievements be measured? **A**ction-oriented – Is an action verb used to describe expected accomplishments? **R**ealistic – Is the outcome achievable with given available resources? **T**ime-sensitive – What is the timeframe?
4	**Operational Period Command Emphasis**	Enter command emphasis for the operational period, which may include tactical priorities or a general weather forecast for the operational period. It may be a sequence of events or order of events to address. This is not a narrative on the objectives, but a discussion about where to place emphasis if there are needs to prioritize based on the Incident Commander's or Unified Command's direction. Examples: Be aware of falling debris, secondary explosions, etc.
	General Situational Awareness	General situational awareness may include a weather forecast, incident conditions, and/or a general safety message. If a safety message is included here, it should be reviewed by the Safety Officer to ensure it is in alignment with the Safety Message/Plan (ICS 208).
5	**Site Safety Plan Required?** Yes ☐ No ☐	Safety Officer should check whether or not a site safety plan is required for this incident.
	Approved Site Safety Plan(s) Located At	Enter the location of the approved Site Safety Plan(s).

Block Number	Block Title	Instructions
6	**Incident Action Plan** (the items checked below are included in this Incident Action Plan): ☐ ICS 203 ☐ ICS 204 ☐ ICS 205 ☐ ICS 205A ☐ ICS 206 ☐ ICS 207 ☐ ICS 208 ☐ Map/Chart ☐ Weather Forecast/ Tides/Currents Other Attachments:	Check appropriate forms and list other relevant documents that are included in the IAP. ☐ ICS 203 – Organization Assignment List ☐ ICS 204 – Assignment List ☐ ICS 205 – Incident Radio Communications Plan ☐ ICS 205A – Communications List ☐ ICS 206 – Medical Plan ☐ ICS 207 – Incident Organization Chart ☐ ICS 208 – Safety Message/Plan
7	**Prepared by** • Name • Position/Title • Signature	Enter the name, ICS position, and signature of the person preparing the form. Enter date (month/day/year) and time prepared (24-hour clock).
8	**Approved by Incident Commander** • Name • Signature • Date/Time	In the case of a Unified Command, one IC may approve the ICS 202. If additional IC signatures are used, attach a blank page.

ORGANIZATION ASSIGNMENT LIST (ICS 203)

1. Incident Name:	2. Operational Period: Date From: Date To: Time From: Time To:

3. Incident Commander(s) and Command Staff:	
IC/UCs	
Deputy	
Safety Officer	
Public Info. Officer	
Liaison Officer	

4. Agency/Organization Representatives:	
Agency/Organization	Name

5. Planning Section:	
Chief	
Deputy	
Resources Unit	
Situation Unit	
Documentation Unit	
Demobilization Unit	
Technical Specialists	

6. Logistics Section:	
Chief	
Deputy	
Support Branch	
Director	
Supply Unit	
Facilities Unit	
Ground Support Unit	
Service Branch	
Director	
Communications Unit	
Medical Unit	
Food Unit	

7. Operations Section:		
Chief		
Deputy		
Staging Area		
Branch		
Branch Director		
Deputy		
Division/Group		
Division/Group		
Division/Group		
Division/Group		
Branch		
Branch Director		
Deputy		
Division/Group		
Division/Group		
Division/Group		
Division/Group		
Branch		
Branch Director		
Deputy		
Division/Group		
Division/Group		
Division/Group		
Division/Group		
Division/Group		
Air Operations Branch		
Air Ops Branch Dir.		

8. Finance/Administration Section:	
Chief	
Deputy	
Time Unit	
Procurement Unit	
Comp/Claims Unit	
Cost Unit	

9. Prepared by: Name: _____ Position/Title: _____ Signature: _____

ICS 203 | **IAP Page** _____ | Date/Time: _____

ICS 203
Organization Assignment List

Purpose. The Organization Assignment List (ICS 203) provides ICS personnel with information on the units that are currently activated and the names of personnel staffing each position/unit. It is used to complete the Incident Organization Chart (ICS 207) which is posted on the Incident Command Post display. An actual organization will be incident or event-specific. **Not all positions need to be filled.** Some blocks may contain more than one name. The size of the organization is dependent on the magnitude of the incident, and can be expanded or contracted as necessary.

Preparation. The Resources Unit prepares and maintains this list under the direction of the Planning Section Chief. Complete only the blocks for the positions that are being used for the incident. If a trainee is assigned to a position, indicate this with a "T" in parentheses behind the name (e.g., "A. Smith (T)").

Distribution. The ICS 203 is duplicated and attached to the Incident Objectives (ICS 202) and given to all recipients as part of the Incident Action Plan (IAP). All completed original forms must be given to the Documentation Unit.

Notes:

- The ICS 203 serves as part of the IAP.
- If needed, more than one name can be put in each block by inserting a slash.
- If additional pages are needed, use a blank ICS 203 and repaginate as needed.
- ICS allows for organizational flexibility, so the Intelligence/Investigations Function can be embedded in several different places within the organizational structure.

Block Number	Block Title	Instructions
1	**Incident Name**	Enter the name assigned to the incident.
2	**Operational Period** • Date and Time From • Date and Time To	Enter the start date (month/day/year) and time (using the 24-hour clock) and end date and time for the operational period to which the form applies.
3	**Incident Commander(s) and Command Staff** • IC/UCs • Deputy • Safety Officer • Public Information Officer • Liaison Officer	Enter the names of the Incident Commander(s) and Command Staff. Label Assistants to Command Staff as such (for example, "Assistant Safety Officer"). For all individuals, use at least the first initial and last name. For Unified Command, also include agency names.
4	**Agency/Organization Representatives** • Agency/Organization • Name	Enter the agency/organization names and the names of their representatives. For all individuals, use at least the first initial and last name.
5	**Planning Section** • Chief • Deputy • Resources Unit • Situation Unit • Documentation Unit • Demobilization Unit • Technical Specialists	Enter the name of the Planning Section Chief, Deputy, and Unit Leaders after each position title. List Technical Specialists with an indication of specialty. If there is a shift change during the specified operational period, list both names, separated by a slash. For all individuals, use at least the first initial and last name.

Block Number	Block Title	Instructions
6	**Logistics Section** • Chief • Deputy **Support Branch** • Director • Supply Unit • Facilities Unit • Ground Support Unit **Service Branch** • Director • Communications Unit • Medical Unit • Food Unit	Enter the name of the Logistics Section Chief, Deputy, Branch Directors, and Unit Leaders after each position title. If there is a shift change during the specified operational period, list both names, separated by a slash. For all individuals, use at least the first initial and last name.
7	**Operations Section** • Chief • Deputy • Staging Area **Branch** • Branch Director • Deputy • Division/Group **Air Operations Branch** • Air Operations Branch Director	Enter the name of the Operations Section Chief, Deputy, Branch Director(s), Deputies, and personnel staffing each of the listed positions. For Divisions/Groups, enter the Division/Group identifier in the left column and the individual's name in the right column. Branches and Divisions/Groups may be named for functionality or by geography. For Divisions/Groups, indicate Division/Group Supervisor. Use an additional page if more than three Branches are activated. If there is a shift change during the specified operational period, list both names, separated by a slash. For all individuals, use at least the first initial and last name.
8	**Finance/Administration Section** • Chief • Deputy • Time Unit • Procurement Unit • Compensation/Claims Unit • Cost Unit	Enter the name of the Finance/Administration Section Chief, Deputy, and Unit Leaders after each position title. If there is a shift change during the specified operational period, list both names, separated by a slash. For all individuals, use at least the first initial and last name.
9	**Prepared by** • Name • Position/Title • Signature • Date/Time	Enter the name, ICS position, and signature of the person preparing the form. Enter date (month/day/year) and time prepared (24-hour clock).

ASSIGNMENT LIST (ICS 204)

1. Incident Name:	2. Operational Period: Date From: Date To: Time From: Time To:	3. Branch: Division: Group: Staging Area:

4. Operations Personnel: Name Contact Number(s)

Operations Section Chief: _____

Branch Director: _____

Division/Group Supervisor: _____

5. Resources Assigned:		# of Persons	Contact (e.g., phone, pager, radio frequency, etc.)	Reporting Location, Special Equipment and Supplies, Remarks, Notes, Information
Resource Identifier	Leader			

6. Work Assignments:

7. Special Instructions:

8. Communications (radio and/or phone contact numbers needed for this assignment)**:**

Name/Function	Primary Contact: indicate cell, pager, or radio (frequency/system/channel)
/	
/	
/	
/	

9. Prepared by: Name: _____ Position/Title: _____ Signature: _____

ICS 204
Assignment List

Purpose. The Assignment List(s) (ICS 204) informs Division and Group supervisors of incident assignments. Once the Command and General Staffs agree to the assignments, the assignment information is given to the appropriate Divisions and Groups.

Preparation. The ICS 204 is normally prepared by the Resources Unit, using guidance from the Incident Objectives (ICS 202), Operational Planning Worksheet (ICS 215), and the Operations Section Chief. It must be approved by the Incident Commander, but may be reviewed and initialed by the Planning Section Chief and Operations Section Chief as well.

Distribution. The ICS 204 is duplicated and attached to the ICS 202 and given to all recipients as part of the Incident Action Plan (IAP). In some cases, assignments may be communicated via radio/telephone/fax. All completed original forms must be given to the Documentation Unit.

Notes:

- The ICS 204 details assignments at Division and Group levels and is part of the IAP.
- Multiple pages/copies can be used if needed.
- If additional pages are needed, use a blank ICS 204 and repaginate as needed.

Block Number	Block Title	Instructions
1	**Incident Name**	Enter the name assigned to the incident.
2	**Operational Period** • Date and Time From • Date and Time To	Enter the start date (month/day/year) and time (using the 24-hour clock) and end date and time for the operational period to which the form applies.
3	**Branch** **Division** **Group** **Staging Area**	This block is for use in a large IAP for reference only. Write the alphanumeric abbreviation for the Branch, Division, Group, and Staging Area (e.g., "Branch 1," "Division D," "Group 1A") in large letters for easy referencing.
4	**Operations Personnel** • Name, Contact Number(s) – Operations Section Chief – Branch Director – Division/Group Supervisor	Enter the name and contact numbers of the Operations Section Chief, applicable Branch Director(s), and Division/Group Supervisor(s).
5	**Resources Assigned**	Enter the following information about the resources assigned to the Division or Group for this period:
	• Resource Identifier	The identifier is a unique way to identify a resource (e.g., ENG-13, IA-SCC-413). If the resource has been ordered but no identification has been received, use TBD (to be determined).
	• Leader	Enter resource leader's name.
	• # of Persons	Enter total number of persons for the resource assigned, including the leader.
	• Contact (e.g., phone, pager, radio frequency, etc.)	Enter primary means of contacting the leader or contact person (e.g., radio, phone, pager, etc.). Be sure to include the area code when listing a phone number.
5 (continued)	• Reporting Location, Special Equipment and Supplies, Remarks, Notes, Information	Provide special notes or directions specific to this resource. If required, add notes to indicate: (1) specific location/time where the resource should report or be dropped off/picked up; (2) special equipment and supplies that will be used or needed; (3) whether or not the resource received briefings; (4) transportation needs; or (5) other information.

Block Number	Block Title	Instructions
6	**Work Assignments**	Provide a statement of the tactical objectives to be achieved within the operational period by personnel assigned to this Division or Group.
7	**Special Instructions**	Enter a statement noting any safety problems, specific precautions to be exercised, dropoff or pickup points, or other important information.
8	**Communications** (radio and/or phone contact numbers needed for this assignment) • Name/Function • Primary Contact: indicate cell, pager, or radio (frequency/system/channel)	Enter specific communications information (including emergency numbers) for this Branch/Division/Group. If radios are being used, enter function (command, tactical, support, etc.), frequency, system, and channel from the Incident Radio Communications Plan (ICS 205). Phone and pager numbers should include the area code and any satellite phone specifics. In light of potential IAP distribution, use sensitivity when including cell phone number. Add a secondary contact (phone number or radio) if needed.
9	**Prepared by** • Name • Position/Title • Signature • Date/Time	Enter the name, ICS position, and signature of the person preparing the form. Enter date (month/day/year) and time prepared (24-hour clock).

INCIDENT RADIO COMMUNICATIONS PLAN (ICS 205)

1. Incident Name:	2. Date/Time Prepared: Date: Time:	3. Operational Period: Date From: Date To: Time From: Time To:

4. Basic Radio Channel Use:

Zone Grp.	Ch #	Function	Channel Name/Trunked Radio System Talkgroup	Assignment	RX Freq N or W	RX Tone/NAC	TX Freq N or W	TX Tone/NAC	Mode (A, D, or M)	Remarks

5. Special Instructions:

6. Prepared by (Communications Unit Leader)**:** Name: _____ Signature: _____

ICS 205	**IAP Page** _____	Date/Time: _____

ICS 205
Incident Radio Communications Plan

Purpose. The Incident Radio Communications Plan (ICS 205) provides information on all radio frequency or trunked radio system talkgroup assignments for each operational period. The plan is a summary of information obtained about available radio frequencies or talkgroups and the assignments of those resources by the Communications Unit Leader for use by incident responders. Information from the Incident Radio Communications Plan on frequency or talkgroup assignments is normally placed on the Assignment List (ICS 204).

Preparation. The ICS 205 is prepared by the Communications Unit Leader and given to the Planning Section Chief for inclusion in the Incident Action Plan.

Distribution. The ICS 205 is duplicated and attached to the Incident Objectives (ICS 202) and given to all recipients as part of the Incident Action Plan (IAP). All completed original forms must be given to the Documentation Unit. Information from the ICS 205 is placed on Assignment Lists.

Notes:

- The ICS 205 is used to provide, in one location, information on all radio frequency assignments down to the Division/Group level for each operational period.
- The ICS 205 serves as part of the IAP.

Block Number	Block Title	Instructions
1	**Incident Name**	Enter the name assigned to the incident.
2	**Date/Time Prepared**	Enter date prepared (month/day/year) and time prepared (using the 24-hour clock).
3	**Operational Period** • Date and Time From • Date and Time To	Enter the start date (month/day/year) and time (using the 24-hour clock) and end date and time for the operational period to which the form applies.
4	**Basic Radio Channel Use**	Enter the following information about radio channel use:
	Zone Group	
	Channel Number	Use at the Communications Unit Leader's discretion. Channel Number (Ch #) may equate to the channel number for incident radios that are programmed or cloned for a specific Communications Plan, or it may be used just as a reference line number on the ICS 205 document.
	Function	Enter the Net function each channel or talkgroup will be used for (Command, Tactical, Ground-to-Air, Air-to-Air, Support, Dispatch).
	Channel Name/Trunked Radio System Talkgroup	Enter the nomenclature or commonly used name for the channel or talk group such as the National Interoperability Channels which follow DHS frequency Field Operations Guide (FOG).
	Assignment	Enter the name of the ICS Branch/Division/Group/Section to which this channel/talkgroup will be assigned.
	RX (Receive) Frequency (N or W)	Enter the Receive Frequency (RX Freq) as the mobile or portable subscriber would be programmed using xxx.xxxx out to four decimal places, followed by an "N" designating narrowband or a "W" designating wideband emissions. The name of the specific trunked radio system with which the talkgroup is associated may be entered across all fields on the ICS 205 normally used for conventional channel programming information.
	RX Tone/NAC	Enter the Receive Continuous Tone Coded Squelch System (CTCSS) subaudible tone (RX Tone) or Network Access Code (RX NAC) for the receive frequency as the mobile or portable subscriber would be programmed.

Block Number	Block Title	Instructions
4 (continued)	TX (Transmit) Frequency (N or W)	Enter the Transmit Frequency (TX Freq) as the mobile or portable subscriber would be programmed using xxx.xxxx out to four decimal places, followed by an "N" designating narrowband or a "W" designating wideband emissions.
	TX Tone/NAC	Enter the Transmit Continuous Tone Coded Squelch System (CTCSS) subaudible tone (TX Tone) or Network Access Code (TX NAC) for the transmit frequency as the mobile or portable subscriber would be programmed.
	Mode (A, D, or M)	Enter "A" for analog operation, "D" for digital operation, or "M" for mixed mode operation.
	Remarks	Enter miscellaneous information concerning repeater locations, information concerning patched channels or talkgroups using links or gateways, etc.
5	**Special Instructions**	Enter any special instructions (e.g., using cross-band repeaters, secure-voice, encoders, private line (PL) tones, etc.) or other emergency communications needs). If needed, also include any special instructions for handling an incident within an incident.
6	**Prepared by** (Communications Unit Leader) • Name • Signature • Date/Time	Enter the name and signature of the person preparing the form, typically the Communications Unit Leader. Enter date (month/day/year) and time prepared (24-hour clock).

MEDICAL PLAN (ICS 206)

1. Incident Name:	2. Operational Period: Date From: Date To: Time From: Time To:

3. Medical Aid Stations:

Name	Location	Contact Number(s)/Frequency	Paramedics on Site?
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No

4. Transportation (indicate air or ground)**:**

Ambulance Service	Location	Contact Number(s)/Frequency	Level of Service
			☐ ALS ☐ BLS
			☐ ALS ☐ BLS
			☐ ALS ☐ BLS
			☐ ALS ☐ BLS

5. Hospitals:

Hospital Name	Address, Latitude & Longitude if Helipad	Contact Number(s)/ Frequency	Travel Time		Trauma Center	Burn Center	Helipad
			Air	Ground			
					☐ Yes Level:_____ ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
					☐ Yes Level:_____ ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
					☐ Yes Level:_____ ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
					☐ Yes Level:_____ ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
					☐ Yes Level:_____ ☐ No	☐ Yes ☐ No	☐ Yes ☐ No

6. Special Medical Emergency Procedures:

☐ Check box if aviation assets are utilized for rescue. If assets are used, coordinate with Air Operations.

7. Prepared by (Medical Unit Leader)**:** Name: _____ Signature: _____

8. Approved by (Safety Officer)**:** Name: _____ Signature: _____

ICS 206	IAP Page _____	Date/Time: _____

ICS 206
Medical Plan

Purpose. The Medical Plan (ICS 206) provides information on incident medical aid stations, transportation services, hospitals, and medical emergency procedures.

Preparation. The ICS 206 is prepared by the Medical Unit Leader and reviewed by the Safety Officer to ensure ICS coordination. If aviation assets are utilized for rescue, coordinate with Air Operations.

Distribution. The ICS 206 is duplicated and attached to the Incident Objectives (ICS 202) and given to all recipients as part of the Incident Action Plan (IAP). Information from the plan pertaining to incident medical aid stations and medical emergency procedures may be noted on the Assignment List (ICS 204). All completed original forms must be given to the Documentation Unit.

Notes:

- The ICS 206 serves as part of the IAP.
- This form can include multiple pages.

Block Number	Block Title	Instructions
1	**Incident Name**	Enter the name assigned to the incident.
2	**Operational Period** • Date and Time From • Date and Time To	Enter the start date (month/day/year) and time (using the 24-hour clock) and end date and time for the operational period to which the form applies.
3	**Medical Aid Stations**	Enter the following information on the incident medical aid station(s):
	• Name	Enter name of the medical aid station.
	• Location	Enter the location of the medical aid station (e.g., Staging Area, Camp Ground).
	• Contact Number(s)/Frequency	Enter the contact number(s) and frequency for the medical aid station(s).
	• Paramedics on Site? ☐ Yes ☐ No	Indicate (yes or no) if paramedics are at the site indicated.
4	**Transportation** (indicate air or ground)	Enter the following information for ambulance services available to the incident:
	• Ambulance Service	Enter name of ambulance service.
	• Location	Enter the location of the ambulance service.
	• Contact Number(s)/Frequency	Enter the contact number(s) and frequency for the ambulance service.
	• Level of Service ☐ ALS ☐ BLS	Indicate the level of service available for each ambulance, either ALS (Advanced Life Support) or BLS (Basic Life Support).

Block Number	Block Title	Instructions
5	**Hospitals**	Enter the following information for hospital(s) that could serve this incident:
	• Hospital Name	Enter hospital name and identify any predesignated medivac aircraft by name a frequency.
	• Address, Latitude & Longitude if Helipad	Enter the physical address of the hospital and the latitude and longitude if the hospital has a helipad.
	• Contact Number(s)/ Frequency	Enter the contact number(s) and/or communications frequency(s) for the hospital.

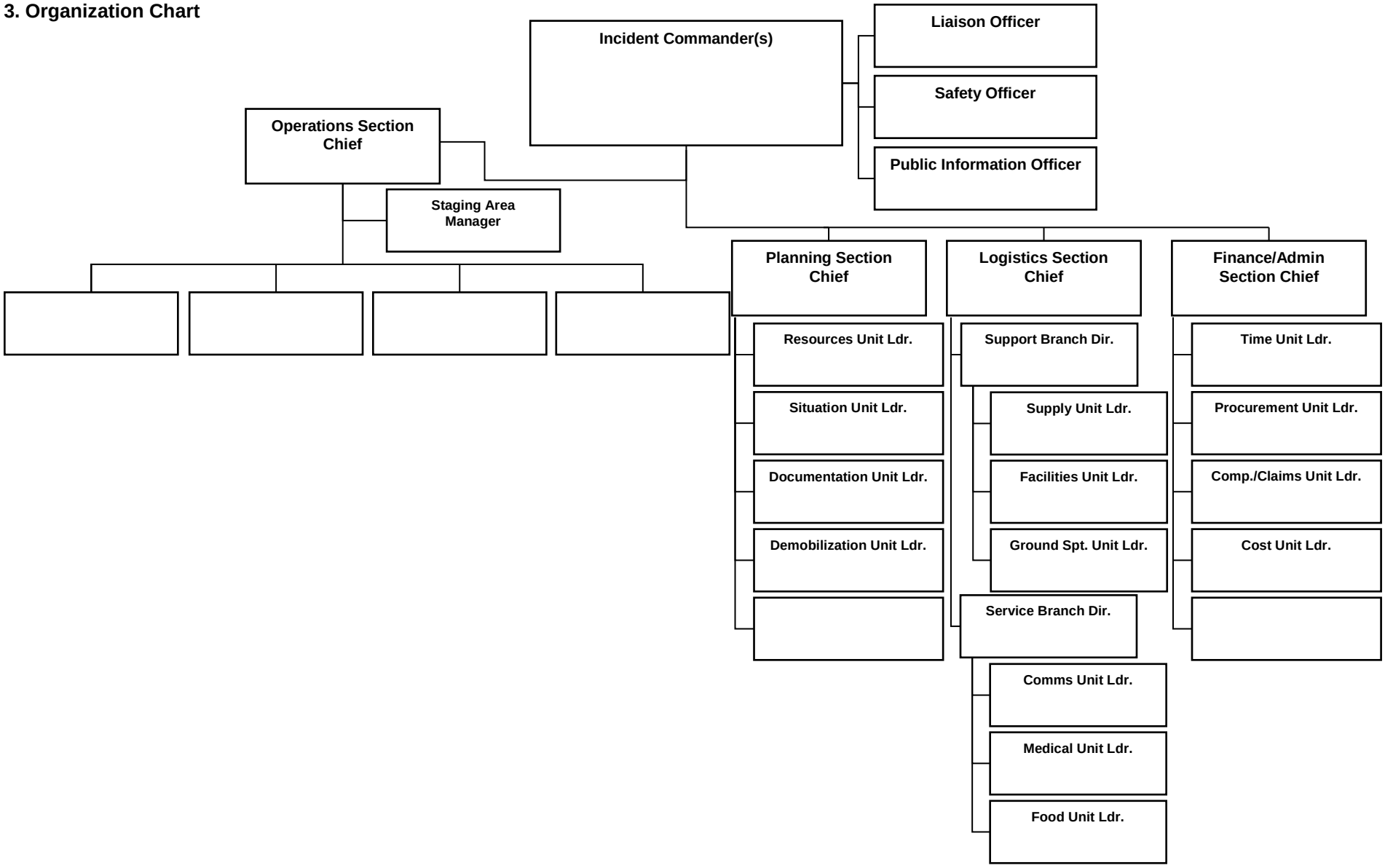
	• Travel Time
	  • Air
	  • Ground
		Enter the travel time by air and ground from the incident to the hospital.

	• Trauma Center ☐ Yes Level:_____	Indicate yes and the trauma level if the hospital has a trauma center.
	• Burn Center ☐ Yes ☐ No	Indicate (yes or no) if the hospital has a burn center.
	• Helipad ☐ Yes ☐ No	Indicate (yes or no) if the hospital has a helipad. Latitude and Longitude data format need to compliment Medical Evacuation Helicopters and Medical Air Resources
6	**Special Medical Emergency Procedures**	Note any special emergency instructions for use by incident personnel, including (1) who should be contacted, (2) how should they be contacted; and (3) who manages an incident within an incident due to a rescue, accident, etc. Include procedures for how to report medical emergencies.
	☐ Check box if aviation assets are utilized for rescue. If assets are used, coordinate with Air Operations.	Self explanatory. Incident assigned aviation assets should be included in ICS 220.
7	**Prepared by** (Medical Unit Leader) • Name • Signature	Enter the name and signature of the person preparing the form, typically the Medical Unit Leader. Enter date (month/day/year) and time prepared (24-hour clock).
8	**Approved by** (Safety Officer) • Name • Signature • Date/Time	Enter the name of the person who approved the plan, typically the Safety Officer. Enter date (month/day/year) and time reviewed (24-hour clock).

INCIDENT ORGANIZATION CHART (ICS 207)

1. Incident Name:	2. Operational Period: Date From: Date To: Time From: Time To:

3. Organization Chart



ICS 207	IAP Page ___	4. Prepared by: Name:_____ Position/Title: _____ Signature: _____ Date/Time: _____

ICS 207
Incident Organization Chart

Purpose. The Incident Organization Chart (ICS 207) provides a **visual wall chart** depicting the ICS organization position assignments for the incident. The ICS 207 is used to indicate what ICS organizational elements are currently activated and the names of personnel staffing each element. An actual organization will be event-specific. The size of the organization is dependent on the specifics and magnitude of the incident and is scalable and flexible. Personnel responsible for managing organizational positions are listed in each box as appropriate.

Preparation. The ICS 207 is prepared by the Resources Unit Leader and reviewed by the Incident Commander. Complete only the blocks where positions have been activated, and add additional blocks as needed, especially for Agency Representatives and all Operations Section organizational elements. For detailed information about positions, consult the NIMS ICS Field Operations Guide. The ICS 207 is intended to be used as a wall-size chart and printed on a plotter for better visibility. A chart is completed for each operational period, and updated when organizational changes occur.

Distribution. The ICS 207 is intended to be **wall mounted** at Incident Command Posts and other incident locations as needed, and is not intended to be part of the Incident Action Plan (IAP). All completed original forms must be given to the Documentation Unit.

Notes:

- The ICS 207 is intended to be **wall mounted** (printed on a plotter). Document size can be modified based on individual needs.
- Also available as 8½ x 14 (legal size) chart.
- ICS allows for organizational flexibility, so the Intelligence/Investigative Function can be embedded in several different places within the organizational structure.
- Use additional pages if more than three branches are activated. Additional pages can be added based on individual need (such as to distinguish more Division/Groups and Branches as they are activated).

Block Number	Block Title	Instructions
1	**Incident Name**	Print the name assigned to the incident.
2	**Operational Period** • Date and Time From • Date and Time To	Enter the start date (month/day/year) and time (using the 24-hour clock) and end date and time for the operational period to which the form applies.
3	**Organization Chart**	• Complete the incident organization chart. • For all individuals, use at least the first initial and last name. • List agency where it is appropriate, such as for Unified Commanders. • If there is a shift change during the specified operational period, list both names, separated by a slash.
4	**Prepared by** • Name • Position/Title • Signature • Date/Time	Enter the name, ICS position, and signature of the person preparing the form. Enter date (month/day/year) and time prepared (24-hour clock).

SAFETY MESSAGE/PLAN (ICS 208)

1. Incident Name:	2. Operational Period: Date From: Date To: Time From: Time To:

3. Safety Message/Expanded Safety Message, Safety Plan, Site Safety Plan:

4. Site Safety Plan Required? Yes ☐ No ☐

Approved Site Safety Plan(s) Located At:

5. Prepared by: Name: _____ Position/Title: _____ Signature: _____

ICS 208	IAP Page _____	Date/Time: _____

ICS 208
Safety Message/Plan

Purpose. The Safety Message/Plan (ICS 208) expands on the Safety Message and Site Safety Plan.

Preparation. The ICS 208 is an optional form that may be included and completed by the Safety Officer for the Incident Action Plan (IAP).

Distribution. The ICS 208, if developed, will be reproduced with the IAP and given to all recipients as part of the IAP. All completed original forms must be given to the Documentation Unit.

Notes:
- The ICS 208 may serve (optionally) as part of the IAP.
- Use additional copies for continuation sheets as needed, and indicate pagination as used.

Block Number	Block Title	Instructions
1	**Incident Name**	Enter the name assigned to the incident.
2	**Operational Period** • Date and Time From • Date and Time To	Enter the start date (month/day/year) and time (using the 24-hour clock) and end date and time for the operational period to which the form applies.
3	**Safety Message/Expanded Safety Message, Safety Plan, Site Safety Plan**	Enter clear, concise statements for safety message(s), priorities, and key command emphasis/decisions/directions. Enter information such as known safety hazards and specific precautions to be observed during this operational period. If needed, additional safety message(s) should be referenced and attached.
4	**Site Safety Plan Required?** Yes ☐ No ☐	Check whether or not a site safety plan is required for this incident.
	Approved Site Safety Plan(s) Located At	Enter where the approved Site Safety Plan(s) is located.
5	**Prepared by** • Name • Position/Title • Signature • Date/Time	Enter the name, ICS position, and signature of the person preparing the form. Enter date (month/day/year) and time prepared (24-hour clock).

INCIDENT STATUS SUMMARY (ICS 209)

*1. Incident Name:			2. Incident Number:	
*3. Report Version (check one box on left): ☐ Initial Rpt # (if used): ☐ Update ☐ Final	*4. Incident Commander(s) & Agency or Organization:		5. Incident Management Organization:	*6. Incident Start Date/Time: Date: _____ Time: _____ Time Zone: _____
7. Current Incident Size or Area Involved (use unit label – e.g., "sq mi," "city block"):	8. Percent (%) Contained _____ Completed _____	*9. Incident Definition:	10. Incident Complexity Level:	*11. For Time Period: From Date/Time: _____ To Date/Time: _____

Approval & Routing Information

*12. Prepared By: Print Name: _____ ICS Position: _____ Date/Time Prepared: _____	*13. Date/Time Submitted: Time Zone:
*14. Approved By: Print Name: _____ ICS Position: _____ Signature: _____	*15. Primary Location, Organization, or Agency Sent To:

Incident Location Information

*16. State:	*17. County/Parish/Borough:	*18. City:
19. Unit or Other:	*20. Incident Jurisdiction:	21. Incident Location Ownership (if different than jurisdiction):
22. Longitude (indicate format): Latitude (indicate format):	23. US National Grid Reference:	24. Legal Description (township, section, range):
*25. Short Location or Area Description (list all affected areas or a reference point):		26. UTM Coordinates:
27. Note any electronic geospatial data included or attached (indicate data format, content, and collection time information and labels):		

Incident Summary

*28. Significant Events for the Time Period Reported (summarize significant progress made, evacuations, incident growth, etc.):				
29. Primary Materials or Hazards Involved (hazardous chemicals, fuel types, infectious agents, radiation, etc.):				
30. Damage Assessment Information (summarize damage and/or restriction of use or availability to residential or commercial property, natural resources, critical infrastructure and key resources, etc.):	A. Structural Summary	B. # Threatened (72 hrs)	C. # Damaged	D. # Destroyed
	E. Single Residences			
	F. Nonresidential Commercial Property			
	Other Minor Structures			
	Other			

** Required when applicable.*

INCIDENT STATUS SUMMARY (ICS 209)

*1. Incident Name:	2. Incident Number:

Additional Incident Decision Support Information

*31. Public Status Summary:	A. # This Reporting Period	B. Total # to Date	*32. Responder Status Summary:	A. # This Reporting Period	B. Total # to Date
C. Indicate Number of Civilians (Public) Below:			*C. Indicate Number of Responders Below:*		
D. Fatalities			D. Fatalities		
E. With Injuries/Illness			E. With Injuries/Illness		
F. Trapped/In Need of Rescue			F. Trapped/In Need of Rescue		
G. Missing *(note if estimated)*			G. Missing		
H. Evacuated *(note if estimated)*			H. Sheltering in Place		
I. Sheltering in Place *(note if estimated)*			I. Have Received Immunizations		
J. In Temporary Shelters *(note if est.)*			J. Require Immunizations		
K. Have Received Mass Immunizations			K. In Quarantine		
L. Require Immunizations *(note if est.)*					
M. In Quarantine					
N. Total # Civilians (Public) Affected:			*N. Total # Responders Affected:*		

33. Life, Safety, and Health Status/Threat Remarks:

35. Weather Concerns (synopsis of current and predicted weather; discuss related factors that may cause concern)**:**

*34. Life, Safety, and Health Threat Management:	A. Check if Active
A. No Likely Threat	☐
B. Potential Future Threat	☐
C. Mass Notifications in Progress	☐
D. Mass Notifications Completed	☐
E. No Evacuation(s) Imminent	☐
F. Planning for Evacuation	☐
G. Planning for Shelter-in-Place	☐
H. Evacuation(s) in Progress	☐
I. Shelter-in-Place in Progress	☐
J. Repopulation in Progress	☐
K. Mass Immunization in Progress	☐
L. Mass Immunization Complete	☐
M. Quarantine in Progress	☐
N. Area Restriction in Effect	☐
	☐
	☐
	☐
	☐

36. Projected Incident Activity, Potential, Movement, Escalation, or Spread and influencing factors during the next operational period and in 12-, 24-, 48-, and 72-hour timeframes:

12 hours:

24 hours:

48 hours:

72 hours:

Anticipated after 72 hours:

37. Strategic Objectives (define planned end-state for incident)**:**

** Required when applicable.*

INCIDENT STATUS SUMMARY (ICS 209)

*1. Incident Name:	2. Incident Number:

Additional Incident Decision Support Information *(continued)*

38. Current Incident Threat Summary and Risk Information in 12-, 24-, 48-, and 72-hour timeframes and beyond. Summarize primary incident threats to life, property, communities and community stability, residences, health care facilities, other critical infrastructure and key resources, commercial facilities, natural and environmental resources, cultural resources, and continuity of operations and/or business. Identify corresponding incident-related potential economic or cascading impacts.

12 hours:

24 hours:

48 hours:

72 hours:

Anticipated after 72 hours:

39. Critical Resource Needs in 12-, 24-, 48-, and 72-hour timeframes and beyond to meet critical incident objectives. List resource category, kind, and/or type, and amount needed, in priority order:

12 hours:

24 hours:

48 hours:

72 hours:

Anticipated after 72 hours:

40. Strategic Discussion: Explain the relation of overall strategy, constraints, and current available information to:

1) critical resource needs identified above,
2) the Incident Action Plan and management objectives and targets,
3) anticipated results.

Explain major problems and concerns such as operational challenges, incident management problems, and social, political, economic, or environmental concerns or impacts.

41. Planned Actions for Next Operational Period:

42. Projected Final Incident Size/Area (use unit label – e.g., "sq mi")**:**

43. Anticipated Incident Management Completion Date:

44. Projected Significant Resource Demobilization Start Date:

45. Estimated Incident Costs to Date:

46. Projected Final Incident Cost Estimate:

47. Remarks (or continuation of any blocks above – list block number in notation)**:**

** Required when applicable.*

INCIDENT STATUS SUMMARY (ICS 209)

1. Incident Name:	2. Incident Number:

Incident Resource Commitment Summary

48. Agency or Organization:	49. **Resources** (summarize resources by category, kind, and/or type; show # of resources on top ½ of box, show # of personnel associated with resource on bottom ½ of box)**:**																					50. **Additional Personnel** not assigned to a resource**:**	51. **Total Personnel** (includes those associated with resources – e.g., aircraft or engines – *and* individual overhead)**:**
52. Total Resources																							

53. Additional Cooperating and Assisting Organizations Not Listed Above:

ICS 209, Page ___ of ___	** Required when applicable.*

ICS 209
Incident Status Summary

Purpose. The ICS 209 is used for reporting information on significant incidents. It is not intended for every incident, as most incidents are of short duration and do not require scarce resources, significant mutual aid, or additional support and attention. **T**he ICS 209 contains basic information elements needed to support decisionmaking at all levels above the incident to support the incident. Decisionmakers may include the agency having jurisdiction, but also all multiagency coordination system (MACS) elements and parties, such as cooperating and assisting agencies/organizations, dispatch centers, emergency operations centers, administrators, elected officials, and local, tribal, county, State, and Federal agencies. Once ICS 209 information has been submitted from the incident, decisionmakers and others at all incident support and coordination points may transmit and share the information (based on its sensitivity and appropriateness) for access and use at local, regional, State, and national levels as it is needed to facilitate support.

Accurate and timely completion of the ICS 209 is necessary to identify appropriate resource needs, determine allocation of limited resources when multiple incidents occur, and secure additional capability when there are limited resources due to constraints of time, distance, or other factors. The information included on the ICS 209 influences the priority of the incident, and thus its share of available resources and incident support.

The ICS 209 is designed to provide a "snapshot in time" to effectively move incident decision support information where it is needed. It should contain the most accurate and up-to-date information available at the time it is prepared. However, readers of the ICS 209 may have access to more up-to-date or real-time information in reference to certain information elements on the ICS 209. Coordination among communications and information management elements within ICS and among MACS should delineate authoritative sources for more up-to-date and/or real-time information when ICS 209 information becomes outdated in a quickly evolving incident.

Reporting Requirements. The ICS 209 is intended to be used when an incident reaches a certain threshold where it becomes significant enough to merit special attention, require additional resource support needs, or cause media attention, increased public safety threat, etc. Agencies or organizations may set reporting requirements and, therefore, ICS 209s should be completed according to each jurisdiction or discipline's policies, mobilization guide, or preparedness plans. It is recommended that consistent ICS 209 reporting parameters be adopted and used by jurisdictions or disciplines for consistency over time, documentation, efficiency, trend monitoring, incident tracking, etc.

For example, an agency or MAC (Multiagency Coordination) Group may require the submission of an initial ICS 209 when a new incident has reached a certain predesignated level of significance, such as when a given number of resources are committed to the incident, when a new incident is not completed within a certain timeframe, or when impacts/threats to life and safety reach a given level.

Typically, ICS 209 forms are completed either once daily or for each operational period – in addition to the initial submission. Jurisdictional or organizational guidance may indicate frequency of ICS 209 submission for particular definitions of incidents or for all incidents. This specific guidance may help determine submission timelines when operational periods are extremely short (e.g., 2 hours) and it is not necessary to submit new ICS 209 forms for all operational periods.

Any plans or guidelines should also indicate parameters for when it is appropriate to stop submitting ICS 209s for an incident, based upon incident activity and support levels.

Preparation. When an Incident Management Organization (such as an Incident Management Team) is in place, the Situation Unit Leader or Planning Section Chief prepares the ICS 209 at the incident. On other incidents, the ICS 209 may be completed by a dispatcher in the local communications center, or by another staff person or manager. This form should be completed at the incident or at the closest level to the incident.

The ICS 209 should be completed with the best possible, currently available, and verifiable information at the time it is completed and signed.

This form is designed to serve incidents impacting specific geographic areas that can easily be defined. It also has the flexibility for use on ubiquitous events, or those events that cover extremely large areas and that may involve many jurisdictions and ICS organizations. For these incidents, it will be useful to clarify on the form exactly which portion of the larger incident the ICS 209 is meant to address. For example, a particular ICS 209 submitted during a statewide outbreak of mumps may be relevant only to mumps-related activities in Story County, Iowa. This can be indicated in both the incident name, Block 1, and in the Incident Location Information section in Blocks 16–26.

While most of the "Incident Location Information" in Blocks 16–26 is optional, the more information that can be submitted, the better. Submission of multiple location indicators increases accuracy, improves interoperability, and increases information sharing between disparate systems. Preparers should be certain to follow accepted protocols or standards when entering location information, and clearly label all location information. As with other ICS 209 data, geospatial information may be widely shared and utilized, so accuracy is essential.

If electronic data is submitted with the ICS 209, do not attach or send extremely large data files. Incident geospatial data that is distributed with the ICS 209 should be in simple incident geospatial basics, such as the incident perimeter, point of origin, etc. Data file sizes should be small enough to be easily transmitted through dial-up connections or other limited communications capabilities when ICS 209 information is transmitted electronically. Any attached data should be clearly labeled as to format content and collection time, and should follow existing naming conventions and standards.

Distribution. ICS 209 information is meant to be completed at the level as close to the incident as possible, preferably at the incident. Once the ICS 209 has been submitted outside the incident to a dispatch center or MACS element, it may subsequently be transmitted to various incident supports and coordination entities based on the support needs and the decisions made within the MACS in which the incident occurs.

Coordination with public information system elements and investigative/intelligence information organizations at the incident and within MACS is essential to protect information security and to ensure optimal information sharing and coordination. There may be times in which particular ICS 209s contain sensitive information that should not be released to the public (such as information regarding active investigations, fatalities, etc.). When this occurs, the ICS 209 (or relevant sections of it) should be labeled appropriately, and care should be taken in distributing the information within MACS.

All completed and signed original ICS 209 forms MUST be given to the incident's Documentation Unit and/or maintained as part of the official incident record.

Notes:

- To promote flexibility, only a limited number of ICS 209 blocks are typically required, and most of those are required only when applicable.
- Most fields are optional, to allow responders to use the form as best fits their needs and protocols for information collection.
- For the purposes of the ICS 209, responders are those personnel who are assigned to an incident or who are a part of the response community as defined by NIMS. This may include critical infrastructure owners and operators, nongovernmental and nonprofit organizational personnel, and contract employees (such as caterers), depending on local/jurisdictional/discipline practices.
- For additional flexibility only pages 1–3 are numbered, for two reasons:
  - Possible submission of additional pages for the Remarks Section (Block 47), and
  - Possible submission of additional copies of the fourth/last page (the "Incident Resource Commitment Summary") to provide a more detailed resource summary.

Block Number	Block Title	Instructions
***1**	**Incident Name**	**REQUIRED BLOCK.** • Enter the full name assigned to the incident. • Check spelling of the full incident name. • For an incident that is a Complex, use the word "Complex" at the end of the incident name. • If the name changes, explain comments in Remarks, Block 47. • Do not use the same incident name for different incidents in the same calendar year.

Block Number	Block Title	Instructions
2	**Incident Number**	• Enter the appropriate number based on current guidance. The incident number may vary by jurisdiction and discipline. • Examples include: o A computer-aided dispatch (CAD) number. o An accounting number. o A county number. o A disaster declaration number. o A combination of the State, unit/agency ID, and a dispatch system number. o A mission number. o Any other unique number assigned to the incident and derived by means other than those above. • Make sure the number entered is correct. • Do not use the same incident number for two different incidents in the same calendar year. • Incident numbers associated with host jurisdictions or agencies and incident numbers assigned by agencies represented in Unified Command should be listed, or indicated in Remarks, Block 47.
***3**	**Report Version** (check one box on left)	**REQUIRED BLOCK.** • This indicates the current version of the ICS 209 form being submitted. • If only one ICS 209 will be submitted, check BOTH "Initial" and "Final" (or check only "Final").
	☐ Initial	Check "Initial" if this is the first ICS 209 for this incident.
	☐ Update	Check "Update" if this is a subsequent report for the same incident. These can be submitted at various time intervals (see "Reporting Requirements" above).
	☐ Final	• Check "Final" if this is the last ICS 209 to be submitted for this incident (usually when the incident requires only minor support that can be supplied by the organization having jurisdiction). • Incidents may also be marked as "Final" if they become part of a new Complex (when this occurs, it can be indicated in Remarks, Block 47).
	Report # (if used)	Use this optional field if your agency or organization requires the tracking of ICS 209 report numbers. Agencies may also track the ICS 209 by the date/time submitted.
***4**	**Incident Commander(s) & Agency or Organization**	**REQUIRED BLOCK.** • Enter both the first and last name of the Incident Commander. • If the incident is under a Unified Command, list all Incident Commanders by first initial and last name separated by a comma, including their organization. For example: L. Burnett – Minneapolis FD, R. Domanski – Minneapolis PD, C. Taylor – St. Paul PD, Y. Martin – St. Paul FD, S. McIntyre – U.S. Army Corps, J. Hartl – NTSB
5	**Incident Management Organization**	Indicate the incident management organization for the incident, which may be a Type 1, 2, or 3 Incident Management Team (IMT), a Unified Command, a Unified Command with an IMT, etc. This block should not be completed unless a recognized incident management organization is assigned to the incident.

Block Number	Block Title	Instructions
*6	**Incident Start Date/Time**	**REQUIRED.** This is always the start date and time of the incident (not the report date and time or operational period).
	Date	Enter the start date (month/day/year).
	Time	Enter the start time (using the 24-hour clock).
	Time Zone	Enter the time zone of the incident (e.g., EDT, PST).
7	**Current Incident Size or Area Involved** (use unit label – e.g., "sq mi," "city block")	• Enter the appropriate incident descriptive size or area involved (acres, number of buildings, square miles, hectares, square kilometers, etc.). • Enter the total area involved for incident Complexes in this block, and list each sub-incident and size in Remarks (Block 47). • Indicate that the size is an estimate, if a more specific figure is not available. • Incident size may be a population figure rather than a geographic figure, depending on the incident definition and objectives. • If the incident involves more than one jurisdiction or mixed ownership, agencies/organizations may require listing a size breakdown by organization, or including this information in Remarks (Block 47). • The incident may be one part of a much larger event (refer to introductory instructions under "Preparation). Incident size/area depends on the area actively managed within the incident objectives and incident operations, and may also be defined by a delegation of authority or letter of expectation outlining management bounds.
8	**Percent (%) Contained or Completed** (circle one)	• Enter the percent that this incident is completed or contained (e.g., 50%), with a % label. • For example, a spill may be 65% contained, or flood response objectives may be 50% met.
*9	**Incident Definition**	**REQUIRED BLOCK.** Enter a general definition of the incident in this block. This may be a general incident category or kind description, such as "tornado," "wildfire," "bridge collapse," "civil unrest," "parade," "vehicle fire," "mass casualty," etc.
10	**Incident Complexity Level**	Identify the incident complexity level as determined by Unified/Incident Commanders, if available or used.
*11	**For Time Period**	**REQUIRED BLOCK.** • Enter the time interval for which the form applies. This period should include all of the time since the last ICS 209 was submitted, or if it is the initial ICS 209, it should cover the time lapsed since the incident started. • The time period may include one or more operational periods, based on agency/organizational reporting requirements.
	From Date/Time	• Enter the start date (month/day/year). • Enter the start time (using the 24-hour clock).
	To Date/Time	• Enter the end date (month/day/year). • Enter the end time (using the 24-hour clock).

Block Number	Block Title	Instructions
APPROVAL & ROUTING INFORMATION		
***12**	**Prepared By**	**REQUIRED BLOCK.** When an incident management organization is in place, this would be the Situation Unit Leader or Planning Section Chief at the incident. On other incidents, it could be a dispatcher in the local emergency communications center, or another staff person or manager.
	Print Name	Print the name of the person preparing the form.
	ICS Position	The ICS title of the person preparing the form (e.g., "Situation Unit Leader").
	Date/Time Prepared	Enter the date (month/day/year) and time (using the 24-hour clock) the form was prepared. Enter the time zone if appropriate.
***13**	**Date/Time Submitted**	**REQUIRED.** Enter the submission date (month/day/year) and time (using the 24-hour clock).
	Time Zone	Enter the time zone from which the ICS 209 was submitted (e.g., EDT, PST).
***14**	**Approved By**	**REQUIRED.** When an incident management organization is in place, this would be the Planning Section Chief or Incident Commander at the incident. On other incidents, it could be the jurisdiction's dispatch center manager, organizational administrator, or other manager.
	Print Name	Print the name of the person approving the form.
	ICS Position	The position of the person signing the ICS 209 should be entered (e.g., "Incident Commander").
	Signature	Signature of the person approving the ICS 209, typically the Incident Commander. The original signed ICS 209 should be maintained with other incident documents.
***15**	**Primary Location, Organization, or Agency Sent To**	**REQUIRED BLOCK.** Enter the appropriate primary location or office the ICS 209 was sent to apart from the incident. This most likely is the entity or office that ordered the incident management organization that is managing the incident. This may be a dispatch center or a MACS element such as an emergency operations center. If a dispatch center or other emergency center prepared the ICS 209 for the incident, indicate where it was submitted initially.
INCIDENT LOCATION INFORMATION		
• Much of the "Incident Location Information" in Blocks 16–26 is optional, but completing as many fields as possible increases accuracy, and improves interoperability and information sharing between disparate systems. • As with all ICS 209 information, accuracy is essential because the information may be widely distributed and used in a variety of systems. Location and/or geospatial data may be used for maps, reports, and analysis by multiple parties outside the incident. • Be certain to follow accepted protocols, conventions, or standards where appropriate when submitting location information, and clearly label all location information. • Incident location information is usually based on the point of origin of the incident, and the majority of the area where the incident jurisdiction is.		
***16**	**State**	**REQUIRED BLOCK WHEN APPLICABLE.** • Enter the State where the incident originated. • If other States or jurisdictions are involved, enter them in Block 25 or Block 44.

Block Number	Block Title	Instructions
***17**	**County / Parish / Borough**	**REQUIRED BLOCK WHEN APPLICABLE.** • Enter the county, parish, or borough where the incident originated. • If other counties or jurisdictions are involved, enter them in Block 25 or Block 47.
***18**	**City**	**REQUIRED BLOCK WHEN APPLICABLE.** • Enter the city where the incident originated. • If other cities or jurisdictions are involved, enter them in Block 25 or Block 47.
19	**Unit or Other**	Enter the unit, sub-unit, unit identification (ID) number or code (if used), or other information about where the incident originated. This may be a local identifier that indicates primary incident jurisdiction or responsibility (e.g., police, fire, public works, etc.) or another type of organization. Enter specifics in Block 25.
***20**	**Incident Jurisdiction**	**REQUIRED BLOCK WHEN APPLICABLE.** Enter the jurisdiction where the incident originated (the entry may be general, such as Federal, city, or State, or may specifically identify agency names such as Warren County, U.S. Coast Guard, Panama City, NYPD).
21	**Incident Location Ownership** (if different than jurisdiction)	• When relevant, indicate the ownership of the area where the incident originated, especially if it is different than the agency having jurisdiction. • This may include situations where jurisdictions contract for emergency services, or where it is relevant to include ownership by private entities, such as a large industrial site.
22	**22. Longitude** (indicate format)**:** **Latitude** (indicate format)**:**	• Enter the longitude and latitude where the incident originated, if available and normally used by the authority having jurisdiction for the incident. • Clearly label the data, as longitude and latitude can be derived from various sources. For example, if degrees, minutes, and seconds are used, label as "33 degrees, 45 minutes, 01 seconds."
23	**US National Grid Reference**	• Enter the US National Grid (USNG) reference where the incident originated, if available and commonly used by the agencies/jurisdictions with primary responsibility for the incident. • Clearly label the data.
24	**Legal Description** (township, section, range)	• Enter the legal description where the incident originated, if available and commonly used by the agencies/jurisdictions with primary responsibility for the incident. • Clearly label the data (e.g., N 1/2 SE 1/4, SW 1/4, S24, T32N, R18E).
***25**	**Short Location or Area Description** (list all affected areas or a reference point)	**REQUIRED BLOCK.** • List all affected areas as described in instructions for Blocks 16–24 above, OR summarize a general location, OR list a reference point for the incident (e.g., "the southern third of Florida," "in ocean 20 miles west of Catalina Island, CA," or "within a 5 mile radius of Walden, CO"). • This information is important for readers unfamiliar with the area (or with other location identification systems) to be able to quickly identify the general location of the incident on a map. • Other location information may also be listed here if needed or relevant for incident support (e.g., base meridian).
26	**UTM Coordinates**	Indicate Universal Transverse Mercator reference coordinates if used by the discipline or jurisdiction.

Block Number	Block Title	Instructions
27	**Note any electronic geospatial data included or attached** (indicate data format, content, and collection time information and labels)	• Indicate whether and how geospatial data is included or attached. • Utilize common and open geospatial data standards. • WARNING: Do not attach or send extremely large data files with the ICS 209. Incident geospatial data that is distributed with the ICS 209 should be simple incident geospatial basics, such as the incident perimeter, origin, etc. Data file sizes should be small enough to be easily transmitted through dial-up connections or other limited communications capabilities when ICS 209 information is transmitted electronically. • NOTE: Clearly indicate data content. For example, data may be about an incident perimeter (such as a shape file), the incident origin (a point), a point and radius (such as an evacuation zone), or a line or lines (such as a pipeline). • NOTE: Indicate the data format (e.g., .shp, .kml, .kmz, or .gml file) and any relevant information about projection, etc. • NOTE: Include a hyperlink or other access information if incident map data is posted online or on an FTP (file transfer protocol) site to facilitate downloading and minimize information requests. • NOTE: Include a point of contact for getting geospatial incident information, if included in the ICS 209 or available and supporting the incident.
INCIDENT SUMMARY		
***28**	**Significant Events for the Time Period Reported** (summarize significant progress made, evacuations, incident growth, etc.)	**REQUIRED BLOCK.** • Describe significant events that occurred during the period being reported in Block 6. Examples include: o Road closures. o Evacuations. o Progress made and accomplishments. o Incident command transitions. o Repopulation of formerly evacuated areas and specifics. o Containment. • Refer to other blocks in the ICS 209 when relevant for additional information (e.g., "Details on evacuations may be found in Block 33"), or in Remarks, Block 47. • Be specific and detailed in reference to events. For example, references to road closures should include road number and duration of closure (or include further detail in Block 33). Use specific metrics if needed, such as the number of people or animals evacuated, or the amount of a material spilled and/or recovered. • This block may be used for a single-paragraph synopsis of overall incident status.
29	**Primary Materials or Hazards Involved** (hazardous chemicals, fuel types, infectious agents, radiation, etc.)	• When relevant, enter the appropriate primary materials, fuels, or other hazards involved in the incident that are leaking, burning, infecting, or otherwise influencing the incident. • Examples include hazardous chemicals, wildland fuel models, biohazards, explosive materials, oil, gas, structural collapse, avalanche activity, criminal activity, etc.
	Other	Enter any miscellaneous issues which impacted Critical Infrastructure and Key Resources.

Block Number	Block Title	Instructions
30	**Damage Assessment Information** (summarize damage and/or restriction of use or availability to residential or commercial property, natural resources, critical infrastructure and key resources, etc.)	• Include a short summary of damage or use/access restrictions/ limitations caused by the incident for the reporting period, and cumulatively. • Include if needed any information on the facility status, such as operational status, if it is evacuated, etc. when needed. • Include any critical infrastructure or key resources damaged/destroyed/ impacted by the incident, the kind of infrastructure, and the extent of damage and/or impact and any known cascading impacts. • Refer to more specific or detailed damage assessment forms and packages when they are used and/or relevant.
	A. Structural Summary	Complete this table as needed based on the definitions for 30B–F below. Note in table or in text block if numbers entered are estimates or are confirmed. Summaries may also include impact to Shoreline and Wildlife, etc.
	B. # Threatened (72 hrs)	Enter the number of structures potentially threatened by the incident within the next 72 hours, based on currently available information.
	C. # Damaged	Enter the number of structures damaged by the incident.
	D. # Destroyed	Enter the number of structures destroyed beyond repair by the incident.
	E. Single Residences	Enter the number of single dwellings/homes/units impacted in Columns 30B–D. Note any specifics in the text block if needed, such as type of residence (apartments, condominiums, single-family homes, etc.).
	F. Nonresidential Commercial Properties	Enter the number of buildings or units impacted in Columns 30B–D. This includes any primary structure used for nonresidential purposes, excluding Other Minor Structures (Block 30G). Note any specifics regarding building or unit types in the text block.
	Other Minor Structures	Enter any miscellaneous structures impacted in Columns 30B–D not covered in 30E–F above, including any minor structures such as booths, sheds, or outbuildings.
	Other	Enter any miscellaneous issues which impacted Critical Infrastructure and Key Resources.

Block Number	Block Title	Instructions
ADDITIONAL INCIDENT DECISION SUPPORT INFORMATION (PAGE 2)		
***31**	**Public Status Summary**	• This section is for summary information regarding incident-related injuries, illness, and fatalities for civilians (or members of the public); see 31C–N below. • Explain or describe the nature of any reported injuries, illness, or other activities in Life, Safety, and Health Status/Threat Remarks (Block 33). • Illnesses include those that may be caused through a biological event such as an epidemic or an exposure to toxic or radiological substances. • NOTE: *Do not estimate any fatality information*. • NOTE: Please use caution when reporting information in this section that may be on the periphery of the incident or change frequently. This information should be reported as accurately as possible as a snapshot in time, as much of the information is subject to frequent change. • NOTE: Do not complete this block if the incident covered by the ICS 209 is *not directly responsible* for these actions (such as evacuations, sheltering, immunizations, etc.) *even if they are related to the incident*. o Only the authority having jurisdiction should submit reports for these actions, to mitigate multiple/conflicting reports. o For example, if managing evacuation shelters is part of the incident operation itself, do include these numbers in Block 31J with any notes in Block 33. • NOTE: When providing an estimated value, denote in parenthesis: "est." **Handling Sensitive Information** • Release of information in this section should be carefully coordinated within the incident management organization to ensure synchronization with public information and investigative/intelligence actions. • Thoroughly review the "Distribution" section in the introductory ICS 209 instructions for details on handling sensitive information. Use caution when providing information in any situation involving fatalities, and verify that appropriate notifications have been made prior to release of this information. Electronic transmission of any ICS 209 may make information available to many people and networks at once. • Information regarding fatalities should be cleared with the Incident Commander and/or an organizational administrator prior to submission of the ICS 209.
	A. # This Reporting Period	Enter the total number of individuals impacted in each category for this reporting period (since the previous ICS 209 was submitted).
	B. Total # to Date	• Enter the total number of individuals impacted in each category for the entire duration of the incident. • This is a cumulative total number that should be adjusted each reporting period.
	C. Indicate Number of Civilians (Public) Below	• For lines 31D–M below, enter the number of civilians affected for each category. • Indicate if numbers are estimates, for those blocks where this is an option. • Civilians are those members of the public who are affected by the incident, but who are not included as part of the response effort through Unified Command partnerships and those organizations and agencies assisting and cooperating with response efforts.
	D. Fatalities	• Enter the number of *confirmed* civilian/public fatalities. • See information in introductory instructions ("Distribution") and in Block 31 instructions regarding sensitive handling of fatality information.

Block Number	Block Title	Instructions
	E. With Injuries/Illness	Enter the number of civilian/public injuries or illnesses directly related to the incident. Injury or illness is defined by the incident or jurisdiction(s).
***31** (continued)	F. Trapped/In Need of Rescue	Enter the number of civilians who are trapped or in need of rescue due to the incident.
	G. Missing (note if estimated)	Enter the number of civilians who are missing due to the incident. Indicate if an estimate is used.
	H. Evacuated (note if estimated)	Enter the number of civilians who are evacuated due to the incident. These are likely to be best estimates, but indicate if they are estimated.
	I. Sheltering-in-Place (note if estimated)	Enter the number of civilians who are sheltering in place due to the incident. Indicate if estimates are used.
	J. In Temporary Shelters (note if estimated)	Enter the number of civilians who are in temporary shelters as a direct result of the incident, noting if the number is an estimate.
	K. Have Received Mass Immunizations	Enter the number of civilians who have received mass immunizations due to the incident and/or as part of incident operations. Do not estimate.
	L. Require Mass Immunizations (note if estimated)	Enter the number of civilians who require mass immunizations due to the incident and/or as part of incident operations. Indicate if it is an estimate.
	M. In Quarantine	Enter the number of civilians who are in quarantine due to the incident and/or as part of incident operations. Do not estimate.
	N. Total # Civilians (Public) Affected	Enter sum totals for Columns 31A and 31B for Rows 31D–M.
***32**	**Responder Status Summary**	• This section is for summary information regarding incident-related injuries, illness, and fatalities for responders; see 32C–N. • Illnesses include those that may be related to a biological event such as an epidemic or an exposure to toxic or radiological substances directly in relation to the incident. • Explain or describe the nature of any reported injuries, illness, or other activities in Block 33. • NOTE: *Do not estimate any fatality information or responder status information.* • NOTE: Please use caution when reporting information in this section that may be on the periphery of the incident or change frequently. This information should be reported as accurately as possible as a snapshot in time, as much of the information is subject to frequent change. • NOTE: Do not complete this block if the incident covered by the ICS 209 is *not directly responsible* for these actions (such as evacuations, sheltering, immunizations, etc.) even if they are related to the incident. Only the authority having jurisdiction should submit reports for these actions, to mitigate multiple/conflicting reports. **Handling Sensitive Information** • Release of information in this section should be carefully coordinated within the incident management organization to ensure synchronization with public information and investigative/intelligence actions. • Thoroughly review the "Distribution" section in the introductory ICS 209 instructions for details on handling sensitive information. Use caution when providing information in any situation involving fatalities, and verify that appropriate notifications have been made prior to release of this information. Electronic transmission of any ICS 209 may make information available to many people and networks at once. • Information regarding fatalities should be cleared with the Incident Commander and/or an organizational administrator prior to submission of the ICS 209.

Block Number	Block Title	Instructions
***32** (continued)	A. # This Reporting Period	Enter the total number of responders impacted in each category for this reporting period (since the previous ICS 209 was submitted).
	B. Total # to Date	• Enter the total number of individuals impacted in each category for the *entire duration* of the incident. • This is a *cumulative* total number that should be adjusted each reporting period.
	C. Indicate Number of Responders Below	• For lines 32D–M below, enter the number of responders relevant for each category. • Responders are those personnel included as part of Unified Command partnerships and those organizations and agencies assisting and cooperating with response efforts.
	D. Fatalities	• Enter the number of *confirmed* responder fatalities. • See information in introductory instructions ("Distribution") and for Block 32 regarding sensitive handling of fatality information.
	E. With Injuries/Illness	• Enter the number of incident responders with serious injuries or illnesses due to the incident. • *For responders, serious injuries or illness are typically those in which the person is unable to continue to perform in his or her incident assignment,* but the authority having jurisdiction may have additional guidelines on reporting requirements in this area.
	F. Trapped/In Need Of Rescue	Enter the number of incident responders who are in trapped or in need of rescue due to the incident.
	G. Missing	Enter the number of incident responders who are missing due to incident conditions.
	H.	(BLANK; use however is appropriate.)
	I. Sheltering in Place	Enter the number of responders who are sheltering in place due to the incident. Once responders become the victims, this needs to be noted in Block 33 or Block 47 and handled accordingly.
	J.	(BLANK; use however is appropriate.)
	L. Require Immunizations	Enter the number of responders who require immunizations due to the incident and/or as part of incident operations.
	M. In Quarantine	Enter the number of responders who are in quarantine as a direct result of the incident and/or related to incident operations.
	N. Total # Responders Affected	Enter sum totals for Columns 32A and 32B for Rows 32D–M.
33	**Life, Safety, and Health Status/Threat Remarks**	• Enter any details needed for Blocks 31, 32, and 34. Enter any specific comments regarding illness, injuries, fatalities, and threat management for this incident, such as whether estimates were used for numbers given in Block 31. • This information should be reported as accurately as possible as a snapshot in time, as much of the information is subject to frequent change. • Evacuation information can be very sensitive to local residents and officials. Be accurate in the assessment. • Clearly note primary responsibility and contacts for any activities or information in Blocks 31, 32, and 34 that may be caused by the incident, but that are being managed and/or reported by other parties. • Provide additional explanation or information as relevant in Blocks 28, 36, 38, 40, 41, or in Remarks (Block 47).

Block Number	Block Title	Instructions
***34**	**Life, Safety, and Health Threat Management**	Note any details in Life, Safety, and Health Status/Threat Remarks (Block 33), and provide additional explanation or information as relevant in Blocks 28, 36, 38, 40, 41, or in Remarks (Block 47). Additional pages may be necessary for notes.
	A. Check if Active	Check any applicable blocks in 34C–P based on currently available information regarding incident activity and potential.
	B. Notes	Note any specific details, or include in Block 33.
	C. No Likely Threat	Check if there is no likely threat to life, health, and safety.
	D. Potential Future Threat	Check if there is a potential future threat to life, health, and safety.
	E. Mass Notifications In Progress	• Check if there are any mass notifications in progress regarding emergency situations, evacuations, shelter in place, or other public safety advisories related to this incident. • These may include use of threat and alert systems such as the Emergency Alert System or a “reverse 911” system. • Please indicate the areas where mass notifications have been completed (e.g., “mass notifications to ZIP codes 50201, 50014, 50010, 50011,” or “notified all residents within a 5-mile radius of Gatlinburg”).
	F. Mass Notifications Completed	Check if actions referred to in Block 34E above have been completed.
	G. No Evacuation(s) Imminent	Check if evacuations are not anticipated in the near future based on current information.
	H. Planning for Evacuation	Check if evacuation planning is underway in relation to this incident.
	I. Planning for Shelter-in-Place	Check if planning is underway for shelter-in-place activities related to this incident.
	J. Evacuation(s) in Progress	Check if there are active evacuations in progress in relation to this incident.
	K. Shelter-In-Place in Progress	Check if there are active shelter-in-place actions in progress in relation to this incident.
	L. Repopulation in Progress	Check if there is an active repopulation in progress related to this incident.
	M. Mass Immunization in Progress	Check if there is an active mass immunization in progress related to this incident.
	N. Mass Immunization Complete	Check if a mass immunization effort has been completed in relation to this incident.
	O. Quarantine in Progress	Check if there is an active quarantine in progress related to this incident.
	P. Area Restriction in Effect	Check if there are any restrictions in effect, such as road or area closures, especially those noted in Block 28.

Block Number	Block Title	Instructions
35	**Weather Concerns** (synopsis of current and predicted weather; discuss related factors that may cause concern)	• Complete a short synopsis/discussion on significant weather factors that could cause concerns for the incident when relevant. • Include current and/or predicted weather factors, and the timeframe for predictions. • Include relevant factors such as: o Wind speed (label units, such as mph). o Wind direction (clarify and label where wind is coming from and going to in plain language – e.g., "from NNW," "from E," or "from SW"). o Temperature (label units, such as F). o Relative humidity (label %). o Watches. o Warnings. o Tides. o Currents. • Any other weather information relative to the incident, such as flooding, hurricanes, etc.
36	**Projected Incident Activity, Potential, Movement, Escalation, or Spread** and influencing factors during the next operational period and in 12-, 24-, 48-, and 72-hour timeframes **12 hours** **24 hours** **48 hours** **72 hours** **Anticipated after 72 hours**	• Provide an estimate (when it is possible to do so) of the direction/scope in which the incident is expected to spread, migrate, or expand during the next indicated operational period, or other factors that may cause activity changes. • Discuss incident potential relative to values at risk, or values to be protected (such as human life), and the potential changes to those as the incident changes. • Include an estimate of the acreage or area that will likely be affected. • If known, provide the above information in 12-, 24-, 48- and 72-hour timeframes, and any activity anticipated after 72 hours.
37	**Strategic Objectives** (define planned end-state for incident)	Briefly discuss the desired outcome for the incident based on currently available information. Note any high-level objectives and any possible strategic benefits as well (especially for planned events).

Block Number	Block Title	Instructions
ADDITIONAL INCIDENT DECISION SUPPORT INFORMATION (continued) **(PAGE 3)**		
38	**Current Incident Threat Summary and Risk Information in 12-, 24-, 48-, and 72-hour timeframes and beyond.** Summarize primary incident threats to life, property, communities and community stability, residences, health care facilities, other critical infrastructure and key resources, commercial facilities, natural and environmental resources, cultural resources, and continuity of operations and/or business. Identify corresponding incident-related potential economic or cascading impacts. **12 hours** **24 hours** **48 hours** **72 hours** **Anticipated after 72 hours**	Summarize major or significant threats due to incident activity based on currently available information. Include a breakdown of threats in terms of 12-, 24-, 48-, and 72-hour timeframes.

Block Number	Block Title	Instructions
39	**Critical Resource Needs** in 12-, 24-, 48-, and 72-hour timeframes and beyond to meet critical incident objectives. List resource category, kind, and/or type, and amount needed, in priority order: **12 hours** **24 hours** **48 hours** **72 hours** **Anticipated after 72 hours**	• List the specific critical resources and numbers needed, in order of priority. *Be specific as to the need.* • Use plain language and common terminology for resources, and indicate resource category, kind, and type (if available or known) to facilitate incident support. • If critical resources are listed in this block, there should be corresponding orders placed for them through appropriate resource ordering channels. • Provide critical resource needs in 12-, 24-, 48- and 72-hour increments. List the most critical resources needed for each timeframe, if needs have been identified for each timeframe. Listing critical resources by the time they are needed gives incident support personnel a "heads up" for short-range planning, and assists the ordering process to ensure these resources will be in place when they are needed. • More than one resource need may be listed for each timeframe. For example, a list could include: o 24 hrs: 3 Type 2 firefighting helicopters, 2 Type I Disaster Medical Assistance Teams o 48 hrs: Mobile Communications Unit (Law/Fire) o After 72 hrs: 1 Type 2 Incident Management Team • Documentation in the ICS 209 can help the incident obtain critical regional or national resources through outside support mechanisms including multiagency coordination systems and mutual aid. o Information provided in other blocks on the ICS 209 can help to support the need for resources, including Blocks 28, 29, 31–38, and 40–42. o Additional comments in the Remarks section (Block 47) can also help explain what the incident is requesting and why it is critical (for example, "Type 2 Incident Management Team is needed in three days to transition command when the current Type 2 Team times out"). • Do not use this block for noncritical resources.
40	**Strategic Discussion: Explain the relation of overall strategy, constraints, and current available information to:** 1) critical resource needs identified above, 2) the Incident Action Plan and management objectives and targets, 3) anticipated results. **Explain major problems and concerns such as operational challenges, incident management problems, and social, political, economic, or environmental concerns or impacts.**	• Wording should be consistent with Block 39 to justify critical resource needs, which should relate to planned actions in the Incident Action Plan. • Give a short assessment of the likelihood of meeting the incident management targets, given the current management strategy and currently known constraints. • Identify when the chosen management strategy will succeed given the current constraints. Adjust the anticipated incident management completion target in Block 43 as needed based on this discussion. • Explain major problems and concerns as indicated.

Block Number	Block Title	Instructions
41	**Planned Actions for Next Operational Period**	• Provide a short summary of actions planned for the next operational period. • Examples: o "The current Incident Management Team will transition out to a replacement IMT." o "Continue to review operational/ engineering plan to facilitate removal of the partially collapsed west bridge supports." o "Continue refining mapping of the recovery operations and damaged assets using GPS." o "Initiate removal of unauthorized food vendors."
42	**Projected Final Incident Size/Area** (use unit label – e.g., "sq mi")	• Enter an estimate of the total area likely to be involved or affected over the course of the incident. • Label the estimate of the total area or population involved, affected, or impacted with the relevant units such as acres, hectares, square miles, etc. • Note that total area involved may not be limited to geographic area (see previous discussions regarding incident definition, scope, operations, and objectives). Projected final size may involve a population rather than a geographic area.
43	**Anticipated Incident Management Completion Date**	• Enter the date (month/day/year) at which time it is expected that incident objectives will be met. This is often explained similar to incident containment or control, or the time at which the incident is expected to be closed or when significant incident support will be discontinued. • Avoid leaving this block blank if possible, as this is important information for managers.
44	**Projected Significant Resource Demobilization Start Date**	Enter the date (month/day/year) when initiation of significant resource demobilization is anticipated.
45	**Estimated Incident Costs to Date**	• Enter the estimated total incident costs to date for the entire incident based on currently available information. • Incident costs include estimates of all costs for the response, including all management and support activities per discipline, agency, or organizational guidance and policy. • This does not include damage assessment figures, as they are impacts from the incident and not response costs. • If costs decrease, explain in Remarks (Block 47). • If additional space is required, please add as an attachment.
46	**Projected Final Incident Cost Estimate**	• Enter an estimate of the total costs for the incident once all costs have been processed based on current spending and projected incident potential, per discipline, agency, or organizational guidance and policy. This is often an estimate of daily costs combined with incident potential information. • This does not include damage assessment figures, as they are impacts from the incident and not response costs. • If additional space is required, please add as an attachment.

Block Number	Block Title	Instructions
47	**Remarks** (or continuation of any blocks above – list block number in notation)	• Use this block to expand on information that has been entered in previous blocks, or to include other pertinent information that has not been previously addressed. • List the block number for any information continued from a previous block. • Additional information may include more detailed weather information, specifics on injuries or fatalities, threats to critical infrastructure or other resources, more detailed evacuation site locations and number of evacuated, information or details regarding incident cause, etc. • For Complexes that include multiple incidents, list all sub-incidents included in the Complex. • List jurisdictional or ownership breakdowns if needed when an incident is in more than one jurisdiction and/or ownership area. Breakdown may be: o By size (e.g., 35 acres in City of Gatlinburg, 250 acres in Great Smoky Mountains), and/or o By geography (e.g., incident area on the west side of the river is in jurisdiction of City of Minneapolis; area on east side of river is City of St. Paul jurisdiction; river is joint jurisdiction with USACE). • Explain any reasons for incident size reductions or adjustments (e.g., reduction in acreage due to more accurate mapping). • This section can also be used to list any additional information about the incident that may be needed by incident support mechanisms outside the incident itself. This may be basic information needed through multiagency coordination systems or public information systems (e.g., a public information phone number for the incident, or the incident Web site address). • Attach additional pages if it is necessary to include additional comments in the Remarks section.

INCIDENT RESOURCE COMMITMENT SUMMARY (PAGE 4)

- This last/fourth page of the ICS 209 can be copied and used if needed to accommodate additional resources, agencies, or organizations. Write the actual page number on the pages as they are used.
- Include only resources that have been assigned to the incident and that have arrived and/or been checked in to the incident. Do not include resources that have been ordered but have *not* yet arrived.

<u>For summarizing</u>:

- When there are large numbers of responders, it may be helpful to group agencies or organizations together. Use the approach that works best for the multiagency coordination system applicable to the incident. For example,
  - o Group State, local, county, city, or Federal responders together under such headings, or
  - o Group resources from one jurisdiction together and list only individual jurisdictions (e.g., list the public works, police, and fire department resources for a city under that city's name).
- On a large incident, it may also be helpful to group similar categories, kinds, or types of resources together for this summary.

Block Number	Block Title	Instructions
48	**Agency or Organization**	• List the agencies or organizations contributing resources to the incident as responders, through mutual aid agreements, etc. • List agencies or organizations using clear language so readers who may not be from the discipline or host jurisdiction can understand the information. • Agencies or organizations may be listed individually or in groups. • When resources are grouped together, individual agencies or organizations may be listed below in Block 53. • Indicate in the rows under Block 49 how many resources are assigned to the incident under each resource identified. o These can listed with the number of resources on the top of the box, and the number of personnel associated with the resources on the bottom half of the box. o For example: ▪ *Resource:* Type 2 Helicopters… 3/8 (indicates 3 aircraft, 8 personnel). ▪ *Resource:* Type 1 Decontamination Unit… 1/3 (indicates 1 unit, 3 personnel). • Indicate in the rows under Block 51 the total number of personnel assigned for each agency listed under Block 48, including both individual overhead and those associated with other resources such as fire engines, decontamination units, etc.
49	**Resources** (summarize resources by category, kind, and/or type; show # of resources on top ½ of box, show # of personnel associated with resource on bottom ½ of box)	• List resources using clear language when possible – so ICS 209 readers who may not be from the discipline or host jurisdiction can understand the information. o Examples: Type 1 Fire Engines, Type 4 Helicopters • Enter total numbers in columns for each resource by agency, organization, or grouping in the proper blocks. o These can listed with the number of resources on the top of the box, and the number of personnel associated with the resources on the bottom half of the box. o For example: ▪ *Resource:* Type 2 Helicopters… 3/8 (indicates 3 aircraft, 8 personnel). ▪ *Resource:* Type 1 Decontamination Unit… 1/3 (indicates 1 unit, 3 personnel). • NOTE: One option is to group similar resources together when it is sensible to do so for the summary. o For example, do not list every type of fire engine – rather, it may be advisable to list two generalized types of engines, such as “structure fire engines” and “wildland fire engines” in separate columns with totals for each. • NOTE: It is not advisable to list individual overhead personnel individually in the resource section, especially as this form is intended as a summary. These personnel should be included in the Total Personnel sums in Block 51.
50	**Additional Personnel** not assigned to a resource	List the number of *additional* individuals (or overhead) that are not assigned to a specific resource by agency or organization.
51	**Total Personnel** (includes those associated with resources – e.g., aircraft or engines – *and* individual overhead)	• Enter the total personnel for each agency, organization, or grouping in the Total Personnel column. • WARNING: Do not simply add the numbers across! • The number of Total Personnel for each row should include both: o The total number of personnel assigned to each of the resources listed in Block 49, and o The total number of additional individual overhead personnel from each agency, organization, or group listed in Block 50.

Block Number	Block Title	Instructions
52	**Total Resources**	Include the sum total of resources for each column, including the total for the column under Blocks 49, 50, and 51. This should include the total number of *resources* in Block 49, as personnel totals will be counted under Block 51.
53	**Additional Cooperating and Assisting Organizations Not Listed Above**	• List all agencies and organizations that are not directly involved in the incident, but are providing support. • Examples may include ambulance services, Red Cross, DHS, utility companies, etc. • Do not repeat any resources counted in Blocks 48–52, unless explanations are needed for groupings created under Block 48 (Agency or Organization).

RESOURCE STATUS CHANGE (ICS 210)

1. Incident Name:	**2. Operational Period:** Date From: Date To: Time From: Time To:

3. Resource Number	**4. New Status** (Available, Assigned, O/S)	**5. From** (Assignment and Status)**:**	**6. To** (Assignment and Status)**:**	**7. Time and Date of Change:**	

8. Comments:

9. Prepared by: Name: _____ Position/Title: _____ Signature: _____

ICS 210 Date/Time: _____

ICS 210
Resource Status Change

Purpose. The Resource Status Change (ICS 210) is used by the Incident Communications Center Manager to record status change information received on resources assigned to the incident. This information could be transmitted with a General Message (ICS 213). The form could also be used by Operations as a worksheet to track entry, etc.

Preparation. The ICS 210 is completed by radio/telephone operators who receive status change information from individual resources, Task Forces, Strike Teams, and Division/Group Supervisors. Status information could also be reported by Staging Area and Helibase Managers and fixed-wing facilities.

Distribution. The ICS 210 is maintained by the Communications Unit and copied to Resources Unit and filed by Documentation Unit.

Notes:

- The ICS 210 is essentially a message form that can be used to update Resource Status Cards or T-Cards (ICS 219) for incident-level resource management.
- If additional pages are needed, use a blank ICS 210 and repaginate as needed.

Block Number	Block Title	Instructions
1	**Incident Name**	Enter the name assigned to the incident.
2	**Operational Period** • Date and Time From • Date and Time To	Enter the start date (month/day/year) and time (using the 24-hour clock) and end date and time for the operational period to which the form applies.
3	**Resource Number**	Enter the resource identification (ID) number (this may be a letter and number combination) assigned by either the sending unit or the incident.
4	**New Status** (Available, Assigned, Out of Service)	Indicate the current status of the resource: • Available – Indicates resource is available for incident use immediately. • Assigned – Indicates resource is checked in and assigned a work task on the incident. • Out of Service – Indicates resource is assigned to the incident but unable to respond for mechanical, rest, or personnel reasons. If space permits, indicate the estimated time of return (ETR). It may be useful to indicate the reason a resource is out of service (e.g., "O/S – Mech" (for mechanical issues), "O/S – Rest" (for off shift), or "O/S – Pers" (for personnel issues).
5	**From** (Assignment and Status)	Indicate the current location of the resource (where it came from) and the status. When more than one Division, Staging Area, or Camp is used, identify the specific location (e.g., Division A, Staging Area, Incident Command Post, Western Camp).
6	**To** (Assignment and Status)	Indicate the assigned incident location of the resource and status. When more than one Division, Staging Area, or Camp is used, identify the specific location.
7	**Time and Date of Change**	Enter the time and location of the status change (24-hour clock). Enter the date as well if relevant (e.g., out of service).
8	**Comments**	Enter any special information provided by the resource or dispatch center. This may include details about why a resource is out of service, or individual identifying designators (IDs) of Strike Teams and Task Forces.
9	**Prepared by** • Name • Position/Title • Signature • Date/Time	Enter the name, ICS position/title, and signature of the person preparing the form. Enter date (month/day/year) and time prepared (24-hour clock).

INCIDENT CHECK-IN LIST (ICS 211)

1. Incident Name:	2. Incident Number:	3. Check-In Location (complete all that apply): ☐ Base ☐ Staging Area ☐ ICP ☐ Helibase ☐ Other	4. Start Date/Time: Date: Time:

Check-In Information (use reverse of form for remarks or comments)

5. List single resource personnel (overhead) by agency and name, OR list resources by the following format:							6. Order Request #	7. Date/Time Check-In	8. Leader's Name	9. Total Number of Personnel	10. Incident Contact Information	11. Home Unit or Agency	12. Departure Point, Date and Time	13. Method of Travel	14. Incident Assignment	15. Other Qualifications	16. Data Provided to Resources Unit
State	Agency	Category	Kind	Type	Resource Name or Identifier	ST or TF											

ICS 211	17. Prepared by: Name: _____ Position/Title: _____ Signature: _____ Date/Time: _____

ICS 211
Incident Check-In List

Purpose. Personnel and equipment arriving at the incident can check in at various incident locations. Check-in consists of reporting specific information, which is recorded on the Check-In List (ICS 211). The ICS 211 serves several purposes, as it: (1) records arrival times at the incident of all overhead personnel and equipment, (2) records the initial location of personnel and equipment to facilitate subsequent assignments, and (3) supports demobilization by recording the home base, method of travel, etc., for resources checked in.

Preparation. The ICS 211 is initiated at a number of incident locations including: Staging Areas, Base, and Incident Command Post (ICP). Preparation may be completed by: (1) overhead at these locations, who record the information and give it to the Resources Unit as soon as possible, (2) the Incident Communications Center Manager located in the Communications Center, who records the information and gives it to the Resources Unit as soon as possible, (3) a recorder from the Resources Unit during check-in to the ICP. As an option, the ICS 211 can be printed on colored paper to match the designated Resource Status Card (ICS 219) colors. The purpose of this is to aid the process of completing a large volume of ICS 219s. The ICS 219 colors are:

- 219-1: Header Card – Gray (used only as label cards for T-Card racks)
- 219-2: Crew/Team Card – Green
- 219-3: Engine Card – Rose
- 219-4: Helicopter Card – Blue
- 219-5: Personnel Card – White
- 219-6: Fixed-Wing Card – Orange
- 219-7: Equipment Card – Yellow
- 219-8: Miscellaneous Equipment/Task Force Card – Tan
- 219-10: Generic Card – Light Purple

Distribution. ICS 211s, which are completed by personnel at the various check-in locations, are provided to the Resources Unit, Demobilization Unit, and Finance/Administration Section. The Resources Unit maintains a master list of all equipment and personnel that have reported to the incident.

Notes:

- Also available as 8½ x 14 (legal size) or 11 x 17 chart.
- Use reverse side of form for remarks or comments.
- If additional pages are needed for any form page, use a blank ICS 211 and repaginate as needed.
- Contact information for sender and receiver can be added for communications purposes to confirm resource orders. Refer to 213RR example (Appendix B)

Block Number	Block Title	Instructions
1	**Incident Name**	Enter the name assigned to the incident.
2	**Incident Number**	Enter the number assigned to the incident.
3	**Check-In Location** ☐ Base ☐ Staging Area ☐ ICP ☐ Helibase ☐ Other	Check appropriate box and enter the check-in location for the incident. Indicate specific information regarding the locations under each checkbox. ICP is for Incident Command Post. Other may include…
4	**Start Date/Time** • Date • Time	Enter the date (month/day/year) and time (using the 24-hour clock) that the form was started.

Block Number	Block Title	Instructions
	Check-In Information	Self explanatory.
5	**List single resource personnel (overhead) by agency and name, OR list resources by the following format**	Enter the following information for resources: OPTIONAL: Indicate if resource is a single resource versus part of Strike Team or Task Force. Fields can be left blank if not necessary.
	• State	Use this section to list the home State for the resource.
	• Agency	Use this section to list agency name (or designator), and individual names for all single resource personnel (e.g., ORC, ARL, NYPD).
	• Category	Use this section to list the resource category based on NIMS, discipline, or jurisdiction guidance.
	• Kind	Use this section to list the resource kind based on NIMS, discipline, or jurisdiction guidance.
	• Type	Use this section to list the resource type based on NIMS, discipline, or jurisdiction guidance.
	• Resource Name or Identifier	Use this section to enter the resource name or unique identifier. If it is a Strike Team or a Task Force, list the unique Strike Team or Task Force identifier (if used) on a single line with the component resources of the Strike Team or Task Force listed on the following lines. For example, for an Engine Strike Team with the call sign "XLT459" show "XLT459" in this box and then in the next five rows, list the unique identifier for the five engines assigned to the Strike Team.
	• ST or TF	Use ST or TF to indicate whether the resource is part of a Strike Team or Task Force. See above for additional instructions.
6	**Order Request #**	The order request number will be assigned by the agency dispatching resources or personnel to the incident. Use existing protocol as appropriate for the jurisdiction and/or discipline, since several incident numbers may be used for the same incident.
7	**Date/Time Check-In**	Enter date (month/day/year) and time of check-in (24-hour clock) to the incident.
8	**Leader's Name**	• For equipment, enter the operator's name. • Enter the Strike Team or Task Force leader's name. • Leave blank for single resource personnel (overhead).
9	**Total Number of Personnel**	Enter total number of personnel associated with the resource. Include leaders.
10	**Incident Contact Information**	Enter available contact information (e.g., radio frequency, cell phone number, etc.) for the incident.
11	**Home Unit or Agency**	Enter the home unit or agency to which the resource or individual is normally assigned (may not be departure location).
12	**Departure Point, Date and Time**	Enter the location from which the resource or individual departed for this incident. Enter the departure time using the 24-hour clock.
13	**Method of Travel**	Enter the means of travel the individual used to bring himself/herself to the incident (e.g., bus, truck, engine, personal vehicle, etc.).
14	**Incident Assignment**	Enter the incident assignment at time of dispatch.
15	**Other Qualifications**	Enter additional duties (ICS positions) pertinent to the incident that the resource/individual is qualified to perform. Note that resources should not be reassigned on the incident without going through the established ordering process. This data may be useful when resources are demobilized and remobilized for another incident.

Block Number	Block Title	Instructions
16	**Data Provided to Resources Unit**	Enter the date and time that the information pertaining to that entry was transmitted to the Resources Unit, and the initials of the person who transmitted the information.
17	**Prepared by** • Name • Position/Title • Signature • Date/Time	Enter the name, ICS position/title, and signature of the person preparing the form. Enter date (month/day/year) and time prepared (24-hour clock).

GENERAL MESSAGE (ICS 213)

1. Incident Name (Optional)**:**		
2. To (Name and Position)**:**		
3. From (Name and Position)**:**		
4. Subject:	**5. Date:**	**6. Time**
7. Message:		
8. Approved by: Name: _____ Signature: _____ Position/Title: _____		
9. Reply:		
10. Replied by: Name: _____ Position/Title: _____ Signature: _____		
ICS 213	Date/Time: _____	

ICS 213
General Message

Purpose. The General Message (ICS 213) is used by the incident dispatchers to record incoming messages that cannot be orally transmitted to the intended recipients. The ICS 213 is also used by the Incident Command Post and other incident personnel to transmit messages (e.g., resource order, incident name change, other ICS coordination issues, etc.) to the Incident Communications Center for transmission via radio or telephone to the addressee. This form is used to send any message or notification to incident personnel that requires hard-copy delivery.

Preparation. The ICS 213 may be initiated by incident dispatchers and any other personnel on an incident.

Distribution. Upon completion, the ICS 213 may be delivered to the addressee and/or delivered to the Incident Communication Center for transmission.

Notes:

- The ICS 213 is a three-part form, typically using carbon paper. The sender will complete Part 1 of the form and send Parts 2 and 3 to the recipient. The recipient will complete Part 2 and return Part 3 to the sender.
- A copy of the ICS 213 should be sent to and maintained within the Documentation Unit.
- Contact information for the sender and receiver can be added for communications purposes to confirm resource orders. Refer to 213RR example (Appendix B)

Block Number	Block Title	Instructions
1	**Incident Name** (Optional)	Enter the name assigned to the incident. This block is optional.
2	**To** (Name and Position)	Enter the name and position the General Message is intended for. For all individuals, use at least the first initial and last name. For Unified Command, include agency names.
3	**From** (Name and Position)	Enter the name and position of the individual sending the General Message. For all individuals, use at least the first initial and last name. For Unified Command, include agency names.
4	**Subject**	Enter the subject of the message.
5	**Date**	Enter the date (month/day/year) of the message.
6	**Time**	Enter the time (using the 24-hour clock) of the message.
7	**Message**	Enter the content of the message. Try to be as concise as possible.
8	**Approved by** • Name • Signature • Position/Title	Enter the name, signature, and ICS position/title of the person approving the message.
9	**Reply**	The intended recipient will enter a reply to the message and return it to the originator.
10	**Replied by** • Name • Position/Title • Signature • Date/Time	Enter the name, ICS position/title, and signature of the person replying to the message. Enter date (month/day/year) and time prepared (24-hour clock).

ACTIVITY LOG (ICS 214)

1. Incident Name:	2. Operational Period: Date From: Date To: Time From: Time To:	
3. Name:	**4. ICS Position:**	**5. Home Agency** (and Unit)**:**

6. Resources Assigned:

Name	ICS Position	Home Agency (and Unit)

7. Activity Log:

Date/Time	Notable Activities

8. Prepared by: Name: _____ Position/Title: _____ Signature: _____

Date/Time: _____

ACTIVITY LOG (ICS 214)

1. Incident Name:	**2. Operational Period:** Date From: Date To: Time From: Time To:

7. Activity Log (continuation)**:**

Date/Time	Notable Activities

8. Prepared by: Name: _____ Position/Title: _____ Signature: _____

 Date/Time: _____

ICS 214
Activity Log

Purpose. The Activity Log (ICS 214) records details of notable activities at any ICS level, including single resources, equipment, Task Forces, etc. These logs provide basic incident activity documentation, and a reference for any after-action report.

Preparation. An ICS 214 can be initiated and maintained by personnel in various ICS positions as it is needed or appropriate. Personnel should document how relevant incident activities are occurring and progressing, or any notable events or communications.

Distribution. Completed ICS 214s are submitted to supervisors, who forward them to the Documentation Unit. All completed original forms must be given to the Documentation Unit, which maintains a file of all ICS 214s. It is recommended that individuals retain a copy for their own records.

Notes:

- The ICS 214 can be printed as a two-sided form.
- Use additional copies as continuation sheets as needed, and indicate pagination as used.

Block Number	Block Title	Instructions
1	**Incident Name**	Enter the name assigned to the incident.
2	**Operational Period** • Date and Time From • Date and Time To	Enter the start date (month/day/year) and time (using the 24-hour clock) and end date and time for the operational period to which the form applies.
3	**Name**	Enter the title of the organizational unit or resource designator (e.g., Facilities Unit, Safety Officer, Strike Team).
4	**ICS Position**	Enter the name and ICS position of the individual in charge of the Unit.
5	**Home Agency** (and Unit)	Enter the home agency of the individual completing the ICS 214. Enter a unit designator if utilized by the jurisdiction or discipline.
6	**Resources Assigned**	Enter the following information for resources assigned:
	• Name	Use this section to enter the resource's name. For all individuals, use at least the first initial and last name. Cell phone number for the individual can be added as an option.
	• ICS Position	Use this section to enter the resource's ICS position (e.g., Finance Section Chief).
	• Home Agency (and Unit)	Use this section to enter the resource's home agency and/or unit (e.g., Des Moines Public Works Department, Water Management Unit).
7	**Activity Log** • Date/Time • Notable Activities	• Enter the time (24-hour clock) and briefly describe individual notable activities. Note the date as well if the operational period covers more than one day. • Activities described may include notable occurrences or events such as task assignments, task completions, injuries, difficulties encountered, etc. • This block can also be used to track personal work habits by adding columns such as "Action Required," "Delegated To," "Status," etc.
8	**Prepared by** • Name • Position/Title • Signature • Date/Time	Enter the name, ICS position/title, and signature of the person preparing the form. Enter date (month/day/year) and time prepared (24-hour clock).

OPERATIONAL PLANNING WORKSHEET (ICS 215)

1. Incident Name:	2. Operational Period: Date From: Date To: Time From: Time To:

3. Branch	4. Division, Group, or Other	5. Work Assignment & Special Instructions	6. Resources													7. Overhead Position(s)	8. Special Equipment & Supplies	9. Reporting Location	10. Requested Arrival Time
			Req.																
			Have																
			Need																
			Req.																
			Have																
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			Have																
			Need																
			Req.																
			Have																
			Need																
		11. Total Resources Required															14. Prepared by: Name:			
		12. Total Resources Have on Hand															Position/Title:			
		13. Total Resources Need To Order															Signature:			
ICS 215																	Date/Time:			

ICS 215
Operational Planning Worksheet

Purpose. The Operational Planning Worksheet (ICS 215) communicates the decisions made by the Operations Section Chief during the Tactics Meeting concerning resource assignments and needs for the next operational period. The ICS 215 is used by the Resources Unit to complete the Assignment Lists (ICS 204) and by the Logistics Section Chief for ordering resources for the incident.

Preparation. The ICS 215 is initiated by the Operations Section Chief and often involves logistics personnel, the Resources Unit, and the Safety Officer. The form is shared with the rest of the Command and General Staffs during the Planning Meeting. It may be useful in some disciplines or jurisdictions to prefill ICS 215 copies prior to incidents.

Distribution. When the Branch, Division, or Group work assignments and accompanying resource allocations are agreed upon, the form is distributed to the Resources Unit to assist in the preparation of the ICS 204. The Logistics Section will use a copy of this worksheet for preparing requests for resources required for the next operational period.

Notes:

- This worksheet can be made into a wall mount.
- Also available as 8½ x 14 (legal size) and 11 x 17 chart.
- If additional pages are needed, use a blank ICS 215 and repaginate as needed.

Block Number	Block Title	Instructions
1	**Incident Name**	Enter the name assigned to the incident.
2	**Operational Period** • Date and Time From • Date and Time To	Enter the start date (month/day/year) and time (using the 24-hour clock) and end date and time for the operational period to which the form applies.
3	**Branch**	Enter the Branch of the work assignment for the resources.
4	**Division, Group, or Other**	Enter the Division, Group, or other location (e.g., Staging Area) of the work assignment for the resources.
5	**Work Assignment & Special Instructions**	Enter the specific work assignments given to each of the Divisions/Groups and any special instructions, as required.
6	**Resources**	Complete resource headings for category, kind, and type as appropriate for the incident. The use of a slash indicates a single resource in the upper portion of the slash and a Strike Team or Task Force in the bottom portion of the slash.
	• Required	Enter, for the appropriate resources, the number of resources by type (engine, squad car, Advanced Life Support ambulance, etc.) required to perform the work assignment.
	• Have	Enter, for the appropriate resources, the number of resources by type (engines, crew, etc.) available to perform the work assignment.
	• Need	Enter the number of resources needed by subtracting the number in the "Have" row from the number in the "Required" row.
7	**Overhead Position(s)**	List any supervisory and nonsupervisory ICS position(s) not directly assigned to a previously identified resource (e.g., Division/Group Supervisor, Assistant Safety Officer, Technical Specialist, etc.).
8	**Special Equipment & Supplies**	List special equipment and supplies, including aviation support, used or needed. This may be a useful place to monitor span of control.
9	**Reporting Location**	Enter the specific location where the resources are to report (Staging Area, location at incident, etc.).
10	**Requested Arrival Time**	Enter the time (24-hour clock) that resources are requested to arrive at the reporting location.

Block Number	Block Title	Instructions
11	**Total Resources Required**	Enter the total number of resources required by category/kind/type as preferred (e.g., engine, squad car, ALS ambulance, etc.). A slash can be used again to indicate total single resources in the upper portion of the slash and total Strike Teams/ Task Forces in the bottom portion of the slash.
12	**Total Resources Have on Hand**	Enter the total number of resources on hand that are assigned to the incident for incident use. A slash can be used again to indicate total single resources in the upper portion of the slash and total Strike Teams/Task Forces in the bottom portion of the slash.
13	**Total Resources Need To Order**	Enter the total number of resources needed. A slash can be used again to indicate total single resources in the upper portion of the slash and total Strike Teams/Task Forces in the bottom portion of the slash.
14	**Prepared by** • Name • Position/Title • Signature • Date/Time	Enter the name, ICS position, and signature of the person preparing the form. Enter date (month/day/year) and time prepared (24-hour clock).

INCIDENT ACTION PLAN SAFETY ANALYSIS (ICS 215A)

1. Incident Name:	2. Incident Number:

3. Date/Time Prepared:	4. Operational Period:	
Date: Time:	Date From: Time From:	Date To: Time To:

5. Incident Area	6. Hazards/Risks	7. Mitigations

8. Prepared by (Safety Officer)**:** Name: _____ Signature: _____

Prepared by (Operations Section Chief)**:** Name: _____ Signature: _____

ICS 215A Date/Time: _____

ICS 215A
Incident Action Plan Safety Analysis

Purpose. The purpose of the Incident Action Plan Safety Analysis (ICS 215A) is to aid the Safety Officer in completing an operational risk assessment to prioritize hazards, safety, and health issues, and to develop appropriate controls. This worksheet addresses communications challenges between planning and operations, and is best utilized in the planning phase and for Operations Section briefings.

Preparation. The ICS 215A is typically prepared by the Safety Officer during the incident action planning cycle. When the Operations Section Chief is preparing for the tactics meeting, the Safety Officer collaborates with the Operations Section Chief to complete the Incident Action Plan Safety Analysis. This worksheet is closely linked to the Operational Planning Worksheet (ICS 215). Incident areas or regions are listed along with associated hazards and risks. For those assignments involving risks and hazards, mitigations or controls should be developed to safeguard responders, and appropriate incident personnel should be briefed on the hazards, mitigations, and related measures. Use additional sheets as needed.

Distribution. When the safety analysis is completed, the form is distributed to the Resources Unit to help prepare the Operations Section briefing. All completed original forms must be given to the Documentation Unit.

Notes:

- This worksheet can be made into a wall mount, and can be part of the IAP.
- If additional pages are needed, use a blank ICS 215A and repaginate as needed.

Block Number	Block Title	Instructions
1	**Incident Name**	Enter the name assigned to the incident.
2	**Incident Number**	Enter the number assigned to the incident.
3	**Date/Time Prepared**	Enter date (month/day/year) and time (using the 24-hour clock) prepared.
4	**Operational Period** • Date and Time From • Date and Time To	Enter the start date (month/day/year) and time (24-hour clock) and end date and time for the operational period to which the form applies.
5	**Incident Area**	Enter the incident areas where personnel or resources are likely to encounter risks. This may be specified as a Branch, Division, or Group.
6	**Hazards/Risks**	List the types of hazards and/or risks likely to be encountered by personnel or resources at the incident area relevant to the work assignment.
7	**Mitigations**	List actions taken to reduce risk for each hazard indicated (e.g., specify personal protective equipment or use of a buddy system or escape routes).
8	**Prepared by** (Safety Officer and Operations Section Chief) • Name • Signature • Date/Time	Enter the name of both the Safety Officer and the Operations Section Chief, who should collaborate on form preparation. Enter date (month/day/year) and time (24-hour clock) reviewed.

SUPPORT VEHICLE/EQUIPMENT INVENTORY (ICS 218)

1. Incident Name:	2. Incident Number:	3. Date/Time Prepared: Date: Time:	4. Vehicle/Equipment Category:

5. Vehicle/Equipment Information

Order Request Number	Incident ID No.	Vehicle or Equipment Classification	Vehicle or Equipment Make	Category/ Kind/Type, Capacity, or Size	Vehicle or Equipment Features	Agency or Owner	Operator Name or Contact	Vehicle License or ID No.	Incident Assignment	Incident Start Date and Time	Incident Release Date and Time

ICS 218	6. Prepared by: Name: _____ Position/Title: _____ Signature: _____

ICS 218
Support Vehicle/Equipment Inventory

Purpose. The Support Vehicle/Equipment Inventory (ICS 218) provides an inventory of all transportation and support vehicles and equipment assigned to the incident. The information is used by the Ground Support Unit to maintain a record of the types and locations of vehicles and equipment on the incident. The Resources Unit uses the information to initiate and maintain status/resource information.

Preparation. The ICS 218 is prepared by Ground Support Unit personnel at intervals specified by the Ground Support Unit Leader.

Distribution. Initial inventory information recorded on the form should be given to the Resources Unit. Subsequent changes to the status or location of transportation and support vehicles and equipment should be provided to the Resources Unit immediately.

Notes:

- If additional pages are needed, use a blank ICS 218 and repaginate as needed.
- Also available as 8½ x 14 (legal size) and 11 x 17 chart.

Block Number	Block Title	Instructions
1	**Incident Name**	Enter the name assigned to the incident.
2	**Incident Number**	Enter the number assigned to the incident.
3	**Date/Time Prepared**	Enter the date (month/day/year) and time (using the 24-hour clock) the form is prepared.
4	**Vehicle/Equipment Category**	Enter the specific vehicle or equipment category (e.g., buses, generators, dozers, pickups/sedans, rental cars, etc.). Use a separate sheet for each vehicle or equipment category.
5	**Vehicle/Equipment Information**	Record the following information:
	Order Request Number	Enter the order request number for the resource as used by the jurisdiction or discipline, or the relevant EMAC order request number.
	Incident Identification Number	Enter any special incident identification numbers or agency radio identifier assigned to the piece of equipment used only during the incident, if this system if used (e.g., “Decontamination Unit 2,” or “Water Tender 14”).
	Vehicle or Equipment Classification	Enter the specific vehicle or equipment classification (e.g., bus, backhoe, Type 2 engine, etc.) as relevant.
	Vehicle or Equipment Make	Enter the vehicle or equipment manufacturer name (e.g., “GMC,” “International”).
	Category/Kind/Type, Capacity, or Size	Enter the vehicle or equipment category/kind/type, capacity, or size (e.g., 30-person bus, 3/4-ton truck, 50 kW generator).
	Vehicle or Equipment Features	Indicate any vehicle or equipment features such as 2WD, 4WD, towing capability, number of axles, heavy-duty tires, high clearance, automatic vehicle locator (AVL), etc.
	Agency or Owner	Enter the name of the agency or owner of the vehicle or equipment.
	Operator Name or Contact	Enter the operator name and/or contact information (cell phone, radio frequency, etc.).
	Vehicle License or Identification Number	Enter the license plate number or another identification number (such as a serial or rig number) of the vehicle or equipment.
	Incident Assignment	Enter where the vehicle or equipment will be located at the incident and its function (use abbreviations per discipline or jurisdiction).

Block Number	Block Title	Instructions
5 (continued)	Incident Start Date and Time	Indicate start date (month/day/year) and time (using the 24-hour clock) for driver or for equipment as may be relevant.
	Incident Release Date and Time	Enter the date (month/day/year) and time (using the 24-hour clock) the vehicle or equipment is released from the incident.
6	**Prepared by** • Name • Position/Title • Signature	Enter the name, ICS position/title, and signature of the person preparing the form.

DEMOBILIZATION CHECK-OUT (ICS 221)

1. Incident Name:	2. Incident Number:	
3. Planned Release Date/Time: Date: Time:	**4. Resource or Personnel Released:**	**5. Order Request Number:**

6. Resource or Personnel:

You and your resources are in the process of being released. Resources are not released until the checked boxes below have been signed off by the appropriate overhead and the Demobilization Unit Leader (or Planning Section representative).

LOGISTICS SECTION

	Unit/Manager	Remarks	Name	Signature
☐	Supply Unit			
☐	Communications Unit			
☐	Facilities Unit			
☐	Ground Support Unit			
☐	Security Manager			
☐				

FINANCE/ADMINISTRATION SECTION

	Unit/Leader	Remarks	Name	Signature
☐	Time Unit			
☐				
☐				

OTHER SECTION/STAFF

	Unit/Other	Remarks	Name	Signature
☐				
☐				

PLANNING SECTION

	Unit/Leader	Remarks	Name	Signature
☐				
☐	Documentation Leader			
☐	Demobilization Leader			

7. Remarks:

8. Travel Information:

Room Overnight: ☐ Yes ☐ No

Estimated Time of Departure: _____

Actual Release Date/Time: _____

Destination: _____

Estimated Time of Arrival: _____

Travel Method: _____

Contact Information While Traveling: _____

Manifest: ☐ Yes ☐ No

Number: _____

Area/Agency/Region Notified: _____

9. Reassignment Information: ☐ Yes ☐ No

Incident Name: _____

Incident Number: _____

Location: _____

Order Request Number: _____

10. Prepared by: Name: _____ Position/Title: _____ Signature: _____

ICS 221

Date/Time: _____

ICS 221
Demobilization Check-Out

Purpose. The Demobilization Check-Out (ICS 221) ensures that resources checking out of the incident have completed all appropriate incident business, and provides the Planning Section information on resources released from the incident. Demobilization is a planned process and this form assists with that planning.

Preparation. The ICS 221 is initiated by the Planning Section, or a Demobilization Unit Leader if designated. The Demobilization Unit Leader completes the top portion of the form and checks the appropriate boxes in Block 6 that may need attention after the Resources Unit Leader has given written notification that the resource is no longer needed. The individual resource will have the appropriate overhead personnel sign off on any checked box(es) in Block 6 prior to release from the incident.

Distribution. After completion, the ICS 221 is returned to the Demobilization Unit Leader or the Planning Section. All completed original forms must be given to the Documentation Unit. Personnel may request to retain a copy of the ICS 221.

Notes:

- Members are not released until form is complete when all of the items checked in Block 6 have been signed off.
- If additional pages are needed for any form page, use a blank ICS 221 and repaginate as needed.

Block Number	Block Title	Instructions
1	**Incident Name**	Enter the name assigned to the incident.
2	**Incident Number**	Enter the number assigned to the incident.
3	**Planned Release Date/Time**	Enter the date (month/day/year) and time (using the 24-hour clock) of the planned release from the incident.
4	**Resource or Personnel Released**	Enter name of the individual or resource being released.
5	**Order Request Number**	Enter order request number (or agency demobilization number) of the individual or resource being released.
6	**Resource or Personnel** You and your resources are in the process of being released. Resources are not released until the checked boxes below have been signed off by the appropriate overhead and the Demobilization Unit Leader (or Planning Section representative). • Unit/Leader/Manager/Other • Remarks • Name • Signature	Resources are not released until the checked boxes below have been signed off by the appropriate overhead. Blank boxes are provided for any additional unit requirements as needed (e.g., Safety Officer, Agency Representative, etc.).
	Logistics Section ☐ Supply Unit ☐ Communications Unit ☐ Facilities Unit ☐ Ground Support Unit ☐ Security Manager	The Demobilization Unit Leader will enter an "X" in the box to the left of those Units requiring the resource to check out. Identified Unit Leaders or other overhead are to sign the appropriate line to indicate release.

Block Number	Block Title	Instructions
6 (continued)	**Finance/Administration Section** ☐ Time Unit	The Demobilization Unit Leader will enter an "X" in the box to the left of those Units requiring the resource to check out. Identified Unit Leaders or other overhead are to sign the appropriate line to indicate release.
	Other Section/Staff ☐	The Demobilization Unit Leader will enter an "X" in the box to the left of those Units requiring the resource to check out. Identified Unit Leaders or other overhead are to sign the appropriate line to indicate release.
	Planning Section ☐ Documentation Leader ☐ Demobilization Leader	The Demobilization Unit Leader will enter an "X" in the box to the left of those Units requiring the resource to check out. Identified Unit Leaders or other overhead are to sign the appropriate line to indicate release.
7	**Remarks**	Enter any additional information pertaining to demobilization or release (e.g., transportation needed, destination, etc.). This section may also be used to indicate if a performance rating has been completed as required by the discipline or jurisdiction.
8	**Travel Information**	Enter the following travel information:
	Room Overnight	Use this section to enter whether or not the resource or personnel will be staying in a hotel overnight prior to returning home base and/or unit.
	Estimated Time of Departure	Use this section to enter the resource's or personnel's estimated time of departure (using the 24-hour clock).
	Actual Release Date/Time	Use this section to enter the resource's or personnel's actual release date (month/day/year) and time (using the 24-hour clock).
	Destination	Use this section to enter the resource's or personnel's destination.
	Estimated Time of Arrival	Use this section to enter the resource's or personnel's estimated time of arrival (using the 24-hour clock) at the destination.
	Travel Method	Use this section to enter the resource's or personnel's travel method (e.g., POV, air, etc.).
	Contact Information While Traveling	Use this section to enter the resource's or personnel's contact information while traveling (e.g., cell phone, radio frequency, etc.).
	Manifest ☐ Yes ☐ No Number	Use this section to enter whether or not the resource or personnel has a manifest. If they do, indicate the manifest number.
	Area/Agency/Region Notified	Use this section to enter the area, agency, and/or region that was notified of the resource's travel. List the name (first initial and last name) of the individual notified and the date (month/day/year) he or she was notified.
9	**Reassignment Information** ☐ Yes ☐ No	Enter whether or not the resource or personnel was reassigned to another incident. If the resource or personnel was reassigned, complete the section below.
	Incident Name	Use this section to enter the name of the new incident to which the resource was reassigned.
	Incident Number	Use this section to enter the number of the new incident to which the resource was reassigned.
	Location	Use this section to enter the location (city and State) of the new incident to which the resource was reassigned.
	Order Request Number	Use this section to enter the new order request number assigned to the resource or personnel.

Block Number	Block Title	Instructions
10	**Prepared by** • Name • Position/Title • Signature • Date/Time	Enter the name, ICS position, and signature of the person preparing the form. Enter date (month/day/year) and time prepared (using the 24-hour clock).

Suggested Questions for Water/Wastewater Utilities

Damage Assessment Form

Date:_____ Time:_____Pictures Taken? Yes No _

Water Installation___Wastewater Installation _ Treatment Facility__

Plant Facility Name: _____

Address or Location: _____

Person Making Report: _____

1) Is the water/wastewater system in operation or partially operating? Describe. If not, what is the cause, power loss or physical damage?

2) Is line power available? If not, are there any obvious reasons (damage overhead lines, line fuses open, line to electrical cabinet damaged)?

3) If no power, is there adequate emergency power capacity (i.e., emergency generator) and fuel supply?

4) Have any pumps been damaged? Describe.

5) Has flooding occurred? If so, determine (Y/N) or describe extent of flooding/damage to key buildings, transformers, motor controls, motors, electrical equipment, chemical feed system, stream bank erosion, protective berms.

This template report was provided via the U.S. EPA's website on Federal Funding for Utilities - Water/Wastewater - in National Disasters (Fed FUNDS). For further information, please visit http://water.epa.gov/infrastructure/watersecurity/funding/index.cfm.

Suggested Questions for Water/Wastewater Utilities

Damage Assessment Form

Date:_____ Time:_____Pictures Taken? Yes No _

Water Installation___Wastewater Installation _ Treatment Facility__

Plant Facility Name: _____

Address or Location: _____

Person Making Report: _____

6) Is there damage to control systems (SCADA) and ability to operate system manually?

7) Have treatment units been damaged?

8) Is there obvious collection system damage (lift stations, grinders)?

9) Are piping systems functioning?

10) Is there evidence of spills or other reportable activity? Is there a plan to clean-up and treat area?

11) Are operators available?

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For further information, please visit http://water.epa.gov/infrastructure/watersecurity/funding/index.cfm.

Suggested Questions for Water/Wastewater Utilities

Damage Assessment Form

Date:_____ Time:_____Pictures Taken? Yes No _ Water Installation___Wastewater Installation _ Treatment Facility__ Plant Facility Name: _____ Address or Location: _____ Person Making Report: _____
12) Is there supply/access to treatment chemicals (e.g., chlorine, lime)?
13) Is there a need for short term assistance (lab support, treatment chemicals, fuel, operators, pumps, heavy equipment and vehicles, etc.)?
14) Will this system require an alternate source of drinking water to meet customer needs? Are interconnects with neighboring systems possible?
15) Does this system require coliform testing before water may be used for human consumption?
16) Has a precautionary boil water notice been issued?
17) Have the customers been advised to conserve water at this time?
18) Have there been by-passes of raw sewage that may adversely impact the potable water system (describe)?
19) What is the location (e.g., GPS coordinates) for critically damaged facilities/equipment?

This template report was provided via the U.S. EPA's website on Federal Funding for Utilities - Water/Wastewater - in National Disasters (Fed FUNDS).
For further information, please visit http://water.epa.gov/infrastructure/watersecurity/funding/index.cfm.

Tampering Threat & Incident Report **FORM 1**
Water Quality Control Division

PWSID_____ PWS Name_____
First Name_____ Last Name_____
Title_____ Work Phone_____ Work Ext._____
Address_____ Mobile Phone_____
_____ Home Phone_____
City_____ Fax Number_____
State_____ E-mail Address_____
ZIP Code_____

Incident Start Date_____ Incident Start Time _____

Is Threat Deemed Credible? _____

Type of Threat
Contamination _____ Contamination Threat_____ Property Damage_____
Personal Assault_____ Bomb Threat_____
Other_____

Mode of Discovery
Threat Received by Mail _____ Threat Received by Phone_____ Unusual Water Quality_____
Consumer Complaint_____ Media Contact_____ Public Health Alert_____
Security Breach _____
Other_____

Initial Response
Law Enforcement Notified_____
Public Notification_____

Sample Collection Begun_____
_____

Assistance Required_____
_____
_____

Primary Location_____
Secondary Location_____

Evidence Description_____
_____
_____
_____

Response Actions_____
_____
_____
_____

Recovery Actions_____
_____
_____
_____

Disposition_____
_____

Appendix H
Public Communication Process and Templates

PUBLIC WORKS EMERGENCY PUBLIC COMMUNICATION PROCESS

For a Public Works-related emergency or broader crisis – including those outside of normal work hours (Mon-Fri, 8a-5p) – Post Point operators and/or PW assistant directors will likely be first to know. In addition to responding to the emergency via normal protocol, it is **vital to consider the communication** response:

- Is this a "need to know now" i.e., public at risk, is there a safety hazard?
- Will citizens require information that directs behavior (such as drive alternate route, flush water, avoiding drinking the water, et cetera)
- Is there the potential for other crisis effects, which could include
    - loss of City services
    - loss of credibility
    - misinformation spread
- Does the public need information before the next business day?

If so, then call on the PW Communications and Outreach Coordinator Amy Cloud, via accloud@cob.org or call 778-7912 or text (360) 318-4356 (alternative email is CloudAmyX@gmail.com.)

If she is unavailable – notify PW Director Eric Johnston (x7710, cell 360/201-3713), then contract COB Communications Director Janice Keller (jkeller@cob.org, 778-8100) and COB IT Marty Mulholland via x8088 (for Steven Niedermeyer, sniedermeyer@cob.org).

Media/public will want to know:
Q: WHAT happened? WHERE? WHO is impacted?
Q: What do you need people to DO?
Q: What do they need to KNOW?
First priorities are to:

- Gather all information available, verify facts and specifics
- Identify stakeholders and community partners (see next page)
- Notify PW leadership (Eric, Chad, Renee, Mike O.) who can determine spokesperson, key messages
- Draft a holding statement (Amy) that –
    - States what happened (or is going on) and our response
    - Provides direction (what do folks need to do)
    - Information on how to get more information or updates (online, via phone, Twitter)
- Exec Team member *must* review and approve all communications before distribution
- Post/distribute the statement – news release (via Amy/Janice/Steven) or just Facebook
    - Template for statement – below ("fill in the blanks" on a pre-built communication)

Considerations:

- What do we need audience to know or do, how and by when; who is the spokesperson; when will we have information updates, where to find information, et cetera
- inform internal audience first before notifying external audience
- in a crisis, use all available tactics simultaneously (once messaging approved)

Communication tactics and channels:

- news release (photo required) - for broadest community "push" communication, distributed to
    - news media
    - City Council, Mayor, departmental leaders
    - Community partners – including WWU, WCC, BTC, and the hospital et cetera
    - Citizens who have opted-in, signed up for news release
    - City's webpage (on the home page click "news"), Facebook page, Twitter account
- Facebook, possible to post only here (i.e. not be distributed as a news release, still need photo)
- City webpage – landing page (per Janice)
- NextDoor posting (via NPO or City staff member who is a neighborhood resident)

- Targeted email blasts, via DL
    - Including to MNAC or individual neighborhoods
    - Internal only
    - Internal and external
- AlertSense - multiple tactics to those who have opted in and/or via landline (expensive)

Template for communication to/for general public:
"We are aware that [X] has happened, we know that is concerning to you. We are trained and prepared for [X] and have already responded. What you need to know is [mark whatever is appropriate]:

_____This is an unsafe/unstable situation. You need to get out of there.
_____It is okay to stay where you are, but you won't have [X service/utility] for about [X period of time]
_____If you are having a life-threatening emergency, phone 9-1-1 immediately.
_____Please continue to check the City's website [and/or] Facebook page for updates on this situation.
_____Other? List:

[TEMPLATE REVISION: 06/1/2021]
Date:

BOIL WATER NOTICE

BOIL YOUR WATER BEFORE USING

Failure to follow this advisory could result in stomach or intestinal illness.

Due to the recent incident [e.g., water outage, power outage, flood, fire, earthquake or other emergency situation], the Washington State Department of Health in conjunction with the Whatcom County Environmental Health, and the City of Bellingham Water System are advising residents of [City, Town, System] to use boiled tap water or bottled water for drinking and cooking purposes as a safety precaution.

DO NOT DRINK THE WATER WITHOUT BOILING IT FIRST. Bring all water to a boil, **let it boil for one (1) minute,** and let it cool before using, or use bottled water. Boiled or bottled water should be used for drinking and food preparation **until further notice**. Boiling kills bacteria and other organisms in the water. [or This is the preferred method to assure that the water is safe to drink.]

- Optional alternative to include for prolonged situations where it fits. An alternative method of disinfection for residents that are not able to boil their water is to use fresh, unscented, liquid household bleach. To do so, add 8 drops (or 1/8 teaspoon) of bleach per gallon of clear water or 16 drops (or 1/4 teaspoon) per gallon of cloudy water, mix thoroughly, and allow it to stand for 30 minutes before using. A chlorine-like taste and odor will result from this disinfection procedure and is an indication that adequate disinfection has taken place.
- Water disinfection tablets may also be used by following the manufacturer's instructions.
  Optional: Potable water is available at the following locations: [List locations] Please bring a clean water container (5 gallons maximum capacity).

We will inform you when tests show that water is safe to drink and you no longer need to boil your water. We anticipate resolving the problem within [estimated time frame].

For more information call:

City of Bellingham Water System: [Name, title, phone & address of responsible utility representative].

Whatcom County Environmental Health: (360) 778-6000

Washington State Department of Health: 1-800-521-0323

Please share this information with all people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

Date:

UNSAFE WATER ALERT

[System Name] water is possibly contaminated with [an unknown substance]

DO NOT DRINK YOUR WATER

Failure to follow this advisory could result in illness.

An unknown substance has been added to the drinking water supplied by the [Water System Name] due to a recent [intrusion; break-in] at [one of the wells; our treatment plant; storage tank; specific facility]. The Washington State Department of Health, the Whatcom County Environmental Health, and the City of Bellingham Water System are advising residents of [Bellingham, System Name] to NOT USE THE TAP WATER FOR DRINKING AND COOKING UNTIL FURTHER NOTICE.

What should I do?

> **DO NOT DRINK YOUR TAP WATER---USE ONLY BOTTLED WATER.** Bottled water should be used for all drinking (including baby formula and juice), brushing teeth, washing dishes, making ice and food preparation **until further notice**.
> **DO NOT TRY AND TREAT THE WATER YOURSELF.** Boiling, freezing, filtering, adding chlorine or other disinfectants, or letting water stand will not make the water safe.

Optional: Potable water is available at the following locations: [List locations] Please bring a clean water container (5 gallons maximum capacity).

We will inform you when tests show that the water is safe again. We expect to resolve the problem within [estimated time frame].

For more information call:

City of Bellingham Water System: [Name, title, phone & address of responsible utility representative]

Whatcom County Environmental Health: (360) 778-6000

Washington State Department of Health: 1-800-521-0323

This notice is being sent to you by the City of Bellingham Water System. Public Water System ID #056003. Date Distributed: [date].

Please share this information with all people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

Date:

UNSAFE WATER ALERT

[System Name] water is possibly contaminated with [an unknown substance]

DO NOT USE YOUR WATER

Failure to follow this advisory could result in illness.

An unknown substance has been added to the drinking water supplied by the [Water System Name] due to a recent [intrusion; break-in] at [one of the wells; our treatment plant; storage tank; specific facility]. The Washington State Department of Health, the Whatcom County Environmental Health, and the City of Bellingham Water System are advising residents of [Bellingham, System Name] to NOT USE THE TAP WATER FOR DRINKING, COOKING, HAND WASHING, OR BATHING UNTIL FURTHER NOTICE.

What should I do?

> **DO NOT USE YOUR TAP WATER---USE ONLY BOTTLED WATER.** Bottled water should be used for all drinking (including baby formula and juice), brushing teeth, washing dishes, making ice, food preparation and bathing **until further notice**.
> **DO NOT TRY AND TREAT THE WATER YOURSELF.** Boiling, freezing, filtering, adding chlorine or other disinfectants, or letting water stand will not make the water safe.
> Optional: Potable water is available at the following locations: [List locations] Please bring a clean water container (5 gallons maximum capacity).

We will inform you when tests show that the water is safe again. We expect to resolve the problem within [estimated time frame].

For more information call:

City of Bellingham Water System: [Name, title, phone & address of responsible utility representative]

Whatcom County Environmental Health: (360) 778-6000

Washington State Department of Health: 1-800-521-0323

This notice is being sent to you by the City of Bellingham Water System. Public Water System ID #056003. Date Distributed: [date].

Please share this information with all people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

City of Bellingham
Department of Public Works



Public Notification Plan

For the Water Treatment Utility

THE PUBLIC NOTIFICATION RULE AND TIER 1 NOTIFICATION

In the event of a Tier 1 violation, the information provided and public notices enclosed (at each tab) in this report are for use by the City of Bellingham.

This document contains the following:

Instructions	Page
Description of a Tier 1 Violation	2
After Hours Emergency Line Summary	3
Instructions for General Tier 1 Notice	4
Instructions for Fecal Coliform/E. coli violation	5
Instructions for Waterborne Disease Outbreak	6
Instructions for Notice for Turbidity Single Exceedance	7
Instructions for Responding to a Threat Against a Water System	8
Instructions for a water quality problem corrected	10
Tab 1	
Public Notice for Fecal Coliform violation with mandatory language	12
Notice above in Spanish	13
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Description of a Tier 1 Violation

A tier 1 violation is one of the following:

1. Violation of the MCL for total coliform, when fecal coliform (or E. coli) are present in the water distribution system. Included here is the failure to test for fecal coliform after a positive total coliform distribution system sample.

2. Violation of the MCL for nitrate or nitrite, (the nitrate-N MCL is 10 mg/L, the nitrite-N MCL is 1 mg/L).

3. Violation of the turbidity MCL of 1.0 NTU, when the State of Washington Department of Health* determines that a Tier 1 Notice is required. Included here is failure to consult with the State DOH within 24 hours after the City learns of the violation.

4. Violation of the Treatment Technique requirement resulting from a single exceedance of the maximum allowable turbidity limit, where the Department of Health* determines after consultation that a Tier 1 notice is required. A Tier 1 Violation automatically occurs when consultation with the State does not occur within 24 hours after the City learns of the violation.

5. Occurrence of a waterborne disease outbreak, or other waterborne emergency (such as: a failure or significant interruption in key water treatment processes, a suspected vandalism or terrorism act, a natural disaster that disrupts the water supply or distribution system, or a chemical spill or unexpected loading of possible pathogens into the source water).

IMPORTANT

*If the City has any of the above violations, it must initiate consultation with the Department of Health (DOH) as soon as practical but within 24-hours after learning of the violation. DOH contact is Mr. John Thielemann **(253) 395-6761**. The DOH after hours emergency hotline is **(877) 481-4901**. A description of the DOH after-hours hotline for drinking water emergencies follows on the next page.

Taken from: http://www.doh.wa.gov/ehp/dw/Publications/after.htm

Washington State Department of Health

After-Hours Hotline for Drinking Water Emergencies toll free 1-877-481-4901

Call this number after-hours if a drinking water emergency:

- Threatens the health of your customers or the integrity of your system
- Can't wait until the next business day

Drinking water staff are available around the clock to troubleshoot drinking water emergencies and help protect the health of your customers. Call it Murphy's Law or whatever - emergencies don't just happen during business hours.

Imagine...

- A midnight landslide damages your distribution system.
- You are notified on Friday evening before a three-day weekend that your repeat samples were E. coli positive.
- A nearby stream floods, leaving your wellhead underwater on the day after Thanksgiving.

Who can you call for technical advice? The division's new after-hours emergency hotline, with access to on-call drinking water experts who will guide you through problems like those described above. This service is intended for water system operators, local health officials, laboratory operators and others who need immediate technical, engineering or public health advice from state drinking water experts during emergencies.

While citizen's concerns will be addressed if they call, this is not a public emergency hotline. Individuals with concerns about their drinking water should call their water utility, their local health department or 911. This hotline is intended for after-hours emergencies only, not for problems that arise during business hours, and not for routine business.

Here's how the system will work:

- After-hours calls will be evaluated to determine the nature of the emergency.
- Callers clearly seeking routine business will be asked to contact their regional office during business hours.
- The division staff person on call will be contacted to return calls dealing with emergencies.
- The staff person on call will return the call within 30 minutes.
- Callers using the emergency number during normal business hours will receive a recorded message directing them to the division regional office serving their area.

This new service was developed as one of several agency quality improvement efforts. Interviews and surveys with customers indicated a need for 24-hour emergency access to division staff.

Instructions for General Tier 1 Notice

The pages that follow contain instructions for action following specific Tier 1 violations, assuming public notification is warranted. These instructions are designed to supplement Chapter 5 of the Public Notification Handbook (EPA 816-R-00-010, June 2000). The tabbed pages have public notices specific to each violation to assist the City of Bellingham in proceeding with prompt notification.

Mandatory language on health effects, which must be included exactly as written in public notices, is presented in *italics* below (141.205(d)):

> *Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.*

You must also include the above italicized language in all notices, where applicable (141.205(d)). Use of this language does *not* relieve the City of its obligation to take steps reasonably calculated to notify all persons served:

Public Notices and fact sheets are available on the Department of Health website at: http://www.doh.wa.gov/ehp/dw/Our_Main_Pages/dwflood.htm.

Consecutive System Notification

Determine if any of the City of Bellingham's consecutive systems (wholesale water districts using treated City of Bellingham water) are impacted by the Tier 1 violation and contact each District impacted. Let them know what the City is doing in the way of Public Notification.

Glenn-Cove Water Association,Marie Erickson, Secretary	(360) 671-3863
Lummi Water and Sewer, Victor Solomon	(360) 758-7167
Water District #2, Lori Whitfield, Secretary	(360) 733-5770
Water District #7, Jim Trowbridge, Manager	(360) 752-9208
Water District #10, Chip Anderson	(360) 734-9224
Montgomery Road Water Association, Paul Troutman	(360) 671-6310
California Street Water Association, Anna Avalon/Don Hicks	(360) 733-4815

Media Notification

Coordinate with the City's Communications Coordinator, Janice Keller 676-6979 x333
Possible media contacts include:

Radio:
Cascade Radio Group
(KAFE 104.3 FM, KBAI 930 AM, KGMI 790 AM, KISM 92.9 FM, KPUG 1170 AM): (360) 734-9790
WWU station (KUGS 89.3 FM): (360) 650-5847

Television:
KVOS Channel 12 (local): (360) 671-1212
KIRO Channel 7 (Seattle): (206) 728-7777
KING Channel 5 (Seattle): (206) 448-3850

Newspaper:
The Bellingham Herald: (360) 676-2600

Instructions for Fecal Coliform or *E. Coli*

Public Notice at Tab 1

Since exceeding the fecal coliform or *E. coli* maximum contaminant level is a Tier 1 violation, you must provide public notice to persons served as soon as practical but **within 24 hours** after you learn of the violation (40 CFR 141.202(b)). During this time, you must also contact the DOH at (253) 395-6750 or at (877) 481-4901 (after-hours emergency line). You should also contact and coordinate efforts with the Whatcom County Health and Human Services Department at (360) 676-6724. A template for public notification follows at Tab 1, you may have to modify the template if you have other coliform MCL violations. You must use one or more of the following methods to deliver the notice to consumers (141.202(c)):

- Radio
- Newspaper
- Television
- Hand or direct delivery
- Posting in conspicuous locations

You may need to use additional methods (i.e. delivery of multiple copies to hospitals, clinics, or apartment buildings), since notice must be provided in a manner reasonably calculated to reach all persons served.

The Fecal Coliform Notice (Tab 1) is appropriate for hand delivery or a newspaper notice. However, you may wish to modify it before using it for a radio or TV notice. Two DOH drafted Fact Sheets follow the Fecal Coliform Notice in Tab 1. The Fact Sheets do not include all required elements (the health effects language in italics on the Fecal Coliform Notice). This language is mandatory (141.205(d)). If you post or hand deliver, print your notice on letterhead, if time allows.

Population Served

Make sure it is clear what areas are served by the water that has violated a water quality standard--you may need to coordinate with Water Division to determine the impacted service areas.

Corrective Action

In your notice, describe corrective actions you are taking. Listed below are some steps commonly taken by water systems with fecal coliform or *E. coli* violations. Use one or more of the following actions, if appropriate, or develop your own:

- We are chlorinating and flushing the water system.
- We are increasing sampling for coliform bacteria to determine the source of the contamination.
- We are repairing the chlorinators.
- We are flushing/repairing the storage tank/water main.
- We are restricting water intake from the river/lake/reservoir to prevent additional bacteria from entering the water system and restricting water use to emergencies.

After Issuing the Notice

Send a copy of each type of notice and a certification that you have met all the public notice requirements (Tab 6) to the Department of Health within ten days from the time you issue the notice (40 CFR 141.31(d)).

It is recommended that you notify health professionals in the area of the violation. That would be Dr. Greg Stern, the County Health officer. He can be reached through the Health and Human Services Department at 676-6720 (after hours this line will give instructions on what number to call). People may call their doctors with questions about how the violation may affect their health, and the doctors should have the information they need to respond appropriately. In addition, health professionals, including dentists, use tap water during their procedures and need to know of contamination so they can use bottled water. Finally food service establishments and institutions (inc. restaurants, hospitals) should be notified directly of the problem. A fact sheet for these businesses is included at Tab 5.

It is a good idea to issue a problem corrected notice when the violation is resolved. An example is included in this report at Tab 4.

Instructions for Waterborne Disease Outbreak

Public Notice at Tab 2

Since a waterborne disease outbreak is a Tier 1 situation, you must provide public notice to persons served as soon as practical but within 24 hours after you learn of the situation (40 CFR 141.202(b)). You must also contact the City Communications Coordinator during this time. You should coordinate with the DOH at (253) 395-6750 or at (877) 481-4901 (after-hours emergency line) and also with the Whatcom County Health and Human Services Department at (360) 676-6724. **You must issue a public notice if you are experiencing a waterborne emergency other than a waterborne disease outbreak, such as one caused by flooding or treatment failure. In such cases, you may be able to modify this template to apply to your situation.** Check with the DOH for more direction. More information on waterborne disease outbreaks and emergencies is available from the Centers for Disease Control and Prevention (www.cdc.gov/health/diseases.htm), (800) 311-3435). For a waterborne disease outbreak or other emergency, you must use one or more of the following methods to deliver the notice to consumers (40 CFR 141.202(c)):

- Radio
- Television
- Hand or direct delivery and posting in conspicuous locations

You may need to use additional methods (e.g., newspaper, delivery of multiple copies to hospitals, clinics, or apartment buildings), since notice must be provided in a manner reasonably calculated to reach all persons served. If you post or hand deliver, print your notice on letterhead, if available. The Notice at Tab 2 is appropriate for hand delivery or a newspaper notice. You may wish to modify this notice before using it for a radio, TV notice, or posting.

Describing the Outbreak

If known, list any organisms detected, the number of affected people, any water treatment problems contributing to the waterborne disease outbreak, and any sources of contamination, such as flooding.

Potential Health Effects

No mandatory health effects language exists for waterborne disease outbreaks. It is suggested that descripters of the types of symptoms consumers could expect upon exposure to the pathogen in drinking water be provided (ie nausea, cramps, diarrhea...). Such information would help consumers determine if they may be experiencing the symptoms of waterborne disease, verses another illness. If appropriate, or contact the DOH or County Health Department for a description of expected symptoms.

Population at Risk

Some people who contract waterborne diseases can be affected more severely than others. There is language to reflect this on the public notice at Tab 2. This language is not mandatory, but you must provide information on the population at risk. In addition, make sure it is clear who is served by your water system--you may need to list the areas you serve.

Corrective Action

In your notice, describe the corrective actions you are taking. Listed below are some steps commonly taken by water systems with waterborne disease outbreaks. Use one or more of the following actions, if appropriate, or develop your own:

- We are repairing our chlorination system.
- We are increasing sampling for disease-causing organisms.

Make sure to send a copy of each type of notice and a statement certifying that you've met all public notification requirements to your primacy agency within ten days after issuing the notice (141.31(d))(see Tab 6). It is a good idea to issue a problem corrected notice (see Tab 4) when the waterborne disease outbreak is under control.

It is recommended that you notify health professionals in the area of the outbreak. That would be Dr. Greg Stern, the County Health officer. He can be reached through the Health and Human Services Department at 676-6720. People may call their doctors with questions about how the situation may affect their health, and the doctors should have the information they need to respond appropriately. In addition, health professionals, including dentists, use tap water during their procedures and need to know of contamination so they can use bottled water. Finally food service establishments and institutions (inc. restaurants, hospitals) should be notified directly of the problem (Fact Sheet at Tab 5).

Instructions for Notice for Turbidity Single Exceedance

Public Notice at Tab 3

If the DOH has designated this turbidity single exceedance as a Tier 1 violation (141.202(a)), you must provide public notice to persons served within 24 hours after it has been designated Tier 1 (141.202(b)). Turbidity violations are Tier 2 by default, but may frequently be elevated to Tier 1 by your primacy agency. In addition, **violations are automatically elevated if you are unable to consult with your primacy agency within 24 hours. In such cases, you must issue a notice within the next 24 hours.** You may elevate the violation to Tier 1 yourself as well. You should also coordinate with the Whatcom County Health Department. One or both agencies should tell you whether to instruct consumers to boil water. You must use one or more of the following methods to deliver the notice to consumers (141.202(c)):

- Radio
- Television
- Hand or direct delivery
- Posting in conspicuous locations

You may need to use additional methods (e.g., newspaper, delivery of multiple copies to hospitals, clinics, or apartment buildings), since notice must be provided in a manner reasonably calculated to reach all persons served. If you post or hand deliver, print your notice on letterhead, if you have it.

The notice at Tab 3 is appropriate for hand delivery or a newspaper notice. However, you may wish to modify it before using it for a radio or TV notice or posting. If you modify the notice, you must leave the health effects language in italics unchanged. This language is mandatory (40 CFR 141.205(d)).

Population Served

Make sure it is clear who is served by your water system--you may need to list the areas you serve.

Corrective Action

In your notice, describe corrective actions you are taking. Listed below are some steps commonly taken by water systems with turbidity single exceedance. Use one or more of the following actions, if appropriate, or develop your own:

- We are adding chemicals that reduce turbidity.
- We are sampling both untreated and treated water for the presence of coliform bacteria.
- We are monitoring chlorine levels and will adjust them as needed to compensate for filtration problems.
- We are inspecting and cleaning the filters.

Source of the Problem

If you know why the turbidity is high, explain it in your notice. For instance, unusual conditions, such as heavy rains and flooding, can overburden the water plant, and treated water may therefore not meet the standards. In addition, run-off from parts of the watershed could contain increased concentrations of sediment and animal waste.

After Issuing the Notice

Send a copy of each type of notice and a certification that you have met public notice requirements to your primacy agency within ten days after you issue the notice (40 CFR 141.31(d)) (see Tab 6). It is a good idea to issue a problem corrected notice when the violation is resolved (see Tab 4).

It is recommended that you notify health professionals in the area of the violation. That would be Dr. Greg Stern, the County Health officer. He can be reached through the Health and Human Services Department at 676-6720. People may call their doctors with questions about how the violation may affect their health, and the doctors should have the information they need to respond appropriately. In addition, health professionals, including dentists, use tap water during their procedures and need to know of potential microbiological contamination so they can use bottled water.

Instructions for Responding to a Threat Against a Water System

For use by Division of Drinking Water staff and water systems when responding to suspected vandalism or terrorism

These guidelines are presented in general sequential order, but the various steps and actions may be adjusted to meet the needs of specific situations. The DOH Division of Drinking Water staff want to work with utility personnel closely and collaboratively on determining specific actions appropriate to any given incident.

Identify the threat

- Take any suspicious activity or evidence of vandalism or sabotage seriously.
- Notify your chain of command immediately. Reference the City of Bellingham's Vulnerability Assessment (12/03) for applicable guidance/information.
- Designate a response coordinator, this would most likely be the Superintendent of Operations.
- Document what you see and keep notes as you go.

Immediately notify officials

- Contact your local law enforcement.
- Contact your Department of Health (DOH) Division of Drinking Water Regional Office and/or Regional Engineer. Use the after hours number (1-877-481-4901) if necessary.
- Alert other officials necessary to protect public health (for example, the Whatcom County Health Department).

Assess and respond to the threat

- Inspect facilities but do not disturb any evidence.
- In consultation with your local law enforcement, determine if the threat is credible. If there is strong evidence of sabotage or terrorist activity, call the FBI at (206) 622-0460.
- Pull together a response team with expertise in the areas needed to resolve the situation.
- Determine if there is biological or chemical contamination or damage that disrupts supply.
- In consultation with DOH, determine immediate actions to protect public health (examples include notifying customers, isolating affected areas, shutting down critical facilities, and issuing "boil water" or "do not drink" advisories).
- If contamination is suspected, sample for coliform, chlorine residual, and nitrates/nitrites. See lower on this page for guidance.
- Collect samples for future analysis and store them appropriately (for example, refrigerate).
- Conduct full assessment of the situation, facilities, and water quality.
- Develop a communication strategy and communicate with affected people regularly.
- If necessary, determine alternative sources of supply for your customers.
- If appropriate, drain, clean, repair, and disinfect the system.

Communicate with others

- Designate one public spokesperson who has the ability to control his or her emotions, remain calm, stay in control, and be firm but polite.
- Identify key messages and keep them current.
- Anticipate possible questions and prepare answers ahead of time.
- Never assume that what you say will be "off the record".
- Avoid conjecture and blame.
- Keep communication succinct and to the point.

Consider additional water testing

Intentional contamination of drinking water could come in many forms, which may be classified into four general categories: inorganics such as metals or cyanide, organics such as pesticides or volatile compounds, radionuclides, and pathogenic microbiological organisms. Even if you suspect contamination, it is unlikely that evidence will point to a particular contaminant. Instead, you may face a decision about which contaminants to test for. Here are some possible tests, each of which could give information about contaminants that may cause acute health effects.

Coliform Bacteria: May indicate whether microbial contamination has been introduced into the system, especially from fecal origins.

Hetertrophic Plate Count (HPC): Can provide information regarding the numbers of bacteria that may have been introduced into the water. HPC counts greater than 500 signal the need to be wary. Very high levels (1000 – 10,000 and greater) would suggest a problem that needs immediate evaluation.
Chlorine Residual: In chlorinated systems, one indication of materials introduced into the water will be the creation of a demand for the chlorine, leaving lower-than-normal or no residual and signaling the need for further evaluations.
Chlorine Demand: In instances where a lower chlorine level is observed, one can intentially increase chlorine levels (better done in a controlled setting such as in the lab) to reveal unusual demands on the oxidizing capability of the added chlorine, indicating the presence of a contaminant that warrants further investigation.
Nitrate/Nitrite: Relatively easy to perform. It is important to know whether these acute contaminants are present at levels that could harm infants.
Total Organic Carbon (TOC): Relatively simple to perform. Normal expected levels range from 0.2 to 4 mg/L for surface water and 0.01 to 2.0 mg/L for groundwater. Higher levels may indicate the presence of organic materials that could pose a health concern.
Total Halogenated Organic Carbon (TOX): Relative simple to perform. Measures the halogenated organic substances, including disinfection by-products such as trihalomethanes and haloacetic acids. High levels suggest that contamination has occurred or that precursor organic materials have been added to enable formation of disinfection byproducts.
Cyanide: Not easily performed, but should be done immediately if cyanide contamination is suspected. Cyanide is very toxic, causing death upon ingestion quite rapidly.

Division of Drinking Water phone numbers ·
· Northwest Regional Office: (253) 395-6750
· After hours: 877- 481-4901

October, 2002
DOH PUB. #331-183

Instructions for Tier 1 Problem Corrected

Template at Tab 4

It is a good idea to issue a notice when a serious violation or situation has been resolved. Although EPA regulations do not require such notices, the DOH may require you to issue one. You should coordinate with Whatcom County Health Department as well. Below are some recommended methods for a problem corrected notice. You should use the same delivery methods you used for the original notice.

- Radio
- Television
- Newspaper
- Hand or direct delivery
- Posting in conspicuous locations

You may wish to use additional methods (e.g., delivery of multiple copies to hospitals, clinics, or apartment buildings) if necessary to reach all persons served. If you post or hand deliver, print your notice on letterhead, if available.

The notice at Tab 4 is very general and can be used for any violation or situation. However, to help restore consumers confidence in the water system, you should modify the notice to fit your situation. Although the public should have seen your initial notice, there may be additional information you learned after the notice was issued. Therefore, you should describe the violation or situation again and discuss how the problem was solved.

DRINKING WATER WARNING

City of Bellingham water is contaminated with [fecal coliform] or [*E. coli*]

BOIL YOUR WATER BEFORE USING

Fecal coliform [or *E. coli*] bacteria were found in the water supply on [date]. These bacteria can make you sick, and are a particular concern for people with weakened immune systems.

What should I do?

- **DO NOT DRINK THE WATER WITHOUT BOILING IT FIRST.** Bring all water to a boil, let it boil for one minute, and let it cool before using, or use bottled water. Boiled or bottled water should be used for drinking, making ice, brushing teeth, washing dishes, and food preparation **until further notice**. Boiling kills bacteria and other organisms in the water.

- *Fecal coliforms and E. coli are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, some of the elderly, and people with severely compromised immune systems.*

- The symptoms above are not caused only by organisms in drinking water. If you experience any of these symptoms and they persist, you may want to seek medical advice. People at increased risk should seek advice about drinking water from their health care providers.

What happened? What is being done?

[Add specifics] Bacterial contamination can occur when increased run-off enters the drinking water source (for example, following heavy rains). It can also happen due to a break in the distribution system (pipes) or a failure in the water treatment process.

[Describe corrective action.] We will inform you when tests show no bacteria and you no longer need to boil your water. We anticipate resolving the problem within [estimated time frame].

For more information, please contact Bill McCourt at (360) 676-7689 or 2221 Pacific Street, Bellingham 98229. General guidelines on ways to lessen the risk of infection by microbes are available from the EPA Safe Drinking Water Hotline at 1(800) 426-4791. Additional Fact sheets and information is also available through the City of Bellingham.

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

This notice is being sent to you by the City of Bellingham Department of Public Works. State Water System ID#: 056003.

Date distributed: _____

AVISO SOBRE SU AGUA POTABLE

El Agua del Sistema City of Bellingham esta contaminado con [bacterias coliformes fecales] [*E. coli*]

HIERVAN EL AGUA ANTES DE USARLA

Bacterias coliformes fecales (o *E. coli*) fueron encontradas en su servicio de agua el dia [date of violation in Spanish (day-month-year)]. Estas bacterias pueden enfermarle, y son especialmente peligrosas para personas con las defensas bajas o sistemas imunológicos débiles.

) Que debo hacer?

- **NO BEBA EL AGUA SIN ANTES HERVIRLA**. Hierva toda el agua, déjela hervir por un minuto, y déjela reposar antes de usarla, o utilize agua embotellada. Agua hervida o embotellada debe ser usada para beber, hacer hielo, lavarse los dientes, lavar los platos y para preparar la comida hasta próximo aviso. Hierviendo morta a bacteria y otros organismos en el agua.

- *Coliformes fecales o E. coli son bacterias cuya presencia indica que el agua esta contaminada con desechos humanos o de animales. Microbios de esos desechos pueden causar diarrhea, cólicos, nausea, dolores de cabeza u otros síntomas. Pueden representar un peligro para la salud de bebés, niños y niñas de corta edad, algunos ancianos, y personas con sistemas immunológicos en alto riesgo.*

- Los síntomas descritos arriba no ocurren solamente debido a los microbios. También pueden ser causados por otros motivos. Si usted siente estos síntomas y estos persisten, usted puede optar por hacer una consulta con su médico. Personas en situaciones de alto riesgo deben consultar con sus proveedores de servicios médicos.

Qué pasó? Qué se está haciéndo al respecto?

Contaminación bacteriana puede ocurrir cuando exceso de aguas rebasan sus cauces y entran a las fuentes de agua potable (por ejemplo, luego de una lluvia fuerte). También pueden ocurrir cuando se rompe un sistema de recolección de aguas negras, o cuando hay una falla en el tratamiento de agua.

[Describe corrective action in Spanish] Le informaremos cuando las pruebas demuestren que no hay bacterias y que usted ya no necesita hervir su agua. Anticipamos que resolveremos el problema el **[date of expected resolution in Spanish day-month-year].**

Para mayor información, por favor póngase en contacto con Bill McCourt al (360) 676-6850 o escribiendo a 2221 Pacific Street, Bellingham, 98229.

Por favor comparta esta información con otros que pueden tomar de esta agua, colocando este aviso en lugares visibles, o remitiéndolo por correo, o entregandolo manualmente. Es de particular interés distribuir este aviso ampliamente si usted lo recibe representando un negocio, un hospital u hogar de infantes u hogar de ancianos o comunidad residencial.

Este aviso ha sido enviado a usted por City of Bellingham. Numero de Identificación : 056003. Fecha de distribución: _____

Fact Sheet

Coliform Bacteria and Drinking Water

September 2002
331-181

Water systems are required to deliver safe and reliable drinking water to their customers 24 hours a day, 365 days a year. However, if the water supply becomes contaminated with disease-causing bacteria, viruses or protozoa, many people can become seriously ill. Fortunately, many steps are taken to ensure the public is provided with safe drinking water. One of these steps is to test water for coliform bacteria.

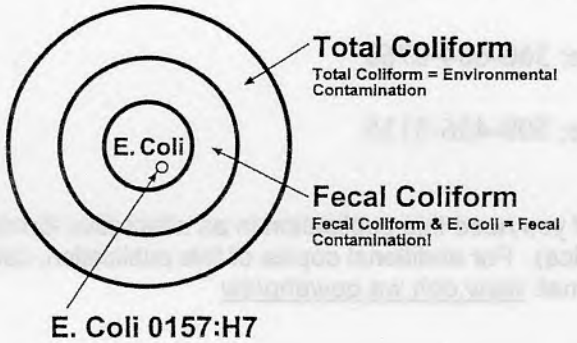
What are coliform bacteria?

Coliform bacteria are organisms that are present in the feces of all warm-blooded animals and humans. Many of the organisms that can contaminate water supplies and cause disease also come from feces. Testing drinking water for all these organisms would be very complex, time-consuming and expensive. However, it is relatively quick and easy to test water for the presence of coliform bacteria, which is the best way to tell if drinking water is contaminated.

Types of coliform bacteria

The term "coliform bacteria" refers to a large collection of many kinds of bacteria. There are three groups of coliform that are used as measures of drinking water quality: total coliform, fecal coliform, and *Escherichia coli* (*E. coli*).

TOTAL COLIFORM, FECAL COLIFORM AND E. COLI



Total coliform: a group of bacteria present in feces of all warm-blooded animals and humans. They can also sometimes grow in soil, lakes or rivers.
Fecal coliform: a sub-group of total coliforms, which are able to grow well at body temperature. Fecal coliforms are more likely to be from fecal contamination.
***E. coli*:** a sub-group of fecal coliform bacteria, which are almost always from fecal contamination.
***E. coli 0157:H7*:** a specific species of *E. coli*, which has been responsible for waterborne and food-borne disease outbreaks.

Washington State Department of Health
Environmental Health Programs
Division of Drinking Water

HELPING TO ENSURE SAFE AND RELIABLE DRINKING WATER

Questions & Answers

Public Health Advisory: Coliform

September 2002
331-179

Why must I boil my water?

Recent testing shows that your water system is contaminated with organisms that could cause illness.

Who can be affected? Can I become ill?

Anyone who drinks contaminated water may become ill. Infants, young children, the elderly, and people with severely compromised immune systems are more at risk of illness.

Who are people with compromised immune systems?

People who are on chemotherapy, organ or bone marrow recipients, those with HIV or AIDS, malnourished children, infants, and some of the elderly have compromised or weakened immune systems. An infection from a disease-causing organism may lead to very serious health problems for these people.

Can these diseases be spread in ways other than drinking the water?

Yes. Many of these disease-causing organisms are shed in the feces of infected people. In fact, some infected people do not have any symptoms but still shed these organisms. Childcare workers, young children who attend childcare, and caregivers for people who are sick and shedding these organisms are at the greatest risk of becoming ill. Washing hands with soap and water after using the toilet and before preparing food prevents the spread of diseases to others.

What are the symptoms to watch for?
What should I do if I think I have a waterborne illness?

Disease-causing organisms in water can cause diarrhea, stomach cramps, bloating, gas, fatigue, weight loss, nausea, vomiting, and/or fever. Symptoms may appear as early as a few hours to several days after infection and may last more than two weeks. If you are ill with these symptoms, contact your health care provider.

How can I make the water safe?

Boiling is the best way to ensure water is free of illness-causing organisms. Bring the water to a rolling boil for 3-5 minutes. When it cools, refrigerate the water in clean covered containers.
If you don't want to boil your water, you can disinfect the water using household bleach. Do not use bleach that contains perfume, dyes, or other additives. Use 1/8-teaspoon bleach per gallon of water, mix thoroughly, and then let stand for 60 minutes before using.

Washington State Department of Health
Environmental Health Programs
Division of Drinking Water

DRINKING WATER WARNING

BOIL YOUR WATER BEFORE USING

Disease-causing organisms have entered the City of Bellingham's water supply.

These organisms are causing illness in people served by the City of Bellingham. We learned of a waterborne disease outbreak from [agency] on [date].

What should I do?

- **DO NOT DRINK THE WATER WITHOUT BOILING IT FIRST.** Bring all water to a boil, let it boil for one minute, and let it cool before using, or use bottled water. Boiled or bottled water should be used for drinking, making ice, brushing teeth, washing dishes, and food preparation until further notice. Boiling kills bacteria and other organisms in the water.

- [Describe symptoms of the waterborne disease.] If you experience one or more of these symptoms and they persist, contact your doctor. People with severely compromised immune systems, infants, and some elderly may be at increased risk. These people should seek advice about drinking water from their health care providers.

What happened? What is being done?

[Describe the outbreak, corrective action, and when the outbreak might end.]

We will inform you when you no longer need to boil your water.

For more information, please contact Bill McCourt at (360) 676-6850 or 2221 Pacific Street, Bellingham, 98229. General guidelines on ways to lessen the risk of infection by microbes are available from the EPA Safe Drinking Water Hotline at 1(800) 426-4791.

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

This notice is being sent to you by the City of Bellingham. State Water System ID #056003.

Date distributed: _____

DRINKING WATER WARNING

The City of Bellingham has high turbidity levels

BOIL YOUR WATER BEFORE USING

We routinely monitor your water for turbidity (cloudiness). This tells us whether we are effectively filtering the water supply. A water sample taken [date] showed turbidity levels of [number] turbidity units. This is above the standard of 1.0 turbidity units. Because of these high levels of turbidity, there is an increased chance that the water may contain disease-causing organisms.

What should I do?

- **DO NOT DRINK THE WATER WITHOUT BOILING IT FIRST.** Bring all water to a boil, let it boil for one minute, and let it cool before using, or use bottled water. Boiled or bottled water should be used for drinking, making ice, washing dishes, brushing teeth, and food preparation until further notice.

- *Turbidity has no health effects. However, turbidity can interfere with disinfection and provide a medium for microbial growth. Turbidity may indicate the presence of disease causing organisms. These organisms include bacteria, viruses, and parasites, which can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.* People with severely compromised immune systems, infants, and some elderly may be at increased risk. These people should seek advice about drinking water from their health care providers.

- The symptoms above are not caused only by organisms in drinking water. If you experience any of these symptoms and they persist, you may want to seek medical advice.

What happened? What is being done?

[Describe reason for the high turbidity, corrective action, and when the system expects to return to compliance.]

We will inform you when turbidity returns to appropriate levels and when you no longer need to boil your water.

For more information, please contact Bill McCourt at (360) 676-6850 or at 2221 Pacific Street, Bellingham, 98229. General guidelines on ways to lessen the risk of infection by microbes are available from the EPA Safe Drinking Water Hotline at 1(800) 426-4791.

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

This notice is being sent to you by the City of Bellingham. State Water System ID#056003.

Date distributed: _____

DRINKING WATER PROBLEM CORRECTED

Customers of the City of Bellingham were notified on [date] of a problem with our drinking water and were advised to [describe recommended action]. We are pleased to report that the problem has been corrected and that it is no longer necessary to [describe recommended action]. We apologize for any inconvenience and thank you for your patience.

[Add further details here when appropriate.]

As always, you may contact Bill McCourt at (360) 676-6850 or at 2221 Pacific Street, Bellingham, 98229, with any comments or questions.

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

This notice is being sent to you by the City of Bellingham. State Water System ID #056003.

Date distributed: _____

Fact Sheet

Emergency Water Supply Guidelines

Restaurants - Food Stores – Schools
Institutions - Convenience Stores

September 2002
331–182

These guidelines are for establishments that provide food service to the public. State law (WAC 246-315-120) requires that food service establishment (FSE) owners ensure that their water supply is from a source approved by the Washington State Department of Health (WAC 246-290).

Procedures During Boil Water Advisory

When a boil water advisory is issued to a water system that supplies a food service establishment, the FSE may only remain open with the authorization of the local health department or district.

Minimum Requirements

Shut off:
- Ice machines
- Drinking fountains
- Produce misters
- Bottled water refill machines

Discard:
- Ice made with contaminated water
- Beverages made with contaminated water

Ice: Use packaged ice from approved source

Use boiled or bottled water for:
- Drinking
- Cooking
- Food preparation
- Washing produce

Hand washing:
- Use antibacterial soap

Dishwashing options:
- Commercial high temperature or chemical dishwasher
- Three compartment sink
  1. Hot soapy water
  2. Hot water rinse
  3. Sanitizing rinse – cool water with bleach solution (1 teaspoon bleach per 1 gallon water) – followed by air drying completely

Employee Information:
- Develop a plan to notify and educate employees about emergency procedures
- Post signs or copies of the water system's health advisory

The local health department or district may impose additional requirements to protect against health hazards during the boil water advisory, such as modifying food preparation steps or prohibiting some menu items.

These procedures should be followed until notified by the local health department or district, or the state Department of Health.

The Department of Health is an equal opportunity agency. If you need this publication in an alternative format, please call 1-800-527-0127 (voice) or 1-800-833-6388 (TDD relay service). For additional copies of this publication, call 1-800-521-0323. This and other publications are available on the Internet: www.doh.wa.gov/ehp/dw

Health

HELPING TO ENSURE SAFE AND RELIABLE DRINKING WATER

Fact Sheet

Getting Drinking Water Information

October, 2002
DOH PUB. #331-185

The Division of Drinking Water supplies information to water purveyors several ways.

Website: http://www.doh.wa.gov/ehp/dw/

The division's Internet website has information specifically for water works operators, such as:

- Program Information (State Revolving Fund, enforcement, certification, exam schedule, publications, water use efficiency)
- Emergencies
- Purveyor Assistance (Water Tap newsletter, lists of contract operators and approved satellite management agencies)
- Rules and Regulations
- Related Sites
- Staff Contacts
- Training Calendar
- Water System Data

Publications

The Division of Drinking Water has produced about 100 currently available publications containing information that is useful to water purveyors. In addition, the division lists "recommended references" produced by other organizations. If you have access to the web, you can view the combined list of division publications and recommended references at: http://www.doh.wa.gov/ehp/dw/Our_Main_Pages/newpub2.htm. Some of the listings are linked to the electronic documents so you can print a copy yourself. Some of the publications are also available through other sources, as noted. You may get an order form online at http://www.doh.wa.gov/ehp/dw/publist.doc

You may request publications from the division in several ways:

1. Call the Training and Outreach office directly at 360/236-3164.
2. Leave a message on the toll-free hotline, 1-800-521-0323.
3. Fill out a publication order form online and submit it electronically through the email link we provide (DWINFO@doh.wa.gov).
4. Print the order form, fill it out, and mail it to:

   Division of Drinking Water
   Building 8, NewMarket Industrial Campus
   P.O. Box 47828
   Olympia, WA 98504-7828

Health

HELPING TO ENSURE SAFE AND RELIABLE DRINKING WATER

Allow two to three weeks for delivery.

Technical assistance

If you are a water purveyor and you have questions, please feel free to call your Division of Drinking Water Regional Office. They are open Monday through Friday, 8:00 a.m. to 5:00 p.m. If you have an after-hours emergency, call 1-877-481-4901.

Eastern Regional Office, 509/456-3115
Serving Adams, Asotin, Benton, Chelan, Columbia, Douglas, Franklin, Garfield, Grant, Kittitas, Klickitat, Lincoln, Okanogan, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman, and Yakima counties.

Northwest Regional Office, 253/395-6750
Island, King, Pierce, San Juan, Skagit, Snohomish, and Whitman counties

Southwest Regional Office, 360/664-0768
Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Kitsap, Lewis, Mason, Pacific, Skamania, Thurston, and Wahkiakum counties

More detailed information about staff contacts can be found at:
www.doh.wa.gov/ehp/dw/Staff_Lists/dwnames.htm

The Department of Health is an equal opportunity agency. If you need this publication in an alternative format, please call 1-800-527-0127 (voice) or 1-800-833-6388 (TDD relay service). For additional copies of this publication, call 1-800-521-0323. This and other publications are available on the Internet: www.doh.wa.gov/ehp/dw

PUBLIC NOTICE CERTIFICATION

Within 10 days of notifying your customers, you must send a copy of each type of notice you distribute (hand-delivered notices, press releases, newspaper articles, etc.) to your Regional Office of the Division of Drinking Water. Also complete and send this form, which certifies that you have met all the public notification requirements. If the boil water advisory remains in effect more than three months, you must notify your water users again and provide another Public Notice Certification to the Department of Health. *With this certification, you are also stating that you will meet future requirements for notifying new billing units of the violation or situation.*

Water System:_____ ID#_____ County:_____

Violation Date:_____ / _____ / _____ ViolationType:_____

This public water system certifies that public notice has been given to water users, following state and federal requirements for delivery, content, and deadlines.

Complete the following items:

Yes	No	
☐	☐	Distribution was completed on ___ / ___ /____. Check all that apply:
	☐	Hand delivery,
	☐	Press release (TV, radio, newspaper, etc.),
	☐	Posting at_____ (by DOH approval only),
	☐	Other _____ (by DOH approval only).
☐	☐	Were the water users notified within 24 hours?

_____ _____ _____

Signature of owner or operator | Position | Date

Washington State Department of Health
Environmental Health Programs
Division of Drinking Water

Northwest Regional Office: 20435 72nd Ave. S., Suite 200, Kent WA 98032 Jennifer Prodzinski and Carol Stuckey: (253) 395-6775 Fax: (253) 395-6760
Southwest Regional Office: 2411 Pacific Ave., PO Box 47823, Olympia WA 98504 Sandy Brentlinger: (360) 753-5090 Fax (360) 664-8058
Eastern Regional Office: 1500 West Fourth Ave., Suite 305, Spokane WA 99204 Pat McCaffery: (509) 456-2788 Fax: (509) 456-2997

Washington State Department of Health
Division of Drinking Water
P.O. Box 47822
Olympia, WA 98504-7822

Treatment of Drinking Water for Emergency Use



Washington State Department of Health
Environmental Health Programs
Division of Drinking Water

DOH Pub. #331-115 (Revised October 2001)

When Do You Need To Treat Drinking Water?

Normally your water is safe to drink, but it may need to be treated if your usual water supply is interrupted or becomes unsafe for drinking. Conditions that may require treatment of drinking water include:

- Disasters such as floods, earthquakes and power outages that interrupt your water supply;
- Water supply system disruption or loss of pressure because of line breaks or repairs;
- Special conditions under which your water system, local health department, or the State Department of Health informs you that the water should be boiled or treated before drinking.

Preparing For Emergencies

The best way to ensure a safe supply of drinking water is to routinely **store enough water to last through an emergency.** Although most emergencies are unexpected, you may be able to anticipate situations by watching or listening to weather reports. You should also pay attention to notices from your water system about planned water disruptions or other conditions that could signal a problem with your water supply.

Whether or not you store supplies of water, keep on hand the following items used to treat water during an emergency:



- Fresh supply of liquid household bleach and kitchen measuring spoons or a medicine dropper (medicine droppers with both teaspoon and milliliter markings are available at drug stores),
- Equipment (propane or gas stoves, outdoor barbeque grills, etc.) needed to boil water (remember that your usual source of energy may not be available during an emergency).

Storing Drinking Water For Emergencies

To be prepared for a drinking water emergency, the American Red Cross recommends storing one gallon of water per person per day (two quarts for drinking, two quarts for each person in your household for food preparation/sanitation). Keep at least a three-day supply of water per person. Extremely warm temperatures and intense physical activity can double that amount; children, nursing mothers, and ill people will need more.



- **Collect the water from a safe supply.** If you are connected to a state-approved public water system, your water should be considered safe unless you have been notified otherwise. If you have your own supply, contact your local health department about how to have it tested.
- **Use proper storage containers.** Store the water in containers that are made for water storage, or glass and plastic jugs previously used for juice, milk, pop or bottled water. Clean containers thoroughly before using and make sure that the container has a tight fitting cap. *Never use containers that were previously used for pesticides, chemicals, solvents, anti-freeze, oils, etc.*



- Add liquid bleach to the water according to the tables provided at the end of this publication in order to keep it safe for drinking.
- **Store in a cool place, safe from flooding, freezing and earthquakes.** It is recommended that you use or discard the stored water and replace it with a fresh supply every two months.

Treating Water In Emergencies: Boil Or Add Bleach

If a safe supply of water is not available, it should be treated before being used for drinking, cooking or brushing teeth.

There are two primary ways of treating water: **boiling or adding bleach**. If the supply has been made unsafe because of untreated surface water (from floods, streams or lakes), boiling is the better treatment.

If the water is cloudy, it should be filtered before boiling or adding bleach. Filters designed for use when camping, coffee filters, towels (paper or cotton), cheesecloth, or a cotton plug in a funnel are effective ways to filter cloudy water.

Boiling

Boiling is the best way to purify water that is unsafe because of the presence of protozoan parasites or bacteria. Boiling should not be used when toxic metals, chemicals (pesticides, solvents, etc.), or nitrates have contaminated the water.



- Place the water in a clean metal or glass container and bring to a full boil. Continue boiling for at least three minutes. If you live more than 5,000 feet above sea level, you must increase the boiling time to at least five minutes.
- Boiled water should be kept covered while cooling and should then be stored in the manner previously described under "Storing Drinking Water For Emergencies."

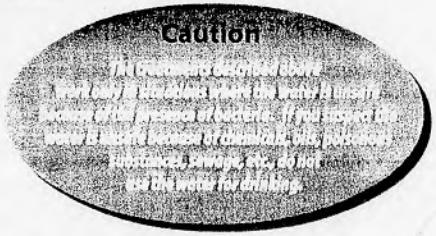
Purifying By Adding Liquid Chlorine Bleach

If boiling is not possible, water can be made safe for drinking by treating with liquid household chlorine bleach, such as Clorox, Purex, etc. Household bleach is typically between 5% and 6% chlorine. Avoid using bleaches that contain perfumes, dyes or other additives. Be sure to read the label.

- Place the water (filtered if necessary) in a clean container. Add the amount of bleach according to the tables at the end of this advisory. Mix thoroughly and allow to stand for at least 30 minutes before using (60 minutes if the water is cloudy, or very cold).
- Purifying tablets or chemicals designed for use when camping or backpacking can also be an effective way to treat water. Always follow the directions on the package.

Note:

Chlorine and other chemicals will <u>not</u> kill oocysts of the parasite *Cryptosporidium* ("Crypto"), which may be present in water supplies affected by untreated surface water. *Cryptosporidium* is an organism that can cause severe illness and even death in persons who have been weakened because of health problems. Boiling is the best water treatment if there is the possibility of contamination by Crypto.



For additional copies or more information call 1-800-521-0323.
The Department of Health is an equal opportunity agency.
If you need this publication in an alternative format, please call 1-800-525-0127 (voice) or 1-800-833-6388 (TDD relay service).
www.doh.wa.gov/ehp/dw/

Treating Water With a 5-6% Liquid Chlorine Bleach Solution

(Allow treated CLEAR water to stand 30 minutes before using; treated CLOUDY water should stand for 60 minutes)

Volume of Water To Be Treated	Treating Clear Water	Treating Cloudy, Very Cold or Surface Water
	Bleach Solution To Add	Bleach Solution To Add
1 quart/1 liter	3 drops	5 drops
1/2 gallon/2 quarts/2 liters	5 drops	10 drops OR 1/8 tsp
1 gallon	10 drops OR 1/8 tsp	20 drops OR 1/4 tsp
5 gallons	50 drops OR 2.5 mL OR 1/2 tsp	5 mL OR 1 tsp
10 gallons	5 mL OR 1 tsp	10 mL OR 2 tsp



tsp = teaspoon; Tbsp = tablespoon; mL = milliliter

Treating Small Quantities of Water

For treating small amounts of water, you may find it easier to use a 1% bleach solution.

- Mix one part of 5-6% household bleach and four parts clean water by volume to yield a 1% bleach solution. For example, add one cup of bleach to four cups water to yield five cups of 1% bleach solution.
- Keep the bleach solution in a tightly capped container labeled as 1% bleach solution. Store in a cool place. Discard and make a fresh solution every two months.

Treating Water With a 1% Liquid Chlorine Bleach Solution

(Allow treated CLEAR water to stand 30 minutes before using; treated CLOUDY water should stand for 60 minutes)

Volume of Water To Be Treated	Treating Clear Water	Treating Cloudy, Very Cold or Surface Water
	Bleach Solution To Add	Bleach Solution To Add
1 quart/1 liter	10 drops OR 1/8 tsp	20 drops OR 1/4 tsp
1/2 gallon/2 quarts/2 liters	20 drops OR 1/4 tsp	40 drops OR 2.5 mL OR 1/2 tsp
1 gallon	40 drops OR 2.5 mL OR 1/2 tsp	5 mL OR 1 tsp
5 gallons	12.5 mL OR 2.5 tsp	25 mL OR 5 tsp
10 gallons	25 mL OR 5 tsp	50 mL OR 10 tsp OR 3 Tbsp

tsp = teaspoon; Tbsp = tablespoon; mL = milliliter

Appendix I
Mutual Aid Agreements

CITY OF BELLINGHAM
CONTRACT #
2019-0550

Contract Entry

Originator
MAN

☐ Check if modifying an existing contract

☐ Check if this is a RUSH contract

☐ Check here for a SPECIAL routing

Originating Department *
PUBLIC WORKS

Contract Type *
INTERLOCAL AGREEMENT

Contracting Party *
WASHINGTON STATE INTRASTATE WATER/WASTEWATER AGENCY RESPONSE NETWORK (WARN)

Project Number/Name *
ILA – MUTUAL AID AND ASSISTANCE AGREEMENT

Project Manager *
MICHAEL OLINGER
10/4/19

A Maximum Payable is required unless the "No Dollar Impact" box is checked

Maximum Payable ☑ No Dollar Impact Primary Funding Source

If Termination Date is blank – At least one checkbox should be checked

Termination Date ☑ See Terms ☐ Special Retention ☐ Renewable

Certificate of Insurance
N/A

Additional Contract Information
Please email fully executed copy to Mike Olinger, Andy Wojciechowski and Mary Newby. Thank you.

10/4/19 Finance
10/7/19 Sec

CITY OF BELLINGHAM
CONTRACT #
2019-0550

Mutual Aid and Assistance Agreement for Washington State for Intrastate Water/Wastewater Agency Response Network (WARN)
As of: 04/13/09

This Agreement ("Agreement") is made and entered into by public water and wastewater utilities that have executed this Agreement.

ARTICLE I
PURPOSE

Recognizing that emergencies may require aid or assistance in the form of personnel, equipment, and supplies from outside the area of impact, the signatories hereby establish an Intrastate Network for Mutual Aid and Assistance (the "Network"). Through the Network, Members (as further defined in this Agreement) may coordinate response activities and share resources during emergencies.

ARTICLE II
DEFINITIONS

A. Authorized Official – An employee or officer of a Member agency that is authorized to:

1. Request assistance;
2. Offer assistance;
3. Decline to offer assistance;
4. Decline to accept offers of assistance, and
5. Withdraw assistance under this Agreement.

B. Emergency – A natural or human-caused event or circumstance causing, or imminently threatening to cause, loss of life, injury to person or property, human suffering, significant financial loss, or damage to environment. For example, Emergencies may include fire, explosion, flood, severe weather, drought, earthquake, volcanic activity, spills or releases of oil or hazardous material, contamination, utility or transportation emergencies, disease, blight, infestation, civil disturbance, riot, intentional acts, sabotage and war that are, or could reasonably be beyond the capability of the services, personnel, equipment, and facilities of a Member to fully manage and mitigate by itself.

C. Member – Any public agency which provides supply, transmission or distribution of water; or collection, conveyance or treatment services of storm water or waste water that executes this Agreement (individually a "Member" and collectively the "Members"). The Members are further classified as follows:

1. Requesting Member – A Member who requests aid or assistance under the Network.
2. Responding Member – A Member that responds to a request for aid or assistance under the Network.

D. Period of Assistance – The period of time when a Responding Member

assists a Requesting Member in response to a Request for Assistance. The Period of Assistance commences when personnel, equipment, or supplies depart from Responding Member's facility and ends when all of the resources return to the Responding Member's facility (*i.e.*, portal to portal).

E. National Incident Management System (NIMS): The national, standardized system for incident management and response that sets uniform processes and procedures for emergency response operations.

F. Associate – Any non-utility participant approved by the Statewide Committee that provides a support role for the Network (such as the State Department of Health). An Associate does not execute this Agreement.

ARTICLE III
ADMINISTRATION

The Network is administered through Regional Committees and a Statewide Committee.

A. Regional Committees. The State is divided into regions that are geographically the same as the existing Department of Health Office of Drinking Water regions of the state, with the exception that the eastern region is divided to create a central region. Each region has a Regional Committee. Each Member within a region may appoint one person to be a member of its Regional Committee. Only those Regional Committee members appointed by Members are entitled to vote on matters before the Regional Committee. An Associate may be a non-voting member of a Regional Committee. Each Regional Committee shall elect a Chair by majority vote of the voting members of that Regional Committee and shall meet annually to review the operations and procedures of the Network.

B. Statewide Committee. The Chairs of the Regional Committees are the voting members of the Statewide Committee. An Associate may be a non-voting member of the Statewide Committee. Further, the Statewide Committee also may include as non-voting members representatives from the Washington State Department of Health Office of Drinking Water, Washington State Department of Ecology, Washington State Emergency Management Division, Rural Community Assistance Corporation, Evergreen Rural Water of Washington, Washington State Public Health Laboratory, EPA Region 10, Washington Association of Sewer and Water Districts, and the Washington PUD Association. Under the leadership of a Statewide Committee Chair elected by majority vote of the voting members of the Statewide Committee, the Statewide Committee shall plan and coordinate emergency planning and response activities for the Network.

C. Members' administrative activities shall be voluntary and members shall not be required to finance the administration of the Network, nor shall the Network hold real or personal property.

ARTICLE IV
PROCEDURES

In coordination with the Regional Committees, and emergency management and public health systems of the State, the Statewide Committee shall develop and adopt operational and planning procedures for the Network that are consistent with this Agreement. The Statewide Committee shall review these procedures at least annually and shall update them as needed.

ARTICLE V
REQUESTS FOR ASSISTANCE

A. Member Information: Promptly after executing this Agreement, the signatory Member shall deliver the following to the Statewide Committee: (1) a certified copy of the action of Member's governing body that authorized the signing of this Agreement and (2) an original signed Agreement. Each Member shall identify an Authorized Official and one alternate Authorized Official. Each Member shall provide current 24-hour contact information for its Authorized Officials to the Statewide Committee, which shall maintain a current list of all Members and the contact information for their Authorized Officials. The Statewide Committee shall provide to all Members an updated version of this list annually and whenever there is an addition or withdrawal of a Member and whenever there is a change of Authorized Officials' contact information.

B. Request for Assistance. In the event of an Emergency, a Member's Authorized Official may request mutual aid and assistance from Members ("Request for Assistance"). Requests for Assistance may be made orally or in writing, provided that when a Request for Assistance is made orally, the Requesting Member shall, as soon as practicable, identify and transmit in writing the personnel, equipment and supplies requested. Requesting Members shall direct Requests for Assistance to Authorized Officials. The Statewide Committee shall provide specific protocols for Requests for Assistance as part of the procedures created pursuant to Article IV of this Agreement.

C. Response to a Request for Assistance – Members are not obligated to respond to a Request for Assistance. After a Member receives a Request for Assistance, the receiving Member's Authorized Official shall evaluate whether to respond to the Request for Assistance, whether resources are available to respond, or if other circumstances would hinder response. Following the evaluation, the Authorized Official shall inform, as soon as possible, the Requesting Member whether the Member will respond to the Request for Assistance. If the Member is willing and able to provide assistance, the Member shall inform the Requesting Member of the type of available resources and the approximate arrival time of such assistance.

D. Discretion of Responding Member's Authorized Official – No Member has any duty to respond to a Request for Assistance. When a Member receives a Request for Assistance, the Authorized Official shall have sole and absolute discretion

as to whether or not to respond to the Request for Assistance, and if responding in the affirmative, to determine the availability of resources to be made available to the Requesting Member. The response of a Member's Authorized Official regarding the availability of resources to a Requesting Member shall be final.

E. No Liability for Failure to Respond – No Member will be liable to any other Member for deciding not to respond to a Request for Assistance or otherwise failing to respond to a Request for Assistance. All Members hereby waive all claims against all other Members arising from or relating to any Member's decision to not respond to a Request for Assistance or to any Member's failure to respond to a Request for Assistance.

ARTICLE VI
RESPONDING MEMBER PERSONNEL

A. National Incident Management System-When providing assistance under this Agreement, the Requesting Member and Responding Member are encouraged (but are not obligated) to be organized and function under NIMS.

B. Coordination and Records – Employees of the Responding Member will remain under the direction and control of the Responding Member to the fullest extent possible. The Responding Member is an independent contractor at all times. The Requesting Member's Authorized Official shall coordinate response activities with the designated supervisor(s) of the Responding Member(s). The Responding Member's designated supervisor(s) shall keep accurate records of work performed by personnel during the Period of Assistance and for the equipment and supplies provided during work.

C. Food and Shelter – Whenever practical, Responding Member personnel must be self sufficient for up to seventy-two (72) hours. Whenever practical, the Requesting Member shall supply adequate food and shelter for Responding Member personnel. If the Requesting Member is unable to provide food and shelter for Responding Member personnel, the Responding Member's designated supervisor is authorized to secure the food and shelter necessary to meet the needs of its personnel.

D. Communication – The Requesting Member shall provide Responding Member personnel with communications equipment as available, radio frequency information to program existing radios if appropriate, or telephone contact numbers, in order to facilitate communications with local responders and utility personnel. Each Requesting Member shall provide contact information for an individual with whom Responding Member's personnel may coordinate while en-route for access, staging instructions and other logistical requirements.

E. Status - Unless otherwise provided by law, the Responding Member's officers and employees shall have the same powers, duties, rights, privileges, and immunities as if they were performing their duties in the jurisdiction in which they are

normally employed.

F. Licenses and Permits – To the extent permitted by law, Responding Member personnel that hold licenses, certificates, or permits evidencing professional, mechanical, or other skills shall be allowed to carry out activities and tasks relevant and related to their respective credentials during a Period of Assistance.

ARTICLE VII
RIGHT TO WITHDRAW RESOURCES

A. Right to Withdraw - A Responding Member may withdraw some or all of its resources at any time for any reason, as determined in the Responding Member's sole and absolute discretion. The Responding Member shall communicate written or oral notice of intention to withdraw all or some of a Responding Member's resources to the Requesting Member's Authorized Official as soon as practicable under the circumstances. To the greatest extent possible, but without limiting in any way a Responding Member's sole and absolute discretion, a Responding Member's determination to withdraw some or all of its resources provided to a Requesting Member should consider the status of the incident and incident stability, to minimize any adverse impacts from the withdrawal of resources by a Responding Member.

B. No Liability for Withdrawal - No Member will be liable to any other Member for first responding to a Request for Assistance by providing resources (such as personnel, materials, and equipment) and later withdrawing or refusing to continue to provide some or all of those resources. All Members hereby waive all claims against all Members arising from or relating to such a withdrawal or refusal.

ARTICLE VIII
COST- REIMBURSEMENT

The Requesting Member shall reimburse the Responding Member for all costs incurred by the Responding Member during a Period of Assistance, unless otherwise agreed in writing by both Members.

A. Personnel – The Requesting Member shall reimburse the Responding Member for personnel costs incurred for work performed during a Period of Assistance. Responding Member personnel costs will be calculated according to the terms provided in their employment contracts, hourly rate schedules or other conditions of employment. The Responding Member's designated supervisor(s) shall keep accurate records of work performed by personnel during a Period of Assistance. The Requesting Member shall include in its reimbursement of the Responding Member all personnel costs, including salaries or hourly wages, costs for fringe benefits, and indirect costs.

Unless otherwise agreed in writing, the Requesting Member shall reimburse the Responding Member for all reasonable and necessary costs associated with providing food and shelter for the Responding Member's personnel, if the food and shelter are

not provided by the Requesting Member. The Requesting Member is not required to reimburse the Responding Member for food and shelter costs in excess of State per diem rates unless the Responding Member demonstrates in writing that the excess costs were reasonable and necessary under the circumstances.

B. Equipment – The Requesting Member shall reimburse the Responding Member for the use of equipment during a Period of Assistance, including, but not limited to, reasonable rental rates, all fuel, lubrication, maintenance, transportation, and loading/unloading of loaned equipment. The Requesting Member shall return all equipment to the Responding Member in good working order as soon as is practicable and reasonable under the circumstances. If equipment cannot be returned in good working order, then Requesting Member shall either provide in-kind replacement equipment to Responding Member at no cost to Responding Member or pay to Responding Member the actual replacement cost of the equipment. Reimbursement rates for equipment use will be no less than the Federal Emergency Management Agency's (FEMA) Schedule of Equipment Rates. If a Responding Member uses rates different from those in the FEMA Schedule of Equipment Rates, the Responding Member shall provide such rates orally or in writing to the Requesting Member prior to supplying the equipment. If reimbursement rates are to be different than those in the FEMA Schedule of Equipment rates, Responding Member and Requesting Member shall agree in writing on which rates will be used prior to dispatch of the equipment to the Requesting Member. Requesting Member shall reimburse for equipment not referenced on the FEMA Schedule of Equipment Rates based on actual recovery of costs. If a Responding Member is required to lease equipment while its equipment is being repaired because of damage due to use during a Period of Assistance, Requesting Member shall reimburse Responding Member for such rental costs.

C. Materials and Supplies – The Requesting Member shall reimburse the Responding Member in kind or at actual replacement cost, plus handling charges, for use of expendable or non-returnable supplies by the Responding Member during a Period of Assistance. The Responding Member shall not charge direct fees or rental charges to the Requesting Member for other supplies and reusable items that are returned to the Responding Member in a clean, damage-free condition. Reusable supplies that are returned to the Responding Member with damage will be treated as expendable supplies for purposes of cost reimbursement.

D. Payment Period – In order to be reimbursed, the Responding Member shall provide an itemized bill to the Requesting Member no later than ninety (90) days following the end of the Period of Assistance for all expenses incurred by the Responding Member while providing assistance to a Requesting Member under this Agreement. The Responding Member may request additional time to submit the itemized bill, and Requesting Member shall not unreasonably withhold consent to such a request. The Requesting Member shall pay the itemized bill in full on or before the forty-fifth (45^{th}) day following the billing date. The Requesting Member may request additional time to pay the itemized bill, and Responding Member shall not unreasonably withhold consent to such a request, but in no event will payment in full occur later than one year after the date a final itemized bill is submitted to the

Requesting Member. If a Responding Member disputes a portion of an itemized bill, the Requesting Member shall promptly pay those portions of the bill not under dispute, pending the resolution of the payment of the disputed portion of the bill.

E. Records - Where a Responding Member provides assistance to a Requesting Member under this Agreement, both Members shall provide the other Member access to the books, documents, notes, reports, papers and other records relevant to this Agreement for the purposes of reviewing the accuracy of a cost bill or making or undergoing a financial, maintenance or regulatory audit. Both Members shall maintain these records for at least three (3) years or longer where required by law.

ARTICLE IX
DISPUTES
NEGOTIATION

Members shall first attempt to resolve any controversy, claim or other dispute arising out of or relating to this Agreement by direct negotiation.

MEDIATION

To the extent not resolved by direct negotiation, Members shall mediate any controversy, claim or other dispute arising out of or relating to this Agreement. Mediation is a condition precedent to arbitration. Unless the disputing Members agree otherwise, the mediation will be administered by the American Arbitration Association (AAA) under its Construction Industry Mediation Procedures. The disputing Members shall pay in equal shares the mediator's fee and any filing fees. Unless otherwise agreed by the disputing Members, the disputing Members shall (1) hold the mediation no later than thirty (30) days after a disputing Member delivers a request for mediation to the other disputing Members and (2) hold the mediation at the location of the Requesting Member. Agreements reached in mediation will be enforceable as settlement agreements.

ARBITRATION

To the extent not resolved by mediation, Members shall arbitrate all controversies, claims and other disputes arising out of or relating to this Agreement. Unless the disputing Members agree otherwise, the arbitration will be administered by the AAA in accordance with its Construction Industry Arbitration Rules in effect on the date a disputing Member makes a demand for arbitration. A disputing Member may make a demand for arbitration before negotiation or mediation if it appears that a claim might be barred by a statute of limitations if the demand were made after the negotiation or mediation. However, in such a case the arbitration will be stayed until the conclusion of negotiation and mediation. The decision and award rendered by the arbitrator(s) shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

ARTICLE X
DUTY TO INDEMNIFY

To the extent of its fault, a Member shall defend, indemnify, and hold harmless all other Members, their elected officials, Authorized Officials, officers, employees and agents from any and all costs, claims, judgments, losses, awards of damage, injury, death and liability of every kind, nature and description, including the reasonable cost of defense and attorneys' fees, directly or indirectly arising from or relating to this Agreement (collectively, "Indemnified Claims"). This indemnity obligation extends to all Indemnified Claims against a Member by an employee or former employee of another Member, and for this purpose, by mutual negotiation, each Member hereby expressly waives, with respect to each other Member only, all immunity and limitation under any applicable industrial insurance act, including Title 51 of the Revised Code of Washington, other worker compensation acts, disability benefit acts or other employee benefit act of any jurisdiction which would otherwise be applicable in the case of Indemnified Claims.

ARTICLE XI
WORKER'S COMPENSATION AND SITE CONDITIONS

The Responding Member is responsible for providing worker's compensation benefits and administering worker's compensation for its employees. The Requesting Member is responsible for providing worker's compensation benefits and administering worker's compensation for its employees.

Each Member shall promptly identify to the other Members concerns about site safety, environmental concerns, and other working conditions. The Safety Officer appointed within the Incident Command System during the Period of Assistance shall address specific safety conditions and mitigations.

ARTICLE XII
NOTICE

Unless otherwise provided in this Agreement, all notices must be in writing. Notice to a Member must be delivered to the Member's Authorized Official.

ARTICLE XIII
EFFECTIVE DATE

This Agreement shall be effective with respect to each Member when that Member's authorized representative executes the Agreement. The Statewide Committee shall maintain a master list of all Members.

ARTICLE XIV
WITHDRAWAL

A Member may withdraw from this Agreement at any time by providing to the Statewide Committee Chair written notice of withdrawal signed by the withdrawing Member's Authorized Official or other person authorized by the withdrawing Member's governing body. Any withdrawal will be effective upon receipt by the Statewide Committee Chair of the notice of intent to withdraw. If there is no Statewide Committee Chair, the withdrawing Member shall provide written notice to each Member in its region, and the withdrawal will be effective upon delivery of those notices. Once withdrawal from this Agreement is effective, the withdrawing Member will have no further obligations under this Agreement, except that withdrawal from this Agreement will not affect any indemnification or reimbursement obligation under this Agreement that arises prior to the effective date of the withdrawal.

ARTICLE XV
TERMINATION

This Agreement shall terminate in its entirety when there are less than two Members. Termination of this Agreement will not affect any indemnification or reimbursement obligation under this Agreement arising prior to the termination. The Statewide Committee Chair shall provide written notice of termination to all remaining Members of the Agreement.

ARTICLE XVI
AMENDMENT

This Agreement may be amended if, after written notice of a proposed amendment to all Members, the proposed amendment is approved by a majority of Members in each region. The Statewide Committee Chair shall provide written notice to all Members of approved amendments. Approved amendments will take effect sixty (60) days after the date the notice is sent to the Members.

ARTICLE XVII
SEVERABILITY

The parties agree that if any term or provision of this Agreement is declared by a court of competent jurisdiction to be illegal or in conflict with any law, the validity of the remaining terms and provisions shall not be affected, and the rights and obligations of the parties shall be construed and enforced as if the Agreement did not contain the particular term or provision held to be invalid.

ARTICLE XVIII
PROHIBITION ON THIRD PARTIES AND ASSIGNMENT OF RIGHTS/DUTIES

Notwithstanding rights of subrogation asserted by a Member's insurance provider, this Agreement is for the sole benefit of the Members and no other person or entity shall have any rights under this Agreement as a third party beneficiary nor shall any Member owe duty to a third party not a signatory of this Agreement by virtue of this Agreement. Assignments of benefits and delegations of duties created by this

Agreement are prohibited and of no effect.

ARTICLE XIX
GOVERNING LAW

This Agreement is governed by the law of the State of Washington, specifically RCW 39.34, Interlocal Cooperation Act.

ARTICLE XX
EXECUTION IN COUNTERPARTS

This Agreement may be executed in any number of counterparts and by different parties in separate counterparts. Each counterpart when so executed shall be deemed to be an original and all of which together shall constitute one and the same Agreement.

The water and wastewater utility listed below executed this Agreement on this 4th day of October 2019

Water/Wastewater Utility: City of Bellingham

By: _____

Title: Mayor

Kelli Linville

By: _____

Title Interim Public Works Director

Eric Johnston

By: _____

Title: Finance Director,

Andrew Asbjornsen

Approved as to form

By: _____

Attorney for Member

Matthew Stamps

Contracts by Number/Department/Description/Expiration Date

Intergovernmental Cooperative Purchasing Agreement

Contract #	Department	Description	Expires
1994-0021	Kitsap County	Purchasing	12/31/3000
1994-0052	Whatcom County		
1994-0060	Yakima County		
1995-0014	Clark County (WA)		
1996-0118	Portland OR City		
1997-0396	Pierce County		
1998-0030	Sumner City		
1998-0052	WC Fire Dist. #3		
1998-0068	University Place City		
1998-0074	Tacoma City		
1998-0176	Lewis County		
1998-0221	Blaine City		
1998-0318	Thurston County		
1999-0010	Bremerton City		
1999-0021	Island County Emergency Svc. Comm. Center		
1999-0028	Lynnwood City		
1999-0326	Ferndale City		
2000-0133	WC Fire Dist. #7		
2001-0351	Everett City		
2002-0032	WA State Puget Sound Water Quality Action		
2002-0399	Kent City		

Interlocal Agreement

1979-0001	Georgia Pacific Corp.	Water Supply	12/31/3000
1987-0001	Bothell City	Purchasing	
1989-0010	Whatcom County	DR-285 Drainage System	
1990-0014	Lummi Tribal Water and Sewer District	Water Service	
1991-0007	Whatcom County PW	Traffic Signal Maintenance	
1992-0024	Telegraph Rd. Water Assoc.	Transfer of Assets & Services	
1992-0025	WC Water District #16	Transfer of Assets & Services	
1992-0026	Van Wyck Water Cooperative	Private Domestic Water	
1993-0009	California St. Water Assoc.	Water Service	
1993-0011	Glen Cove Water Cooperative	Water Sampling	
1993-0025	Western WA University	Construct Bill McDonald Pkwy.	
1993-0035	WC Water District #7	Water Sampling	

Contract #	Department	Description	Expired
1993-0039	Whatcom Transport. Authority	Bus Pullout Bill McDonald Pky.	12/31/3000
1994-0050	WC Lynden City PUD No. 1	Nooksack Basin Water Steering Committee	
1994-0053	WC Transportation Srv Dept.	Traffic Signal Maintenance	
1995-0022	Lynden City	Equipment and Assistance	
1995-0023	King County	Purchasing	
1995-0056	Whatcom County	McLeod Rd. Boundaries	
1996-0098	Whatcom County PW	Signal Maintenance	
1996-0098A	Whatcom County PW	Amendment to 0098	
1997-0374	Street Light Acquisition Group	Street Light Studies	
1997-0440	WC Water District #2	Water Service	
1998-0072	Whatcom County	Solid and Hazardous Waste	
1998-0289	Bellingham School District	Supplies and Equipment	
1998-0311	US Dept. of Interior	Water Resource Investigation	
1999-0005	WA State Dept. of Transport.	ST-922 Samish Way Overpass	
1999-0006	Skagit County	Supplies and Services	
1999-0030	WA State Dept. of Transport.	Haul/Road/Detour Agreement	
1999-0034	Whatcom County PW	Design & Reconstruct Yew St.	
1999-0077	Whatcom County	Solid & Haz. Waste Management	
1999-0098	NW Regional Council	Supplies and Equipment	
1999-0129	Water District #10	Services Exchange	
1999-0154	Bainbridge Island Fire Dept.	Supplies and Services	
1999-0159	WA State Dept. of Transp.	Widen Sunset Drive	
1999-0306	Spokane City	Procurement Agreement	
2000-0044	Lynden City	Endangered Species Act Recovery Plan	
2000-0072	Whatcom County	Solid & Haz. Waste Management	
2000-0107	Ferndale City	Exchange Operational Services	
2000-0188	Port of Bellingham	Fiber Optic System	
2000-0190	WA State Dept. of Ecology	Reduce Pollutant Load Lake Whatcom	
2000-0259	WA State Dept. of Ecology	Salmon Recovery Project	
2000-0317	Whatcom County	Reconstruct E. Bakerview/ James St. Intersection	
2001-0042	WC Health & Human Services	Onsite Sewage System Survey	
2001-0065	Whatcom County PW	Solid & Haz. Waste Management	
2001-0075	WC Council of Governments	Legislative Specialist	
2001-0081	Skagit County	Provide Material, Equip. Rental	
2001-0104	WC Council of Governments	North Sound Intermodel Project	
2001-0124	US Dept. of Interior	Water Resource Investigation	
2001-0137	Whatcom County	Fiber Optic Conduit Maint.	
2001-0149	Whatcom County	Fiber Optic Installation #1	
2001-0150	Whatcom County	Fiber Optic Installation #2	

Contract #	Department	Description	Expires
2001-0197	Port of Bellingham	Crosswalk Maintenance	12/31/3000
2001-0215	Whatcom County	Endangered Species Act	
2001-0239	Seattle City	Cooperative Purchasing Agree.	
2001-0261	WA State Conservation Corps	Salmon Recovery & Environmental Education	
2001-0268	Whatcom County	Squalicum Cr. Berm Project	
2001-0295	Whatcom County PW	Reuse Facility for Street Waste	
2001-0297	WA State Dept. of Transport.	Same	
2001-0310	Lynden City	Water Request	
2001-0315	Water District 10	Design & Construction of Joint Sewer Project	
2001-0322	WA State Dept. of Transport.	Sunset Drive ES0140	
2001-0370	Georgia Pacific Corporation	B'ham Bay Near Term Remedial Action	06/30/2006
2002-0007	WC Fire District #8	Maint., Repair, Purchasing	12/31/3000
2002-0019	WA State Dept. of Ecology	Centennial Clean Water Fund	
2002-0048	WC Council of Governments	Legislative Specialist	
2002-0179	Bellingham School District	Fiber Optic Broadband	
2002-0180	Port of Bellingham	ES-0164 City of B'ham Kiosk	12/31/2004
2002-0186	WA State Dept. of Ecology	Laboratory Services	12/31/3000
2002-0201	Whatcom County	Solid & Haz. Waste Management	
2002-0206	WA State Dept. of Transport.	Wayfinding System Fund	
2002-0223	Whatcom County	Onsite Sewer System Survey	
2002-0227	US Dept. of Agriculture	Snow Measuring, Middle Fork	
2002-0282	Whatcom County	What-Comm Communication	
2002-0300	Port of Seattle	Purchasing Interlocal Agree.	
2002-0303	Whatcom County	Memo of Understanding – POB	
2002-0309	Whatcom Conservation Dist.	Purchasing Agreement	
2002-0313	Bellingham City	Marine Resource Creosote Piling Removal	
2002-0349	WA State Interagency Office	Middle Fork Fish Ladder	
2002-0367	WA State Dept. of Ecology	Natural Resource Initiative	
2002-0388	Whatcom County	Marine Summit & Forage Fish	
2002-0388C	Whatcom County	Marine Summit & Forage #2	
2002-0391	WC Health Department	OSS Survey & Maint. Educ.	
2002-0407	WA State Dept. of Ecology	Laboratory Services	
2002-0408	Whatcom County	Reciprocal Maintenance Agree.	
2002-0418	WA State Dept. of Interior	Water Resource Investigation	
2002-0420	WC Council of Governments	Intermodal Connections & Commuter Study	
2002-0423	Burlington Northern Santa Fe	Wharf St./Pine St. Crossing	
2002-0427	Port of Bellingham	Sanitary Lift Station	

Contract #	Department	Description	Expires
2003-0006	Bellingham Whatcom Public Facilities District	City/District. Purchasing Agreement Use of Parking Lot Facilities	12/31/3000
2003-0009	WA State Dept. of Licensing	Iowa St. Resurfacing	
2003-0018	WA State Dept. of Transport.	Laboratory Services	
2003-0026	WA State Dept. of Ecology	Sudden Valley Water Dist. 10	
2003-0040	Whatcom County	Interlocal Agreement InfiNet	
2003-0066	Public Utility District #1	Certification Agreement	
2003-0068	WA State Dept. of Transport.	Olsen Estate Property	
2003-0082	Whatcom County	Northwest Fiber Conduit	
2003-0227	Bellingham School District	GCA 3462 Supp #1 Iowa/Moore Sts.	
2003-0261	WA State Dept. of Transport.	Reciprocal Maint. Interagency ES-236 Sunset Dr. Widening	
2003-0282	Whatcom County PW	ES-161 Central Avenue	
2003-0317	WA State Dept. of Transport.	Water Resource Investigation	
2003-0334	WA State Dept. of Transport.	Northeast Fiber Circuit	
2003-0338	US Dept. of Interior	South Fiber Circuit	
2003-0356	Bellingham School District	Interim Use Agreement	12/31/2050
2003-0357	Bellingham School District		12/31/2050
2003-0403	Whatcom Transportation Authority	Solid Waste Management	***No Date***
	Whatcom County PW	OSS Survey and Maintenance	
2003-0405	WC Health Department	Sudden Valley, District 10	12/31/2004
2003-0407	Whatcom County	Iris Ln. to Padden Cr. Bridge	12/31/2004
2004-0045	WA State Dept. of Transport.	Natural Resource Improvement	***No Date***
2004-0082	WA State Dept. of Ecology	Noise Wall & Safety Improvement	***No Date***
2004-0110	WA State Dept. of Transport.	Use Permit - Cornwall	09/30/2004
2004-0138			07/30/2004
2004-0142	Port of Bellingham		05/15/2004

Non-Conforming Agreement

Contract #	Department	Description	Expires
1985-0006	WA State Dept. of Natural Res.	LK. Whatcom Watershed	12/31/3000
1989-0040	WA State Dept. of Transport.	Maint. Agreement Traffic	
1993-0041	WA State Dept. of Transport.	Reciprocating Agreement	
1993-0043	WA State Dept. of Transport.	Design Proposal	
1996-0256	WA State Dept. of Transport.	Detour Road Bridge	
1997-0270	Burlington Northern Santa Fe	Pipeline License	
1997-0336	WA State Dept. of Transport.	Emer. Response Mutual Aid	
2001-0028	Burlington Northern Santa Fe	Roeder Ave/F St.	***No Date***
2001-0054	WA State Dept. of Transport.	Participating Agreement	***No Date***
2001-0057	WA State Dept. of Transport.	Pickett Bridge	***No Date***

Appendix J
AWIA Additional Requirements

This Appendix represent a summary of the additional AWIA requirements.

Interconnected Utilities

Although the City of Bellingham supplies several other small water systems on a wholesale basis, the City does not have any interties with other water systems that enable alternative supply to the City. Lake Whatcom is the primary and sole water supply source to the City.

Alternative Source Water Options

Lake Whatcom is the primary and sole water supply source to the City. The City also owns and has rights to the Nooksack River, but the Nooksack River source can only be used to supplement the primary water supply source, Lake Whatcom.

Additional AWIA Requirements

Table J-1. Strategies and Resources to Improve Resilience of the System

Topic	Location	Summary of Compliance
Using the results of the RRA for the highest threat likelihood	Appendix C of this ERP contains emergency action plans and checklists that address the results of the RRA.	EAPs can be used as staff training tools to expedite the response and mitigation process to an incident. EAP training will also lead to service interruptions being addressed more quickly, thereby improving the resilience of the system.
Robust spare parts inventory	Appendix A of this ERP contains categorized lists of emergency service providers including contractors available to deliver equipment when the Water System inventory is exhausted.	The PW Department is a member of WAWARN. This membership serves water and wastewater utilities by organizing inter-agency mutual aid that includes available spare parts and emergency staff, along with many other need's utilities may have during an emergency. The Water System also maintains a physical inventory of spare parts (two of every type) on the shelf for all water systems operations.
Interagency exercise and training	Located in Section 8 of this ERP.	Training and exercises are a large part of the strategies the Water System has in place to enhance preparedness and response capabilities. Section 8 of this ERP defines training and exercises recommendation to improve staff awareness and resiliency. Exercising with emergency external response partner agencies also builds preparedness through teamwork.
Cybersecurity	Assessing cybersecurity is required under AWIA Section 2013 for the RRA. See Appendix C Checklists #29 - SCADA Electronic Attack and #30 - SCADA Physical Attack.	Process Sabotage Cyber Insider/ Outsider was rated as a risk in RRA. Insider/outsider collaboration is considered a serious threat at present in the United States. SCADA systems are vulnerable to these threat types. Appendix C provides relevant response checklists.

Physical Security	Assessing physical security is required under AWIA Section 2013 for the RRA. Appendix C of this ERP provides procedural checklist addressing RRA results.	Diversion/Theft Physical and Physical Process Sabotage was rated as a high risk during the RRA. Insider/outsider collaboration is considered a serious threat at present in the United States with regard to the physical security of utilities. Addressing the results of the RRA, this ERP contains actions and procedures that provide guidance for preparedness and response to physical security breaches.

Table J-2. Plans and Procedures in the Event of a Malevolent Act or Natural Hazard

Topic	Location	Summary of Compliance
2021 Water System Emergency Response Plan	City of Bellingham, 2021 Water System ERP	This 2021 ERP developed for the Water System contains plans and procedures that can be implemented in the event of a malevolent act or natural hazard. This plan was developed with the input of Water System staff including operations, maintenance, procurement, and public information staff. External agency input was provided by members of the Local Emergency Planning Committee (LEPC) and Office of Emergency Management. Additional documents, such as SOPs, were reviewed and language from those documents was incorporated into this 2021 ERP. This AWIA requirement was addressed in this ERP with a primary focus on the Water System's ability to deliver safe drinking water.

Table J-3. Identification of Procedures and Equipment that can Obviate or Lessen Impact

Topic	Location	Summary of Compliance
Identification of procedures that can obviate or significantly lessen the impact of an event involving the Water System	Appendix C of this ERP provides step-by-step procedures in response to incidents impacting the PW Department, including the threat results specified in the RRA. Appendix A includes WAWARN contact information for emergency spare parts, and other equipment lists are located in Appendix E.	Checklists (provided in Appendix C) have been developed to address all AWIA requirements regarding the results of the RRA. Additional EAPs and checklists have been developed for other emergency events that either have occurred in the past or are capable of occurring. Section 4 of this emergency response plan also addresses the threat notification process that the Water System should follow regarding threat characterization for a contaminated water incident along with other malevolent threats.

Table J-4. Strategies for Use to Aid in the Detection of Malevolent Acts or Natural Hazards

Topic	Location	Summary of Compliance
Detection capability malevolent	Identified during the RRA site visits.	Physical security at many remote sites, such as pump stations, includes door alarms and interior motion detectors, which are interconnected to Programmable Logic Controllers (PLCs) and monitored via the SCADA system. Cameras are installed at some sites.
Detection capability natural hazards	To address risks assessed in the RRA. Appendix C provides checklists for the natural hazard threats identified.	During the RRA, a number of natural hazards received high risk ratings, including earthquakes. Preparedness and response guidance is included in Appendix C for AWIA compliance.

Table J-5. Coordination with Local Emergency Planning Committees

Topic	Location	Summary of Compliance
Whatcom County - LEPC	Whatcom Unified Emergency Operations Center The LEPC meetings are held quarterly. (currently, meetings are held online due to COVID-19). Each term of service is 1 year. The City of Bellingham is a member of the local LEPC.	Section 2013 of AWIA states that a Water System shall, to the extent possible, coordinate with the LEPC when developing or updating emergency response plans. Jacobs contacted the LEPC on March 3, 2021. The Office of Whatcom Unified was interviewed and encouraged the Water System to continue to be involved in the LEPC. Water System participation in LEPC planning meetings have contributed to the coordination and development of this ERP.

APPENDIX Y

CROSS-CONNECTION CONTROL PROGRAM

City of Bellingham Department of Public Works

2221 Pacific St Bellingham, WA 98229 P: (360) 778.7700 ◆ F: (360) 778.7701

CROSS-CONNECTION CONTROL PROGRAM

Marty Gray

Superintendent of Operations

Fabriciano Cruz

Water Standards Supervisor – Distribution

Cross-Connection Control Specialists

February 22, 2022

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4.07 Certified Tester
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5.14 Degree and Minimum Type of Backflow Protection Required
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5.33 Tester Competency Requirements
5.34 Approved Backflow Prevention Assembly Test Gauges
5.35 Backflow Prevention Assembly Test Gauge Calibration
5.36 Groundwater Wells-Domestic Auxiliary Supply

Article 1.00 Purpose
This document outlines the Cross-Connection Control Program implemented by the City of Bellingham that has the two-fold purpose of protecting the City's potable water supply against actual or potential contamination through cross-connection and backflow and eliminating existing, unknown Cross-connections through a Citywide Hazard Assessment program.

Article 2.00 Scope
The City's Cross-Connection Control Program contains the following elements to ensure compliance with the Washington Administrative Code 246-290-490 and Bellingham Municipal Code BMC 15.08.260.

- Operating instructions for implementing the Cross-Connection Control Program.
- Performance of surveys to identify water user locations where cross-connections are likely to occur and the degree of hazard.
- Installation of backflow protection by the water customer at the point of hazard or connection.
- Training and experience of personnel delegated to implement the cross-connection control program.
- Approved test procedures for testing backflow prevention assemblies to ensure backflow protection.
- Maintenance of records of locations, tests, and repair or replacement of backflow prevention assemblies.

Article 3.00 Administration and Authority
The Water Utility administers the City of Bellingham's Cross-Connection Control Program under the direction of the City of Bellingham Superintendent of Operations and the Water Utility Supervisor-Distribution These positions have the formal oversight of the program under the direction of the Washington State Department of Health. The Cross-Connection Control Program Specialist is responsible for the day-to-day operation and management of the program. The City of Bellingham Building Services division and Fire Department will work with the Water Utility to ensure that appropriate backflow assemblies are installed on all new construction projects and tenant improvements.

The authority for the Cross-Connection Control Program is with the:

- Federal Safe Drinking Water Act Amendments of 1996
- Washington State Department of Health WAC 246-290-490
- State of Washington Uniform Plumbing Code WAC 51-56
- Plumbing Code amendments WAC 51-57
- City of Bellingham Municipal Code BMC 15.08.260
- City of Bellingham Uniform Plumbing Municipal Code BMC 17.40

Article 3.50 Responsibility
The City has the responsibility to prevent water from unapproved sources, any other substances, contamination, or pollution from entering the City's water system. Such responsibility begins at the point of origin of the City's water supply, and includes adequate treatment facilities, water mains, and appurtenances ending at the point of connection of the customer's water service. The City's water utility will ensure adequate backflow and back-siphonage protection is maintained on the customer's water systems directly connected to the City's water distribution system. The City will not be responsible for any loss or damage directly or indirectly resulting from, or caused by any improper or negligent installation, operation, use, repair, or maintenance of, or interfering with, any approved backflow prevention assembly, required by this program, by any customer or any other person. The customer will bear all costs for the installation of pumps or renovation of existing customer piping, because of any decreases in line pressure attributed to the upgrading of existing backflow prevention assemblies or the installation of approved backflow prevention assemblies. The City will not be held responsible for any losses or damages incurred by the consumer because of upgrading existing backflow prevention assemblies or the installation of approved backflow prevention assemblies.

Article 4.00 Definitions
The following definitions describe those terms and phrases that are pertinent to the City of Bellingham's Cross-Connection Control Program.

4.02 Approved Backflow Prevention Assemblies
Assemblies that have passed laboratory and field evaluation tests performed by a recognized testing organization, which has demonstrated their competency to perform such tests, to the Washington State Department of Health. The Department of Health publishes a list of the assemblies.

4.03 Approved Water Supply
A water source that has been approved by the Washington State Department of Health for domestic use and designated as such in a domestic water supply permit.

4.04 Auxiliary Water Supply
Any water supply on or available to, a premise in addition to the City's approved potable water supply. An auxiliary supply may be a well, pond, creek, rainwater catchment system, etc. The term equipped means that appurtenances such as inactive wells, pumps, power supply, intakes, suction lines, pipelines, connection fittings, or storage tanks are in place and readily available for use.

4.05 AWWA
American Water Works Association

4.06 Backflow
A flow condition caused by a differential in pressure that causes the flow of water or other liquid, gases, mixtures, or substances to flow back into the water distribution system of a potable supply from any source or sources other than an approved water supply source.
Back-siphonage is one cause of backflow and is created by a negative or reduced pressure in the water distribution system.
Backpressure may occur when the potable supply piping is connected to a system or fixture that exceeds the operating pressure of the supply piping. This higher pressure can be caused by a booster pump, elevated storage, fire suppression equipment, or high-rise buildings.

4.07 Certified Tester
A person who has proven their competency in testing, repair, and making test reports on approved backflow prevention assemblies to the satisfaction of the City Water Standards Supervisor-Distribution. Individuals shall be certified through the Washington State Department of Health.

4.08 City

City of Bellingham.

4.09 Contamination
Degradation of the quality of the potable water by any foreign substance which creates a hazard to the public health, or which may impair the usefulness or quality of the water.

4.10 Cross-Connection
The term as used in this document means any unprotected actual or potential connection between a potable water system used to supply potable water for drinking purposes and any source or system containing unapproved water or a substance that is not or cannot be approved as safe, wholesome, and potable and that is possible to enter the water system by backflow. By-pass arrangements, jumper connections, removable sections, swivel or changeover assemblies, or assemblies that have not been tested annually by a certified backflow tester or properly maintained, through which backflow could occur shall be cross-connections.

4.11 Cross-Connection Control Program Specialist
A person certified as a Cross Connection Control Program Specialist by the Washington State Department of Health.

4.12 Critical Services
Water services that cannot be shut off, even for a few moments.

4.13 Customer
The owner or operator of a business or residential property.

4.14 Degree of Hazard
Shall be determined by a Cross-connection Control Specialist from an inspection of conditions upon the customer or water users premises and are classified as either a pollution (non-health), contamination (health) or on the Washington State Department of Health WAC 246-290-490 Table 9.

4.15 Department
The Washington State Department of Health.

4.16 Health Hazard
An actual or potential threat of contamination of a physical or toxic nature to the City of Bellingham's water distribution system.

4.17 Irrigation system
Use of the public water system for landscape irrigation containing piping, sprinkler heads and control valves or any irrigation system into which fertilizers, herbicides, or pesticides are, or can be pumped or injected.

4.18 Person
An individual, corporation, company, association, partnership, municipality, public utility, or other public body or institution.

4.19 Point of Connection
The downstream point of the water service where the City's responsibility and liability stops. Also known as the point where the City no longer controls the potable quality of the water.

4.20 Point of Use
The connection within the users plumbing system where an actual or potential cross connection may exist.

4.21 Pollution
Impairment of water quality to a degree that does not create a hazard to the public health but does adversely and unreasonably affect the aesthetic qualities of such waters for domestic use.

4.22 Potable Water
Any water which, according to the Washington State Department of Health regulations, is safe for human consumption.

4.23 Premises
All areas on a customer's property that receive service or have the potential to receive service by the City water distribution system.

4.24 Public Water System
A water distribution system that provides for the piping of water to the public for human consumption that has five or more service connections or regularly serves an average of 25 individuals daily at least 60 days out of the year.

4.25 Reclaimed Water
The term "reclaimed water" means a wastewater which, because of treatment, is suitable for uses other than potable use.

4.26 Service Connection
Piping, curb stop, meter box, and meter used to convey water service from a City water distribution main to the customer's property line or premises.

4.27 WAC 246-290-490
Washington State Administrative Code, 246-290-490 Cross connection control

4.28 USC Foundation
The University of Southern California Foundation for Cross-Connection Control and Hydraulic Research

4.29 Water Purveyor
The entity that owns or operates the approved water supply system. As cited in this document shall mean the City of Bellingham.

4.30 Water User
Any person or company obtaining water from the City of Bellingham's water distribution system and related appurtenances.

Article 5.00 Operating Instructions for Implementing the Cross-Connection Control Program

5.10 New Construction and Improvement Construction

All applications for new water service, or modification to premises with existing water service(s) are processed through the City's Building Services Division Development Section.
Based upon the information submitted on the application, the following City Cross-Connection Control Program requirements will be enforced on all new construction:

- *Air Gap*
  Severe health hazard

- *Reduced Pressure Detector Assembly (RPDA)*
  Fire sprinkler system with chemical addition

- *Double Check Detector Assembly (DCDA)*
  Commercial fire sprinkler system
  Residential fire sprinkler systems, two inch and larger in size

- *Reduced Pressure –Backflow Assembly (RPBA)*
  Premises isolation for high health hazards
  High health hazards, point of use

- *Double Check Valve Assembly (DCVA)*
  Premises isolation for low Health Hazards
  Residential fire sprinkler systems, none required if connected to water closet
  Irrigation systems
  Low health hazards, point of use

- *Pressure Vacuum Breaker (PVB) Spill Resistant Vacuum Breaker (SVBA)*
  Low health hazard, point of use

Improvement construction applications that are either commercial in nature or propose to change on-site historical water uses will require an on-site hazard assessment performed by the City's Cross Connection Control Program Specialist prior to completion of the permitted work. After the inspection, if it is determined that a backflow prevention assembly or a correction to the installation of an assembly is required, a correction notice will be issued. This will include a list of deficiencies along with the City's Construction Standard for the installation of the required backflow prevention assembly and a list of City approved certified backflow prevention assembly testers will be provided to the customer.

5.11 Hazard Assessment

Through the process of performing surveys to identify water user locations where cross connections are likely to occur, if it is determined that an actual or potential cross connection or backflow condition is present in an existing facility, the installation of an approved backflow prevention assembly commensurate with the actual or potential hazard will be required. Upon written notification, the customer shall install, within a prescribed period, an approved assembly, or assemblies at their own expense. Failure, refusal, or inability on
the part of the customer to install the assembly or assemblies within this prescribed time period shall result in the termination of water service to the premises until such time the assembly or assemblies is/are properly installed and tested.
If an existing backflow prevention assembly already installed does not comply with the current installation requirements or meet the appropriate level of protection as required by the Cross-Connection Control Program, then the Water Utility Supervisor-Distribution, shall require the assembly be changed to one that is approved and commensurate with the degree of hazard as required by the policy. A letter of confirmation will be sent to the affected customer informing them of their responsibility to correct, install, or upgrade an existing backflow prevention assembly to resolve an actual or potential backflow or cross-connection condition.

5.12 Conditions Requiring a Backflow Prevention Assembly
An approved backflow prevention assembly shall be installed wherever the following conditions exist:

- In the case of premises where water uses include those listed on the WAC 246-290-490 Table 9

  Agricultural (farms and dairies)
  Beverage bottling plants
  Car washes
  Chemical plants
  Commercial laundries and dry cleaners
  Premises where both reclaimed water and potable water are provided
  Film processing facilities
  Food processing plants
  Hospitals, medical centers, nursing homes, veterinary, medical and dental clinics, and blood plasma centers
  Premises with separate irrigation systems using the purveyor's water supply and with chemical addition+
  Laboratories
  Metal plating industries
  Mortuaries
  Petroleum processing or storage plants
  Piers and docks
  Radioactive material processing plants or nuclear reactors*
  Survey access denied or restricted
  Wastewater lift stations and pumping stations
  Wastewater treatment plants*
  Premises with an unapproved auxiliary water supply interconnected with the potable water supply

  \+ For example, parks, playgrounds, golf courses, cemeteries, estates, etc.

  * RPBAs for connections serving these premises are acceptable only when used in combination with an in-plant approved air gap; otherwise, the purveyor shall require an approved air gap at the service connection.

- In the case of premises on which any industrial fluid or any other objectionable substance is handled in such a fashion as to create an actual or potential hazard to the City's water system. The water system shall be protected against backflow from the premises by installing a backflow prevention assembly commensurate with the degree of hazard. This shall include the handling of process water and waters originating from the City's water distribution system, which have been subjected to deterioration in quality.

- In the case of premises having (1) internal cross-connections that cannot be permanently corrected and controlled, (2) intricate plumbing and piping arrangements, or it is impractical or impossible to ascertain whether dangerous cross-connections exist, the City water system shall be protected against backflow from the premises by the installation of an RPBA on the water service line before the first branch.

- In the case of commercial premises that have multiple tenant spaces with a single water service connection that may create an actual or potential hazard to the City's water system. The building shall be protected by a minimum of a DCVA, and any suites within the building posing a high health hazard that cannot be controlled by the installation of a point of use backflow assembly or are on the WAC 246-290-490 Table 9 shall be protected by an RPBA on the water supply line to the suite prior to the first branch within the suite. The City's water system shall be protected against backflow conditions from the premises by a customer installed premise isolation backflow prevention assemblies.

5.13 Type of Backflow Protection Required
The type of protection that shall be provided to prevent backflow into the City water supply shall be commensurate with the actual or potential degree of hazard that exists on the customer's premises. The type of backflow prevention assembly that may be required (listed in an increasing level of protection) includes:

- Pressure Vacuum Breaker (PVB) Spill Resistant Vacuum Breaker (SVBA)
- Double Check Valve Assembly (DCVA)
- Double Check Detector Assembly (DCDA)
- Reduced Pressure Backflow Assembly (RPBA)
- Reduced pressure Detector Assembly (RPDA)
- Air-Gap Separation (AG)

Section 5.14 lists the minimum types of backflow protection required to protect the City water supply at the customer's connection to premises with various degrees of hazard are listed in Section 5.14. Situations that are not covered in Section 5.14 shall be evaluated on a case-by-case basis and appropriate backflow protection determined by the Water Utility Supervisor-Distribution.

5.14 Degree and Minimum Type of Backflow Protection Required

RPBA

- Premises where reclaimed water is used and there is no interconnection with the City water system.
- Premises where there is wastewater pumping and there is no interconnection with the City water system. This does not include a single-family residence that has a sewage lift pump.
- Premises where hazardous substances are handled in any way the substances may enter the City water system. This does not include a single-family residence that has a sewage lift pump.
- Premises where the irrigation system is directly supplied from the City water system into which fertilizers, herbicides, or pesticides are, or can be, injected.
- Premises where the City distribution water pressure is used to inject industrial chemicals.
- Premises where there is a repeated history of cross-connections being established or reestablished.

DCVA

- Premises with a low health assessed degree of hazard
- Premises where the irrigation system is directly supplied from the City water system and does not possess injection capabilities.

5.15 Fire Protection Systems
Fire sprinkler systems with chemical addition shall be protected by the installation of an RPDA
Fire sprinkler systems shall be protected by the installation of a DCDA
Residential fire sprinkler systems sized two inches and larger shall be protected by a DCDA, those smaller than two inch shall be protected by the installation of a DCVA, unless the end use is connected to a water closet.

5.16 Inspection of Premises Where Cross-Connections May Exist
The customer's premises shall be open for inspection at all reasonable times to authorized representatives of the City's Water Utility to determine whether cross-connections, potential cross-connections or other sanitary hazards exist, see BMC15.04.030. When such a condition is identified, the Water Utility Supervisor-Distribution may deny or immediately discontinue water service to the customer's premises by providing for a physical breach in the water service line until the customer has corrected the condition(s) in conformance with WAC 290-490-460, and Uniform Plumbing Code and City Municipal Codes BMC 15.08.260 relating to cross-connection control. The customer will be informed of their responsibility to provide backflow protection and the type of backflow prevention assembly required in accordance with Bellingham Municipal Codes and Cross connection control standards.

5.17 Installation of Backflow Protection by the Water User at the User's Connection
Backflow prevention assemblies shall be installed in accordance with WAC 246-290-490 of the Washington State Department of Health, City of Bellingham Cross connection control standards.

5.18 Air-Gap Separation (AG)
The unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture, or other assembly and the flood level rim of said vessel. An approved Air-gap shall be at least two times the diameter of the supply pipe, measured vertically, above the flood rim of the vessel, and in no case less than one inch.

5.19 Reduced Pressure Backflow Assembly (RPBA)
An assembly approved by the Washington State Department of Health consisting of two independently operating approved check valves with an automatically operating differential relief valve between the two check valves, tightly closing shut-off valves on either side of the check valves, and properly located test ports for the testing of the check and relief valves. The assembly shall operate to maintain the pressure in the zone between the two check valves at a pressure less than the pressure on the public water supply side of the assembly. When the normal flow of water across an assembly stops, the pressure between the two check valves shall be less than the pressure on the public water supply side of the assembly. In case of leakage of either of the check valves, the differential relief valve shall operate to maintain the reduced pressure in the zone between the check valves by discharging to the atmosphere. When the inlet pressure is two pounds per square inch or less, the relief valve shall open to the atmosphere.
In no case shall a cut, tee, or tap be made between the user's service connection at water meter and the backflow prevention assembly.

5.20 Double Check Valve Assembly (DCVA)
An assembly approved by the Washington State Department of Health consisting of two independently operating approved check valves with tightly closing shut-off valves on each side of the check valves, and properly located test ports for the testing of each check valve. Double-check valve assemblies are used in low health hazard situations. In no case shall a cut, tee, or tap be made between the user's service connection at water meter and the backflow prevention assembly.

5.21 Pressure Vacuum Breaker (PVB) Spill Resistant Vacuum Breaker (SVBA)
An assembly approved by Washington State Department of Health consisting of a spring-loaded check valve with tightly closing shut-off valves, properly located test ports for the testing of the check valve. PVB's and SVBA's can provide adequate protection for cross connection control for low health hazard point of use protection if the system has no means of inducing a back pressure condition and the system is supplied from only one water connection

5.22 Location of Backflow Prevention Assembly
The backflow prevention assembly shall be installed at the point of connection on each service line to a customer's water system, or as close as practical, but in all cases before the first branch line leading off the service line. When the installation of a DCDA is in a vault at the property line all test ports shall be plugged if a flooding condition might occur, in no case shall an RPBA or RPDA be installed in a vault or below grade without the written permission of the Water Utility Supervisor-Distribution. In no case shall a backflow preventer be installed on a public right of way or dedicated easement without the written permission of the Water Utility Supervisor – Distribution. The Water Utility Supervisor – Distribution shall have the final authority to determine the location of a backflow assembly.

5.23 Backflow Prevention Assembly Freeze Protection
It is the responsibility of the property owner to install freeze protection. If the backflow prevention assembly cannot be inspected due to the presence of freeze protection material, the freeze protection may be removed. The City shall not be responsible for reinstallation of freeze protection. The relief port at the bottom of the reduced pressure principal backflow assembly must not be covered by freeze protection. All test ports must be easily accessible along with the serial number and model number. Freeze protection shall be maintained in a neat, aesthetically pleasing condition. Torn or dislodged freeze protection may be removed by the City.

5.24 Critical Services
In cases where water service cannot be shut off, even for a few moments, at any time, the City Water utility will recommend that two services be established to the premise. In such case, the same level of backflow protection will be required for each service. In cases where water system configuration facilitates only a single point of connection two backflow prevention assemblies shall be installed in parallel. This shall apply only to the domestic water service and shall not apply to the fire protection system point of connection.

5.25 Water Service Termination
When the Water Utility Supervisor-Distribution is notified of a water use that represents a clear and immediate hazard to the City’s water supply that cannot be immediately abated, the Water Utility will institute the procedure for discontinuing water service to the premises.

5.26 Basis for Termination
Conditions or water uses that create a basis for water termination shall include, but are not limited to, the following items:

- Refusal to install a required backflow prevention assembly.
- Refusal to allow access onto premise for inspection purposes.
- Refusal to test a backflow prevention assembly.
- Refusal to repair or replace a faulty backflow prevention assembly.
- Removing or bypassing a required backflow preventer.
- Direct or indirect connection between the City water system and sewer line.
- Unprotected direct or indirect connection between the City water system and a system or equipment containing contaminants.
- Unprotected direct or indirect connection between the City water system which presents an immediate health hazard to the City’s water system.

5.27 Water Service Termination and Restoration Procedure

The City will terminate water service to a customer's premises after two written notices specifying the corrective action needed have been sent to the service address, and a third notice sent to the service address and to the legal owner of the property indicating that a Notice of Termination will be issued in five business days The City shall issue and deliver a Notice of Termination to the service address with the specific actions required. Water service to the service address will be terminated twenty-four hours after the notice is delivered.

The first letter is an information letter that will be sent to the water service customer by United States Mail and outlines the make, model, serial number, and location of assemblies to be tested or repaired and a specific period of time to comply with the testing or repairs requirement.

If no response is received in that specified period, a second letter will be sent by Certified United States Mail to the water service customer and Certified United States Mail to the legal owner of the property. The second letter contains the same information as the first letter and includes a copy of the first letter that was delivered and allows a specific period of time to comply with the testing or repair requirements. Statements shall be added; for more information to contact the Water Utility Supervisor- Distribution, or to contest the requirement to contact the City's Hearing Examiner, and that failing to comply with the requirement will result in this information being forwarded to the Director, or his representative for a Notice of Termination under BMC 15.08.260(G).

If the water customer, or legal owner of the property if not the same, fails to comply with the testing or repair correction requirements the Director or his representative shall issue a Notice of Termination. The Notice shall be hand delivered to the service address where the requirements are to be met, if no person is at the address the notice will be left in a conspicuous place at the front of the property. The Notice of Termination will include the required corrections, if the requirements are not meet the City will disconnect the water service line at the service connection to the property by providing for a physical breach in the water service line within twenty-four hours. Should the water customer request a meeting with the Hearing Examiner the water service will remain connected until such time as the Hearing Examiner determines that a potential risk to the public water system exists. Upon the water customer or legal owner of the property requesting that water service be restored for backflow assembly testing the City will provide a temporary connection that will accommodate the testing. If test results indicate the assembly is functioning as designed the water service connection will be restored and the customers water account will be assessed the shut off and turn on fees.

Should the City determine that the water customer or the legal owner of the property is manipulating the City's water service equipment used to provide service to the property, the water service account will be assessed a Tampering Fee for each occasion per BMC 15.04.050, If the water customer or the legal owner of the property makes a connection to any other water service provided by the City, the water service to that property will also be assessed the Tampering Fee per BMC 15.04.050.

Notwithstanding the above, when conditions create an immediate danger to the City's water supply, immediate termination of the water service to the customer's premise(s) may be without notice. However, where practical, the City shall give to the customer or the legal owner of the property oral notice of the danger and the water service shut off. The water customer or the legal owner of the property shall be entitled to an emergency meeting with the Water Utility Supervisor-Distribution. Prompt restoration of water service shall be done following an inspection that reveals compliance with this code has been attained.

5.28 Backflow Prevention Assembly Maintenance and Testing

As provided in the Washington State Department of Health, WAC 246-290-490 requires backflow prevention assemblies to be tested at least annually and immediately after installation, relocation, or repair by a person who has demonstrated to the City their competency as a Backflow Assembly Tester.

All backflow protection assemblies shall be tested in accordance with the procedures outlined in Section 9 of the University of Southern California Manual Of Cross-Connection Control, Ninth Edition. The Water Utility Supervisor-Distribution may require a more frequent schedule if it is determined to be necessary. No assembly shall be placed back in service unless it is functioning as required. A report form supplied by or acceptable to the City Water Utility shall be completed and returned to the City Water Utility each time an assembly is either tested, relocated, repaired, or replaced. These assemblies shall be serviced, overhauled, or replaced whenever they are found to be defective. Each customer with a backflow assembly(s) on their premises will be notified by mail when the annual testing of an assembly is required.
The City of Bellingham shall be responsible for administering the testing of backflow prevention assemblies owned by and within the City's water distribution system. Testing shall be by a person that has demonstrated their competency in the testing of these assemblies. Competency is demonstrated by the possession of a valid Washington State Department of Health Backflow Assembly Tester (BAT) Certification.

5.29 Air-gap Separation Inspection Procedure
The installation of each air-gap separation shall be in accordance with the definition for the air gap in WAC 246-290-490 Table 9. The air-gap shall be inspected annually to verify their status.

5.30 Double-Check Valve Assembly Testing Procedure
All double-check valve assemblies shall be inspected and tested in accordance with the procedures outlined in Section 9 of the University of Southern California Manual Of Cross-Connection Control, Ninth Edition.

5.31 Reduced Pressure Backflow Assembly Testing Procedure
All reduced pressure backflow assemblies shall be inspected and tested in accordance with the procedures outlined in Section 9 of the University of Southern California Manual of Cross-Connection Control, Ninth Edition.

5.32 Pressure Vacuum Breaker and Spill Resistant Vacuum Breaker Testing Procedure
All pressure vacuum breakers and Spill Resistant Vacuum Breaker shall be inspected and tested in accordance with the procedures outlined in Section 9 of the University of Southern California Manual of Cross-Connection Control, Ninth Edition.

5.33 Tester Competency Requirements
Any person interested in testing backflow assemblies may request the Water Utility Supervisor-Distribution to be added to the list of certified testers. Competency in all phases of backflow prevention assembly testing and repair must be demonstrated by means of education and/or experience to be included on the list. Each tester shall be responsible for the competency and accuracy of all tests and reports.

Minimum Competency Requirements:

- Each tester shall have in his possession a valid Washington State Department of Health, Backflow Assembly Tester card
- Each test gauge kit shall have a current certificate of accuracy
- Each tester shall have the required Washington State Contractor's License
- Each tester shall have the required City of Bellingham Business Registration
- Each tester must use the testing procedures outlined in the Manual of Cross-Connection, 9th edition, University of Southern California Foundation for Cross-Connection Control and Hydraulic Research, Chapter 9

- Each tester must be familiar with the City of Bellingham's Cross Connection Control Program processes and procedures
- Each tester shall furnish evidence to show they have available the necessary tools and equipment to properly test backflow assemblies

After notice and a hearing, a tester may be omitted from the annual list for improper testing, repairs and reporting or any action that indicates a lack of knowledge or support of the City's program. Such omissions are at the discretion of the Water Utility Supervisor-Distribution.

5.34 Approved Backflow Prevention Assembly Test Gauges
Any test gauge meeting the requirements to perform the necessary tests of the assembly and has received an accuracy calibration certificate within the previous twelve months.

5.35 Backflow Prevention Assembly Test Gauge Calibration
Backflow assembly test gages shall be calibrated at least once every twelve months. Proof of test gauge calibration shall be provided with testers initial request to be placed on the City's approved Testers List. Existing approved testers shall submit proof of calibration annually, with their Backflow Assembly Tester renewal card.

5.36 Groundwater Wells-Domestic Auxiliary Supply
To comply with the Cross Connection Control Program one of the following alternatives for parcels with groundwater wells may be implemented:

- Install as a minimum level of protection a reduced pressure backflow assembly.
- Abandon the well per Whatcom County Health Department requirements under RCW Title 18 Chapter 18.104.050.

APPENDIX Z

CITY'S STANDARD CONSTRUCTION SPECS

Development Guidelines & Improvement Standards

Version 2.0

Last Updated: 13 June 2018

(See Appendix 5 for revision history)

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actual PDF names should be consistent and match what's in this TOC.
Personally, I would name files as detail number and description, fully matching the TOC, for identification at a quick glance.

consistency

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previous details used en-dash, rather than these em-dashes

suggest either having this be: 3" to 8", or making it an ordered list, this is difficult to parse.

Section 1. Introduction

1-1 Introduction

Implemented: 09/11/2001 Revised: 09/11/201

These development standards have been prepared to assist you in understanding the requirements of the Public Works Department and to provide the basis for consistent design standards and policies. The Public Works Department is responsible for the construction, operation and maintenance of public facilities that include: transportation facilities, domestic water distribution systems, sanitary sewer systems, and stormwater runoff quantity and quality management.

This manual addresses the standards for construction of streets, alleys, water systems, sanitary sewer systems, stormwater facilities, erosion and sediment control and traffic management facilities. These standards are to be incorporated in all designs and proposals for facilities that will be placed in the public right-of-way and owned, operated, and maintained by the City of Bellingham.

Many of the standards, tables, graphs and diagrams contained herein are self-explanatory in their basic presentation. The contents in this manual related to design should not, however, be perceived as a "cookbook approach" to accomplishing engineering designs. The City of Bellingham requires that all construction plans submitted for approval must be certified (stamped and signed) by a Professional Engineer with a current registered license to practice civil engineering in the State of Washington.

Users of this manual should realize that compliance with the requirements and standards herein may not fulfill all of the necessary requirements and conditions to pursue a development project. Applicants are reminded that other city departments, as well as state and federal agencies, have requirements that must be addressed to obtain a development permit. Other common requirements and conditions include, but are not limited to, the following:

- State Environmental Policy Act (SEPA)
- Hydraulic Project Permit
- Corps of Engineers (404 Permit)
- Bellingham Comprehensive Plan
- Bellingham Fill and Grade Permit
- Shorelines Substantial Development Permit
- Washington State Department of Transportation (WSDOT) Permit
- Department of Ecology

The standards and policies presented in this manual are not intended to substitute for innovative or creative efforts or good engineering judgment; however, any deviations from the standards and procedures are subject to the approval of the Director of Public Works. Deviations should be submitted only in the event that unique physical or environmental circumstances don't allow the standards to be implemented.

Private utilities must also conform with the policies and standards of this manual as well as their franchise agreements. The City will not allow the placement of communication cables, conductors, conduits or other facilities within, over, or across the public right-of-way unless the applicant possesses the appropriate franchise(s) with the City.

1-2 Abbreviations

Implemented: 09/11/2001 Revised: 01/01/1998

A.A.S.H.T.O.	American Association of State Highway Transportation Officials
A.C.	Asphalt Concrete
A.P.W.A.	American Public Works Association
A.S.T.M.	American Society of Testing Materials
A.T.B.	Asphalt-Treated Base
A.W.W.A.	American Water Works Association
B.C.	Begin Curb
B.C.R.	Begin Curb Return
C.F.	Cubic Feet
C.M.P.	Corrugated Metal Pipe
E.I.S.	Environmental Impact Statement
F/L	Flow Line
I.T.E.	Institute of Transportation Engineers
L.F.	Linear Feet
LID	Local Improvement District
M.J.	Mechanical Joint
M.U.T.C.D.	Manual on Uniform Traffic Control Devices
P.C.	Point of Curvature
P.C.C.	Portland Cement Concrete
P.I.	Point of Intersection
P.S.I.	Pounds Per Square Inch
P.T.	Point of Tangency
P.V.C.	Poly Vinyl Chloride
R/W	Right-of-Way
S.E.P.A.	State Environmental Policy Act
S.F.	Square Feet
T.S.M.	Transportation System Management
V.C.	Volume to Capacity
WSDOT	Washington State Department of Transportation

1-3 Glossary of Terms

Implemented: 09/11/2001 Revised: 12/12/2014

Access: Driveway or other point of access such as a street, road, or highway that connects to the general street system. Where two public streets intersect, the secondary street will be the access.

Approach: The portion of an intersection leg which is used by traffic approaching the intersection.

Arterial Street: Every public highway, or portion thereof, or major street designated as such by ordinance in accordance with the law of the State of Washington.

Average Design Flow: Average monthly flow of the maximum month, estimated for the design year of the sewage works.

Base Flood: The flood having a 1% chance of being equaled or exceeded in any given year.

Butterfly Valve: A valve wherein the disk, as it opens or closes, rotates about a spindle supported by the frame of the valve. The valve is opened at a stem. At full opening, the disk is in a position parallel to the axis of the conduit.

Capacity: The maximum number of vehicles that have reasonable expectation of passing over a given roadway or section of roadway in one direction during a given time period under prevailing roadway and traffic conditions.

Channelization: The separation or regulation of conflicting traffic movements into definite paths of travel by the use of pavement markings, raised islands or other suitable means to facilitate the safe and orderly movement of both vehicles and pedestrians.

Combined Sewer: A sewer intended to receive both wastewater and storm or surface water.

Commercial Driveway: A driveway providing access to an office, retail or institutional building, or to an apartment building having 5 or more dwelling units.

Curb Return-Type Driveway: A driveway which is essentially a T intersection with constant curb cross section from curb-return to curb-return as found at the intersection of two streets.

Delay: Stopped time per approach vehicle.

Depressed-Type Driveway: A driveway in which the curb is depressed along the curb line per City of Bellingham Standard Plans drawing CG-260.

Driveway: A vehicle access between abutting property and a city right-of-way or a city street.

Driveway Width: The driveway throat distance, measured at the property line, for both depressed and curb entry-type driveways. (See Figure 12-1)

Easement: An acquired legal right to the use of land owned by others.

Existing Street: Existing street means a present traveled way with a minimum width of 18 feet of hard surfacing irrespective of whether it has been accepted by the City for maintenance. A hard-surfaced street shall be a street consisting of either portland cement or asphalt concrete as a wearing surface.

Floodway: The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.

Floodway Fringe: The area in the floodplain excluding the floodway.

Flow Line: The position of the water surface in a flowing stream or conduit.

Gate Valve: A valve in which the closing element consists of a disk which slides over the opening or cross-sectional area through which water passes and fits tightly against it.

Geometric Design: The arrangement of the visible elements of a street such as alignment, grade, sight distance, widths and slopes.

Grade: Rate or percent of change in slope, either ascending or descending, from or along the street. It is measured along the centerline of the street.

Hydrant: A device, connected to a water main and provided with the necessary valves and outlets, to which a fire hose may be attached for discharging water at a high rate for the purpose of extinguishing fires, washing down streets, or flushing out the water main. Also called a fireplug.

Industrial Driveway: A driveway directly serving substantial numbers of truck movements to and from loading docks of an industrial facility, warehouse, truck terminal, or community or regional mall loading area.

Industrial Wastes: Liquid or other wastes resulting from any process of industry, manufacture, trade, business, or from the development of any natural resources.

Infiltration: Groundwater that enters the sewer system through sewer joints, cracks, service connections and other sources.

Inflow: Surface water that enters the sewer system through storm drains, roof drains, manhole covers, and other sources.

LID Commitment: An agreement to support a local improvement district to bring the abutting streets to the standards specified in Section 4, such agreement to be a covenant running with the land.

Minimum-Standard Street: A street constructed to line and grade having not less than 20’ of paved width with 4’ shoulders and adequate provision for storm drainage.

Minor Street: Any city street not designated by competent authority as an arterial street, a state highway, a parkway, an expressway or a freeway.

Monument: An object used to permanently mark a surveyed location. The size, shape and design of the monument is to be in accordance with standards specified by the Washington State Department of Natural Resources as authorized by RCW 58.17 and City of Bellingham Standard Plan ST-170, ST-171, ST-172, ST-173, ST-174.

Parcel: Any piece of real property in a single ownership.

Public Works Department: The Department of Public Works of the City of Bellingham.

Queue: A line of vehicles waiting to perform a movement.

Residential Driveway: A driveway providing access to a single-family residence, duplex, or an apartment building containing not more than 4 dwellings.

Right-of-Way: A right of passage over another person’s land.

R-Value: A method of evaluating treated and untreated materials for bases, sub-bases, and subgrades for pavement thickness design.

Sewage: The water-carried human wastes from residences, buildings, industrial establishments, or other places together with such industrial wastes or underground, surface, storm, or other water, as may be present.

Shoulder: That portion of the roadway contiguous with the traveled way for accommodating stopped vehicles, for emergency use, and for lateral support of base and surface courses.

Signal Progression: Progression movement of traffic at a planned rate of speed through signalized locations within a traffic control system without stopping.

Street Sign: A device mounted on a fixed or mountable support, conveying a message or symbol to regulate, warn or guide traffic.

Stopping Sight Distance: The distance traveled by the vehicle from the instant the driver of a vehicle sights an object necessitating a stop, to the instant the brakes are applied, and the distance required to stop the vehicle from the instant brake application begins.

Superelevation: The rotation or banking of the roadway cross section to overcome part of the centrifugal force that acts on a vehicle traversing a horizontal curve.

Surety: Bonds or letters of credit.

Trips: A single or one-direction vehicle or pedestrian movement with either the origin or destination (exiting or entering) a study site or area.

Volume: The number of vehicles passing a given point during a specified period of time.

Warrants: Warrants provide guidance to the engineer in evaluating the potential safety and operational benefits of traffic control devices, and are based on average or normal conditions. (NOTE: Warrants are not a substitute for engineering judgment.)

Section 2. Development Requirements

2-1 Introduction

Implemented: 09/12/2001 Revised: 03/01/1993

Most of the public improvements undertaken by private developers come about as a prerequisite to the completion of the building permit process. In order to build upon a parcel of land, certain basic public facilities are required. If any of these required facilities are missing or inadequate, the developer will be required to construct the required facilities according to the standards and procedures spelled out in these standards prior to completion of a building project.

2-2 Water Service

Implemented: 09/12/2001 Revised: 03/01/1993

In order to obtain water service from the City, the property in question must abut a City-owned water main located within the right-of-way or an approved easement. The main must have adequate flow to meet both domestic and fire suppression requirements.

If the required abutting main does not exist or the abutting main does not have sufficient flow to meet either domestic or fire needs, the developer must construct a water main extension prior to obtaining water service. Extensions shall be constructed to the far property line of the subject property. (Exceptions may be granted by the Director of Public Works in cases where future extension of the main is deemed unnecessary.) The first step in the process is for the developer to retain the services of a licensed civil engineer to design the main extension. The engineer will submit the proposed design to the City Engineer. (See Section 6 for details on Water Design Standards.) The developer will enter into a contract with the City for the construction of said main extension. (See Section 3 for details on Public Facilities Contracts.) Upon completion of the contract requirements, the developer may then apply for a water service and be granted same upon payment of applicable connection fees.

2-3 Sewer Service

Implemented: 09/12/2001 Revised: 03/01/1993

In order to obtain sewer service from the City, the property in question must abut a City-owned sewer main located within the right-of-way or an approved easement. The main must have adequate capacity to handle the anticipated flow from the developer's project.

If the property in question does not abut the required sewer main or if the abutting main does not have the necessary capacity, the developer will be required to construct a sewer main extension prior to obtaining a sewer permit. Extensions shall be constructed to the far property line of the subject property. (Exceptions may be granted by the Director of Public Works in cases where future extension of the main is deemed unnecessary.) The first step in the process is for the developer to retain the services of a licensed civil engineer to design the sewer main extension. The engineer will submit the design to the City Engineer. (See Section 5 for details on Sewer Design Standards.) The developer will enter into a contract with the City for the construction of said sewer main extension. (See Section 3 for details on Public Facilities Contract.) Upon completion of the contract requirements, the developer may then apply for sewer service and be granted same upon payment of applicable connection fees.

2-4 Street Improvements

Implemented: 09/12/2001 Revised: 01/01/1990

Requirements for street improvements depend upon two basic factors: the type of development and the existing level of improvement.

2-4.01 Type of Development

Implemented: 09/12/2001 Revised: 01/01/1990

2-4.01.01 Single-Family Residence

Implemented: 11/08/2001 Revised: 01/01/1990

In order to obtain a building permit for a single-family residence, the property being built upon must abut a street at least 18' in width, paved, and located within a public right-of-way of at least 60' in width.

If the property does not abut upon the above-described street, the developer must construct a 20' minimum-standard street (see Section 4 for minimum street standards). Said minimum-standard street shall be extended from the nearest acceptable street (18' wide, paved) to the far side of the property. The street shall be constructed or bonded for prior to the issuance of a building permit.

If an alley is proposed as access, the property must abut on an existing platted alley built to standard plans ST-100, ST-104 or ST-106. If the current condition does not meet one of these standards, the alley shall be improved to the selected standard of the nearest street or alley meeting construction standards. Gravel alleys are not permitted as part of a newly platted right of way.

The first step in the process is for the developer to retain the services of a licensed civil engineer to design the street extension. The engineer will submit the proposed design to the City Engineer. (See Section 4 for design standards.) The developer will enter into a contract with the City for the construction of the street extension. (See Section 3 for details on public facilities construction agreement.) Upon completion of the contract requirements, the developer may then apply for their building permit.

2-4.01.02 Increased Density Residential

Implemented: 11/08/2001 Revised: 01/01/1990

Increased density residential refers to adding dwelling units to an existing property. In order to obtain a building permit for increased-density residential, the property must abut an existing street, at least 18 feet in width, paved, and be located within a public right-of-way of at least 60 feet in width.

If the property does not abut upon the above-described street, the developer must construct a 20-foot minimum-standard street (see Section 4 for minimum-street standards). Said minimum-standard street shall be extended from the nearest acceptable street (18-feet wide, paved) to the far side of the property.

The Bellingham Municipal Code may require a property abut a standard street or even a modified standard street cross section that includes additional lanes or wider sidewalk. In those cases the developer must or may elect to construct a three-quarter standard street (half of a full-standard street on development side and a 10-foot driving lane with 4-foot shoulder on the other). Said three-quarter street shall extend the entire frontage of the property. If said three-quarter street does not connect to an acceptable street (18-feet wide, paved), then a 20-foot minimum-standard street shall be constructed to connect the three-quarter street to the nearest acceptable street.

If an alley is proposed as access for additional single family units (for example accessory dwelling unit), the property must abut on an existing platted alley built to standard plans ST-100, ST-104 or ST-106. If an alley is proposed or required as access for additional multifamily units (for example multifamily infill type units), the property must abut on an alley built to standard plans ST-100 or ST-104. If the current condition does not meet one of these standards, the alley shall be improved to the selected standard of the nearest street or alley meeting construction standards. Gravel alleys are not permitted as part of a newly platted right of way.

The developer shall retain the services of a licensed civil engineer to design the street extension. The engineer will submit the proposed design to the City Engineer. (See Section 4 for design standards.) The developer shall enter into a contract with the City for the construction of the required street improvements. (See Section 3 for details on public facilities construction agreement.) Upon completion of the contract requirements, the developer may apply for a building permit.

2-4.01.03 Commercial and Industrial Building

Implemented: 11/08/2001 Revised: 01/01/1990

In order to obtain a building permit for a commercial or industrial building, the property must abut an existing paved street at least 18 feet in width and located within a public right-of-way at least 60 feet in width.

If the property does not abut such a street or street improvements are required by zoning or other sections of the Bellingham Municipal Code, the developer must construct a 20-foot minimum standard street (see Section 4 for Minimum Street Standards) or provide street improvements as described in Bellingham Municipal Code.. Street improvements shall extend from the nearest acceptable street (18-feet wide, paved) to the far side of the property.

The Bellingham Municipal Code may require a property abut a standard street or even a modified standard street cross section that includes additional lanes or wider sidewalk. In those cases the developer must or may elect to construct a three-quarter standard street (half of a full-standard street on development side and a 12-foot driving lane with 4-foot shoulder on the other). Said three-quarter street shall extend the entire frontage of the property. If said three-quarter street does not connect to an acceptable street (18-feet wide, paved), then a 20-foot minimum-standard street shall be constructed to connect the three-quarter street to the nearest acceptable street.

If an alley is proposed or required to as access, the property must abut on an alley built to standard palns ST-100 or ST-104.

The developer shall retain the services of a licensed civil engineer to design the street extension. The engineer will submit the proposed design to the City Engineer. (See Section 4 for Design Standards) The developer shall enter into a contract with the City for the construction of the street extension. (See Section 3 or Public Facilities Construction Agreement) Upon completion of the contract requirements, the developer may apply for their building permit.

2-5 Other Permits, Fees

Implemented: 09/12/2001 Revised: 01/01/1990

In addition to the procedures described in this manual, other permits and fees may be applicable as explained below

2-5.01 Street Obstruction Permit

Implemented: 09/12/2001 Revised: 01/01/1990

A street obstruction permit is required for any construction within the public right-of-way. A permit is not required for work performed under contract with the City. This includes, but is not limited to, driveways, sidewalks, sewer or water services, trenches, utility excavations, fences, foundations or other structures. Permits are obtained along with building permits. The person or company undertaking the work shall be covered by a $5,000.00 street obstruction bond acceptable to the City. In lieu of the bond for a one-time-only job, a cash deposit in the amount of 150% of the estimated cost of the work shall be deposited with the City Finance Director. The deposit will be returned upon acceptance of the work.

2-5.02 Water/Sewer Permit

Implemented: 09/12/2001 Revised: 08/01/95

Water/sewer permits are required to connect to the City's water or sewer system. Permits are obtained along with building permits upon payment of applicable connection fees. All permitted construction must be inspected by the Public Works Department's Engineering Division.

2-6 Easements

Implemented: 09/12/2001 Revised: 06/01/97

Public utilities shall be located within the public right-of-way unless field conditions make this impractical. In the event that a public utility must be placed on private property, a maintenance easement 20 feet wide and centered over the utility shall be granted to the City. Where more than one public utility is to be placed in the easement, the utilities must be separated by 10 feet with a 10-foot buffer to the outside of the easement. In other words, two utilities would require a 30-foot easement width, three utilities would require 40 feet, etc.

Section 3. Public Facilities Construction

3-1 Introduction

Implemented: 09/12/2001 Revised: 01/01/1998

The following chapter has been developed to assist an owner, developer, or engineer with the Bellingham Public Works Department's requirements for all improvements being contemplated within City right-of-way. Improvements to public rights-of-way are normally required of an owner or developer as a condition to receiving a building permit or as a condition to subdividing property.

Early in the plan review process, the owner will be asked to sign a Public Facilities Construction Agreement which will bind the owner to the project description, the project schedule, required fees and deposits, bond requirements, and other related items.

3-2 Beginning the Process

Implemented: 09/12/2001 Revised: 01/01/1998

The process begins with submittal of an engineering plan and Public Facilities Agreement to the City Engineer along with a Letter of Intent containing the following:

1. Identification of the property owner.
2. Type of ownership: Corporation, Partnership, Sole Proprietor, or Joint Venture.
3. Name and title of owner's officer with authority to sign.
4. Address of owner.
5. Complete description of the project to be constructed and conveyed to the City.
6. The approximate construction schedule.
7. An estimate of the project cost.
8. The type of financial security the owner intends to use: a standard surety bond, an assignment of funds, cash deposit, or letter of credit.

Upon receipt of the above, the City Engineer will assign a project engineer to act as the project manager on behalf of the City for the purpose of carrying out the terms of the Public Facilities Construction Agreement.

3-3 Plan Check for Completeness

Implemented: 09/12/2001 Revised: 01/01/1998

Upon receipt of a construction plan package, the project manager will check for completeness of the plan using the following guide:

1. Are the drawings signed by a Civil Engineer?
2. Are the plan and profile drawings complete? (See Section 7)
3. Are drainage calculations included? (See Section 9) Do the plans include provisions for erosion control?
4. Does the Letter of Intent contain sufficient information?

If the plan package is determined to be incomplete, the project manager will notify the applicant of any additional materials or information needed for the process to continue. Upon receipt of the needed information, the project manager will request three copies of the plan and will have the Public Facilities Construction Agreement prepared.

3-4 Public Facilities Construction Agreement

Implemented: 09/12/2001 Revised: 01/01/1998

The project manager will use the information supplied in the Letter of Intent to create a document package, which will contain the following:

1. Public Facilities Permit Application
2. Surety Bond
3. Public Works Project Permit
4. Deed of Conveyance of Public Improvements

As soon as available, the project manager will send the applicant a copy of the agreement and the surety bond form for signature. The plans and specifications will not be reviewed by the project manager until he/she receives the signed agreement, the surety bond, and payment of all fees and deposits listed in the agreement. Fees and deposits normally required are as follows:

1. Administration Deposit (percent of estimated cost)
2. Water Connection Deposit (estimated cost by Water Division)
3. Sanitary Sewer Scan Fee ($0.50 per linear foot)
4. Storm Water Permit Fee
5. Hydrant Fund Fee ($3 per linear foot)

3-5 Plan Review Process

Implemented: 09/12/2001 Revised: 01/01/1998

As soon as the project manager receives three copies of the plans, he/she will send one copy to the Operations Division and one copy to the Engineering Division for review by Staff. The third copy will be retained by the project manager for reference and for his/her future review.

Upon receipt of the signed agreement, the financial security, and payment of all fees and deposits, the project manager will carefully review the plans and specifications. Comments will be sent to the applicant regarding the corrections, additions, or deletions that should be made to the plans and specifications before approval can be granted. After final corrections are made to the plans and specifications, the originals shall be delivered to the project manager who will procure the signature of the City Engineer, thereby, approving the plans and specifications.

When the applicant is prepared to begin construction, he/she shall notify the project manager and request that a preconstruction conference be scheduled. The Public Works project permit will be presented to the applicant following the preconstruction conference authorizing the construction to begin.

3-6 Building Permit or Subdivision Approval

Implemented: 09/12/2001 Revised: 01/01/1998

Plans and specifications approval for improvements within the City right-of-way or within a City easement is one of many review processes one must pursue before receiving a building permit or plat approval. The specific requirements for these are described in Section 2 of this manual.

City departments other than Public Works also will be involved in the review process for building permit or subdivision approval. They are as follows:

1. Planning and Economic Development Department
2. Building Services Division
3. Fire Department (Fire Marshal)

The applicant should contact each City department to discuss specific requirements prior to finalizing plans and specifications. The project manager should be contacted as soon as possible if a plan change becomes imminent.

3-7 Project Acceptance

Implemented: 09/12/2001 Revised: 01/27/2006

Upon completion of the construction work, the applicant will notify the project manager and request an inspection. The project manager will schedule the inspection, then provide the applicant with a list of deficiencies (punch list) which must be corrected within 30 calendar days. Upon completion of the punch list, the applicant will again notify the project manager who will then schedule a final inspection.

After all deficiencies have been corrected, the applicant will be asked to provide the following:

1. Certified "as-built" mylars.
2. Certified statement of the full cost of the project using Public Works Cost Statement.
3. A copy of all required easements which have been recorded at the County Courthouse.
4. The Deed of Conveyance for all project improvements which are to be accepted by the City for maintenance.

Upon receipt of all the above, the project manager will accept the project on behalf of the City and authorize the reduction of the financial security to 25% of the actual project cost to protect the City against defects in materials and workmanship in the project for one year.

Prior to one year following project acceptance, the City will conduct an end of maintenance period inspection and develop a list of deficiencies. The applicant will be given 30 days to correct the deficiencies. After all deficiencies are corrected, the financial security will be released.

3-7.01 RECORD DRAWING POLICY

The following is intended to provide necessary guidelines for development of required construction record drawings:

1. Certified record drawings are to be provided by the owner and shall accurately reflect all field revisions made during the construction process. Record drawings shall be submitted on the same number of sheets as the original approved drawings.

2. The owner shall retain a licensed professional engineer to track all relevant field changes to the approved construction drawings. Changes shall be clearly identified in a comprehensive manner on one set of City-approved Xerox black-line,

3. At the time the record drawings are transmitted to the City, each sheet shall include a signature block similar to that shown below located in the bottom right-hand corner of the sheet when possible:

Recording Drawing Certification
This drawing reflects the work as constructed and all modifications meet the performance standards of the original design. By:_____Date:_____

4. The record drawings shall identify all existing or abandoned utilities that were encountered or installed during construction that were not shown on the approved construction drawings.

5. All sanitary sewer, storm sewer, and water service stub locations shall be stationed and marked in accordance with City Standard specifications, SS-790 and WA-897. Stationing for sanitary sewer and water mains shall be independent from the roadway centerline.

6. Substantial changes made to storm drainage shall be reflected in a modified storm drainage report and shall be certified by the professional engineer that the modifications made during construction meet the performance standards of the original design.

7. The final project approval shall not be processed until the City has received and approved the certified record drawings. The City Engineer may accept a deposit of 150% of the cost of preparation of record drawings in lieu of performance. A deposit will require a commitment from the owner to (A) complete the record drawings within 90 days; (B) hold the City harmless from any damages caused by the delay in performance; and (C) require the engineer of record to provide free and timely information to the City and Public.

8. All underground facilities shall be shown on the record drawings to the nearest 1-foot horizontal and the nearest 0.1-foot vertical unless otherwise noted by the engineer. Water services shall be shown to the nearest 5-foot horizontal and the nearest 1-foot vertical. Side sewers shall be shown to the nearest 2-foot horizontal and the nearest 0.1-foot vertical.

3-7.02 RECORD DRAWINGS (SEWER AND WATER)

The purpose of this letter is to inform you that the City of Bellingham will now require the developer's engineer to supply us with a full set of certified record drawings upon completion of the Public Facilities Contract. These as-built drawings will reflect the exact location of all underground and aboveground utilities and will include, but not be limited to, the following:

1. The location of all vertical and horizontal bends in the water system.

2. The location of all water service taps into the water main.

3. The location of all water service boxes and meters with distances to the main tap and to the corresponding property corners.

4. The locations of all water valves, hydrants, hydrant valves, and blow-offs as to distance from the centerline and distances to the nearest property lines or property corners.

5. The location of all utilities within easements. This will include distances to the utilities from the easement lines.

6. The location of all side sewer tees into the sewer main from the back-station manhole.

7. The location of all side sewer ends according to the attached drawings and with the additional stipulations:

    a. The ends must be tied out to the corresponding property corners.

    b. The depth of the end at the location board must be noted.

8. The location of all sanitary manholes, storm sewer manholes, storm sewer catch basins and back-of-walk drains. These locations must include distances from the centerline monuments, easement lines, or property corners.

9. All easements will be staked in advance of utility installations to ensure that the utilities fall within the proper boundaries. Construction offset staking will not fulfill this requirement.

3-8 Latecomers Contracts

Implemented: 08/26/2004 Revised: 02/01/2004

Under the authority of the Bellingham Municipal Code (Ch. 14.02) property owners who construct public improvements may be partially reimbursed by benefiting owners if a contract, facilitated by the City of Bellingham, with other property owners is implemented. Public improvements include streets, water mains, sanitary sewer mains, and storm water facilities. Entering into a "Latecomer Contract" requires a timely request by the project proponent and procedures that must be followed by both the proponent and the City as described below.

3-8.01 Procedures To Be Followed By The Proponent:

1. Prior to the time the project is accepted by the City, the proponent must notify the City of the intent to seek a Latecomer Contract. Notification consists of a letter stating the intention along with a list and map of the property owners who the proponent believes will benefit from the improvement(s). Signature of the “Acknowledgement of Understanding” letter provided to developers with the deed of conveyance information can satisfy this requirement.

2. Once the City receives the request, a pre-application meeting will be scheduled and the proponent will have the opportunity to present the proposal to City staff. This meeting will consist of discussion of the proposal, comments and suggestions from the City, and general preparation for submittal of the formal application.

3. Within 30 days of street and/or utility system improvements being deeded to the city (Deed of Conveyance), the proponent may request a Latecomer Contract by making a formal application. Application shall be made on forms prepared by the Public Works Department and shall be accompanied by the base fee portion of the City Administrative Fees as set forth in BMC 14.02.130. The application shall be prepared and/or approved by a professional licensed engineer and shall contain the following information:

    a. A legal description of the applicant's property.
    b. A legal description of the properties within the applicant's proposed assessment reimbursement area together with the names and addresses of the owners of each property as shown in the records of the Assessor's Office of Whatcom County.
    c. Vicinity map of applicant's property, proposed reimbursement area, and location of all improvements.
    d. Itemized cost data for cost of construction certified by a Professional Engineer.
    e. Cost of construction = direct construction costs + developer administrative costs + construction interest + city latecomer administrative fee. (See Bellingham Municipal Code 14.02 for eligible costs and calculation details.)
    f. The applicant's proposed allocation of cost of construction to the individual properties within the applicant's proposed assessment reimbursement area and the method of such allocation.
    g. Payment of the base fee portion of the City Administrative Fee, which shall be non-refundable. Fee shall be calculated as follows:
    h. Base Fee ($400 for utility project and $590 for street project) + 1% of direct construction cost + $200 for every separate parcel of property within the applicant's proposed assessment reimbursement area. Fees are adjusted annually in accordance with BMC 14.02.130(C) and should be confirmed prior to submitting a latecomers application.

4. Within 30 days of the Public Works Department receiving the application for a Developer Reimbursement Agreement, the Public Works Department will provide the applicant written notice of whether the application is complete and, if incomplete, what must be done for the application to be considered complete. The applicant will have no more than 30 days from the date of the written notice to respond and provide the information required to complete the application or, if the applicant cannot submit the required information within the 30-day period, the applicant shall provide the City with a written explanation of why they cannot provide the information within the designated time period and a date that the requested information will be submitted. In its discretion, the Public Works Department may grant the applicant an extension of not more than 60 days to submit the required information.

5. Sign and return the Application Summary (to be prepared by City Staff) for recording by Staff with the County Auditor’s Office.

6. In the event a hearing is requested by a person owning property within the proposed reimbursement area, the proponent must attend or send a representative to attend the hearing.

7. Sign and return Latecomer Contract to the City.

3-8.02 Procedures to Be Followed By The City:

1. Schedule and conduct pre-application meeting. Make recommendations to applicant for determination of assessment method and area for property benefited by the improvement(s).

2. Review application costs and confirm the potential benefit to properties within the proposed assessment area. Confirm that the method used to calculate the allocation of assessment is equitable and reasonable. If agreement between the developer and City staff cannot be reached, the issue will be addressed by the Public Works Advisory Board and/or the Bellingham Hearing Examiner.

3. Prepare and record the Application Summary with the County Auditor's office.

4. Send notices by certified mail to all property owners of record within the preliminary assessment reimbursement area. Each property owner will be given the opportunity to protest and to request a public hearing before the Bellingham Hearing Examiner.

5. Prepare Latecomer Contract for applicant's signature.

6. Record signed agreement at the County Auditor's Office together with a map of affected properties.

7. Upon issuance of new connections, the City will collect specified latecomers assessments and reimburse the proponent.

8. City will file a release with the Auditor's Office upon satisfaction of the latecomer's assessment.

3-8.03 Future Segregation of Properties Within Assessment Area:

1. A property owner who wishes to segregate a latecomer's assessment must hire a professional engineer to prepare the request. The request shall include a map showing the proposed subdivision of property including legal descriptions and proposed cost segregation based on the original method of assessment.

2. The segregation fee is $150 per parcel created by the segregation. The fee shall be submitted with the segregation request.

3. The City will record new parcel assessments together with a map of affected properties at the County's Auditor's

3-9 Turnaround Time

Implemented: 09/12/2001 Revised: 01/01/1998

The time required for the public facilities construction process will vary depending on the complexity of the project and the owner's ability to communicate with the City. The following are average time requirements necessary for various tasks:

- City receipt of complete plan package 5 working days. Public Facilities Construction Agreement and related documents are sent to applicant.

- City receipt of executed Public Facilities Construction Agreement, Surety Bond and payment of fees and deposits 5 working days. Project Manager returns comments to Applicant.

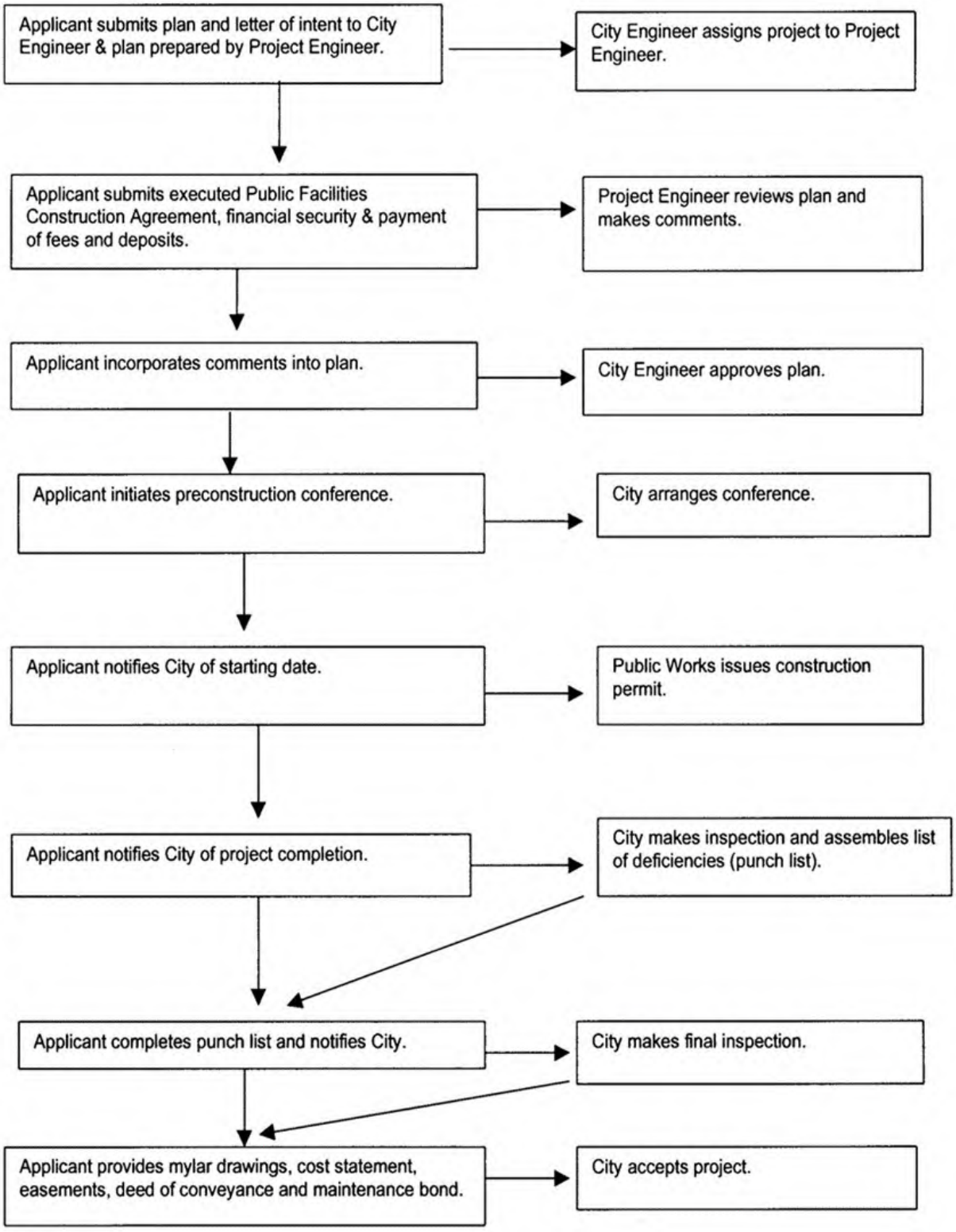
- Applicant initiates pre-construction conference 5 working days.

- Pre-construction conference date.

- Applicant notified City of project completion 10 working days. Punch list sent to applicant.

3-10 Flow Chart for Private Implementation of Public Improvements

Implemented: 10/09/2001 Revised: 01/01/1999



Section 4. Street Design Standards

4-1 Introduction

Implemented: 09/14/201 Revised: 08/01/1995

This section has been prepared to reflect City policy, outline a uniformity of methods and procedures, and to communicate vital information to the street design engineer. The contents include maximum and minimum design criteria for street design, as well as specification requirements for various project construction items.

4-1.01 Design Speed

Implemented: 07/01/2007 Revised: 06/15/2007

Design speed for streets shall be 10mph over the existing posted speed or 10mph over the proposed posted speed.

4-2 Street Classifications

Implemented: 09/14/2001 Revised: 08/01/1995

The following street classifications are to be used with the street design standards. Typical sections are provided in Standard Plans ST-108 through ST-132.

4-2.01 Principal Arterial Street

Implemented: 09/14/2001 Revised: 08/01/1995

Standard Plan ST-132

4-2.02 Secondary Arterial Street

Implemented: 09/14/2001 Revised: 08/01/1995

Standard Plan ST-132

4-2.03 Collector Arterial Street

Implemented: 09/14/2001 Revised: 08/01/1995

Standard Plan ST-132

4-2.04 Neighborhood Collector Street

Implemented: 09/14/2001 Revised: 08/01/95

Standard Plan ST-132

4-2.05 Residential Access Street

Implemented: 09/14/2001 Revised: 08/01/1995

1. Standard Asphalt - Gravel or A.T.B. Base (Standard Plan ST-120)
2. Standard Concrete (Standard Plan ST-124)

4-2.06 Minimum-Standard Street

Implemented: 09/14/2001 Revised: 08/01/1995

1. Asphalt (Standard Plan ST-108)
2. Concrete (Standard Plan ST-112)

4-2.07 Alleys

1. Minimum Standard Alley Cross Section I (ST-100)
2. Minimum Standard Alley Cross Section II (ST-104)
3. Minimum Standard Alley Gravel (ST-106)

4-3 Lane Widths

Implemented: 09/14/2001 Revised: 08/01/1995

Lane widths to be used are as follows:

	Standard
Through-Traffic Lane	11’
Curb Lane	14’
Curb Lane/Bike Lane	16’
Left-Turn Only Lane	11’
Parking Lane	8’
Parking Lane on Bus Route	10’
Bus Lane	12’

4-4 Horizontal Street Alignment

Implemented: 09/14/2001 Revised: 08/01/1995

4-4.01 Horizontal Stopping Sight Distance

Implemented: 09/14/2001 Revised: 08/01/1995

Stopping sight distance is where sight obstructions (walls, cut slopes, wooded areas, buildings, etc.) exist on the inside of a curve. (Use Figure 4-1 to determine adequate stopping sight distance.)

4-4.02 Superelevation on Horizontal Curves

Implemented: 09/14/2001 Revised: 01/01/1990

Superelevation is the rotation or banking of the roadway cross section to overcome part of the centrifugal force that acts on a vehicle traversing a horizontal curve. All street designs utilizing superelevation are subject to review and approval by the City Engineer. For design details and methodology, it is recommended that the WSDOT Design Manual or AASHTO be used.

4-4.03 Monumentation

Implemented: 09/14/2001 Revised: 01/01/1990

Monuments are as defined by the City of Bellingham, Subdivision Ordinance No. 8182, under 18.08.290.

"Monument" means an object used to permanently mark a surveyed location. The size, shape and design of the monument is to be in accordance with standards specified by the Washington State Department of Natural Resources as authorized by RCW 58.17, and City of Bellingham Standard Plan ST-170, ST-172, ST-173.

1. All existing survey control monuments which are disturbed, lost, or destroyed during construction or maintenance shall be replaced by the responsible party at his own expense.

2. All existing survey control monuments which are covered over by a street improvement shall be raised to the new finished surface.

3. At un-monumented street intersections, new permanent control monuments shall be established in the centers of all intersecting streets on a street improvement project. Additional monuments shall be installed if requested by the City Engineer.

4. If any of the above conditions occur, a Land Corner Record or Record of Survey shall be filed by a Licensed Land Surveyor in accordance with all federal, state, county, and city laws, regulations, and standards. The City shall be provided with a mylar copy.

4-5 Vertical Street Alignment

Implemented: 09/14/2001 Revised: 01/01/1990

A well-designed vertical street alignment should attempt to reduce undulations and avoid mid-block sag vertical curves. Although the vertical alignment is a product, to some extent, of existing conditions, the City requires that new and rehabilitated streets be designed so as to minimize vertical deflections.

4-5.01 Street Grades

Implemented: 09/14/2001 Revised: 01/01/1990

The minimum grade on any street shall not be less than 0.5%. The maximum gradient on any street shall be as follows:

	Maximum
Primary Arterial	7% maximum
Secondary Arterial	8% maximum
Collector Arterial	9% maximum

Neighborhood Collector	12% maximum
Residential Access	15% maximum

4-5.02 Stopping Sight Distance

Implemented: 09/14/2001 Revised: 08/01/1995

Refer to Figure 4-2 to find the minimum length for a crest vertical curve when given the design speed and algebraic difference in grades. Refer to Figure 4-3 to find the minimum length for a sag vertical curve when given the design speed and the algebraic difference in grades.

4-6 Intersections

Implemented: 09/14/2001 Revised: 08/01/1995

4-6.01 Intersection Angle

Implemented: 09/14/2001 Revised: 08/01/95

Proposed public streets shall intersect as close to 90 degrees as possible, but in no case shall be less than 70 degrees

4-6.02 Corner Radii

Implemented: 09/14/2001 Revised: 08/01/1995

Intersection curb radius standards are as follows: Truck

	Minimum	Desirable	Route
Arterial to Arteria	25’	35’	50’
Arterial to Residential	20’	25’	N/A
High-Volume Truck and/or Bus Turns	30’	50’	N/A
When Vehicular Turn is Illegal	10’	10’	N/A

4-6.03 Sight Distance on Public Streets

Implemented: 09/14/2001 Revised: 01/01/1995

See Figure 4-1, Figure 4-2, Figure 4-3

4-6.04 Sight Distance at Driveways

Implemented: 09/14/2001 Revised: 01/01/1990

See Section 12-13

4-7 Roadway Transitions

Implemented: 09/17/2001 Revised: 08/01/1995

The standard taper length for the narrowing or offsetting of a lane is L = W x S x S/60, where W = the offset distance in feet, L = length of taper in feet, and S = speed limit in miles per hour. (Refer to MUTCD for details.)

4-8 Pavement Thickness

Implemented: 09/17/2001 Revised: 08/01/1995

Standard street thicknesses may be used provided the native soil R-value is at least 30. Standard total asphalt thickness for various types of streets shall be as follows:

	Full Depth Asphalt	Min Class B	ATB	Gran. Base Substitution for ATB
Principal Arterial	11	4	7	14
Secondary Arterial	10	3 ½	6 ½	13
Collector Arterial	9	3	6	12
Neighborhood Collector	8	3	5	10
Residential Access	7 ½	2 ½	5	10

When paving industrial or commercial streets, when the subgrade R-value is less than 30, or when a deviation from the standard thickness is requested; a pavement determination shall be made using the Asphalt Institute Thickness Design Method. Substitution of granular base for ATB will normally be allowed at a 2:1 ratio. Reduction of Class B asphalt thickness will not be allowed. Portland cement concrete pavement as an alternate to full asphalt pavement is acceptable provided a pavement analysis is performed. In all cases, the subgrade shall be certified by a Professional Engineer prior to placement of asphalt or cement concrete pavement.

4-9 Guardrail Placement

Implemented: 09/17/2001 Revised: 01/01/1990

Roadway hazards that may require shielding by a roadside barrier can be placed into two basic categories: fixed objects and embankment hazards. Curb and gutter will not be regarded as an adequate barrier for redirecting vehicles. Design of guardrails shall be in accordance with the WSDOT Design Manual.

4-9.01 Embankment Criteria

Implemented: 09/17/2001 Revised: 01/01/1990

Height and slope of embankments are the basic factors in determining barrier need for a fill section. Criteria for fill sections are shown in Figure 4-4, where embankments with slope and height combinations below the curve do not warrant protection and embankments with slope and height combinations above the curve warrant protection

4-9.02 Fixed-Object Criteria

Date Composed: 09/17/2001 Revised: 01/01/1990

A clear, unobstructed, flat roadside is highly desirable. When these conditions cannot be met, criteria to establish barriers needed for shielding roadside objects are necessary. The removal of fixed objects should be considered as the first alternative. If it is not feasible or possible to remove or relocate a hazard, then a barrier may be necessary. A barrier should be installed only if it is clear that the barrier offers the least hazard potential.

Figure 4-5 shows criteria for determining the clear zone on both cut and fill slopes. Fixed objects located within the clear zone should be removed, relocated, or shielded by a barrier.

4-10 Vertical Clearance

Implemented: 09/17/2001 Revised: 01/01/1990

A minimum vertical clearance of 16.5 feet shall be provided for all overhead obstacles measured from the crown of the street (allowing for future overlays) to the lowest portion of the obstacle. The minimum vertical clearance over sidewalks and bikeways shall be 8 feet.

4-11 Lateral Clearance

Implemented: 09/17/2001 Revised: 01/01/1990

The lateral clearance between the curb face and the closest part of any fixed object (excluding traffic-control sign and parking meter posts) not protected by a guardrail shall be a minimum of 18 inches. If no guardrail exists, use Table 4-1 to determine lateral clearance.

4-12 Illumination and Drainage Design Standards

Implemented: 09/17/2001 Revised: 01/01/1990

Illumination and drainage design criteria is located in Sections 8 and 9, respectively.

4-13 Construction Specifications

Implemented: 09/17/2001 Revised: 01/01/1990

The following specifications list City requirements for materials and workmanship for various items of work. For any item of work not listed below, the current edition of the Standard Specifications for Road, Bridge, and Municipal Construction as published by the WSDOT and the APWA shall apply.

TABLE 4-1 CLEAR-ZONE DISTANCE
(in feet from edge of travel lane)

Posted Speed MPH	Average Daily Traffic	3:1	4:1	5:1	6:1	8:1	10:1	3:1	4:1	5:1	6:1	8:1	10:1
5 or Less	The minimum clear-zone distance is established at 10 feet from the edge of the travel lane in a shoulder section or 18 inches beyond face-of-curb in urban conditions.												

40	Under 250	10	10	10	10	10	10	*	13	11	11	10	10
	250 – 400	11	12	12	12	12	12	*	15	14	13	12	12
	400 – 2000	13	13	13	13	13	13	*	16	15	15	14	13
	2001 – 5000	14	14	14	14	14	14	*	18	17	16	15	14
	Over 5000	15	15	15	15	15	15	*	19	18	17	16	15
45	Under 250	11	11	12	12	12	12	*	16	13	13	12	12
	250 – 400	12	13	14	14	14	14	*	19	16	15	14	14
	400 – 2000	14	14	15	15	15	15	*	21	18	17	15	15
	2001 – 5000	15	16	16	16	16	16	*	23	20	19	17	16
	Over 5000	16	17	17	18	18	18	*	24	21	20	18	18
50	Under 250	11	12	13	13	13	13	*	18	15	14	13	13
	250 – 400	13	14	15	15	15	15	*	22	18	17	15	15
	400 – 2000	14	15	16	16	16	16	*	25	20	19	16	16
	2001 – 5000	16	17	18	18	18	18	*	27	23	21	18	18
	Over 5000	17	18	19	20	20	20	*	29	24	22	20	20
55	Under 250	13	15	16	16	16	17	*	23	20	18	17	17
	250 – 400	14	16	18	18	18	19	*	28	24	21	20	19
	400 – 2000	15	18	20	20	20	21	*	31	26	24	22	21
	2001 – 5000	17	20	22	23	23	23	*	35	29	26	24	23
	Over 5000	18	21	23	24	24	25	*	37	31	28	26	25

4-13.01 Shoring and Cribbing

Implemented: 09/17/2001 Revised: 01/01/1990

All trench excavation over a depth of 4 feet shall be shored and cribbed in accordance with the requirements of the Washington Industrial Safety and Health Act, Chapter 49.17 RCW, and in accordance with Section 2.09 of the Standard Specifications.

4-13.02 Drain Pipe

Implemented: 09/17/2001 Revised: 01/01/1990

Where shown on the plans or designated by the Engineer, the Contractor shall install drain pipe of specified diameters. Included in this item are trench excavation, furnishing and installing the pipe, making all connections, backfilling and compaction of all backfill. Drain pipe shall be in accordance with Section 7-01 of the Standard Specifications.

4-13.03 Underdrain Pipe

Implemented: 09/17/2001 Revised: 01/01/1990

Where shown on the plans or designated by the Engineer, the Contractor shall install underdrain pipe of specified diameters. Included in this item are trench excavation, furnishing and installing the pipe, making all connections, and backfilling with washed rock. Underdrain pipe shall be in accordance with Section 7-01 of the Standard Specifications and City of Bellingham Standard Plan No. DR-525.

4-13.04 Plain Concrete Storm Sewer Pipe

Implemented: 09/17/2001 Revised: 01/01/1990

This item shall consist of constructing storm sewers of specified diameters shown on the plans or designated by the Engineer and shall include trench excavation, furnishing and installing the pipe, making all connections, backfilling, compaction of all backfill, and removal of existing pavement over trenches.

Storm sewer pipe alternates to concrete storm sewer pipe shall be in accordance with City of Bellingham Standard Plan ST-36.

Furnishing and placing Class "B" bank-run gravel trench backfill may be required in locations designated by the Engineer.

Trench excavation, bedding and pipe laying shall be performed in accordance with Section 7-04 of the Standard Specifications. Pipe compaction and backfill shall be in accordance with Standard Plan B-11.

4-13.05 Reinforced Concrete Storm Sewer Pipe

Implemented: 09/17/2001 Revised: 01/01/1990

This item shall consist of constructing storm sewers of specified diameters shown on the plans or designated by the Engineer and shall include trench excavation, furnishing and installing the pipe, making all connections, backfilling, compaction of all backfill, and removal of existing pavement over trenches.

Storm sewer pipe alternates to concrete storm sewer pipe shall be in accordance with City of Bellingham Standards.

Furnishing and placing Class "B" bank-run gravel trench backfill may be required in locations designated by the Engineer.

Trench excavation, bedding and pipe laying shall be performed in accordance with Section 7-04 of the Standard Specifications. Pipe compaction and backfill shall be in accordance with Standard Plan B-11.

4-13.06 Manhole Type

Implemented: 09/17/2001 Revised: 01/01/1990

This item consists of constructing manholes in accordance with the provisions of Section 7-05 of the Standard Specifications and with the City of Bellingham Standard Plan No. SS-700.

4-13.07 Concrete Inlet

Implemented: 09/17/2001 Revised: 07/10/2014

Thru-curb inlets conforming to the requirements of Section 7-05 of the Standard Specifications shall be installed at such locations and to such dimensions and details as shown on the plans or designated by the Engineer and in conformance with City of Bellingham Standard Plans DR-500 and DR-505. Vaned grates shall be used in accordance with B-30.40-01 or B-30.30.01, depending on location.

4-13.08 Catch Basins

Implemented: 09/17/2001 Revised: 02/19/2009

Thru-curb catch basins conforming to the requirements of Section 7-05 of the Standard Specifications shall be constructed at the low points of the curbs and to the locations, dimensions and details as shown on the plans or designated by the Engineer and in conformance with City of Bellingham Standard Plans DR-500 and DR-505. Vaned grates shall be used in accordance with Standard Plan B-2b.

All joint sections in catch basin will be sealed with a layer of grout between sections.

Catch basins Type I-C having 8 inch outfall pipe shall include furnishing and installing Type 60 B-1 outlet traps as per City of Bellingham Standard Plan No. DR-515.

4-13.09 Flared-End Section

Implemented: 09/17/2001 Revised: 01/01/1990

These items consist of installation of flared-end sections in accordance with Standard Plan B-7 at locations shown on the plans

4-13.10 Hand-Placed Riprap

Implemented: 09/17/2001 Revised: 01/01/1990

This item consists of supplying and placing 12-inch minus crushed rock for rock line channel at a location as shown on the plans or designated by the Engineer. All rock shall be dense, angular, sound, and durable. It shall be free from segregation, seams, cracks, and other defects conductive to accelerated weathering.

Bulk specific gravity shall not be less than 2.5 and absorption shall not be more than 2%.

All rock delivered to and incorporated in the project shall meet the following requirements:

- 100% of rock shall be 12" or less
- 10% maximum shall be less than 2"
- 2" to 12" rock shall be well-graded

4-13.11 Rock Wall

Implemented: 09/17/2001 Revised: 01/01/1990

Rock walls shall be constructed to the approximate limits shown on the plans and shall conform to the Standard Plan included herein.

Rock used for rock walls shall be sound-ledge rock of a uniform color, and obtained from a commercial quarry. Rock is to be free from seams or loose stratification. The rock shall have a density of at least 145 pounds per cubic foot.

All rock used in rock walls less than 3 feet in height shall be 12 inches in the least dimension and weigh a minimum of 150 pounds. All rock in rock walls greater than 3 feet, but less than 6 feet high, shall be 18 inches in the least dimension and 500 pounds minimum weight. All rock in rock walls greater than 6 feet high shall be 24 inches in the least dimension and 1,200 pounds minimum weight.

All rock is to be individually placed in rock walls. Each rock is to be placed in such a manner as to interlock with adjoining units to provide a maximum continuity of the finished wall. Rock arrangement is to provide uniform texture, even batter, and match the top of the embankment in a straight line. All rock walls shall be battered uniformly to the slope shown on the Standard Plans.

Voids in the rockery face shall not be greater than 50-square inches for rocks over 3-feet high and 36-square inches under 3-feet high. The maximum thru void area shall not exceed 15-square inches over 3-feet high and 10-square inches under 3-feet high. All openings shall properly retain the backfill material and not allow free spillage from behind the rock walls. All rock walls shall be backfilled in uniform layers as construction proceeds.

A permeable membrane made of cloth woven with synthetic threads shall be placed against the wall prior to backfilling. This filter cloth shall be no coarser than a No. 70 equivalent sieve size and shall have a minimum thickness of 50 mils. A minimum lap distance of 2 feet shall be used and care shall be taken during construction so as not to puncture fabric during installation.

4-13.12 Pedestrian Handrail

Implemented: 09/17/2001 Revised: 01/01/1990

This item shall include the furnishing of all materials for, and the construction of, the steel handrail on the top of the rock retaining walls as shown and detailed in the plans and in the specifications.

All sections of the steel handrail shall be galvanized after fabrication in accordance with the provisions of ASTM designation A123. The handrail shall not be painted, however, all erection marks and stock numbers shall be removed before completion of the project. All welding to galvanized surfaces shall be painted with approved galvanizing repair paint.

4-13.13 Cement Concrete Curb and Gutter

Implemented: 09/17/2001 Revised: 02/20/2008

Cement concrete curb and gutter shall be constructed where shown on the plans or as designated by the Engineer, in accordance with Section 8-04 of the Standard Specifications and City of Bellingham Standard Plan No. DR-500 and CG-200. Where new cement concrete curb and gutter is to be constructed to connect to existing curbed roadway, care shall be taken to assure that no abrupt offsets in line or grade shall be constructed which will be unsightly or impede flow in the gutter line. Depressed curb driveway and alley openings shall be provided at such locations as directed by the Engineer or shown on the plans and shall be paid at the same price per linear foot as cement concrete curbs and gutter Type "A" modified. Wheelchair ramps shall be constructed at such locations as shown on the plans or designated by the Engineer.

Curb drains shall be constructed of 2-inch P.V.C. pipe or other materials subject to approval by the Engineer, cut to length to pass from the back-of-curb through the curb to the face-of-curb at the gutter line. Extreme care shall be taken during subsequent sidewalk placement to ensure that drains are not obstructed. Spacing will be maximum of 60 feet, center-to-center and/or each side of the driveways and at such locations as designated by the Engineer to intercept existing roof drains.

Drains must be level, have their invert at the flow line of the gutter, and be normal to the back surface of the curb.

4-13.13.01 Cement Concrete Rolled Curb

Implemented: 11/16/2001 Revised: 01/01/1990

Cement concrete rolled curb shall be constructed where shown on the plans or as designated by the Engineer in accordance with City of Bellingham Standard Plans CG-204 and DR-510 and shall be allowed as an option under the following conditions:

1. Any street of 100 or more homes per outlet would require standard vertical curbs.

2. All rolled curbing shall have a sidewalk adjacent to it which shall have a minimum thickness of 6 inches.

3. Transition to vertical curbs will take place at intersections with arterial and through streets.

4. Handicapped ramps and vertical curb drainage grates will be utilized on corners where applicable.

4-13.14 Integral Cement Concrete Curb

Implemented: 09/17/2001 Revised: 01/01/1990

Integral cement concrete curb shall be constructed where shown on the plans or as designated by the Engineer in accordance with Section 8-05 of the Standard Specifications. Depressed curb driveway and wheelchair ramp openings shall be provided at such locations as directed by the Engineer or shown on the plans.

4-13.15 Cement Concrete Sidewalk

Implemented: 09/17/2001 Revised: 01/27/2006

Cement concrete sidewalk Type "B" shall be constructed as shown on the plans or as designated by the Engineer, in accordance with City of Bellingham Standard Plan No. CG-230.

GENERAL NOTES: SIDEWALKS

- Minimum sidewalk widths to be 5’ for residential, 8’ for commercial/business with 60’ right-of-way, and 10’ for commercial/business with 80’ right-of-way.

- Minimum radius of curb return to be 15’ on residential access streets and 20’ on arterial, commercial and industrial streets.

- Concrete shall be Class C.

- 3/4“ deep “V” grooves to be placed 5’ C/C.

- 3/8” x 2” minimum dummy joints to be placed 20’ C/C in line with contraction joints in curb.

- 3/8” x 4-1/2” expansion joints to be placed at curb returns, driveway section, cold joints, changes in section, or maximum 80’ C/C. Joints to protrude 1/2” below sidewalk.

- ¼” x 4-1/2” expansion joints to be placed between sidewalk and back-of-curb and around all junction boxes, meter boxes, etc.

- All joints to be cleaned and edged with 1/4 radius.

- Sidewalk to be brush-finished in traverse direction with fiber-hair brush, except at driveways where it shall be bushed longitudinally.
- Concrete shall be cured in accordance with the standard specifications.
- Sidewalks in cut sections shall be drained according to Standard Plan No. CG-230.
- Washed rock shall be 3/4”.

Further requirements shall be as specified in the standard specifications.

4-13.16 Cement Concrete Driveway

Implemented: 09/17/2001 Revised: 08/01/1995

Cement concrete driveways, 6 inches thick, shall be constructed where shown on the plans or designated by the Engineer. A 2-inch layer of 3/4-inch drain rock shall be used for driveway bedding and will receive no additional compensation under a separate pay item but shall be considered incidental to this item

4-13.17 Cobblestone Sidewalk

Implemented: 09/17/2001 Revised: 08/01/1995

This item shall consist of constructing a 4-inch cement concrete sidewalk with a cobblestone texture in accordance with Standard Plan CG-238 and the contract plans. Specifications shall otherwise be in accordance with those of the item, "Cement Concrete Sidewalk."

4-13.18 Asphalt Treated Base

Implemented: 09/17/2001 Revised: 08/01/1995

This item shall consist of supplying, placing and compacting in place asphalt-treated base at such locations as shown on the plans or designated by the Engineer in accordance with Section 4-06 of the Standard Specifications. Placement of asphalt treated base on frozen ground shall not be allowed.

4-13.19 Asphalt Concrete, Class HMA 1/2"

Implemented: 09/17/2001 Revised: 09/15/2009

This item consists of constructing Class HMA 1/2" asphaltic concrete at such locations as shown on the plans or designated by the Engineer.

Materials and construction methods shall conform with the requirements of Section 5-04 of the Standard Specifications except as modified herein. Connections to existing pavement shall be to a straight, neatly-trimmed line.

The grade of asphalt used shall be PGAB conforming with Section 9-2 of the Standard Specifications. Specification designations and AASHTO test methods for asphalt cement to be in accordance to Section 9-2 of the Standard Specifications.

The Contractor shall apply one application of an approved soil residual herbicide on all previously unpaved areas in order to prevent vegetation damage to the asphalt pavement. The soil residual herbicide to be used shall not have a detrimental chemical reaction to the asphalt pavement or damage

the pavement. Application of the herbicide shall be a uniform spray in accordance with the manufacturer's recommendation and in accordance with the Standard Specifications.

4-13.20 Asphalt Concrete Pavement Class "G"

Implemented: 09/17/2001 Revised: 01/01/1990

This item consists of supplying and placing asphalt concrete Class "G" wearing course at such locations as shown on the plans or designated by the Engineer. Materials and construction methods shall conform with the requirements of Section 5-04 of the Standard Specifications.

4-13.21 Cement Concrete Pavement

Implemented: 09/17/2001 Revised: 01/01/1990

All cement concrete pavement shall be constructed in accordance with the details shown on the plans and Section 5-05 of the Standard Specifications. The cement concrete pavement is to be constructed either with equipment utilizing stationary side forms or by the use of slip-form paving equipment at the option of the Contractor.

Transverse construction joints shall be sawed and the longitudinal joints may be formed or sawed at the option of the Contractor.

4-13.22 Illumination System Complete

Implemented: 09/17/2001 Revised: 01/07/2002

This work consists of illumination construction as shown on the plans and as specified herein. The successful Contractor shall submit four copies of shop drawings for Contractor supplied equipment to the Engineer for approval before ordering. All material shall be obtained from a source approved by the Engineer.

The illumination system shall be demonstrated to the Engineer and at an agreed upon time after completion and prior to final approval. The Contractor shall provide manpower and equipment for any necessary final adjustments and/or corrections.

4-13.22.01 Lighting Standard Base

Light standard bases shall be constructed in conformance with the attached Standard Plan No. EL-432 at such locations shown on the plans or designated by the Engineer. The concrete and backfilling used shall conform to the latest edition of the Standard Specifications.

The backfill material shall be controlled density fill (CDF) as per State Specification 2-09.3(1) E. If utilizing an auger for foundation excavation, the concrete must bear against undisturbed earth. The top-of-concrete base shall be flush finish grade.

4-13.22.02 Conduit

PVC conduit shall be furnished and installed between junction boxes and standards as detailed on the plans. Fittings shall be the same material. Conduit shall also be installed to the extents of the project limits to provide for future and/or existing connectivity.

All conduit to be installed in compliance with National Electric Code (NEC) at locations shown on the plans or designated by the Engineer.

When installing conduit in paved areas (either shoulder or the traveled roadway), the installation shall be accomplished by either jacking, use of an air ram, or saw cut trenching.

All trenches shall be constructed as straight and narrow as practicable to provide a minimum of pavement disturbance. The trenches shall be saw cut on both sides of the trench and then the asphalt chipped out. Except for the existing asphalt thickness, backfilling shall be entirely with controlled density fill (CDF) as per State Specification 2-09.3(1)E. The Contractor shall ensure to the satisfaction of the Engineer, that all voids are filled with CDF. The top of the trench shall be patched with compacted asphalt concrete pavement Class "B" equaling the thickness of the existing asphalt. Care shall be taken to provide a smooth driving surface.

4-13.22.03. Junction Boxes

Junction boxes shall conform to Standard Plan EL-452 and/or J-11a (with the exception that the J-11a lids shall be hot-dip galvanized and bear the legend “lighting"). Junction boxes shall be furnished and installed at such locations shown on the plans or as designated by the Engineer. The junction boxes shall sit on patio type concrete blocks which shall be placed on 6-inch compacted crushed gravel. All cover plates and metal surfaces for junction boxes shall be hot-dipped galvanized. Conduit into junction boxes shall be 6 to 8 inches from the top of the box at final grade. Conduit entering through the bottom of a junction box shall be located near the end walls to leave the major portion of the box clear. At all outlets, conduit shall enter from the direction of the run terminating within 3 inches of the box wall nearest its entry location and have bell ends. Care shall be taken to ensure a neat and convenient arrangement of conduit as outlined in Section 8.20.3(5) of the Standard Specifications.

4-13.22.04 Arterial Streetlighting Standards

Streetlighting standards shall be supplied and installed on light standard bases, shall be set plumb, and the base shall be grouted to cover leveling nuts and to fill the void under the base plat with a non-shrinking grout. Top of concrete base shall be flush with finished grade. Unless directed by the Engineer, standards shall match existing standards in the vicinity so long as they meet current standards.

Streetlighting standards shall be provided and installed where shown on the plans and/or as designated by the Engineer. Streetlighting standards shall be in accordance with City of Bellingham Standard Plan Nos. EL-404 and EL-432. Fusing shall be per WSDOT Standard Plan J-1E.

The following streetlight luminaires shall be used with the above poles.

Luminaires shall be the cutoff type with a cobra-head shaped housing. Lens shall be shatterproof, flat, tempered glass and in an extruded-aluminum frame. Reflectors shall be provided and the lamp position selected such that the luminaire produces an IES/ANSI Type III distribution with essentially complete light cutoff above 75 degrees from Nadir when operated with an E-18, high-pressure sodium lamp. If not on a circuit controlled by a service cabinet, each luminaire shall utilize a photo-cell.

The luminaire shall be bracket-arm mounted. The ballast shall be rated at 240 VAC and be of the regulated output or constant-wattage type. The ballast shall be suitable for operating a high-pressure sodium lamp of the specified wattage.

4-13.22.05 Alternate Arterial Streetlighting Standards

Streetlighting standards shall be provided and installed where shown on the plans and/or as designated by the Engineer in accordance with EL-408. The standard shall be square, tapered, pre-stressed concrete, anchor base spun hollow standards machine made in steel molds by the centrifugal process. Pre-stressing wire, caging and other reinforcement shall be placed in a manner that assures no cracking during normal handling. The pole shall have cast-in inserts on the side for attaching of the luminaire. Coordination shall be made with the luminaire manufacturer to ensure that placement of the inserts

matches the attachment centers of the luminaire. The poles shall be Centrecon MBQ-9 meter poles or approved equal with exposed natural aggregate finish #113 and have a 29foot, 6 inch pole height above ground. Fusing shall be per section 4-13.22, Subsection 7, Paragraph 2 below.

The following streetlight luminaires shall be used with the above poles.

Streetlighting luminaires shall be the cutoff type with one piece extruded aluminum rectangular housing. Lens shall be shatterproof glass, flat-tempered in an extruded aluminum frame with a medium bronze finish. Reflectors shall be provided and the lamp position selected such that the fixture produces an IES/ANSI Short Type II distribution with essentially complete light cutoff above 75 degrees from Nadir when operated with a 250-watt E-18, high-pressure sodium lamp. Sterner ST light #EX25-A-10-3-25-5 is claimed to meet these criteria. Each luminaire shall utilize a photo-cell unless controlled by a service cabinet.

The luminaire housing shall be bracket-arm mounted. The ballast shall be rated for 240 VAC and be of the Autoregulator type. The ballast shall be suitable for operating a high-pressure sodium lamp of the specified wattage. The luminaire shall be bolted to the pole by means of cast inserts and this detail shall be coordinated with the pole manufacturer to ensure proper fit. The complete luminaire assembly shall have a medium bronze alkydemelamine baked-enamel finish. No fusing shall be located in the luminaire.

4-13.22.06 Residential Streetlighting Standards

Streetlighting standards shall be in accordance with Standard Plan EL-400 and be the same as noted in Section 4-13.22, Subsection 5 except for the poles shall be Centrecon SEQ-5.7 or prior approved equal with exposed natural aggregate finish #113 and shall have 18 foot 8 inch pole height above ground.

The following streetlight luminaires shall be used with the above-mentioned residential poles.

Luminaires shall be the same type as noted in Section 4-13.22, Subsection 5 except it shall be a Sterner #EX20 70 watt HPS luminaire in medium bronze.

4-13.22.07 Wiring

All wire shall conform to the WSDOT Specifications. Conductors above grade and up the poles shall be copper, No. 12 AWG or larger, and shall be stranded.

Insulation shall be Type THW or better, 600V minimum rated, 75 o C and be color-coded in a consistent manner.

All wiring between j-boxes shall be 1 - #8 green wire 2 - #6 black wires stranded copper. Wiring from the nearest j-box up the pole shall be #12 copper. Fusing will be required in the j-box next to the service and in the j-box next to all concrete poles (see EL-400). Fuse holders shall be Buss #HEB-LW-RLA or prior approved equal. Fusing in all metal poles shall be in accordance with WSDOT Standard Plan J-1e.

The Contractor shall provide a complete grounding system with grounding continuity throughout the system. Ground rods and ground wire shall conform to the latest revision of the NEC.

All splices in underground illumination circuits shall be installed at junction boxes. Underground illumination circuit splices shall employ copper crimped connectors installed with an approved tool designed for the purpose. Shrink-on insulators (heat shrink end-caps), model HSC2-20 or epoxy splices with clear rigid molds shall be required on splices in all underground illumination circuits.

All wiring in metal luminaire poles shall be fused with breakaway fusing per WSDOT Standard Plan J-1e.

All wiring in concrete poles shall have waterproof breakaway fusing installed in the adjacent J-box per City of Bellingham Standard Plan EL-400.

4-13.22.08 Service Cabinet

An illumination service cabinet with panel and photocell control shall be provided and installed where shown on the plans per Bellingham Standard Plan EL-444.

The electric eye shall be Model LC4536LA precision or equal installed in the panel for control of the streetlighting system. An override feature shall also be provided.

Service to the panel shall be provided from the power source noted on the plans. Additional conduit and wire up the power pole shall be provided as required.

Conduit from the panel to the traffic signal controller shall be a minimum of 2-inch P.V.C. for the 120 V.A.C. service with two #6 wires and one #8 green wire for ground. Conduit from the panel to the first hand hole for the streetlighting circuits shall be 3 inch P.V.C. and shall contain the necessary wires as noted on the plans and installation schedule.

The service cabinet shall be bottom fed and installed on a concrete pad. The pad shall be 15 inches deep with 12 inches below grade and 3 inches above grade. The concrete pad shall be 6 inches outside the dimensions of the base of the service cabinet. The service cabinet and controller cabinet may be mounted on the same pad where applicable.

4-13.23 Traffic Signal System Complete

Implemented: 09/17/2001 Revised: 01/07/2002

This work consists of signalization construction as shown on the plans and as specified herein. The successful Contractor shall submit four copies of shop drawings for Contractor-supplied equipment to the Engineer for approval before ordering. All material shall be obtained from a source approved by the Engineer.

The signal system shall be demonstrated to the Engineer at an agreed upon time after completion and prior to final approval. The Contractor shall provide manpower and equipment for any necessary final adjustments and/or corrections.

4-13.23.01 Signal Base

Signal bases shall be constructed in conformance with the attached Standard Plan No. EL-432 at such locations shown on the plans or designated by the Engineer. The concrete used shall conform to APWA Specifications, Class "B", with 5% air entrainment.

4-13.23.02 Conduit

All conduit to be installed in compliance with National Electric Code (NEC) at locations shown on the plans or designated by the Engineer. Fittings shall be the same material.

When installing conduit in paved areas (either shoulder or the traveled roadway), the installation shall be accomplished by either jacking, use of an air ram or sawcut trenching.

If the sawcut trenching method is used, the trenches shall be constructed as detailed in the plans. All trenches shall be as straight and narrow as practicable to provide a minimum of pavement disturbance. The trenches shall be sawcut on both sides of the trench and then the asphalt chipped out. Except for the top existing asphalt thickness, backfilling shall be entirely with a controlled density fill (CDF) as per the State’s Standard Specification 2-09.3(1)E. The Contractor shall ensure to the satisfaction of the Engineer that all voids are filled with CDF. The top of the trench shall be patched with compacted asphalt concrete pavement Class "B" equaling the thickness of existing asphalt. Care shall be taken to provide a smooth driving surface.

4-13.23.03 Junction Boxes (Pull Boxes)

Junction boxes shall conform to Standard Plan EL-452 and/or J-11a. The junction boxes shall sit on patio type concrete blocks which shall be placed on a 6 inch crushed compacted gravel base. All cover plates and metal surfaces for junction boxes shall be hot-dipped galvanized. Conduit into junction boxes shall be 6 to 8 inches from the top of the box. Conduit entering through the bottom of a junction box shall be located near the end walls to leave the major portion of the box clear. At all outlets, conduit shall enter from the direction of the run, terminating within 3 inches of the box wall nearest its entry location and have bell ends. Care shall be taken to ensure a neat and convenient arrangement of conduit as outlined in Section 8-20.3(5) of the Standard Specifications.

4-13.23.04 Conductors

Electrical conductors used on this project shall conform to all pertinent requirements of Section 9-29.3 of the State's Standard Specifications, except as otherwise provided herein or on the plans. Insulated spades shall be used at the end of each conductor at wire terminations, splices or devices. Each conductor shall have a PVC wire marking sleeve bearing the circuit number indicated in the wiring schematic drawings. The terminal strips shall also bear the circuit number consistent with the wiring schematic. No splicing of any traffic signal conductors or detector conductors shall be permitted, including service wires.

The following conductors are exceptions to the Standard Specifications:

1) 20 conductor Signal Cable

    a) The 20 conductor cable shall conform to Bellingham Standard Plan EL-448

2) Loop Wire

    a) Wire for the vehicle detection loops shall be #12 USE.

3) Loop Lead-In Cable

    a) Cable used for lead-in conductor between the encapsulated splice between the loop wire in the junction box closest to the detection loop and the traffic signal controller shall be #14 shielded cable conforming to WSDOT/APWA Specification 9-29.3-7. The outside jacket shall be polyethylene.

4) Emergency Vehicle Preemption

    a) The three conductor cable used for the preemption circuits shall be 3M detector cable #138, or approved equal.

5) Cable Marking and Identification

    a) In addition to the circuit numbers noted above for conductors and wires, all cables shall also be labeled at both ends with a labeling system as follows:

        i) 20-Conductor Cable: Shall be labeled with colored tape by pole numbers at each end and labeled at each J-box they pass thru.
            (1) Pole #1 is on controller corner and remaining poles at the intersection are numbered clockwise around intersection.
            (2) Pole #1 shall have brown tape.
            (3) Pole #2 shall have red tape.
            (4) Pole #3 shall have orange tape.

(5) Pole #4 shall have yellow tape.

ii) 5-Conductor Cable: Shall be labeled with signal head and ped head numbers consistent with the wiring diagram schematic at both signal/ped head and terminal cabinet ends. Both 5-conductor cable and individual wires shall be labeled.

iii) 3-Conductor Cable (Emergency Vehicle Preemption Cable): Shall be numbered 1-6 as follows:
(1) #1 Phase 1 and 6
(2) #2 Phase 2 and 5
(3) #3 Phase 3 and 8
(4) #4 Phase 4 and 7
(5) #5 Extra
(6) #6 Extra

In addition, each cable shall be color-coded according to the pole from which it comes and the individual conductors in each cable shall be numbered according to the supplied wiring diagram.

iv) 2-Conductor Cable (Loop Lead-In Cable): Shall be labeled with phase number, lane number and type of loop as follows:

(1) Phase (1st number)	1 through 8
(2) Lanes for Phase (2nd number)	1 through 4
(3) Type of Loop (3rd number)	A = Advanced
	B = Presence
	C = Intermediate

Cables shall be color-coded at both ends and at all J-boxes they pass thru. In addition, individual conductors within each cable shall be numbered according to supplied diagram at the controller cabinet end.

4-13.23.05 Signal Standards

The signal poles shall be Type II and Type III as shown on WSDOT Standard Plan J-7A and attached Standard Plan EL-404 or the standard may be fabricated from shop drawings that meet the requirements of the latest AASHTO specifications for structural supports for highway signs, luminaires and traffic signals and have been submitted in accordance with said Standard Plan

J-7A and Section 8-20.2(1) of the State's Standard Specifications and have been approved by the Engineer. The mast arm lengths shall be as shown on the plans and hand hole shall be added to the signal standard behind signal arm.

Signal heads on the mast arm shall be mounted using mounting Type "M" or Type "K" (modified) as shown on Standard Plan J-6f and J-6g. Type "K" (modified) shall require hubs welded in the pole prior to galvanizing for nipple connections. The minimum vertical clearance to any portion of the cantilever arms or any mast-arm-mounted signal shall be 16 feet 6 inches from the top of pavement. The maximum vertical clearance shall be 19 feet. All signals shall be rigidly attached to the arm. There shall be approved wireway fixtures installed to facilitate pulling wire from the base to an outlet at each signal head after the structure is erected. The pole base shall accommodate the conduit stubbed up from the foundation. The finished structure shall be raintight.

4-13.23.06 Vehicle Detectors - Induction Loop

The intention of this specification is to describe a detection system consisting of an induction loop embedded in the roadway surface with a lead-in cable connected to a detector amplifier which shall detect the presence or passage of vehicles over the induction loop.

Type I and Type II induction loops shall conform to Bellingham Standard Plans EL-460 and EL-462. The loops shall be a minimum of 3 inches below the final roadway surface and shall utilize #12 USE wire.

After the lead-in and loop sawcuts are completed, the slot shall be thoroughly blown out with 100 psi air pressure so that no rocks and debris remain in the sawcut. If traffic is allowed to travel over the sawcuts before they are sealed, they shall be blown out again before placement of the wire and sealing. The sawcuts shall be sealed with craftco detector-loop sealant, preco sealant, 3M sealant, or prior approved equal.

Any existing loop that is to be replaced shall either be removed or shall have each leg and ends cut with no remaining wire being longer than 3 feet in length.

The conductors that form the induction loop and terminate in the lead-in junction box shall be joined to the cable as follows:

Detector lead-ins shall be spliced at the junction box nearest to the induction loop. Sufficient cable length shall always be provided to permit the preparation of wire splices 2 to 4 feet above ground.

The conductors and detector lead-in shall be twisted together then soldered, conforming to the wiring diagram for loop identification. The soldered connections shall then be trimmed and taped, assuring good electrical insulation of the loop pair. Pigtail splices are permissible.

Each loop pair shall then be sealed in an epoxy resin, Scotchsast size "G" (Sealing Pack #3570) or approved equal, assuring a good seal on the splice and insulated sheaths of the conductors.

Overlap splices, parallel splices, "Y" or "T" splice kits shall not be allowed.

Loops shall be tested as per Section 8-20.3 (14) of the Standard Specifications. Documentation of test results shall be provided to the City.

4-13.23.07 Vehicular Signal Heads

Polycarbonate heads shall not be allowed. All traffic signal heads shall meet the requirements of Sections 9-29.16, and 9-29.16(2), of the State's Standard Specifications. All signal heads shall be 12 inches and shall contain Dialight LED signal faces.

Each conventional signal head shall have a 1/4-inch drain hole at the bottom. Signal heads shall have square doors and shall be equipped with tunnel visors. Signal heads shall be powder coated dark olive green. All conventional signal heads used on the project shall be by one manufacturer. Five-inch backplates shall be provided on all vehicular signal heads.

Overhead-mounted traffic signal heads shall be adjusted in the field such that a person standing on the pavement at a distance four times the numerical value of the speed limit expressed in feet from the stop-bar shall see the brightest image of the red section. All signal heads shall be plumbed as viewed from the direction which they face.

4-13.23.08 Pedestrian Signal Heads

All pedestrian signal heads employed on this project shall be LED. Pedestrian signal heads shall be the "clamshell" type housing with an integral terminal compartment attached to the signal pole and the signal heads affixed to the compartment by a hinge. All pedestrian signal heads used on this project shall be by one manufacturer.

4-13.23.09 Pedestrian Push Buttons

Pedestrian push button assemblies shall be in accordance with Standard Plan J-5 except the push button shall be magnetic and shall be made of ultra-high molecular weight polyethylene (UHMWPE). The "Bumble Bee" pedestrian button is said to meet these specifications. The backplate shall be curved to fit the pole. A drain hole will be drilled in the bottom of the pedestrian push button.

4-13.23.10 Terminal Cabinet

A terminal cabinet with terminals according to City of Bellingham Standard Plan EL-424 shall be recessed in each traffic signal pole.

4-13.23.11 Traffic Signal Controller

The City will supply one eight-phase signal controller with cabinet fully equipped to the Contractor who shall install the cabinet on a new Type P controller cabinet base per Standard Plan EL-436 and seal with silicone. All field wiring shall be connected in the cabinet by the Contractor.

Contractor shall verify controller delivery to City Shop prior to developing their project schedule.

The City will also supply all necessary "Canoga" 4-channel loop-detector amplifiers and two Model 752 Phase Selectors for Contractor installation in accordance with the plans and as directed by the Engineer.

A professionally-drafted sketch of the intersection shall be provided by the Contractor and mounted on the door of the cabinet protected by a clear plastic overlay. The sketch shall conform to the geometrics of the intersection and show the numbered detectors for the particular intersection. In addition, the sketch shall identify each movement by the phase designation used by the controller. The sketch shall include a north arrow and street names. A film reproducible of the sketch shall be provided by the Contractor.

All wires terminated at the terminal strip shall have an insulated open-end, crimp-style solderless terminal. All solderless terminals shall be installed with a tool designed for the installation of this type of terminal and crimping with pliers, wire cutters, etc., will not be allowed. All conductor runs shall terminate at the proper terminal compartment strip with pressure-type binding posts. All wiring inside controller cabinets and at intermediate points shall be trimmed and cabled together with nylon wraps or equivalent. All cables shall be color-coded with tape according to their pole of origin. All individual conductors shall be numbered according to supplied diagram.

4-13.23.12 Service

Electrical service for signal controller will be 120 volts, 60 Hz AC, 50 AMP single-phase, where and as noted in the plans.

4-13.23.13 Emergency Preemption

The emergency preemption optical detectors shall be 3M Company "Opticom" brand.

4-13.24 Beam Guardrail

Implemented: 09/17/2001 Revised: 05/01/1990

Beam guardrail shall be installed as shown on the plans or as designated by the Engineer in accordance with Section 8-11 of the Standard Specifications. Each "run" shall contain one Design "A" or "B" terminal section and one Design "C" terminal section.

4-13.25 Chain-Link Fence

Implemented: 09/17/2001 Revised: 05/01/1990

Chain-link fence shall be installed where shown on the plans or designated by the Engineer in accordance with Section 8-12 of the Standard Specifications and WSDOT Standard Plan L-2.

4-13.26 Brass Cap Placement

Implemented: 09/17/2001 Revised: 05/01/1990

The work performed under this item shall consist of constructing brass cap monuments conforming to the attached standard plan at such locations shown on the plans or designated by the Engineer. The brass caps will be supplied by the City at no cost to the Contractor.

4-13.27 Seeding, Fertilizing, and Mulching

Implemented: 09/17/2001 Revised: 05/01/1990

This work consists of preparing slopes and surfaces, seeding, fertilizing and mulching in accordance with Section 8-01 of the Standard Specifications.

Applications of seed, fertilizer and mulch shall be as follows:

1. Seed
   Grass seed of the following composition proportion and quality shall be applied at the rate of 150 pounds per acre on all areas requiring roadside seeding within the project:

Kind & Variety of Seed in Mixture	% by Weight	Minimum % Pure Seed	Minimum % of Germination
Colonial Bentgrass (Highland or Astoria)	10%	9.80% (min)	85%
Red Fescues (Illahee Rainier or Pennlawn)	45%	44.10% (min)	90%
Perennial Rye	30%	29.40% (min)	
White Clover (pre-inoculate)	15%	14.70% (min)	
Weed Seed		1.00% (max)	
Inert and Other Crop		1.00% þ (max)	
TOTAL	100%		

2. Fertilizer
   The Contractor shall apply sufficient quantities of fertilizer to supply the following amounts of nutrients:

   Total Nitrogen as N-90 pounds per acre.
   Available Phosphoric Acid as P2O5 - 70 pounds per acre. Soluable Potash as K2O - 70 pounds per acre.

   The fertilizer formulation and application rate shall be approved by the Engineer before use.

3. Mulch
   Mulch shall be applied at a rate of 2,000 pounds per acre.

4-13.28 Seeded Lawn Installation

Implemented: 10/04/2001 Revised: 05/01/1990

1. Materials
   A. Topsoil: Topsoil shall be natural, fertile, agricultural soil, capable of sustaining vigorous plant growth. It shall be of uniform composition throughout with a mixture of

subsoil. It shall be free of stones, lumps, live plants and their roots, sticks and other extraneous matter.

B. Fertilizer

i. Fertilizer shall be supplied by the Contractor and incorporated and mixed thoroughly into the soil at the following rate:
10 lb. 12-4-8 per 1,000 square feet.

ii. Requirements
50% of the nitrogen shall be derived from unreaformaldehyde; 50% of the potash shall be derived from sulfate of potashmagnesia.

iii. In addition to the above, the fertilizer shall contain the following additives:
F.T.E. 2.0%
Multritracin 0.5%

iv. Fertilizer shall be packed in new, waterproof, non-overlaid bags clearly labeled as to weight, manufacturer and content.

2. Lawn Installation

All planting strips within the project limits as shown on the plans shall be contoured to the Engineer's satisfaction and seeded as outlined in Section 8-02.3(14) in the Standard Specifications. Three inches of topsoil, Type "A," shall be used in all lawn installation areas.

A. Seed

i. Analysis:

1. 50% improved fine-textured Perennial Ryegrass. Select from following list of any three (3) with no single selection to total over 25% of total mixture.
    a. Manhattan
    b. Pennfine
    c. Loretta
    d. Derby
    e. Citation
    f. Yorktown
2. 50% improved low-growing Kentucky Bluegrass. Select from following list any three (3) with no single selection to total 25% of total mixture.
    a. Baron
    b. Victa
    c. Bonnie Blue
    d. Adelphi
    e. Pennstar
    f. Bristol

B. Seeding Rates

75 lbs. per acre or 4.0 lbs. per 1,000 sq. ft.

C. Certification

Seed shall conform to the standards for "certified" grade seed or better. Seed shall be furnished in standard containers on which shall be shown the following information: seed name, lot number, net weight, percentage of purity, percentage of germination, percentage of weed seed, and inert material.

D. Upon Request

Contractor shall furnish to the Engineer duplicate copies of a statement signed by the vendor certifying that each lot of seed has been tested by a recognized seed testing laboratory within 6 months before the date of delivery on the project. Seed which has become wet, moldy, or otherwise damaged in transit or storage will not be accepted. The Contractor shall perform all necessary operations of mowing, fertilizing and watering to fully establish the grass through the second mowing. After the second

mowing, all lawn areas shall be fertilized with 15 pounds of 12-4-8, per 1,000 square feet.

3. Guarantee

A. Initial Acceptance

The Contractor may request inspection for initial acceptance 30 days after planting is complete. Upon completion at this time, initial acceptance will be certified in writing by the Engineer.

The Contractor's guarantee shall extend for one year from the date of the initial acceptance of the work. All lawn must be in vigorous growing condition at the end of the guarantee period. Defective materials, as determined by the Engineer, shall be replaced at the beginning of the first succeeding planting season and shall be in place prior to final acceptance. Failure on the part of the Contractor to comply with this requirement shall constitute grounds for the owner, or another Contractor of his choosing, to replace the necessary lawn on a time-and-materials basis, plus 15% overhead, and to utilize the maintenance bond for payment.

B. Final Acceptance

One year after initial acceptance in response to ten days written notice from the Contractor, a final inspection of the work will be completed jointly by the Contractor and the Engineer. Upon completion of the repairs or renewals which the Engineer deems necessary at this inspection, final acceptance shall be certified in writing by the Engineer.

4-13.29 Tree Planting

Implemented: 10/04/2001 Revised: 08/01/1995

This item shall consist of furnishing and planting trees at locations shown on the plans.

Trees shall be planted in pits having diameters at least twice that of the root ball or root system. The outer 6 inches of material shall be removed byhand methods. The wall and bottom of the pits shall be removed by hand methods. The wall and bottom of the pits shall be roughed to allow for root penetration. All planting pockets shall be backfilled by jetting to prevent air pockets in the lower third of the hole. Trees shall be watered generously during and after backfill. Backfill materials shall be sandy loam.

All trees shall be_____inches to_____inches caliper, B & B, unless otherwise noted. Measurements, caliper, branching, grading, quality, balling and burlapping shall follow the Code of Standards of the American Association of Nurserymen in the American Standard for Nursery Stock. All plants shall have natural shape.

Fertilizer for trees shall be Formula 4-2-2 "Transplanter" as manufactured by Pacific Agro Company and shall be applied at the rate of 8 ounces per tree. Four planting tablets, 21 gram size as manufactured by Agriform International Chemicals, Inc., 20-10-5 analysis shall be applied. Tree staking shall be in accordance with details in the plan.

All trees shall be properly protected against harm from wind, unusual weather and the public. The Contractor shall perform all necessary maintenance including watering, pruning and spraying until one year after acceptance. All trees must be in a vigorous growing condition at the end of the one-year guarantee period. Defective materials, as determined by the Engineer, shall be replaced immediately with specimens of the same species and size as the original.

4-13.30 Bicycle Facilities Standards

Implemented: 10/04/2001 Revised: 08/01/1995

1. Referenced Standards, Regulations and Policy
   A. AASHTO Guide for the Development of Bicycle Facilities, 1999
   B. Manual on Uniform Traffic Control Devices (MUTCD) & WSDOT Chapters 840 & 850.
   C. WSDOT Design Manual: Section 1020 1.4; RCW 35.75.060
   D. All arterials are to be designed and constructed under the assumption that they will be used by bicyclists and that sidewalks are not a substitute for bicycle facilities.
   E. All Public Works street projects are to have a bicycle check-off to determine in the early planning and design stages, whether or not there is a bicycle element or bicycling impact. When such conditions exist, the project shall be reviewed by a bicycle transportation specialist to ensure that any negative impacts on bicycle traffic are mitigated in the design process.
   F. Standard Drawing TC-315, Bicycle Lane Standards
   G. Standard Drawing MS-1040, Bicycle Parking Standards
2. Signs, Signals, and Roadway Markings
   A. Signing and marking of bikeways must be uniform and consistent to provide safety to all users and all signing and marking must be warranted by use and need. Care must be taken to avoid oversigning of bikeways which can lessen the impact of warnings and may confuse vehicle operators rather than enhance safety.
   B. Roads with shoulders less than 4 feet wide or that have obstructions with less than 4 feet of clearance to motor vehicle lanes should not be signed as bikeways.
   C. High conflict situations, where bike shoulders or bike lanes end and encroachments, obstructions, or a narrowing shoulder require that bicyclist merge into the motor lanes, may be marked and signed in accordance with the MUTCD.
   D. Raised pavement markers are incompatible with safe bicycle travel and should not be used in the expected path of bicycles on new roadway construction, or replaced when existing roadways are altered or resurfaced. Existing raised pavement markers that present a hazard should be removed and replaced with flat surface markings which are in accordance with MUTCD.
3. Roadway Facilities
   A. Width of Arterials
      i. Arterial streets without delineated bicycle lanes are required to have a minimum clear curb lane width of 14 feet (4.3 m) to provide for safe co-usage of the lane by bicycles and motor vehicles. Re-striping programs on existing multi-lane roads should consider the resizing of inside lanes in order to provide for the minimum curb lane width.
      ii. Bulbed intersections protruding up to the edge of the traffic lanes must not be designed to extend into the minimum curb lane width.
   B. Drainage Grates
      i. It is required that grates and utility covers be adjusted flush to the surface, including when an existing road is resurfaced. New installation of parallel bar (to travel direction) drainage grate inlets is prohibited.
   C. Railroad Crossings
      i. Railroad grade crossings should be at a right angle to the rails and the roadway approach at the same elevation as the top of the rails. If the crossing angle is less than 45 degrees, then widening the outside traffic lane, shoulder, or bicycle lane is required to allow bicyclists adequate room to cross the tracks at a right angle.
      ii. Warning signs and pavement markings are to be installed in accordance with the MUTCD. Abandoned tracks are to be removed.
   D. Shoulders
      i. Where it is intended that bicyclists ride on shoulders, smooth paved shoulder surfaces are to be provided and maintained.

ii. Where intended for bicycle travel, a clear shoulder width of 5 feet (1.5 m) is required.
iii. When existing widths, rights-of-way or other limitations require prioritization of facilities, shoulder improvements or bike lanes on uphill sections are to take precedence to provide slow-moving bicycles more maneuverability and to minimize conflicts with motorized vehicles.

4. Bicycle Lanes
   A. Bicycle lanes delineated and signed for the exclusive use by bicyclists (WSDOT 1020.02 Class II) are to be one-way facilities and carry traffic in the same direction as adjacent motorized traffic. Bicycle lanes on one-way streets are to be on the right side of the street, except in areas where a bicycle lane on the left will decrease the number of conflicts.
5. The minimum width of a bicycle lane is 5 feet (1.5 m) with a 4-inch wide lane strip separating the bike lane from motorized traffic lanes and the parking lane. Gutterless curbs (with vertical drain inlets) will allow for a reduction of the minimum bicycle lane width to 4 feet (1.2 m) because gutter skirts and seams do not encroach on the travel path. Where the minimum width is not possible, marked lanes separating bicyclists from motor-traffic lanes should not be provided; however, signing and/or pavement markings such as the bike symbol can be used to enhance safe co-usage of arterial streets (see bicycle lane standard drawing TC-315).
6. Bicycle Routes
   A. Bicycle routing must not end at a barrier nor require an abrupt entry into other traffic lanes without warning markings and signage in accordance with the MUTCD. Rerouting must be clearly signed to inform bicyclists of the barrier and the re-route destination.
7. Bicycle Parking
   A. Bicycle racks shall be constructed from 2" O.D. schedule 40 pipe in accordance with Bellingham Standard Plan MS-1040. Racks shall be galvanized after construction.

      Racks shall be installed in existing concrete using 3/8" galvanized threaded rod and hardware, epoxied with a mortaring epoxy system. Installation in asphalt areas or areas other than concrete shall use a minimum of 1 cubic foot concrete footing on each end with 3/8" galvanized anchor bolts placed in the concrete.

4-13.31 Traffic Control Signing Standards

Implemented: 10/04/2001 Revised: 01/27/2006

Traffic control signing for new construction within the city right-of-way shall be installed in accordance with the following procedures and specifications:

1. All construction plans and specifications pertaining to traffic signing are to be reviewed by the Transportation Engineering Section of Public Works to verify correct type and approximate location of traffic signing.
2. The contractor shall request the Transportation Engineering Section to locate the signing on all project sites. Transportation Engineering will field locate and inventory all signs required by the project. The contractor will be notified when field locations are complete.
3. The contractor shall be responsible for verifying utility locations thru the one-call system
4. The contractor will contact the project inspector to have the signing inspected and approved immediately upon installation.
5. All signing shall conform to the guidelines specified in the Manual on Uniform Traffic Control Devices. Signs shall be fabricated according to the specifications in WSDOT's Sign Fabrication Manual, be of standard size, and shall have a reflective grade equal to or greater than the following:
   A. Regulatory Signs:
      R1-1, R1-2, R1-3, R1-4, R5-1, R6-1, R3-16, R3-17 - High intensity or better. All other regulatory signing - Engineer grade or better.
   B. Warning Signs:

High intensity or better (all signs including school zone signs).

6. Signs shall be installed on posts described in Standard Plan TC-320 of the Development Guidelines and Improvement Standards.
7. Street Name Signs Shall:
   A. Be reflective (engineer grade).
   B. Have a standard size of 6" tall x 24" or 30" long depending on length of word.
   C. Have white lettering on a green background.
   D. Be made of extruded aluminum.
   E. Have 4" lettering for the street name and 2" lettering for the abbreviated street type (i.e., St, Ln, Rd, Blvd). Only the first letter of the word to be capitalized.
   F. Have a lettering font Highway Gothic Series "C".

4-13.31.01 Traffic Control Within City Right-of-Way

1. GENERAL REQUIREMENTS
   A. All traffic control devices used in the City right-of-way shall conform to the applicable specifications of the Manual on Uniform Traffic Control Devices.

      Traffic control devices shall be installed at the inception of surveying, construction or maintenance operations, and shall be properly maintained and/or operated during the time such special conditions exist. They shall remain in place only as long as they are needed and shall be immediately removed thereafter. Where operations are performed in stages, there shall be in place only those devices that apply to the conditions present. Signs that do not apply to existing conditions shall be removed, covered, or turned so as not to be readable by oncoming traffic. Barricades and sign supports shall be constructed and erected in a workmanlike manner.

      Weeds, shrubbery, construction materials or equipment, spoil, etc., shall not be allowed to obscure any traffic control device.
2. DESIGN OF SIGNS
   A. Signs shall meet the following standards:
      i. They shall conform in size, shape, color and message with those in part VI of the MUTCD and meet minimum dimensions in the State of Washington Sign Fabrication Manual MSS-05.
      ii. The use of stripes (other than the standard border) or other geometric patterns or contrasting colors on or around the sign in an attempt to make it more conspicuous shall not be permitted; however, standard fluorescent red-orange flags or yellow flashing lights may be used for added emphasis so long as they do not interfere with the sign message.
      iii. All signs used shall be properly reflectorized except for parking and pedestrian prohibition signs. Reflectorization of the sign face shall be accomplished using an approved weatherproof, reflectorized sheeting. Paint impregnated with glass beads shall not be used, the source shall be properly shielded to reduce glare. Street or highway lighting shall not be considered adequate for illuminating signs. All reflectorized or illuminated signs shall be checked by the Contractor during the hours of darkness to insure that they are functioning properly.
      iv. Signs shall be constructed from material which will not deteriorate abnormally under normal weather conditions. Sign blanks should be weatherproof plywood or non-corrosive metal. Roll-up signs fabricated from vinyl-coated nylon or vinyl-coated nylon mesh may also be used. If such signs are not reflectorized, they shall not be used at night.
3. FLAGGING
   A. Flagging is provided at work sites either to stop traffic intermittently as necessitated by work progress or to maintain continuous traffic flow past the work site at reduced speeds to help protect the work crew. The flagger must at all times, be clearly visible to approaching traffic for a

sight distance sufficient to permit proper response by the motorist to the flagging instructions and to permit traffic to reduce speed before entering the work site area.

Flaggers and operators of construction and maintenance machinery or trucks should make every reasonable effort to allow the driving public the right-of-way so as to avoid excessive traffic delays.

Thus, the flagger has three basic functions -- all of equal importance:

i. To guide traffic safely through a work area.
ii. To protect the lives of the public and fellow employees working on and near the public right-of-way.
iii. To answer courteously and intelligently reasonable questions.

B. Training: Flaggers shall complete a Washington State approved flagging course, or the equivalent, prior to being assigned duties as a flagger.
C. Equipment: When on duty, flaggers should be appropriately dressed to alert the motorist. The standard orange vest, hat, and other equipment shall be worn. All equipment must be reflectorized except if it will never be used during dusk, or night conditions.
D. Tools: Hand signaling devices, such as red flags, STOP/SLOW paddles and lights are used in controlling traffic through work areas; the STOP/SLOW paddle shall be the primary hand-signaling device.
    i. Sign paddles shall be at least 24 inches wide by 24 inches high. A rigid handle must be provided. This combination sign may be fabricated from sheet metal or other light semi-rigid material and have an octagonal shape. The background of the STOP face shall be red with white letters and borders. The background of the SLOW face shall be orange with black letters and borders. All such paddle signs must be reflectorized, unless the paddle will only be used during daylight hours.

4-13.31.02 Traffic Control Within and Abutting the Project

Any time the Contractor's operation is expected to disrupt the normal flow of traffic, the Contractor shall submit a traffic control plan to the Engineer for approval. As construction progresses, each traffic control plan shall be modified and re-submitted if deemed necessary by the Engineer. All signing and traffic control measures shall conform to the Manual on Uniform Traffic Control Devices as adopted by the State of Washington. Construction shall not be allowed to commence until the traffic control plan is approved.

Streets within the project limits may be closed to traffic only under the following conditions:

1. The Contractor submits a complete signing and traffic control plan for approval by the Traffic Engineer five (5) working days prior to the desired implementation date.
2. Approved traffic controls to be in place and operational before commencement of construction.
3. The Contractor shall have total responsibility for the procurement, installation and maintenance of all traffic control devices required for the duration of the contract.
4. The Contractor shall not close or cause to be closed, any arterial street or portion thereof between 7 a.m. and 9 a.m. or 4 p.m. and 6 p.m., unless otherwise approved by the Traffic Engineer.

All costs encountered in the maintenance of traffic, including the placement of traffic cones, construction signs, detours, etc., and traffic control within the abutting the project as specified above and in the Standard Specifications shall generally be considered incidental to construction and no compensation shall be allowed; any allowance for traffic control labor is, however, an exception.

The Contractor shall an acceptable means of securing signs, cones and barricades to prevent them from being wind-blown or tipped while in service. A penalty of twenty dollars ($20.00) per day will be assessed

for each traffic control device which is not in its proper position because of poor installation techniques or lack of maintenance by the Contractor.

4-13.31.03 Notification of Adjacent Residents and Businesses

The Contractor shall notify residents and business occupants in writing a minimum of 36 hours and a maximum of 72 hours prior to any work affecting access or service. A daily notification record shall be maintained during the life of the contract. A copy of the notification record shall be supplied to the Engineer upon request. Access interruptions shall be minimized whenever possible. Any costs associated with these requirements shall be considered incidental to other items of work.

Section 5. Sanitary Sewer System

5-1 Introduction

Implemented: 10/04/2001 Revised: 06/01/1997

The City of Bellingham requires sanitary sewer construction plan submittal on development projects when improvements are proposed within public right-of-way or an easement. The following chapter has been developed to assist in preparation of sewer construction plans. It includes items pertinent for the City's review and reflects established professional civil engineering practice for preparation of construction plans. Three sets of plans must be submitted to the Public Works Department for initial review.

5-2 Criteria for Sewage Design

Implemented: 10/04/2001 Revised: 06/01/1997

This section serves as a guide for the design of sewage collection systems for the City of Bellingham. The goals are:

1. To ensure that the design of sewage collection systems is consistent with public health and water quality objectives of the State of Washington.
2. To establish a basis for the design and review of plans and specifications for sewage systems.
3. To assist the owner or their authorized engineer in the preparation of plans, specifications, reports, and other data.
4. To guide departments in their determination of whether an approval, permit, and/or a certificate for a sewage system should be issued.

5-2.01 DESIGN

Implemented: 11/09/2001 Revised: 06/01/1997

Sewer systems shall be designed and constructed to achieve total containment of sanitary wastes and maximum exclusion of infiltration and inflow. No new combined storm water and sanitary sewers will be allowed.

In keeping with good engineering practice and with the Uniform Plumbing Code, public sewers shall be designed to provide gravity service to all abutting individual building lots. Installation of sewers or utilization of sewers that cannot provide for gravity service will only be allowed if a gravity system is considered by the City to be impractical to install.

5-2.01.01 Overflows

Implemented: 11/16/2001 Revised: 06/01/1997

No overflows in separate sewers or new overflows in existing combined sewers shall be permitted.

5-2.01.02 Calculations

Implemented: 11/16/2001 Revised: 06/01/1997

Computations and other data used for design of the sewer system shall be submitted to the Department upon request.

5-2.02 DESIGN CONSIDERATION

Implemented: 11/16/2001 Revised: 06/01/1997

5-2.02.01 Design Period

Implemented: 11/16/2001 Revised: 06/01/1997

Collection sewers should be designed for the ultimate development of the tributary areas.

Selection of the design period for trunk and interceptor sewers should be based on evaluation of economic, functional, and other considerations; such as:

1. Possible solids deposition, odor, and pipe corrosion that might occur at initial flows.
2. Population and economic growth projections and the accuracy of the projections.
3. Comparative costs of staged construction alternatives.
4. Effect of sewer sizing on land use and development.

5-2.02.02 Design Basis

Implemented: 11/16/2001 Revised: 06/01/1997

New sewer systems shall be designed on the basis of per capita flows or alternative methods. Documentation of the alternative method shall be provided upon request.

Per Capita Flow: New sewer systems designed on the basis of an average daily per capita flow may be designed for flow equal to that set forth in Table 5-1, with an appropriate peaking factor.

TABLE 5-1 DESIGN BASIS FOR NEW SEWAGE WORKS

Discharge Facility	Design Units	Flow (gpd)
Dwelling	per person	150
Schools (w/showers and cafeteria)	per person	16
Schools (cafeteria but no showers)	per person	10
Boarding Schools	per person	75
Motels, at 65 gal/person (rooms only)	per room	130
Trailer Courts, at 3 persons/trailer	per trailer	300
Restaurants	per seat	50
Service Station	per serviced vehicle	10
Factories, per shift	per person	15-35
Shopping Centers	per 1,000 s.f. area	200-300
Hospitals	per bed	300
Nursing Homes	per bed	200
Retirement Homes	per bed	100
Doctor's Office in Medical Center	per 1,000 s.f. area	500
Laundromats (9 to 12 machines)	per machine	500
Community Colleges	per student-faculty	15
Swimming Pools	per swimmer	10
Theaters (drive-in type)	per car	5
Theaters (auditorium type)	per seat	5
Picnic Areas	per person	5
Resort camps (limited plumbing)	per campsite	50
Luxury Camps (w/flush toilets)	per campsite	100

These figures are assumed to cover normal infiltration, but an additional allowance should be made where conditions are unfavorable. If there is an existing water system in the area, water consumption figures can be used to help substantiate the selected per capita flow.

Generally, the sewers should be designed to carry, when running full, not less than the following:

1. Lateral and Submains:

   "Minimum peak" design flow should be not less than 400 percent of the average. "Lateral" is defined as a sewer that has no other common sewers discharging into it. "Submain" is defined as a sewer that receives flow from one or more lateral sewers.

2. Main, Trunk, and Interceptor Sewers:

   "Minimum peak" design flow should be not less than 250 percent of the average design flow. "Main" or "trunk" is defined as a sewer that receives flow from one or more submains. "Interceptor" is defined as a sewer that receives flow from a number of main or trunk sewers, force mains, etc. An alternate method for trunk sewers is to use 80 gallons per capita, per day, a peaking factor from Figure 5-1 subject to the above limits, and 1,200 gallons per acre, per day, for infiltration and inflow.

   New sewer systems may be designed by alternative methods other than on the basis of per capita flow rates. Alternative methods may include the use of peaking factors for the contributing area, allowances for future commercial and industrial areas, separation of infiltration and inflow from the normal sanitary flow, and modification of per capita flow rates (based on specific data). Documentation of the alternative method used shall be provided upon request.

5-2.02.03 Design Factors

Implemented: 11/16/2001 Revised: 01/01/1990

The following factors must be considered in the design of sanitary sewers:

1. Peak sewage flows from residential, commercial, institutional, and industrial sources
2. Groundwater infiltration
3. Topography and depth of excavation
4. Treatment plant location
5. Soil conditions
6. Pumping requirements
7. Maintenance
8. Existing sewers
9. Existing and future surface improvements
10. Controlling service connection elevations
11. Easements (See Section 2-6)

5-2.03 DESIGN AND CONSTRUCTION DETAILS

Implemented: 10/04/2001 Revised: 08/01/1992

5-2.03.01 Gravity Sewers

Implemented: 11/16/2001 Revised: 08/01/1992

1. Minimum Size: No sewer shall be less than 8 inches in diameter.

2. Depth: In general, sewers should be a minimum of 3 feet deep to prevent freezing and physical damage and should receive sewage from existing dwellings by gravity.

3. Roughness Coefficient: An "n" value of 0.013 shall be used in Manning's formula for the design of all sewer, facilities (regardless of pipe material) except inverted siphons, where an "n" value of up to 0.015 can be used.

4. Slope: All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second. The following minimum slopes should be provided, however, slopes greater than these are desirable:

Sewer Size	**Minimum Slope**
(inches)	(feet per 100 feet)
8"	0.40
10"	0.28
12"	0.22
15"	0.15

Under special conditions, slopes slightly less than those required for the 2.0 feet per second velocity when flowing full may be permitted. Such decreased slopes will only be considered where the depth of flow will be 0.3 of the diameter or greater for design average flow. Whenever such decreased slopes are proposed, the design engineer shall furnish with their report their computations of the depths of flow in such pipes at minimum, average, and daily or hourly rates of flow. The City must recognize and accept in writing the problems of additional maintenance caused by decreased slopes.

Sewers shall be laid with uniform slope between manholes.

Sewers on 20% slope or greater shall be anchored securely with concrete anchors or equal. Suggested minimum anchorage spacing is as follows:

A. Not over 36 feet center-to-center on grades 20% and up to 35%.

B. Not over 24 feet center-to-center on grades 35% and up to 50%.

C. Not over 16 feet center-to-center on grades 50% and over.

5. Alignment: Gravity sewers 24 inches or less in diameter shall be designed with straight alignment between manholes. Curved sewers may be approved, where circumstances warrant, for sewers greater than 24 inches in diameter.

6. Matching Pipe: Where a smaller sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation.

7. High-Velocity Protection: The use of ductile-iron pipe is required where velocities greater than 15 feet per second are expected.

8. Material: Any generally accepted material for sewers will be given consideration, but the material selected should be adapted to local conditions, such as characteristics of industrial wastes, possibility of septicity, soil characteristics, exceptionally-heavy external loadings, abrasion, and similar problems.

Material and installation specifications for all pipe, except cleanouts, shall conform to the Standard Specifications, current edition. Material and installation specifications for PVC pipe shall conform to Section 9-05.12. Cleanouts shall be according to City of Bellingham Specification SS-720. Unless

otherwise stated, all materials specifications shall conform to the Standard Specifications, current edition.

Requirements shall be set forth in the specifications for the pipe and methods of bedding and backfilling so as not to damage the pipe or its joints, impede cleaning operations and future tapping, nor create excessive side fill pressure or ovalation of the pipe, nor seriously impair flow capacity.

All sewers shall be designed to prevent damage from superimposed loads. Proper allowance for loads on the sewer shall be made based on the width and depth of trench. When standard-strength sewer pipe is not sufficient, the additional strength needed may be obtained by using extra-strength pipe or by special construction, such as improving bedding conditions or encasing the pipe in concrete. When extra-strength pipe is required, the design criteria (loading requirements, soil strengths, etc.) shall be supplied to the City.

9. Specifications for Sewer Pipe: The following specifications are to be used in conjunction with the Standard Specifications for Road, Bridge and Municipal Construction.

   Material to be used for bedding of these flexible conduits shall conform to material listed in City of Bellingham Standard Plan SS-760. No bedding material shall be used unless accepted by the City Engineer. Samples shall be submitted by the Contractor at least 72 hours in advance of its intended use to enable it to be inspected and tested.

   Bedding shall be placed in more than one lift as shown on Standard Plan No.SS-750. The first lift to provide at least 4-inch thickness under any portion of the pipe (6 inches in the case of solid rock excavation) to be placed before the pipe is installed. This bedding layer shall extend the full width of the trench bottom to the specified thickness after being consolidated by the use of a "flat tamper." This lift shall be spread smoothly and bell holes dug where necessary to ensure uniform support along the full length of the pipe barrel.

   Subsequent lifts of not more than 6 inches shall be placed up to the spring line of the pipe. These lifts shall be consolidated first by the use of tamping bars, taking care to work the material under the pipe haunches so that no voids are left, then a flat tamping bar shall be used to compact the bedding material along the side of the pipe to the trench walls to provide lateral support for the pipe. These lifts shall be individually compacted to 90% density, as determined by ASTM D698, Method "D."

   Further lifts of moderately-compacted bedding material shall be placed, not more than 6 inches thickness to a minimum of 8 inches, above the crown of the pipe (a minimum of 12 inches above the crown of pipe where rock is encountered in trench excavation).

10. Bank-Run Gravel for Trench Backfill: Wherever a trench is excavated in the existing or newly-paved roadway, sidewalk or other areas where minor settlement would be detrimental, the entire trench shall be backfilled with Bank-Run Gravel, Class "B," and compacted to a 95% density as defined by ASTM D-1556. Selected native materials may be used for trench backfill in other areas if approved by the City Engineer.

11. Joints and Infiltration: The method of making joints and materials used shall be included in the specifications. Leakage tests shall be according to Standard Specification SE-7-17.3(4)F for non-air-permeable materials and SE-7-17.3(4)D for air-permeable materials.

The use of television camera or other visual methods for inspection prior to placing the sewer in service is required.

5-2.03.02 Pressure Systems

Implemented: 11/16/2001 Revised: 01/01/1990

Pressure sewer systems are considered developmental technology. All pressure systems will be designed by a professional engineer and will be judged on a case-by-case basis.

5-2.03.03 Manholes

Implemented: 11/16/2001 Revised: 10/03/2003

Manholes shall conform to City of Bellingham Standard Plan No. SS-700.

Manholes shall be installed at the end of each line of 8-inch diameter or greater unless the 8-inch line is expected to be extended in the foreseeable future in which case, a cleanout shall be installed at the end of the line; at all changes in grade, size, or alignment; at all intersections; and at distances not greater than 400 feet for sewers 15 inches or less and 500 feet for sewers 18 inches to 30 inches. Cleanouts may be used in lieu of manholes at the end of lines 8 inches in diameter and not more than 150 feet long if they are accessible to the City's maintenance equipment. Cleanouts shall conform to City of Bellingham Standard Plan No. SS-720.

Drop manholes shall conform in all respects to City of Bellingham Standard Plan SS-700 except for the additional drop detail shown on Standard Plan B-18. An outside drop connection should be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert should be filleted to prevent solids deposition.

The minimum diameter of manholes should be 48 inches, although larger diameters are preferable. The minimum clear opening in the manhole frame should be 23 inches.

Manholes connecting significant industries to the system should be larger, to provide space for monitoring and sampling equipment.

Flow channels in manholes shall be of such shape and slope to provide a smooth transition between inlet and outlet sewers and to minimize turbulence. Channeling height shall be to the crowns of the sewers. Benches shall be sloped from the manhole wall toward the channel to prevent accumulation of solids.

Watertight manhole covers shall be used wherever the manhole tops may be flooded. Manholes of brick or segmented block should be waterproofed on the exterior with plaster coatings, supplemented by a bituminous waterproof coating where groundwater conditions are unfavorable.

Direct-line connections to the manholes or to short stubs integral with the manholes should be made with flexible joints. Flexible joints are those which permit the manholes to settle without destroying the watertight integrity of the line connections.

Ventilation of gravity sewer systems should be considered where continuous watertight sections greater than 1,000 feet in length are incurred.

Frames and covers shall conform to current City of Bellingham Standard Plan No. SS-700. Frames and covers of aluminum material will be allowed if approved by the City Engineer.

All covers shall be the locking type as per SS-704.

Materials used for manhole steps should be highly corrosion resistant. The use of galvanized steel should be avoided.

5-2.04 SPECIAL DETAILS

Implemented: 10/04/2001 Revised: 01/01/1997

5-2.04.01 Protection of Water Supplies

Implemented: 11/16/2001 Revised: 01/01/1997

There shall be no physical connection between a public or private potable water supply system and a sewer, or appurtenance thereto, which would permit the passage of any sewage or polluted water into the potable supply.

No sewer shall be constructed within 100 feet of a potable water supply well or other potable water source or structure without approval of the City and the Department of Social and Health Services (DSHS).

Relation to water mains shall be as follows:

1. Horizontal Separation: Whenever possible, sewers should be laid at least 10 feet, horizontally, from any existing or proposed water main. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to a water main if the sewer is constructed of cast-iron or ductile-iron pipe with watertight joints, and:
   A. It is laid in a separate trench; or
   B. It is laid in the same trench with the water mains located at one side on a bench or undisturbed earth.

   In either case, the elevation of the crown of the sewer is at least 18 inches below the invert of the water main and in no case will the sewer be separated horizontally from the water main less than 4 feet.
2. Vertical Separation: Whenever sewers must cross under water mains, the sewer shall be laid at such an elevation that the top of the sewer is at least 18 inches below the bottom of the water main. When the elevation of the sewer cannot be buried to meet the above requirements, the water main shall be relocated to provide this separation or the sewer constructed with slip-on or mechanical-joint cast-iron pipe, or pre-stressed-concrete cylinder pipe for a distance of 10 feet on each side of the water main. One full pipe length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.

5-2.04.02 Easements

Implemented: 11/16/2001 Revised: 01/01/1997

Easements required for construction of sewer lines or water lines shall be properly dedicated to the City of Bellingham and recorded prior to plan approval. Easements crossing land to be subdivided in conjunction with the main construction can be dedicated on the face of the plat and recorded after the main is accepted by the City.

5-2.04.03 Access Roads

Implemented: 11/16/2001 Revised: 09/08/2008

Access roads to manholes on easements shall be 10-feet wide, 6-inch thick bank-run gravel and 2-inch C.S.T.C. with 15% maximum grade. Access roads from 10% to 15% shall be paved with 2-1/2" of Asphalt Concrete, Class "B". (See Section 2-6 for easement description.)

5-2.04.04 Stream Crossings

Implemented: 11/16/2001 Revised: 01/01/1997

Sewers entering or crossing streams shall be constructed of watertight pipe. The pipe and joints shall be tested in place, shall exhibit "0" infiltration, and shall be designed, constructed, and protected against anticipated hydraulic and physical, longitudinal, vertical, and horizontal loads, erosion, and impact. Sewers laid on piers across ravines or streams shall be allowed only when it can be demonstrated that no other practical alternative exists. Such sewers on piers shall be constructed in accordance with the requirements for sewers entering or crossing under streams. Construction methods and materials of construction shall be such that sewers will remain watertight and free from change in alignment or grade.

Permits from other agencies or departments are required for work in or adjacent to waterways.

Inverted siphons shall have not less than two barrels with a minimum pipe size of 6 inches, and shall be provided with necessary appurtenances for convenient flushing and maintenance. The manholes shall be designed to facilitate cleaning, and, in general, sufficient head shall be provided and pipe size selected to secure velocities of at least 3.0 feet per second for average flows. A rock catcher and coarse screen should be provided to prevent plugging of the siphons. The inlet and outlet details shall be arranged so that normal flow can be diverted to one barrel and so that either barrel may be removed from service for cleaning or other maintenance.

5-2.04.05 Side Sewer Installation

Implemented: 11/16/2001 Revised: 04/08/2009

Four-inch or 6-inch side sewer installations and as-builts shall conform to City of Bellingham Standard Plans No. SS-730 and SS-740. For new sewer main construction, 4- or 6-inch tees shall be placed on sewer mains as shown on plans or as the City Engineer designates.

Section 6. Water Distribution System

6-1 Introduction

three sets implies paper, what size is required? are full size or half size acceptable? if 24x36 is acceptable per section 7 and half size is acceptable for delivery, are non-scale sizes (11x17) accepted, or 12x18 required?

Implemented: 10/04/2001

The City of Bellingham requires water distribution system construction plan submittal for development projects when improvements are proposed within public right-of-way or in easements.

The following chapter has been developed to assist in preparation of water distribution system construction plans. It includes items pertinent for the City's review and reflects established professional civil engineering practice for preparation of construction plans.

Three sets of plans must be submitted to the Department of Public Works for initial review.

6-2 Water Distribution System Design Requiremen

suggest a reference to 331-068 in the intro, as these standards are meant to be specifics built on the WA state standards

Implemented: 10/04/2001 Revised: 01/01/1990

When adding to or extending the City's water distribution system, the policies outlined in this section will apply. These are minimum standards, however, and larger mains or other additions may be required where deemed necessary by the Director of Public Works.

is there a minimum depth? clearances from other wet, dry utilities?

6-2.01 Minimum Size Water Main

Implemented: 10/04/2001 Revised: 01/01/1990

6-2.01.01 Residential Zones

Implemented: 11/16/2001 Revised: 01/01/1990

The minimum size water main shall be 6 inches in diameter with an average gridded spacing not to exceed 600 feet. An 8-inch diameter main shall be used where an average grid of 600 feet is not possible, however, the maximum ungridded length may not exceed 1,500 feet. Four-inch diameter pipes may be allowed by the Department when future extension is not anticipated, such as in a cul-de-sac, provided the main does not serve a fire hydrant.

It looks like there may be so blocks which exceed 1/4 mi How are those handled?

6-2.01.02 Commercial, Industrial, and Institutional Zones

Implemented: 11/16/2001 Revised: 01/01/1990

The minimum size water main shall be 8 inches in diameter with an average gridded spacing not to exceed 600 feet. A 10-inch diameter water main shall be used when the system is not gridded. The maximum ungridded length and size of the water main may be determined by site conditions and requirements for fire flow.

6-2.01.03 Supply Water Mains

Implemented: 11/16/2001 Revised: 01/01/1990

Where required, the minimum size supply main shall be 12 inches in diameter and shall be spaced on approximately 3,000 foot centers. The actual size of the supply main shall be determined by its ability to deliver water based on the peak-daily demand, plus designated fire flow.

6-2.02 Valve Spacing

Implemented: 10/04/2001 Revised: 03/15/2010

Valves shall be placed on each main at a junction point (node) and should be spaced along the water main at intervals not to exceed 500 feet for pipe sizes 10 inches in diameter and above, and not to exceed 800 feet for pipe sizes less than 10 inches in diameter. Gate valves shall be used on all diameter pipes.

6-2.03 Fire Hydrant Spacing

Implemented: 10/04/2001 Revised: 03/01/1993

Fire hydrants shall be spaced as follows:

1. One- and two-family unit developments: no greater than 500-foot intervals along public streets or approved fire routes.
2. All other developments: not greater than 300-foot intervals along public streets or approved fire access routes

6-2.04 Fire Flow Rates

Implemented: 10/04/2001 Revised: 03/01/1993

All water main construction and reconstruction shall be done pursuant to a design that, when fully implemented, will provide the fire flow requirements of the Bellingham Fire Department's fire protection standards.

In any circumstance, when improvements which increase the fire flo system must be upgraded to support the changes.

suggest adjusting language to be more similar to 2-6 (centered is important, and should be included here as well):
A minimum 20-foot wide maintenance easement centered over the utility...

6-2.05 Fire Mains And Hydrants Located On Private Pro

Implemented: 10/04/2001 Revised: 09/04/2002

All fire hydrants and water mains serving hydrants ~~ill~~ will be publicly owned and maintained. A minimum 20-foot maintenance easement shall be granted to the City and recorded for any public water main on private property. Construction must meet City standards. (See Section 2-6 for easement description.)

Water mains on private property serving building sprinkler systems will be privately owned and maintained as long as the main serves only one property and no hydrants are required. In this ~~cae~~ case, the following requirements apply:

1. An approved backflow device must be installed.
2. No domestic or other water service allowed on fire main.
3. Disinfection procedures per AWWA Section C-6-51 following Fire Department pressure test.
4. No maintenance easement is necessary.

fire main hasn't been defined in this section
perhaps "building sprinkler service line"?

why necessary here. Is it permitted but not required? suggest "required"

6-3 Construction of Water Main Extension

Implemented: 10/04/2001 Revised: 01/27/2006

The petitioner shall contract with a contractor licensed to perform the construction in the State of Washington to install a main extension as approved by the Department of Public Works.

are there any ongoing testing/ maintenance requirements that the property owner(s) must comply with?

The Department of Public Works shall inspect the installation of the water main to ensure compliance with the specifications. The charges for such inspection, including administrative and overhead charges, shall be withdrawn from the construction inspection fee deposited with the Finance Director. At such time as the Director of Public Works determines the remaining funds are not adequate to provide necessary inspection for the project, the petitioner shall be notified and an estimate of additional inspection fees required will be provided. The additional fees shall be deposited with the Finance Director prior to the depletion of the funds on deposit. The City reserves the right to reject any installation not inspected and approved by the Department of Public Works. Any monies unexpended from the inspection fee upon completion of the project shall be returned to the petitioner.

Upon satisfactory completion of all required tests and acceptance of the main extension, the Department of Public Works shall cause the extension to be connected to the City system. All costs incurred in the connection, including overhead and administrative charges, shall be paid by the petitioner. Any adjustment of the actual cost of installation because of a variance between the estimate and the actual costs shall be refunded upon completion of the job to the petitioner or by payment by the petitioner to the City of any additional expense above the estimate.

When a main extension is to serve a new single-family residential area, individual services shall be installed by the developer to supply each proposed building site. These services shall be installed to City standards. All fees and charges for installation of the services shall be paid at the time a plumbing permit is obtained.

All extensions of water mains shall be subject to the payment of a hydrant fee. Whenever the installation of a hydrant is required by the Director of Public Works during the course of a water main extension, the established value thereof may be applied to reduce any hydrant fees due for that extension.

RECORD DRAWING POLICY

The following is intended to provide necessary guidelines for development of re drawings:

1. Certified record drawings are to be provided by the owner and shall accura revisions made during the construction process. Record drawings shall be number of sheets as the original approved drawings.
2. The owner shall retain a licensed professional engineer to track all relevant approved construction drawings. Changes shall be clearly identified in a co one set of City-approved Xerox black-line.
3. At the time the record drawings are transmitted to the City, each sheet shall include a signature block similar to that shown below located in the bottom right-hand corner of the sheet when possible:

Recording Drawing Certification
This drawing reflects the work as constructed and all modifications meet the performance standards of the original design.
By:_____ Date:_____

4. The record drawings shall identify all existing ~~or abandoned~~ utilities that were encountered or installed during construction that were not shown on the approved construction drawings.
5. All sanitary sewer, storm sewer, and water service stub locations shall be stationed and marked in accordance with City Standard specifications, SS-790 and WA-897. Stationing for sanitary sewer and water mains shall be independent from the roadway centerline.

suggest defining how the city would find this method clearest. are we talking red-line on a black-line original?

black-line, with old text crossed out? or is this defined elsewhere in general city standards and needs a reference?

encountered, installed, or abandoned

Probably a larger discussion, but curious on the benefits of independence from roadway centerline. Typically those establish a static grid, so that as the water system evolves over time, there's a reference for the main and ancillaries (alternatively Northing, Easting).

is this fuzzy to provide the city flexibility? what defines substantial?

6. Substantial changes made to storm drainage shall be reflected in a modified storm drainage report and shall be certified by the professional engineer that the modifications made during construction meet the performance standards of the original design.
7. The final project approval shall not be processed until the City has received and approved the certified record drawings. The City Engineer may accept a deposit of 150% of the cost of preparation of record drawings in lieu of performance. A deposit will require a commitment from the owner to (A) complete the record drawings within 90 days; (B) hold the City harmless from any damages caused by the delay in performance; and (C) require the engineer of record to provide free and timely information to the City and Public.
8. All underground facilities shall be shown on the record drawings to the nearest 1-foot horizontal and the nearest 0.1-foot vertical unless otherwise noted by the engineer. Water services shall be shown to the nearest 5-foot horizontal and the nearest 1-foot vertical. Side sewers shall be shown to the nearest 2-foot horizontal and the nearest 0.1-foot ver

Consider providing an intro to this letter, since it is partially re-covering items above and partially new information.

RECORD DRAWINGS (SEWER AND WATER)

The purpose of this letter is to inform you that the City of engineer to supply us with a full set of certified record dra Contract. These as-built drawings will reflect the exact lo utilities and will include, but not be limited to, the followin

Maybe also tab it over so that it's separated from the remainder of the document.

1. The location of all vertical and horizontal bends in the
2. The location of all water service taps into the water n
3. The location of all water service boxes and meters w corresponding property corners.
4. The locations of all water valves, hydrants, hydrant v centerline and distances to the nearest property lines or property corners.
5. The location of all utilities within easements. This will include distances to the utilities from the easement lines.
6. The location of all side sewer tees into the sewer main from the back-station manhole.
7. The location of all side sewer ends according to the attached drawings and with the additional stipulations:
   A. The ends must be tied out to the corresponding property corners.
   B. The depth of the end at the location board must be noted.
8. The location of all sanitary manholes, storm sewer manholes, storm sewer catch basins and back-of-walk drains. These locations must include distances from the centerline monuments, easement lines, or property corners.
9. All easements will be staked in advance of utility installations to ensure that the utilities fall within the proper boundaries. Construction offset staking will not fulfill this requirement.

Also consider that examples for how the city prefers this information shown should be shown on WA-897 (or other appropriate detail(s)) and references to those details should be made as well.

6-3.01 Energizing Main Extensions

Implemented: 10/04/2001 Revised: 03/01/1993

the purposes of tests performed by duly authorized personnel

No main extensions shall be energized other than for ~~test purposes by duly authorized personnel~~ until the main extension has been accepted by the City and all fees and charges have been paid. If energizing a main is necessary to restore service to existing customers, fire hydrants will not be activated until acceptance of the main extension.

6-3.02 Payment For Water Mains

Implemented: 10/04/2001 Revised: 01/01/1990

Water mains placed in public rights-of-way or easements and connected to City mains may be paid for by:

1. The party benefiting from the installation;
2. The City;
3. A local improvement district, as provided by law; or
4. Latecomer Agreements. The City may, in accordance with state law, grant the party constructing a new water main the right to partial reimbursement from other abutting property owners benefited by the improvement. Such reimbursement shall be administered by the City and shall be subject to reasonable overhead and administrative charges by the City.

refer to law or city code implementation here

6-3.03 Standards For Water Main Construction

Implemented: 10/04/2001 Revised: 01/01/1990

6-3.03.01 Pipe For Water Main

Implemented: 11/16/2001 Revised: 03/11/2014

is field lok accepted?

All pipe shall be AWWA Standards H3-71, C151-71 and cement lining C104-71, and shall be ductile cast-iron, Thickness Class 50 push-on joints or M.J. joints. The pipe shall be of 150 psi working pressure, plus 100 psi surge pressure. No PVC or AC pipe will be allowed.

Pipe laying shall meet the requirements of Section 7-09 of the Standard Specifications. All pipe shall have minimum covering of 3.5 feet. Pipe shall be installed with bedding and back fill as specified in City of Bellingham Standard Plan No. WA-820.

consistency: one word in plan 820

6-3.03.02 Fittings

Implemented: 11/16/2001 Revised: 03/15/2010

Material for fittings such as crosses, tees, bends, reducers and sleeves shall be ductile iron. Joints shall be M.J. or push-on joints and shall conform to AWWA Specification C-110-71 and C-104-71. All fittings shall have full bolting holes and no knock outs. Fittings shall be Tyler, Clow or equivalent.

WA-860, WA-862, WA-865

6-3.03.03 Concrete Thrust Blocking

Implemented: 11/16/2001 Revised: 03/15/2010

City needs new detail to cover vertical blocking

Concrete blocking shall be as specified in City of Bellingham Standard Plan No. WA-860, or as directed by the Project Engineer. Blocks shall be installed as specified in Section 7-09 of the Standard Specifications. All concrete shall remain a minimum of 6 inches away from all bolts. All concrete thrust blocks shall be formed using forms approved by City Project Engineer. No precast blocks shall be allowed.

The way this reads, it implies to me a preference for "belt and suspenders" (ie: if RMJ is used, blocking is still required). Is that the city's intent?

6-3.03.04 Connection to Existing Water Mains

Implemented: 11/16/2001 Revised: 01/01/1990

The Contractor must notify the Project Engineer of a proposed connection time at least four working days in advance.

6-3.03.05 Hydrostatic Testing and Disinfection of Water Main

Implemented: 11/16/2001 Revised: 03/15/2010

This section shall replace Sections 7-09 of the Standard Specifications.

references further down make this seem like this is intended to supplement, rather than replace. suggest: "Section 7-09 of the Standard Specifications are [modified/supplemented] with the following:" yellow highlights are areas that seem to supplement

All pressure testing and leakage testing shall be conducted in accordance with Section 13 AWWA C-600-99 Standards, with the following exceptions.

All reference to the owner furnishing any equipment used in the testing procedure is hereby deleted. The necessary apparatus, including temporary plugs, required for testing shall be supplied by the Contractor and subject to the Engineer's approval.

The testing shall be conducted after the piping has been completely backfilled and all thrust blocks are in place and cured. The test sections shall be limited to sections between valves or as modified by the Engineer; but in any event no test section shall contain more than 3,500 linear feet of pipe. Several valved sections may be combined but these sections, when combined, shall not be greater than any length specified above. The temporary connection will be to City of Bellingham Standard Plan No. WA-858 with the approved backflow devices. Device shall be tested prior to activation as per WAC246-290-490.7.(b).(IV)

250? design is to 150 psi working + 100 psi surge

The pressure test and leakage test shall be combined as follows. The test pressure shall be 200 psi, measured at the highest elevation of the section being tested. This pressure plus 5 psi shall be maintained for a period of one hour and the amount of makeup water required to maintain this pressu shall be carefully measured. The allowable leakage shall not exceed the number of gallons per hour as determined by the formula:

$$L = \frac{ND\sqrt{P}}{7,400}$$

in which L = Allowable leakage, gallons/hour
N = Number of joints in the length of pipeline tested
D = Nominal diameter of the pipe in inches
P = Average test pressure during the leakage test, psi

If the section of pipe being tested does not meet the above requirements, the Contractor shall, at his own expense, locate and repair the defects and retest the section as provided above.

All disinfection and bacteriological tests shall be conducted by the City's testing lab in accordance with AWWA Section C651.

Chlorine powder or a solution of chlorine shall be continuously introduced into the pipe at the water source by means of an adjustable feeder. The initial dose shall indicate a minimum of 50 ppm and shall be measured at nearest blow-off or hydrant and the furthest location or locations from point of application. An approved backflow device per Standard Plan WA-858 shall be installed by the Contractor on the City side of the chlorine-injection device to prevent the backflow of highly-chlorinated water into the existing service system. Before placing the lines into service a satisfactory report shall be received from the City of Bellingham on samples collected from representative points in the new system. Samples will be collected and bacteriological tests obtained by the Engineer or his/her representative. The pipe will not be placed into service until a zero atypical and coliform bacteria count is obtained for two consecutive tests 24 hours apart.

All other provisions of Section 7-09 of the Standard Specifications not in conflict with the above shall remain in effect.

The lump sum bid for hydrostatic testing and disinfection of water main shall be full compensation for furnishing the necessary chlorine feeder and chlorine, making the necessary main taps and all labor and other additional materials that may be required to chlorinate the main as indicated above. No additional and/or extra compensation will be allowed in performing the hydrostatic tests and for disinfection of water mains.

missing info on disposal/dechlor

this seems to be describing installations, not transfers

lacking information for larger mains/sprinkering

6-3.03.06 Water Service Transfers

Implemented: 11/16/2001 Revised: 11/10/2014

the only detail provided covers 1" water service, more detailing needed

Tap installations shall meet the requirements of City of Bellingham Standard Plan No.WA-824 and WA-826.

add space

1. WATER SERVICE INSTALLATION - Standard 1" to 2" Water Services:
   A. Both direct tap or tapping with tapping clamp and saddle must use C-C-Threaded corporations. If the dry-tap method is used, a hole the same diameter as the service tap shall be used. Caution, care and prudence is necessary in aligning the clamp and saddle to assure full- flow capability. Single-strap saddles are not aceptable. Double-strap wide band stainless steel saddles equivalent to Romac Saddle #201S shall be used.
   B. Corporation taps shall make as nearly as possible a 45 angle off the vertical center line of the main. No tap is to be made on the top of a water main.
   C. Type "K" copper shall be used on water services within the public right-of-way.
   D. Curb stops shall be flare by female type and located no closer than three (3) feet or farther than five (5) feet from the property line. Any other location requires specific written approval of the Project Engineer. Stop-and-waste curb stops are not allowed. Curb stops shall be Ford brass or equal, flare by female type. Teflon ball type curb stops are not allowed. WA-824.
   E. Cast-iron curb boxes shall be required on all services unless the City requires a meter, then see meter box requirements.
   F. All underground fittings shall be Ford Brass or equal and flared within the public right-of- way. No sweat or compression connections are to be used. The use of Teflon tape as a sealant is acceptable, the use of pipe dope is not acceptable.
   G. The water service pipe shall have a minimum of 22" depth and a maximum of 24" depth, including under ditch sections. To facilitate water meter installations, there shall be 24" cover to finished grade at the curb stop location. All meters will be purchased from the City and will be installed by the City Water Division.
   H. No service is to be covered until the City Project Inspector has inspected the initial installation. Note that all corporations must be in an ON position and all curb stops must be in the OFF position.
   I. Service testing shall be done in conjunction with water main testing. Any air relief and flushing shall be the responsibility of the developer. City crews will operate existing valves to aid the developer.

city crews are operating only main valves in this description, right?

   J. An acceptance inspection will be made by the City upon completion of all project work. During the inspection, every service shall be turned on to its full capacity to check flow and guarantee that each service line has been flushed. In no case shall the acceptance inspection be made until all project work is complete. Damage incurred during other construction work on the project shall be corrected by the developer or his agent prior to acceptance by the City.
   K. The bond release inspection shall be made prior to the end of the 1-year maintenance bond period. Any problems noted at this time shall be corrected by the developer and/or bonding company prior to releasing the bond.
   L. Staking of lots and/or property lines to assure correct water service locations is the responsibility of the developer. Locations are to be as shown on the approved drawings. Errors due to failure to provide a property survey or due to changing lot locations during final plat approval shall be corrected by the developer at the time of such change or when the error is detected by the City. If mains have been accepted the City will correct and the costs shall be the responsibility of the developer.
   M. Tools, materials and work area shall be maintained in a sanitary condition at all times. All excavations shall be backfilled at the end of the day.
2. WATER METER BOX INSTALLATION - Requirement for Type "K" Copper Standard Sized 1" Water Services will be installed by the City:

at whose expense?

A. A minimum of 22", a maximum of 24" cover from finished grade to the service pipe shall be maintained, except where a variance is approved by the City Engineer. There shall be 24" cover from finish grade in the meter installation area. Note that the top of the box shall be flush with the finished grade and that this includes the expansion material when required.
B. The curb stop shall be located within the meter box.
   i. Minimum clearance of 1" from inside surface.
   ii. Maximum clearance of 2" from inside surface shall be maintained fr
hall be a minimum of 3' or a maximum of 5' from the propert
way or as approved by the City, except when this places the
e the stop will be located in the planting strip. Stops shall be located outside of back
of walk drain.

detail looks replaced, clarify requirement, is this called "standard meter box"?

detail labeled "standard" is HDPE/Polymer composite, clarify what you mean here

C. Concrete meter box shall be standard or better. See attached standard plan. P.V.C. boxes are not to be used.

are metal boxes permitted?

D. Location of meter boxes.
   i. If a meter box for a 1" service is to be located within the street or sidewalk area, a #3 skagit meter traffic-type box must be used with a heavy-duty 1/4" deck plate lid or better.
   ii. An expansion material must be used around the lid section to enable removal for maintenance. The material shall be flush with the lid section to avoid any cracks or protrusions.
   iii. For 1 + 1/2" and 2" services a #2 concrete box with a steel lid must be used.

are these al
to be traffic

is traffic rate
which traffic
H-20?) defir
elsewhere i
document?

E. Caution must be exercised when setting the bottom section of a meter box to assure that the copper has clearance in the notch area. The weight of the meter box must not be on the service pipe.

3. PROJECT REQUIREMENTS
A. The City of Bellingham shall make the final connection of all water mains to the existing system.
B. A deposit to cover the cost of connection by the City shall be made to the City Finance Director. The Operations Division shall supply the necessary estimate upon request by the developer or his agent.
C. All costs, fees, or deposits relative to the total project must be paid prior to water system acceptance. Proof of payment shall be by copies of receipts from the Finance Director specifying for what payment was received.
D. Final cost accounting must be supplied for the entire project including separate costs for:
   i. Water main and appurtenances;
   ii. Fire hydrant assembly - including the tee at the main;
   iii. Water services, including curb box and/or meter box when required;
   iv. Sewer main trunks;
   v. Side sewer connection; and/or
   vi. Street construction.
E. The final project shall not be accepted until all requirements are met.
F. The Operations Division shall determine that the project has been accepted by the City prior to connection of the water main to the City system.

6-3.03.07 Gate Valves 2" and Above

Implemented: 11/16/2001 Revised: 03/15/2010

and shock shut-off valve of 250 psi?

Gate valves shall be installed with cast-iron valve boxes. Short-body valves suitable for a nonshock shut-off pressure of 130 psi. Valves shall conform to the latest revision of AWWA Standards C-515 covering resilient seated wedge gate valves equivalent to MH, CLOW and Kennedy valves and suitable for direct burial as specified. Gate valves shall have bronze center stem with bronze stem nut. All valves shall be furnished with MJ kits manufactured by Tyler, Romac or equivalent.

All valves shall have nonrising stems and shall open counterclockwise and shall be equipped with a 2-inch square operating nut. Valves will be flange or M.J. joints.

All valves shall be AWWA approved.

6-3.03.08 Gate Valves 12" and Above

Implemented: 11/16/2001 Revised: 03/30/2010

This Section has been deleted — no valving in supply main?

6-3.03.09 Hydrant Installation

Implemented: 10/04/2001 Revised: 03/15/2010

Hydrants shall be supplied and installed according to City of Bellingham Standard Plan No. WA-802 and as of January 1, 1990, shall include a Storz-type fire hose adapter fitting. Hydrants shall be M&H 929, Clow Madalion, Waterous Pacer or equivalent.

CITY OF BELLINGHAM HYDRANT SPECIFICATIONS

1. Fire hydrants shall be for common Bellingham water works service and shall be in compliance with the latest edition of AWWA C 502 "Standard for Dry-Barrel Fire Hydrants."
2. Each hydrant shall be 5-1/4" main valve opening with "O" ring seals and traffic-type breakaway design.
3. Hydrant operating nut shall open counter-clockwise with the direction of "open" clearly marked at top of hydrant. Operating and cap nuts shall be pentagon in shape and the dimension shall be 1- 1/4" point to flat (National Standard).
4. Hydrant shall be 6" inlet mechanical joint (with accessories) or as specified. Hydrant shall have two hose and one pumper nozzle made of brass. Nozzles shall be screw type, threaded counter clockwise into hydrant barrel and sealed to a 200 psi working pressure. Hydrants to be acceptable for a 3-1/2' depth of bury. Hydrant to have rust-proof automatic drain. — 200 or 250?
5. Hydrant to be capable of rotating through 360 degrees.
6. Thread Specifications: Hose nozzles to be 2-1/2" inside diameter with National Standard Threads. Pumper nozzle to be 4" inside diameter with Pacific Coast Threads as follows: 60 degree - 6 threads per inch, pitch diameter - 4.7018", outside diameter - 4.798".
7. Each hydrant pumper port shall be equipped with a non-locking Snap-Tite Storz #FSAF/MF, 5" fitting and blind cap (Stortz or equal). The blind cap shall be attached to the fitting with a section of aircraft cable.
8. Hydrant to be painted red with white dome and caps. Paint shall be Rustoleum #2766 for white and #1210 for red or equal.
9. Only hydrants of the "Corey Type" or center-stem hydrants with APWA approved rating of 200 psi working pressure will be accepted. — 200 or 250?
10. Acceptance of any hydrant, other than a type currently in service on the City system, will be allowed only if all necessary special repair tools and a training session for maintenance and repair is provided at no cost to the City. Any hydrant that deviates from the specifications must be approved by the operations engineer and/or the water superintendent.

What about Pressure Reducing Valve/Vault assemblies and backflow prevention (vault) assemblies?

What requirements for PRVs and BPVs, how are they maintained, are PRVs dual feed (domestic and fire)?

Any corrosion details that need to be added/covered?

Show a detail of utility crossing, including low-cover requirements (Cased/CDF/Ethafoam or eq)

Are there locations where individual service booster pumps/bladders are required? what are the requirements for those?

Section 7. Plan Preparation

7-1 General Requirements

Implemented: 10/05/2001 Revised: 01/01/1990

1. All work shall be in accordance with the current Standard Specifications for Road, Bridge, and Municipal Construction.
2. Plans must be drawn on mylar plan sheets or plan and profile sheets 24 inches vertical by 36 inches horizontal.
3. Each sheet must have a title block located in the lower right-hand corner of the working area of the sheet placed adjacent to the marginal lines.
4. The project title, as renamed by the City's project engineer, shall appear in the title block along with the City's project number.
5. The elevation datum shall be "City" on all construction plans.
6. All storm sewer pipe shall have a minimum of 2 feet of cover.
7. All storm sewer pipe slopes shall be 2% or greater unless otherwise show
8. All trench backfill below the street, sidewalk, or driveways shall be bank-run gravel.

why is water not covered here?

7-2 Plan and Profile Sheets - Profile Layout

Implemented: 10/05/2001 Revised: 01/01/1990

1. The profile grid must be at the bottom of the sheet.
2. Scales must be as follows:
   A. The horizontal scale must be 1 inch = 20 feet or larger.
   B. Where there is 10 feet or less of vertical differential in the street design profile on any sheet, the vertical scale must be 1 inch = 2 feet.
   C. Where there is more than 20 feet of vertical differential in the street design profile on any sheet, the vertical scale must be 1 inch = 5 feet.
3. Stationing must advance from left to right on the sheet, regardless of compass direction, or where north points in reference to the sheet top.
4. Stations in the profile must line up vertically with the same stations in the plan as closely as practical.
5. Show profiles of the existing ground lines along the center line of construction.
6. Provide profile of the design crown line of the new street.
7. Provide grades at 25-foot intervals and at vertical P.I.'s and at angle points.
8. The lengths of vertical curves and the gradients of each tangent should be clearly labeled.
9. A profile of each storm drain, catch basin, manhole, or culvert must be shown in its entirety.
10. Sanitary sewer profiles may be shown.
11. Water main profiles may be shown.

suggest: "shall be shown if present", profiles are a great spot to identify conflicts, even if there are no water mains being installed

7-3 Plan and Profile Sheets - Plan L

Implemented: 10/05/2001 Revised: 01/01/1990

The following data must be included in the plan section of the plan and profile sheets:

1. North arrow.
2. Centerline of construction as the major line in the plans.
3. Tics for each even 100-foot station along the centerline of construction with the adjacent stations enumerated.
4. Stationing must:

   A. Increase in magnitude from left to right on the sheet, regardless of where north points in relation to the top of the sheet.
   B. Increase from west to east and from south to north, except where stationing has previously been established contrary to this rule.
5. Name or names of all streets shown on sheet.
6. Right-of-way and improvement widths.
7. Curb return data (radius and elevations at quarter points).
8. Centerline horizontal curve data.
9. Show lot lines and numbers.
10. Show improvements to be constructed with solid lines.
11. Show future improvements with dotted lines.
12. Show existing improvements with dashed lines.
13. Show locations of all existing underground and surface installations in relation to the centerline of construction stationing and its offsets.
14. Show storm drain installations, including all structures and types.
15. Show the street section to be constructed and the location.
16. Show streetlight, conduit, junction boxes, and location of streetlight service.
17. Show all street signs and pavement markings normally required by MUTCD.

Section 8. Illumination Plan Requirements And Design Criteria

8-1 When Streetlighting is Required

Implemented: 10/05/2001 Revised: 06/01/2001

1. On all principle and secondary arterial streets.
2. In a Central Business District (CBD) or in a commercial zone with high traffic volumes greater than 3,000 VPD.
3. On a residential street being constructed with a plat.

8-2 Streetlighting Design Requirements

Implemented: 10/05/2001 Revised: 06/01/2001

1. Lighting plans shall be submitted to the City Engineer by a person qualified to do illumination design.
2. Illumination specifications to be used are shown in City of Bellingham Standard Plans EL-400, EL-404, EL-408, EL-444, EL-432 and WSDOT Standard Plan J-11a, unless otherwise approved by the City Engineer.
3. Table 8-3 lists acceptable pole spacing for various roadway classifications, lamp sizes and pavement widths. Also shown in Table 8-3 is the required design criteria for any illumination system.
4. All new illumination systems shall be multi-light circuits with a new controller service panel cabinet per EL-444.
5. All lighting plans shall include, but not limited to, the following:
   A. Location of each light standard and the junction box "feeding" each luminaire.
   B. Location of all conduit connecting the J-11a junction boxes.
   C. Conduit installed to the extents of the project limits and terminating in a Type I J-box.
   D. Location of the service cabinet and the Puget Power transformer being used as a power source.
   E. Plan notations showing the conduit and wire size for each conduit run.
      i. Two-inch conduit shall be used for all runs.
      ii. Wire size shall be #6. Ground wire shall be #8.
   F. A wiring schedule shall be shown if more than one circuit is being designed. The maximum number of lights on one circuit shall be fourteen.
6. Construction shall be in accordance with Standard Specifications for Road and Bridge Construction as prepared by the WSDOT and the APWA.

TABLE 8-3 ILLUMINATION DESIGN CRITERIA

Roadway Classification	Average Footcandle	Lamp Size	Pavement Width*	Pole Spacing
Secondary	1.0	150 W	28	133
Arterial			34	122
			40	111
		200 W	28	187
			34	171
			40	156
Primary	1.4	200 W	40	108
Arterial			48	93
		250 W	40	131
			48	115
			>48	**
Central Business District	2.0		All	**

*Horizontal distance between luminaire and far curb (spacing should be adjusted for luminaire overhang)

**Special two-side design necessary (staggered design is not acceptable without approval of the City Engineer)

Design parameters used above:
Mounting Height = 30 feet
Lamp Type = High-Pressure Sodium
= Flat-Lens Cobrahead
= Type II, Medium, Cutoff Maintenance
Factor = 0.70 Maximum Uniformity Ratio = 4:1 One-Sided Layout
Overhang = 0 feet

8-3 Collector and Residential Streets

Implemented: 10/05/2001 Revised: 06/01/2001

The City has no requirement for a minimum lighting level on collector and residential streets. Streetlights on new residential streets being constructed with a plat shall be shown on the lighting plan at intersections, in cul-de-sacs, and at specified locations requiring added safety.

Section 9. Drainage

9-1 Culvert Installation Guidelines and Specifications

Implemented: 03/03/2006 Revised: 06/12/2014

GENERAL GUIDELINES

Roadside ditches are an integral part of the design of minimum-standard streets. In the absence of a full-standard street with its engineered drainage pipe system, it is considered in the best interest of the public to keep these ditches in an open state to the maximum extent possible. These ditches can provide a valuable benefit to the public by improving water quality and lowering peak run-off rates.

The primary purpose of culvert installations is to provide driveway access to developed property and, as such, they are to be limited to the amount necessary for this purpose (generally 30 feet). While installation of culvert pipe in excess of that necessary for a driveway is not prohibited, it is allowed at Departmental discretion.

Culvert installations in excess of the minimum needed for property access shall be judged by the following criteria:

1. The effect of the enclosure on fish passage, water quality and quantity concerns.
   For instance, ditches that are steep and subject to erosive velocities are higher candidates for enclosure than ditches that have the ability to act effectively as a water-quality swale.
2. Abnormal safety considerations.
   Ditches that present traffic risks will be given higher consideration for enclosure.
3. Street drainage and protection of adjacent properties.
   The ability of the system to adequately drain the pavement and its subgrade while protecting adjacent property from run-off should not be compromised.
4. Compatibility with the development of the street to full standard.
   Installation of culverts is not a substitute for a property designed and installed full-standard street drainage system. Whenever possible, culvert installations should not interfere with future street construction.
5. Aesthetics.
   Aesthetic considerations for an enclosure will be taken into account when not in conflict with other criteria.

SPECIFICATIONS

1. Material
   A. Concrete tongue and groove or bell and spigot, Class C-14-3.
   B. PVC plastic or double wall corrugated polyethylene (ADS N-12), with engineer's approval.
   C. Precast concrete box or bottomless culvert
   D. No metal
2. Size
   A. Within 300' of crest of hill - 8" minimum or larger as required by engineer.
   B. Over 300' of crest of hill - 12" minimum or larger as required by the engineer.
3. Inlet Structures
   A. To ensure access for maintenance purposes and to maintain adequate storm water management, inlets shall be provided as follows:
      i. Every 200' of continuous tile or as determined by engineer’s analysis.
      ii. At all intersections.

iii. At junctions of dissimilar materials (PVC, concrete, metal) Alternate joining methods must be submitted to and approved by the City Engineer or a designee. An asbuilt of the pipe change shall be provided.
iv. At junctions of dissimilar pipe sizes.
v. At changes in horizontal or vertical alignment.
vi. As required by the engineer.

B. Inlet Design
i. WSDOT Type 1 or 2 as specified by the City Engineer.
ii. Equivalent alternative structure as approved by the City Engineer.

4. Installation
A. Bedding
i. Remove sod.
ii. Bedding material and installation shall be per City of Bellingham or the pipe manufacturer's specifications.

B. Alignment
i. Straight horizontal.
ii. Vertical - on grade with flow line of existing ditch or upstream and downstream tile where properly installed.
iii. Install and align as not to create ponding at either end.
iv. Where substantial ditch realignment is necessary to properly accommodate a new installation, said realignment in front of applicant's property shall be accomplished by the applicant at the time of the tile installation. All other realignment will be scheduled to be accomplished by City forces.

C. Length
i. Minimum of 18 feet for driveway. Maximum of 30 feet without specific approval by Public Works (see General Guidelines).
ii. Any ditch gap of 10 inches or less to be tiled.
iii. Culvert installations in excess of 100 feet in length (when allowed) may require submission of a plan and profile.

D. Backfill
i. Minimum of 12 inches of granular material over the pipe meeting the City of Bellingham's and WSDOT materials and compaction standards.
ii. Areas around exposed pipe ends to be covered with riprap mortared in place. The ditch end slope at the pipe ends shall not exceed 2 horizontal to 1 vertical unless a cemented headwall is provided.
iii. It is desirable to obtain 2 feet of pipe coverage with backfill. Any culvert subject to vehicular traffic shall have a minimum of 12 inches of cover.
iv. Backfill shall be placed so that a minimum of 2% slope will be maintained away from the edge of pavement.

E. Permits and Inspection
i. Public Works permit required prior to installation.
ii. Call for inspection prior to backfilling and when installation is complete (360 778-7900).
iii. Installation of culverts shall be by a licensed contractor bonded with the City of Bellingham for performing work within the right-of-way. At departmental discretion, small installations may be performed by the proponent with a Guarantee Deposit with the City's Finance Department.

Silt Fence Installation

- Maximum sheet or overland flow path length to the fence of 100 feet.
- No flows greater than 0.5 cfs.

- The geotextile used shall meet the following standards. All geotextile properties listed below are minimum average roll values (i.e., the test result for any sampled roll in a lot shall meet or exceed the values shown in Table 4.10):

	Geotextile Standards
Polymeric Mesh AOS (ASTM D4751)	0.60 mm maximum for slit film wovens (#30 sieve). 0.30 mm maximum for all other geotextile types (#50) sieve). 0.15 mm minimum for all fabric types (#100 sieve).
Water Permittivity (ASTM D4491)	0.02 sec minimum
Grab Tensile Strength (ASTM D4632)	180 lbs. minimum for extra strength fabric. 100 lbs. minimum for standard strength fabric.
Grab Tensile Strength (ASTM D4632)	30% maximum
Ultraviolet Resistance (ASTM D4355)	70% minimum

- Standard strength fabrics shall be supported by wire mesh, chicken wire, 2-inch x2-inch wire, safety fence, or jute mesh to increase the strength of the fabric. Silt fence materials are available that have synthetic mesh backing attached.
- Filter fabric material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature of 0°F. to 120°F.

Maintenance Standards	Any damage shall be repaired immediately. If concentrated flows are evident uphill of the fence, they must be intercepted and conveyed to a sediment pond.

- It is important to check the uphill side of the fence for signs of the fence clogging and acting as a barrier to flow and then causing channelization of flows parallel to the fence. If this occurs, replace the fence or remove the trapped sediment.
- Sediment deposits shall either be removed when the deposit reaches approximately one-third the height of the silt fence. Or a second silt fence shall be installed.

Standard Notes for construction plans and specifications

The contractor shall install and maintain temporary silt fences at the locations shown in the Plans. The silt fences shall be constructed in the areas of clearing, grading, or drainage prior to starting those-activities. A silt fence shall not be considered temporary if the silt fence must function beyond the life of the contract. The silt fence shall prevent soil carried by runoff water from going beneath, through, or over the top of the silt fence, but shall allow the water to pass through the fence.

The minimum height of the top of silt fence shall be 2 feet and the maximum height shall be 2% feet above the original ground surface.

The geotextile shall be sewn together at the point of manufacture, or at an approved location as determined by the Engineer, to form geotextile lengths as required. All sewn seams shall be located at a support post. Alternatively, two sections of silt fence can be overlapped, provided the Contractor can demonstrate, to the satisfaction of the Engineer, that the overlap is long enough and that the adjacent fence sections are close enough together to prevent silt laden water from escaping through the fence at the overlap.

The geotextile shall be attached on the up-slope side of the posts and support system with staples, wire, or in accordance with the manufacturer's recommendations. The geotextile shall be attached to the posts in a manner that reduces the potential for geotextile tearing at the staples, wire, or other connection device. Silt fence back-up support for the geotextile in the form of a wire or plastic mesh is dependent on the properties of the geotextile selected for use. If wire or plastic back-up mesh is used, the mesh shall be fastened securely to the up-slope of the posts with the geotextile being up-slope of the mesh back-up support.

The geotextile at the bottom of the fence shall be buried in a trench to a minimum depth of 4 inches below the ground surface. The trench shall he backfilled and the soil tamped in place over the buried portion of the geotextile, such that no flow can pass beneath the fence and scouring cannot occur. When wire or polymeric back-up support mesh is used, the wire or polymeric mesh shall extend into the trench a minimum of 3 inches.

The fence posts shall be placed or driven a minimum of 18 inches. A minimum depth of 12 inches is allowed if topsoil or other soft subgrade soil is not present and a minimum depth of 18 inches cannot be reached. Fence post depths shall he increased by 6 inches if the fence is located on slopes of 3:l or steeper and the slope is perpendicular to the fence. If required post depths cannot he obtained, the posts shall be adequately secured by bracing or guying to prevent overturning of the fence due to sediment loading.

Silt fences shall be located on contour as much as possible, except at the ends of the fence, where the fence shall be turned uphill such that the silt fence captures the runoff water and prevents water from flowing around the end of the fence.

If the fence must cross contours, with the exception of the ends of the fence, gravel check dams placed perpendicular to the back of the fence shall be used to minimize concentrated flow and erosion along the back of the fence. The gravel check dams shall be approximately 1-foot deep at the back of the fence. It shall be continued perpendicular to the fence at the same elevation until the top of the check dam intercepts the ground surface behind the fence. The gravel check dams shall consist of crushed surfacing base course, gravel backfill for walls, or shoulder ballast. The gravel check dams shall be located every 10 feet along the fence where the fence must cross contours. The slope of the fence line where contours must be crossed shall not he steeper than 3:1.

9-2 Floodplain Development

Implemented: 10/05/2001 Revised: 01/01/1990

City of Bellingham Ordinances 9136 and 9740 establish the floodplain management standards upon which this section is based. Floodplains and designated floodways are as indicated on the Federal Emergency Management Agency (FEMA) generated flood boundary maps which are available for inspection in the Engineering Division office.

The following definitions apply:

"Base Flood" means the flood having a one percent chance of being equaled or exceeded in any given year.

"Floodway" means the channel of a river or other water course and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.

"Floodway Fringe" means the area in the floodplain excluding the floodway.

Land alteration within a designated floodway is prohibited unless certified by a registered professional engineer that encroachments shall not result in any increase in flood levels during the occurrence of the base flood discharge. To assure the City's continued participation in the National Flood Insurance Program, the express written approval of the certified plans by FEMA is required for issuance of permits.

Construction and substantial improvement within the floodway fringe shall meet the requirements of the floodplain ordinances. A floodplain supplement to the building permit is required in which a registered engineer or architect certifies that the ordinance provisions have been met. The provisions are as follows.

9-2.01 General Standards

Implemented: 10/05/2001 Revised: 01/01/1990

In all areas of special flood hazards the following standards are required

9-2.01.01 Anchoring

Implemented: 11/16/2001 Revised: 01/01/1990

All new construction and substantial improvement shall be anchored to prevent flotation, collapse, or lateral movement of the structure.

All occupied manufactured homes shall be anchored to resist flotation, collapse, or lateral movement by providing over-the-top and frame ties to ground anchors. Specific requirements shall be that:

Over-the-top ties be provided at each of the four corners of the manufactured home, with two additional ties per side at intermediate locations, with manufactured homes less than 50 feet long requiring one additional tie per side;

Frame ties be provided at each corner of the home with five additional ties per side at intermediate points, with manufactured homes less than 50 feet long requiring four additional ties per side;

All components of the anchoring system be capable of carrying a force of 4,800 pounds; and,

Any additions to the manufactured home be similarly anchored.

An alternative method of anchoring may utilize a system designed to withstand a wind force of 90 miles per hour or greater. Certification must be provided to the Public Works Director that this standard has been met.

9-2.01.02 Construction Materials and Methods

Implemented: 11/16/2001 Revised: 01/01/1990

All new construction and substantial improvements shall be completed with materials and utility equipment resistant to flood damage.

All new construction and substantial improvements shall be completed using methods and practices that minimize flood damage.

Electrical, heating, ventilation, plumbing and air conditioning equipment and other service facilities shall be designed and/or otherwise elevated or located so as to prevent water from entering or accumulating within the components during conditions of flooding.

9-2.01.03 Utilities

Implemented: 11/16/2001 Revised: 01/01/1990

All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharge from the systems into flood waters. On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

9-2.01.04 Subdivision Proposals

Implemented: 11/16/2001 Revised: 01/01/1990

All subdivision proposals shall be consistent with the need to minimize flood damage, and shall have public utilities and facilities such as sewer, gas, electrical and water systems located and constructed to minimize flood damage. All subdivision proposals shall have adequate drainage provided to reduce exposure to flood damage, and base flood elevation data shall be provided for subdivision proposals and other proposed development which contain at least 50 lots or 5 acres (whichever is less).

9-2.01.05 Encroachments

Implemented: 11/16/2001 Revised: 01/01/1990

Any proposed development shall be analyzed to determine effects on the flood-carrying capacity of the area of special flood hazard.

9-2.02 Specific Standards

Implemented: 10/05/2001 Revised: 01/01/1990

In all areas of special flood hazard where base flood elevation data has been provided, the following standards are required.

9-2.02.01 Residential Construction

Implemented: 11/16/2001 Revised: 01/01/1990

New construction and substantial improvement of any residential structure shall have the lowest habitable floor, including basement, elevated to at least one foot above the base flood elevation. The long axis of the foundation must be aligned with the flood flow.

Fully-enclosed areas below the lowest floor that are subject to flooding are prohibited, or shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or must meet or exceed the following minimum criteria:

A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided.

The bottom of all openings shall be no higher than one foot above grade.

Openings may be equipped with screens, louvers, or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.

9-2.02.02 Nonresidential Construction

Implemented: 11/16/2001 Revised: 01/01/1990

New construction and substantial improvement of any commercial, industrial or other nonresidential structure shall either have the lowest habitable floor, including basement, elevated to at least one foot above the base flood elevation, or, together with attendant utility and sanitary facilities, shall:

Have the long axis of the foundation aligned with the flood flow;

Be floodproofed so that below the base flood level, the structure is watertight with walls substantially impermeable to the passage of water;

Have structural components capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy; and

Be certified by a registered professional engineer or architect that the standards of this subsection are satisfied.

Additionally, nonresidential structures that are elevated, not floodproofed, must meet the same standards for space below the lowest floor as for residential structures.

9-2.02.03 Manufactured Homes

Implemented: 11/16/2001 Revised: 01/01/1995

Manufactured homes shall be anchored in accordance with the previous Section 9-2.01.1.

For new manufactured homes in appropriately-approved residential-multi planned areas and manufactured home subdivisions, for expansions to existing manufactured home subdivisions, for existing residential-multi planned areas which include manufactured homes not placed in a manufactured home subdivision, it is required that:

Stands or lots are elevated on compacted fill or on pilings so that the lowest floor of the manufactured home will be at least one foot above the base flood level;

Adequate surface drainage and access for a hauler are provided; and,

In the instance of elevation on pilings, that lots are large enough to permit steps, piling foundations are placed in stable soil no more than ten feet apart, and reinforcement is provided for pilings more than 6 feet above the ground level.

No manufactured home shall be placed in a floodway, except in an existing manufactured home park or existing manufactured home subdivision.

Section 10. Local Improvement District Process

10-1 Introduction

Implemented: 10/05/2001 Revised: 01/01/1990

The Local Improvement District (LID) is a method by which property owners within a defined geographical area can make an improvement benefiting their property. Improvements financed by the LID can include street and sidewalk construction, water mains, sanitary sewer and storm drains. Assessments are usually determined by the size and location of each property in relation to the improvement and the benefit to the property.

10-2 Procedure

Implemented: 10/05/2001 Revised: 01/01/1990

The LID may be initiated by City Council resolution or by petition of the majority of property owners along the frontage of the improvement within the proposed boundaries of the district.

City Engineering Staff will assist the property owners interested in creating an LID in preparing the petition and will be available to answer questions or meet with neighborhood groups.

10-3 Steps

Implemented: 10/05/2001 Revised: 01/01/1990

The following steps will outline the procedure that will be followed after the petition has been accepted or the resolution has been passed.

1. The City Council will call for a public hearing and instruct the City Engineer to:
   A. Estimate the cost of the improvement.
   B. Prepare a drawing defining the boundaries of the LID.
   C. Determine the preliminary assessment (to be a viable project, the sum of the preliminary assessments cannot exceed the true value of the property to be assessed, plus one quarter of the value of the improvements located on that property).
2. The City Council will:
   A. Determine the assessment formula (rate per square foot, rate per front foot, zone and termini, etc.) which considers the benefit to each property.
   B. Direct Staff to mail to each affected property owner a notice of the date for public hearing and the amount of preliminary assessment, and advertise the notice in two consecutive issues of the newspaper at least fifteen days before the hearing.
3. The project is explained by Staff at the public hearing and testimony is heard by the Council. If a majority of the Council votes to accept the LID ordinance, Staff is directed to publish the ordinance.
4. Once published, a 30-day protest period begins (an improvement judged necessary for public health and safety may not be challenged but requires the unanimous vote of all Councilmembers present). Property owners that comprise sixty percent or more of the total preliminary assessments may stop the LID by filing a written protest with the City Clerk within the thirty day period.
5. The LID project surviving the protest period is:
   A. Designed by the City's Engineering Division.
   B. Advertised for competitive bidding. The construction contract is awarded to the lowest responsible bidder after Engineering Staff review. If final costs are projected to exceed the preliminary estimate by more than ten percent, the project is reconsidered.

C. Finalized by compiling all costs associated with the project and preparing a final assessment roll. Costs will include administration, design, construction, appraisal services, right-of-way and interest on warrants issued by the City to provide payment for work in progress until bonds are sold.

6. The notice of the hearing on the final assessment is:
   A. Mailed to all property owners within the LID district at least 15 days before the hearing. Advertised five times in a daily newspaper or twice in a weekly publication at least 15 days before the hearing.
7. The City Council holds the assessment roll hearing. Modifications to the assessment roll may only be made at this time, unless a mistake or omission is discovered later. Once passed and published, appeals may only be directed to the Superior Court within ten days of the LID ordinance publication.
8. The City Clerk publishes notice of the assessment in the official newspaper once a week for two weeks and mails collection notices to all property owners. Interest-free payment may be made within 30 days of published notice (the prepayment period). Payment installments are due one year from the expiration date of the 30-day prepayment period.
9. Minimum time needed to complete a project utilizing the LID process is approximately 10 months from the time the petition is accepted and the resolution is adopted.

Section 11. Traffic Studies

11-1 Responsibilities for Traffic Studies

Implemented: 10/05/2001 Revised: 01/01/1990

Traffic studies may be required by the City in order to adequately assess the impacts of a development proposal on the existing and/or planned street system. This would typically be provided in the traffic circulation section of an EIS. The primary responsibility for assessing the traffic impacts associated with a proposed development will rest with the developer, with the City serving in a review capacity and, upon approval, accepting the assessments made as its own.

Unless waived by the City, a written study meeting the City criteria will be required for a development proposal when trip generation during any peak hour is expected to exceed 50 vehicles or the criteria provided in Appendix 1.

Developments within 10% of these criteria may, at the discretion of the Public Works Department, be required to provide a traffic study. If they are more than 10% below the criteria, a traffic study should not be required unless there are special extenuating circumstances such as safety concerns over access, neighborhood opposition to the project or existing levels of service on area roads are at "D", "E", or "F." Levels of service are defined in Subsection 11-2.06.

An applicant must submit a traffic study as part of any environmental review process, as part of any application as listed below, or obtain a determination from the City that a traffic study will not be required. Such a study may be required prior to deeming a project complete for processing.

This study will be the responsibility of the applicant and must be prepared by a registered professional traffic or civil engineer with adequate experience in transportation engineering.

Upon submittal of a draft traffic study, the Public Works Department and the Planning and Economic Development Department will review the study data sources, methods, and findings.

Comments will be provided in a written form to the Planning and Economic Development Department. The developer and the private engineer will then have an opportunity to incorporate necessary revisions prior to submitting a final report.

Due to the time lines involved in processing an application, a report may be required prior to deeming a project submitted as complete. Generally, draft reports should be completed for review and comment within 40 calendar days after notice to proceed.

Final reports should be completed and submitted within 14 days after Staff comments on the draft are returned to the consultant.

The findings of all approved traffic studies will be summarized and forwarded to the Planning and Economic Development Department by the Public Works Department.

The following applications will require traffic studies prepared in the format required by the Public Works Department as part of the submittal materials for a development project submitted to be deemed complete unless waived by the City:

1. Any application for which the proposed development exceeds the criteria for requiring traffic studies provided in Appendix 1.
2. Additional access off a state highway or a city road to an existing project which exceeds the criteria in Appendix 1.

3. A change of use affecting access from a state highway or a city road for a project exceeding the criteria in Appendix 1.
4. Any application, which is located in an area where existing levels of service on area roads, are "D", "E" or "F."

The applicant will be required to submit a new traffic study if, after submitting an original traffic study for any of the above applications, the land use intensity is increased or the land use is changed so that trip generation is increased and existing levels of service on area roads are at "D", "E", or "F."

All previous traffic studies relating to the development that are more than 2 years old will have to be updated unless the Planning and Economic Development Department and Public Works Department determines that conditions have not changed significantly.

Where access points are not defined at the time the traffic study is prepared, additional traffic work may be required when the access points are defined.

Transportation consultants are required to discuss projects with the Engineering Division of the Public Works Department and the Division of Environmental Review of the Planning and Economic Development Department prior to starting the study.

As a minimum, topics for possible discussion will include trip generation, directional distribution of traffic, trip assignment, definition of the study area, intersections requiring critical lane analysis, and methods of projecting build-out volume of cumulative projects. This will provide a firm base of cooperation and communication between the City, the owner or developer, and the project's consultants in forecasting future traffic characteristics, which realistically define traffic movement associated with the proposed development.

Specific requirements will vary depending on the site location.

No traffic study will be accepted unless the traffic study requirements form provided in Appendix 4 is filled out by the consultant and approved by the Public Works Department, prior to the consultant preparing the traffic study.

All completed traffic studies that have been reviewed and approved by the Public Works Department will become the joint property of the project and the City of Bellingham.

11-2 Traffic Study Format

Implemented: 10/05/2001 Revised: 06/01/1996

In order to provide consistency and to facilitate Staff review of traffic studies, the following format must be followed in the preparation of such studies by transportation consultants.

A summary outline is provided in Appendix 2.

11-2.01 Introduction

Implemented: 10/05/2001 Revised: 06/01/1996

The introduction portion of the report must contain the following:

1. Land Use, Site and Study Area Boundaries

   A brief description of the size of the land parcel, general terrain features, the location within the jurisdiction, and the region must be included in this section. In addition, the roadways that afford access to the site and are included in the study area must be identified.

The exact limits of the study area should be based on engineering judgment, and an understanding of existing traffic conditions surrounding the site. In all instances, however, the study area limits must be mutually agreed upon by the developer, their engineer, the Planning and Economic Development Department, the Public Works Department, and justified in the report. These limits will usually result from initial discussions with the City. A vicinity map that shows the site and the study area boundaries, in relation to the surrounding transportation system, must be included.

2. Existing and Proposed Site Uses

   The existing and proposed uses of the site must be identified in terms of the various zoning categories of the City. In addition, the specific use for which the request is being made must be identified, if known, since a number of uses may be permitted under the existing ordinances. This information should include the square footage of the various uses or the number and size of the units proposed.

   It will be the intent of the traffic study to evaluate the worst-case traffic impacts for the proposed development allowed by the zoning. If several different uses are permitted by the zoning, the land use with the greatest overall traffic impact must be assumed for the study.

3. Existing and Proposed Uses in Vicinity of Site

   A complete description of all unbuilt but approved projects, projects in process, and projects with pre-applications within the study area, and their approved future uses must be provided.

   If approved uses are not available, a City-approved estimate of the probable future uses based on zoning designations should be provided. This latter item is especially important where large tracts of undeveloped land are in the vicinity of the site and within the prescribed study area.

   A list of unbuilt but approved projects, projects in process and projects with pre-applications submitted must be obtained from the Planning and Economic Development Department. One hundred percent occupancy must be assumed for all developments in the cumulative analysis.

4. Existing and Proposed Roadways and Intersections

   Within the study area, the applicant must describe and provide volumes for existing roadways and intersections including geometric and traffic signal control as well as improvements that have been funded by government agencies and other development projects. An official list of funded projects must be obtained from the City. This would include the nature of the improvement project, its extent, implementation schedule, and the agency or funding source responsible. A map must be provided showing the location of such facilities.

11-2.02 Project Trip Generation and Design -Hour Volumes

Implemented: 10/05/2001 Revised: 01/01/1990

A summary table listing each type of land use, the size involved, the average trip-generation rates used (total daily traffic and AM/PM peak hours of the street), and the resultant total trips generated must be provided for the project site and all unbuilt but approved projects, projects in process, and projects with pre-applications within the study area.

A current list of projects to be included in the cumulative analysis must be obtained from the Division of Environmental Review, Planning and Economic Development Department.

Trip generation must be calculated for the maximum uses allowed under the existing and proposed zoning based on the latest data contained within the latest edition of the Institute of Transportation Engineer's (ITE) Trip Generation Manual or more appropriate local data as approved by the Public Works Department.

In the event that data is not available for the proposed land use, the Public Works Department must approve estimated rates prior to acceptance of the draft traffic study report.

The calculation of design-hour volumes used to determine study area impacts must be based on:

1. Peak-hour trip generation rates as published in the ITE Trip Generation Summary.
2. Recent traffic volume counts for an acceptable number of similar existing uses if no published rates are available. Counts of this nature must be acceptable to the Public Works Department.
3. Additional sources from other jurisdictions, or W.S.D.O.T. if acceptable to the Public Works Department. A list of trip generation publications has been included in the bibliography.
4. For mixed-use developments, ITE rates must be used to estimate average daily traffic. The PM peak hour of the street may be estimated by using 9% of total daily traffic.

Use of the percentage rates (as shown in Table 11-2 in Subsection 11-2.13) to account for passerby traffic may be considered upon approval of the Public Works Department.

Internal trip reductions and modal-split assumptions will require analytical support to demonstrate how the figures were derived and will require approval by the Public Works Department.

See Technical Requirements in Subsection 11-2.13.

11-2.03 Trip Distribution

Implemented: 10/05/2001 Revised: 01/01/1990

The estimates of percentage distribution of trips from the proposed development to destinations, both within and outside the City, must be clearly stated in the report using the north, south, east, and west compass points.

Market studies, planning data, driveway counts at adjacent uses or other information concerning origin of trip attractions to the proposed development may be used to support these assumptions where available.

A map showing the percentage of site traffic on each street based on average-daily volumes must be provided as part of the traffic study graphic material. Where microcomputer modeling is used, such a map need not be provided, but the model's distribution methodology must be discussed.

11-2.04 Trip Assignment

Implemented: 10/05/2001 Revised: 01/01/1990

The direction of approach of site-generated traffic via the area's street system will be presented in this section. The technical analysis steps, basic methods, and assumptions used in this work must be clearly stated and agreed to by the Public Works Department.

The assumed trip distribution and assignment must represent the most logically traveled route for drivers accessing the proposed development. These routes can be determined by observation of travel patterns to existing land uses in the study area.

11-2.05 Existing and Projected Traffic Volumes

Implemented: 10/05/2001 Revised: 01/01/1990

Graphics must be provided which show the following traffic impacts for private access points, intersections and streets specified in the traffic study requirements form.

1. PM peak-hour site traffic (in and out) including turning movements.
2. PM peak-hour traffic total including site-generated traffic (in and out). These volumes must include through- and turning-movement volumes for current conditions and a separate set of numbers that also include all projects to be included in the cumulative analysis.
3. Any other peak hour which is determined by the City to be critical to site traffic and the road system in the study area should be included in the graphics and show the same information as is provided for the AM/PM peak hours (i.e., recreational and seasonal traffic).
4. Actual counts of existing total daily traffic for the road system in the study area at the time the study is being prepared.
5. Projected total daily traffic for the road in the study area based on traffic from the proposed development and counts of existing daily traffic obtained in Item 6. The component of the existing daily traffic attributable to the existing uses must be identified and the increases in total daily traffic from the proposed uses.
6. Projected total daily traffic for the street system in the study area based on traffic from the proposed development, counts of existing daily traffic obtained in Item 4 above, and traffic projections based on all projects to be included in the cumulative analysis. The projects to be included in the cumulative analysis must be those specified by the Planning and Economic Development Department.

A list of current projects to be included in the cumulative analysis must be obtained from the Division of Environmental Review.

Peak hours referred to in this section are for the street and not the generator or project.

Where necessary, volume projections for background traffic growth will be provided by the Public Works Department, or alternatively, a method for determining the volume will be recommended.

All total daily traffic counts must be actual machine count and not based on factored peak-hour sampling. Latest available machine counts from WSDOT, the Public Works Department, or other agencies may be acceptable if not more than one year old.

11-2.06 Capacity Analysis

Implemented: 10/05/2001 Revised: 01/01/1990

A capacity analysis will be conducted for all public road intersections impacted by the proposed development and for all private property access points to street adjacent to the proposed development as specified in the traffic study requirements form and within the limits of the previously defined study area.

The PM, and any other peak period specified by the Public Works Department, will be tested to determine which peak hours need to be analyzed.

Capacity calculations should also include an analysis for cumulative impacts.

At 4-way stop sign intersections, estimates of the delay per vehicle and queue lengths on critical approaches must be provided.

At 2-way stop intersections, the unsignalized intersection analysis contained in the Highway Capacity Manual must be used.

11-2.07 Level of Service

Implemented: 10/05/2001 Revised: 01/01/1990

Level of service "C" will be the peak-hour design objective for all movements, and under no circumstances will less than level of service "D" be accepted for site- and non-site traffic including existing traffic at build out of the study area.

The traffic study must recommend feasible mitigation measures to bring the intersection level of service within acceptable standards.

The following interpretations of "level of service" have been provided:

Level of Service A	A condition of free flow with low traffic density, where no vehicle waits longer than one signal cycle.
Level of Service B	A stable flow of traffic where occasionally drivers wait through more than one signal cycle.
Level of Service C	Still in the zone of stable flow, but intermittently drivers must wait through more than one signal cycle and back-ups may develop behind left-turning vehicles.
Level of Service D	Approaching instability, drivers are restricted in their freedom to change lanes and delays for approaching vehicles may be substantial during peak hours.
Level of Service E	Traffic volumes are near or at the capacity of the arterial, and long queues of vehicles may create lengthy delays especially for left-turning vehicles.
Level of Service F	Congested condition of forced traffic flow, where queued backups from locations downstream restrict or prevent movement of vehicles out of the approach, creating a storage area during part or all of the peak hour.

For existing conditions, levels of service should be calculated either by the operational analysis method from the new Highway Capacity Manual or the TRB Circular 212 Method. Where available, existing levels of service will be certified and supplied by the City.

For future conditions, levels of service should be calculated by the TRB Circular 212 Method or by any other method satisfactorily documented by the consultant and approved by the City.

Maximum sums of critical lane volumes for determining levels of service using the Critical Lane Planning Analysis Technique are provided in Appendix 3.

All levels of service must be provided with corresponding volume to capacity ratios.

11-2.08 Traffic Signals

Implemented: 10/05/2001 Revised: 01/01/1990

The need for new traffic signals will be based on warrants contained in the Manual on Uniform Traffic Control Devices.

In determining the location of a new signal, traffic progression is of paramount importance.

Pedestrian movements must be considered in the evaluation, and adequate pedestrian clearance provided in the signal cycle-split assumptions.

To provide flexibility for existing conditions and ensure optimum 2-way signal progression, an approved traffic engineering analysis must be made to properly locate all proposed access that may require signalization.

The section of roadway to be analyzed for signal progression will be determined by the Public Works Department and will include all existing and possible future signalized intersections.

The progression pattern calculations must use a cycle consistent with current signal timing policies of the City. A desirable bandwidth of 50% of the signal cycle must be used where existing conditions allow.

Where intersections have no signals presently, but are expected to have signals, typically a 60% main line, 40% cross-street cycle-split should be assumed.

Cycle-split assumptions must relate to volume assumptions in the capacity analysis of individual intersections; and where computerized progression analysis techniques are used, they must be of the type that utilize turning movement volume data and pedestrian clearance times in the development of time/space diagrams.

The green time allocated to the cross street will be considered no less than the time which is required for a pedestrian to clear the main street using the Manual on Uniform Traffic Control Devices standards.

Those intersections, which would reduce the optimum bandwidth if a traffic signal were installed, may be required to remain unsignalized and have turning movements limited by access design or median islands.

11-2.09 Traffic Accidents

Implemented: 10/05/2001 Revised: 01/01/1990

Traffic accident data for affected street corridors may be required for the study. The study period will normally be three years. Such locations will be specified by the Public Works Department and data provided by the City.

Where account data is required, estimates of increased or decreased accident potential must be evaluated for the development, particularly if the proposed development might impact existing traffic safety problems in the study area. Safety improvements shall be recommended where necessary.

11-2.10 Recommendations

Implemented: 10/05/2001 Revised: 01/01/1990

In the event that analysis indicates unsatisfactory levels of service ("D" or below) on study area roadways, a description of proposed improvements to return intersections to level of service "C" must be included.

Proposals could include projects by the City or State for which funds have been appropriated and obligated.

The assumptions regarding all future roads and lanes in an analysis will require approval from the City. In general, the recommendation section should include:

1. Proposed Recommended Improvement

   This section must describe the location, nature, and extent of proposed improvements to ensure sufficient roadway capacity.

A sketch of each improvement should be provided showing the length, width, and other pertinent geometric features of the proposed improvements. (Sketches are only necessary for major improvements that would result in significant changes in circulation patterns.)

2. Volume/Capacity Analysis at Critical Point

   A table must be provided clearly showing levels of service at critical intersections for the following scenarios:
   A. Existing conditions.
   B. Existing plus project traffic.
   C. Existing plus project traffic with mitigation.
   D. Existing plus project plus cumulative traffic.

   A list can be obtained from the City of funded and unfunded projects. New mitigation measures not on this list will be considered unfunded unless a funding source is identified in the text of the study. No levels of service can be shown that included unfunded projects as part of the mitigation measures.

   Tables should show mitigation with funded projects. Footnotes could be included, or narrative discussion that discuss unfunded recommendations.

3. Traffic Volume Proportions

4. Percentages based on the traffic impact analysis may be required to determine the proportion of traffic using various public improvements (both existing and proposed) from several developments within the study area. This apportionment will not apply to traffic impact fees but to the construction of improvements adjacent to the project, which may be shared by other new developments.

5. Significant Adverse Impacts

6. A project has significant adverse traffic impacts when:
   A. The addition of project traffic to an intersection increases the volume to capacity (V/C) ratio by the values provided in Table 11-1. At level of service "D", "E" or "F," the addition of 5 or more additional peak-hour trips will be considered significant.

TABLE 11-1: SIGNIFICANT CHANES IN LEVELS OF SERVICE

Level of Service (including project)	Increase in V/C Greater Thank
A	0.20
B	0.15
C	0.10
D	5 trips
E or F	5 trips

   B. The project's access to a major road or arterial road would require an access that would create an unsafe situation or a new traffic signal or major revisions to an existing traffic signal.
   C. The project adds traffic to a roadway that has design features (e.g., narrow width, roadside ditches, sharp curves, poor sight distance, inadequate pavement structure) that will become potential safety problems with the addition of project traffic.
   If the above thresholds are exceeded, construction of improvements or other methods to reduce the level of significance to insignificance by the Developer are required.

11-2.11 Revisions to Traffic Study

Implemented: 10/08/2001 Revised: 01/01/1990

Revisions to the traffic study must be provided as required by the City. The City will determine whether revisions are necessary.

The need for revisions will be based on the completeness of the traffic study, the thoroughness of the impact evaluation, and the compatibility of the study with the proposed access and development plan.

11-2.12 Executive Summary

Implemented: 10/08/2001 Revised: 01/01/1990

The executive summary of the report must be a clear, concise description of the study findings. It is anticipated that the report's final chapter will serve as an executive summary.

It must include a general description of all data, project scope and purpose, findings, conclusions, and mitigation measures and recommendations.

Technical publications and calculations, documentation, data reporting and detail design must not be included in this section.

The executive summary should be short, complete in itself, and not dependent on supplementary data included by reference.

11-2.13 Technical Requirements of Final Report

Implemented: 10/08/2001 Revised: 01/01/1990

The final report must also meet the following requirements:

1. Transportation System Management (TSM) concepts must be fully explored and discussed. An updated generalized statement offered as a solution to a specific problem is not acceptable. The solutions offered must be backed by data to confirm practicability of successful implementation.
2. All computerized analysis output sheets and supporting raw-count data, both ADT, turning movement, and intersection-delay data should be submitted with draft reports for review.
   All assumptions used in the calculations must be referenced to the appropriate table, chart or page in approved publication (e.g. V/C ratios, operating speeds, etc). Calculations must be comprehensive and clear.
3. All maps and graphics involving improvements must be drawn to scale with roadway geometrics appropriately dimensioned (e.g. road width, lane widths, etc). Intersection geometrics must include bus stops, parking areas, pedestrian crossings, driveway restrictions, etc.
4. For employee-intensive uses, such as office buildings, trip rates may be reduced to account for the effects of ride sharing. The text of the report must fully justify the use of any ride sharing percentage adjustments.
5. Normally, ride-sharing reductions will not be applied to such uses as hotels, restaurants, retail, financial, or medical related uses.
6. Daily-trip rates may be reduced for those land uses potentially served by transit. The effects of van pooling would not be considered as a portion of "ride sharing." The use of any transit percentage adjustments must be justified in the text of the report. The current maximum allowable transit use assumption is 5%.
7. Normally, transit reductions would only apply to employee-intensive uses and residential uses. Uses not expected to have transit reductions would include hotels, restaurants, retail and financial uses.

8. After the daily-trip adjustment factors have been applied to produce daily trips, the peak-hour trips are to be calculated. Where fully justified, peak hour percentages may be adjusted by up to 25% to account for flex time, staggered work hours and other measures that result in the use of non-traditional peak-hour periods.
9. Peak hours are 7:30 AM to 8:30 AM and 4:30 PM to 5:30 PM. The use of any flex time, staggered work hours, etc., must be justified in the text of the report. Enforcement of such measures must be guaranteed over the long term and be fully documented in the report.
10. The use of peak-hour adjustment factors does not eliminate any traffic. It merely assumes less peaking in a single hour and a spreading of peaking tendencies.
11. Peak-hour adjustment factors are typically only applied to employee-intensive projects, which are candidates for improvements through TSM measures.
12. Where build-out intersection configurations are different from those currently existing, they must be based on approved and guaranteed construction projects as certified by the City.
13. Passerby factors are to be used to reduce the estimated additional total-daily traffic to street(s) serving a proposed development. They are not to be applied directly to reduce trip generation and turning-movement volumes at driveways serving the proposed development.

TABLE 11-2 PASSERBY FACTORS	
Land Use	Passerby Component
Banks	14.0%
Regional Shopping Center	9.0%
Supermarkets	28.0%
Hardware Stores	8.0%
Auxiliary Commercial Uses	16.0%
Neighborhood Convenience Centers	40.0%
Drive-In Restaurants	50.0%
Service Stations	50.0%

Section 12. Access And Site Access Design

12-1 Introduction

Implemented: 10/08/2001 Revised: 01/15/1990

This section pertains to the access of private properties from the arterial street system of the City as contained in Ordinance 8760. This is considered a summary of the ordinance and if a conflict arises, the ordinance shall take precedence.

12-2 Definitions

Implemented: 10/08/2001 Revised: 01/15/1990

"Arterial Street" means every public highway, or portion thereof, or a major street designated as such by ordinance, in accordance with the law of the State of Washington.

"Minor Street" means any city street not designated by competent authority as an arterial street, a state highway, a parkway, an expressway, or a freeway.

"Driveway" means a vehicle access between abutting property and a city right-of-way or a city street.

"Residential Driveway" means one providing access to a single-family residence, to a duplex, or to an apartment building containing not more than 4 dwellings.

"Commercial Driveway" means one providing access to an office, retail or institutional building, or to an apartment building having 5 or more dwelling units.

"Industrial Driveway" means one directly serving substantial numbers of truck movements to and from loading docks of an industrial facility, warehouse, truck terminal, or community or regional mall loading area.

"Curb Return-Type Driveway" means one which is essentially a "T" intersection with constant curb cross section from curb-return to curb-return as found at the intersection of two streets.

"Depressed-Type Driveway" means one in which the curb is depressed along the curb line per City of Bellingham standard plans ST-9 and CG-260.

"Driveway Width" means the driveway throat distance, measured at the property line, for both depressed- and curb-entry type driveways (see Figure 12-1).

"Parcel" means any piece of real property in a single ownership.

12-3 Permit Required

Implemented: 10/08/2001 Revised: 01/15/1990

A permit, issued by the Public Works Department on written application, is required for the construction or reconstruction of any driveway giving access from a parcel to a street or alley.

No other permit for driveway construction or reconstruction shall be required when such a permit is obtained. The Public Works Department shall only issue permits for driveways after that Department has ensured that the requirements of the ordinance are complied with, that the proposed construction or reconstruction is in accordance with standard plans and specifications, and that the proposed construction or reconstruction is in accordance with good and accepted engineering practice.

12-4 Number of Driveways Permitted

Implemented: 10/08/2001 Revised: 01/01/1990

Each parcel shall be permitted one driveway giving access to an abutting arterial street, either permitting direct access to the parcel, or jointly with an adjoining parcel. Additional driveways giving access to one or more arterial streets shall be permitted only under the following conditions:

1. When the owner of the parcel can demonstrate that the daily volume of traffic using a single driveway would be in excess of 5,000 one-way vehicle trips per day; or,
2. When the owner of the parcel can demonstrate that the vehicle traffic using a single driveway would exceed the capacity of a stop sign-controlled intersection during one peak-street traffic hour, or the peak-site traffic hour, as capacity is determined by a qualified professional engineer, and approved by the Director of Public Works; or,
3. When the owner of the parcel can demonstrate, by a traffic engineering study, that the addition of another driveway will benefit the flow of traffic on the abutting arterial street.

12-5 When Traffic Signals May Be Required

Implemented: 10/08/2001 Revised: 01/01/1990

The Public Works Department may require the installation of an electronic traffic signal at the cost of the owner of a parcel to control the ingress and egress of traffic from the driveway when the parcel would normally be allowed two or more driveways and a traffic signal(s) is warranted. A signal may be required either at the time a driveway permit is applied for or after a traffic study demonstrates its need.

12-6 Driveway Spacing

Implemented: 10/08/2001 Revised: 01/01/1990

Driveways providing access to arterial streets shall be spaced a minimum of 200 feet apart; however, the Public Works Department may issue a permit, which will result in lesser spacing when all of the following factors are present:

1. The parcel does not have adequate frontage on the arterial street to provide the 200 foot spacing;
2. After good faith attempts, the owner of the parcel is unable to secure joint access through an adjoining parcel;
3. The parcel to be served cannot be served from another street; and,
4. The resultant driveway provides maximum spacing from adjacent driveways giving access to the arterial street, and proper corner clearance is provided. When measuring distances to or between driveways, distance shall be measured from the edge-of-throat to edge-of-throat as shown in Figure 12-3.

12-7 Joint-Access Driveways

Implemented: 10/08/2001 Revised: 01/15/1990

The Public Works Department shall encourage and facilitate use of joint-access driveways serving two or more adjoining parcels. Where joint-access driveways are feasible and not objected to by the owners of the affected parcels, the Public Works Department may require:

1. Owners of parcels using the joint-access driveway to share the cost of construction or reconstruction of the driveway;

2. Owners of parcels using the joint-access driveway to share the cost of electric or electronic traffic signals at the driveway; and,
3. Location of the joint-access driveway in order to more conveniently serve all parcels using it.

12-8 Driveway Cuts on Existing Lots

Implemented: 10/08/2001 Revised: 01/15/1990

Driveways installed on streets of non-standard paving width and design shall be constructed as if the street improvements were constructed to full City standards, except where construction to full standards would create substantial additional expense or hardship to the property owner. In such a case, the owner for himself, his successors, and assigns must agree to release and indemnify the City against any expense for the driveway adjustment arising from the future improvements of the roadway to full City standards.

12-9 Corner Clearance

Implemented: 10/08/2001 Revised: 01/15/1990

The minimum-tangent curb length between a driveway giving access to an arterial street shall be at least 50 feet as measured from the beginning of curb return (BCR) to the nearest edge of driveway throat as shown in Figure 12-2. If there is no curb, the distance shall be 80 feet measured from the edge of pavement of the intersecting street to the beginning of a driveway opening.

12-10 Regulation of Turns

Implemented: 10/08/2001 Revised: 01/15/90

The Public Works Department, through its Traffic Engineer or other responsible official, may in accordance with the City's traffic code or as otherwise permitted by law, limit or prohibit turns to or from driveways giving access to arterial streets by requiring the placement of official traffic-control devices when it appears that there is inadequate corner clearance, sight distance or driveway spacing, or when traffic capacity, delay or safety conditions require such prohibitions. The cost of the traffic-control devices shall be borne by the owner of the parcel.

12-11 Standards For All Driveway Construction

Implemented: 10/08/2001 Revised: 01/01/1990

All driveways providing access to arterial streets shall be constructed in such a manner that:

1. The minimum driveway width is 15 feet for all types of driveways.
2. The maximum driveway width for a commercial driveway is 15 feet for one-way and 40 feet for two-way.
3. The maximum driveway width for an industrial driveway is 20 feet for one-way and 45 feet for two-way.
4. Driveways shall have one lane in and one lane out unless the owner of the parcel can demonstrate, through an analytical traffic engineering analysis, the need for an additional lane.
5. Depressed-curb driveways shall range in width between 15 and 30 feet. Width is measured at the throat (see Figure 12-1).
6. Curb-return driveways shall range in width between 30 and 45 feet. Width is measured at the throat (see Figure 12-1). The curb-return radius shall be 15 feet and shall include provisions for wheelchair

ramps. The driving surface through the limits of the right-of-way shall be smooth, at a grade less than 8% and free of stormwater, vaults or any structures, which may impede traffic flow.

12-12 Standards for Driveway Installation

Implemented: 10/08/2001 Revised: 01/01/1990

Driveway installations shall be in accordance with the volume of the arterial street and the daily volume of traffic through the driveway.

1. Commercial and industrial driveways abutting an arterial street with a traffic volume of 15,000 vehicles per day or greater shall be of the curb-return type (regardless of the volume of the driveway) unless the driveway serves "egress only" traffic.
2. Driveways through which the daily-traffic volume is less than 2,500 one-way vehicle trips shall be the depressed-curb type.
3. Driveways through which the daily-traffic volume is in excess of 2,500 one-way vehicle trips may be either the depressed-curb or curb-return type, at the option of the owner of the parcel.

12-13 Sight Distance

Implemented: 10/08/2001 Revised: 01/01/90

All driveways giving access to arterial streets shall be constructed in such a manner that the following minimum sight distances are available along the arterial in each direction from the driveway:

Street Design Speed	**Minimum Sight Distance**
20 m.p.h.	175 feet
25 m.p.h.	220 feet
30 m.p.h.	265 feet
35 m.p.h.	310 feet
greater than 35 m.p.h.	as determined by Public Works Dept.

NOTE: Sight distance shall be measured in accordance with good engineering practices.

12-14 Driveway Maintenance and Alignment

Implemented: 10/08/2001 Revised: 01/01/1990

Maintenance of driveway approaches or intersection openings shall be the responsibility of the owner whose property they serve. Driveways shall be aligned wherever possible with existing driveways on the opposite side of the street: first come, first served.

12-15 Arterial Access Denied Variances

Implemented: 10/08/2001 Revised: 01/01/1990

The Public Works Department may when required or permitted by traffic conditions and the maintenance of safety on any arterial street:

1. Deny an application for a driveway permit, when a parcel abuts on both an arterial street and a minor street, and adequate access is available via the minor street, regardless of the degree of improvement of the minor street; and,
2. Grant variances from the requirements of the driveway ordinance where:
   A. The use of the parcel is either single-family, or duplex residential; or,

B. The owner of a parcel provides a traffic study acceptable to the Department of Public Works showing that the variance is feasible and desirable and in accordance with the intent of the driveway ordinance.

12-16 Changes in Driveway Access When Arterial Improves

Implemented: 10/08/2001 Revised: 01/01/1990

When the City undertakes to improve an arterial street, including improvements to curbing, gutters, drainage, widening, or major changes in traffic flow controls, the Department of Public Works may, as part of the improvement project, present a plan for improving driveway access to the City Council, which shall hold a public hearing on the plan, after providing no less than 15 days notice to owners of parcels abutting the arterial to be improved.

12-17 City Council Hearing on Driveway Improvements

Implemented: 10/08/2001 Revised: 01/01/1990

The City Council, after hearing on the driveway access plan, shall declare its findings, and thereupon may approve the plan, and direct it to be carried out, modify the plan or require its modification, or, reject the plan.

12-18 Duty of Owner of Parcel on Finalization of Driveway Improvement Plan

Implemented: 10/08/2001 Revised: 01/01/1990

Owners of driveways affected by a driveway improvement plan finalized by the City Council shall bear such costs of improvements as the City Council shall direct; and shall do such other things to improve driveway access to their parcels as shall be required by the City Council; and shall ensure that such work is inspected by, and approved by, the Public Works Department.

12-19 Unsafe Driveway Traffic Study

Implemented: 10/08/2001 Revised: 01/01/1990

When, in the judgment of the Public Works Department, a driveway access to an arterial street is unsafe, the Public Works Department may conduct a traffic study of the driveway access and prepare a plan improving the same or requiring its elimination.

12-20 City Council Hearing on Unsafe Driveway

Implemented: 10/08/2001 Revised: 01/01/1990

After at least 15 days notice to the owner of the parcel served by the driveway access deemed by the Public Works Department to be unsafe, the City Council shall hold a public hearing thereon. After public hearing, the City Council shall declare its findings, and as a result thereof, may:

1. Direct improvement of the driveway in accordance with the standards set forth in the driveway ordinance including signalization as appropriate pursuant to Section 12-5; or
2. Direct that the driveway be closed or barricaded in accordance with the provisions of the driveway ordinance; and

3. Declare who shall bear the cost of such barricading, closing, signalization or other improvement.

12-21 Public Works Department to Inspect Improvements to Unsafe Driveway

Implemented: 10/08/2001 Revised: 01/01/1990

The Public Works Department shall be responsible for inspection and approval of all improvements to driveways found by the City Council to be unsafe, and no driveway improvements undertaken after a declaration that they are unsafe shall be deemed completed until the Public Works Department approves the work.

12-22 Unused Driveways on Arterial Streets

Implemented: 10/08/2001 Revised: 01/01/1990

Whenever an established driveway providing access to an arterial street is abandoned, or ceases to be used as a driveway, the owner of the parcel to which the driveway provides access shall take such measures, including the reconstruction of curbing and sidewalks or the provision of barriers, and shall close the driveway to vehicular traffic.

12-23 Enforcement

Implemented: 10/08/2001 Revised: 01/01/1990

The City's Public Works Department shall be responsible for the enforcement and administration of the driveway ordinance, except that regularly appointed inspectors and law enforcement officers of the following departments of the City shall have authority to issue citations for violations of the driveway ordinance:

1. Public Works Department
2. Police Department
3. Legal Department
4. Department of Planning and Economic Development and Building Services Division
5. Any governmental agency having authority to enforce the Building Codes.

12-24 Fees for Permits and Inspection

Implemented: 10/08/2001 Revised: 01/15/1990

The Public Works Department shall be authorized to charge a fee of $25.00 for examining plans and issuing a driveway permit.

12-25 Prohibited Acts

Implemented: 10/08/2001 Revised: 01/15/1990

It is a misdemeanor:

1. For any person to construct, reconstruct, or cause to be constructed a driveway providing access to an arterial street without first obtaining a permit therefor;

2. For any person who is the owner of a parcel abutting on an arterial street, to occupy the parcel while it is served by a driveway that was constructed or reconstructed after the effective date of the ordinance without first obtaining a permit required by the driveway ordinance;
3. For any person who is the owner of a parcel abutting on an arterial street to allow the existence of an abandoned or unused driveway that provides access to the arterial street; or,
4. To fail to comply with the directions of the City Council relating to the improvement, barricading, or closing of any driveway.

12-26 Nuisances Declared - Abatement

Implemented: 10/08/2001 Revised: 01/15/1990

The City may undertake an action to abate nuisance driveways in accordance with the procedures for abatement of nuisances provided by the City's criminal code or otherwise by law. Nuisance driveways are those driveways providing access from a parcel to an arterial street that have been constructed or reconstructed after the effective date of the driveway ordinance without first having obtained a permit, or that have been abandoned or have fallen into disuse but are still passable to vehicular traffic, or that have been allowed by the parcel's owner to continue to exist unchanged for more than 120 days after the City Council has directed that the driveway be improved, closed, or barricaded.

12-27 Safe Access to Public Streets

Implemented: 10/08/2001 Revised: 01/15/1990

Access to public streets and alleys shall be located to minimize safety hazards. The Public Works Director may deny access to a street or alley where physical conditions create a safety hazard. The criteria for evaluating locations shall be based on the Manual on Uniform Traffic Control Devices, Washington State Department of Transportation Standards, Institute of Traffic Engineers Standards, and AASHTO Standards.

Section 13. Subdivisions

13-1 Introduction

Implemented: 10/08/2001 Revised: 01/01/1990

This section pertains to the subdivision of land within the corporate limits of the City of Bellingham, which is regulated by the Subdivision Ordinance (No. 8192). This section is intended to summarize the ordinance, and if a conflict is perceived, the ordinance shall take precedence.

The Director of Planning and Economic Development is designated and assigned the administrative and coordinating responsibility for approval or disapproval of plats and subdivisions within the City.

13-1.01 Compliance - Division into Nine or Fewer Lots (Ordinance 9390)

Implemented: 10/08/2001 Revised: 01/01/1990

Division of land into nine or fewer lots shall be in compliance with the regulations and standards of this section governing "short subdivision" as set forth in Section 13-4. Division of land into ten or more lots shall comply with regulations and standards dealing with subdivision and must follow the preliminary and final platting procedures.

13-1.02 Sale Restrictions

Implemented: 10/08/2001 Revised: 01/01/1990

Sale of land is prohibited unless it is a duly platted parcel of land or lot, or is a tract of record at time of passage of the ordinance (February 5, 1973) or is a parcel of land approved under short subdivisions, Section 13-4.

13-1.03 Exceptions

Implemented: 10/08/2001 Revised: 01/01/1990

This section shall not apply to the following:

1. Cemeteries and other burial plots while used for that purpose.

2. Division of land into lots or tracts where the smallest lot is 20 acres or more and not containing a dedication of a public right-of-way.

3. Divisions made by testamentary provisions or the laws of descent.

4. Divisions of land into lots or tracts classified for industrial or commercial use when the City of Bellingham has approved a binding site plan for the use of the land pursuant to Section 13-7.

13-2 Definitions

Implemented: 10/08/2001 Revised: 01/01/90

For the purpose of this section, unless it is clearly evident from the context that a different meaning is intended, certain words and terms are defined as follows.

"Alley" means a public right-of-way, not greater than 30 feet in width, which affords a secondary access to abutting property.

"Binding Site Plan" means a drawing to a scale which: (a) identifies and shows the areas and locations of all streets, roads, improvements, utilities, open spaces, and any other matters specified by local regulations; (b) contains inscriptions or attachments setting forth such appropriate limitations and conditions for the use of the land as are established pursuant to Section 13-7.

"Block" means a group of lots, tracts, or parcels within well-defined and fixed boundaries.

"Building Setback Line" means a line parallel to the front property line in front of which no structure shall be erected. The location of such line is determined from the regulations of Title 20.

"Cluster Subdivision" means a subdivision in which minimum lot size requirements may be diminished so as to provide desirable open space with-out increasing the overall density of dwelling units per acre as provided in Title 20.

"Commission" means the Bellingham City Land Use Commission.

"Controlling Corner" means all angle points of the perimeter of a subdivision or separate divisions of a subdivision.

"Covenant" means a binding and solemn agreement made by two or more individuals, parties, etc., to do or keep from doing a specified thing or things.

"Dedication" means the deliberate appropriation of land by an owner for any general and public uses reserving to himself no other rights such as are compatible with the full exercise and enjoyment of the public use to which the property has been devoted. The intention to dedicate shall be evidenced by the owner by presenting the final plat or a short plat for filing by showing the dedication thereon; and the acceptance by the public is evidenced by the approval of such plat for filing by the appropriate governmental unit.

"Existing Street" means a presently traveled way with a minimum width of 18 feet of hard surfacing irrespective of whether it has been accepted by the City for maintenance. A "hard-surfaced street" is a street consisting of either portland cement or asphaltic concrete as a wearing surface.

"Greenbelt" means a parcel of land usually of strip or ribbon shape left in an undeveloped and natural state, excluding all development except recreation.

"Lot Line Adjustment" means a division made for the purpose of adjusting boundary lines which does not create any additional lot, tract, parcel, site or division nor create any lot, tract, parcel, site or division which contains insufficient area and dimension to meet minimum requirements for width and area for a building site.

"Through Lot" means a lot other than a corner lot abutting more than one street. "Pipe-Stem Lot" (sometimes called a flag or panhandle lot) means a parcel of land which resembles a rectangle with a lot taken out of a corner or corners leaving the remainder with considerably less width on the front lot line than the width at the rear of the parcel.

"Metes and Bounds" means a description of real property which starts at a known point and describes the bearings and distances of the line forming the boundaries of the property and is completed when the description returns to the point of beginning.

"Monument" means an object used to permanently mark a surveyed location. The size, shape and design of the monument is to be in accordance with standards specified by the Washington State Department of Natural Resources as authorized by RCW 58.17.

"Neighborhood Standards" means the street standards specified in the applicable neighborhood of the Comprehensive Plan of Bellingham.

"Open Space" means a parcel of land excluding building sites, parking areas, and access routes which is designated and maintained as an area for leisure, recreation and other activities normally carried on outdoors. Open space includes greenbelt and recreational areas.

"Plat" means a map or representation of a subdivision, showing thereon the division of a tract or parcel of land into lots, blocks, streets and alleys or other division and dedications.

"Plat Certificate" means a title report by a title insurance company certifying the ownership, deed restrictions, covenants, etc., of the land being subdivided.

"Final Plat" is the final drawing of the subdivision and dedication prepared for filing for record with the County Auditor and containing all elements and requirements set forth in the ordinance.

"Preliminary Plat" is a neat and approximate drawing of a proposed subdivision showing the general layout of streets and alleys, lots, blocks, and restrictive covenants applicable to the subdivision, and other elements of a plat or subdivision which furnish a basis for the approval or disapproval of the general layout of a subdivision.

"Short Plat" is the map of representation of a short subdivision.

"Accepted Street" means a street that has been accepted for maintenance. Usually any street that has or had been improved to the prevailing minimum City standard is regarded as an accepted street. The City has pledged that the accepted streets will be kept in repair and maintained at no expense to the abutting property owners.

"Arterial Street" means an existing or proposed roadway designated an arterial by City ordinances, or a roadway carrying more than 1,500 vehicles per day.

"Collector Street" means a roadway designed to carry medium volumes of vehicular traffic, provide access to the major street system, and collect the vehicular traffic from the intersecting minor streets.

"Cul-de-sac" means a street intersecting another street at one end and permanently terminated by a vehicular turnaround at the other end.

"Local or Minor-Access Street" means a street providing vehicular access to abutting properties.

"Marginal-Access Street" means a street parallel to and adjacent to a major arterial which provides access to the properties abutting it and which separates the abutting properties from high-speed vehicular traffic.

"Subdivision" means a division or resubdivision of land into 5 or more lots, tracts, parcels, sites or divisions.

"Short Subdivision" means a division or redivision of land into 9 or fewer lots, tracts, parcels, sites or subdivisions for the purpose of sale, lease or transfer of ownership.

13-3 Lot Line Adjustments

Implemented: 10/08/2001 Revised: 01/01/1990

Ordinance 9135

13-3.01 Approval Required

Implemented: 10/08/2001 Revised: 01/01/1990

Any action which will result in a lot line adjustment as defined in this section shall be submitted to the Planning and Economic Development Department for approval prior to recording.

13-3.02 Procedure

Implemented: 10/08/2001 Revised: 01/01/1990

The proposal shall be submitted to the Department of Planning and Economic Development for review on forms provided by that department. A pencil drawing showing the existing and proposed lot line shall accompany the application together with a $25.00 review fee. A filing fee of $25.00 per lot shall be collected prior to recording with the County Auditor. (Ordinance 9630)

The Department of Planning and Economic Development shall give preliminary approval to the request if it finds that:

1. No new lots are created;
2. Each parcel as proposed meets minimum lot standards as specified in Section 13-10, or that each parcel, if already less than the required minimum, is not further reduced as a result of the proposed lot line adjustment;
3. The lot line adjustment does not further infringe on any applicable section of the City Land Use Development Ordinance.
   Upon receiving preliminary approval, the applicant(s) shall have prepared a mylar as described in Section 13-3.03 to be recorded in the County Auditor's office at the expense of the applicant after receiving final City approval.

13-3.03 Mylar

Implemented: 10/08/2001 Revised: 01/01/1990

A document of mylar quality or better shall be prepared by a State of Washington licensed land surveyor based upon a record survey. The mylar shall be 18 inches by 18 inches in size and shall clearly indicate the previous and new lot lines and shall be signed by all property owners in whom title is vested and shall be notarized. A space shall be reserved for legal descriptions, and authorized signatures of the land surveyor, Planning and Economic Development Department and Auditor's office. A reproducible copy of the recorded mylar shall be submitted to the City for their records on the day of recording. (Ordinance 9550)

13-4 Short Subdivisions

Implemented: 10/08/2001 Revised: 01/01/1990

Any action which will result in a short subdivision of any lot, tract, parcel, or plot of land for any reason whatsoever shall be subject to approval by the Department of Planning and Economic Development. Approval shall be based on standards and conditions set forth in this section.

13-4.01 Approval Procedure

Implemented: 10/08/2001 Revised: 01/01/1990

1. All short subdivisions shall be submitted to the Department of Planning and Economic Development for review and approval. Approving, with specified alterations, or disapproving action will be taken by the Director of Planning and Economic Development within 30 days of the submission date unless the applicant consents to a time extension.
2. An application for approval of a short subdivision shall be accompanied by an accurately-scaled and -dimensioned drawing of the proposed subdivision prepared by a registered land surveyor. Such drawing shall be on 11-inch by 17-inch paper. Four copies shall be submitted if the property is residential, 5 copies if it is commercial or industrial. (Ordinance 9550)
3. An environmental checklist shall be completed and submitted with any application for short subdivision of property within shoreline jurisdiction. (Ordinance 9550)
4. The application shall contain an accurate legal description of the area involved in the subdivision. In the event the boundaries are described by metes and bounds, the accuracy of the description shall be attested to and signed by a registered land surveyor. Basis of bearings shall be stated.
5. The total property owned by the applicant which is contiguous to the parcel being subdivided shall be accurately indicated on the drawing. All existing buildings on the property being subdivided must be accurately illustrated on the drawing. In addition, all adjacent property and owners must be clearly shown on the drawing.
6. In the event the proposed subdivision is not sewered, a recommendation for approval from the Health Department shall be obtained prior to approval by the Planning and Economic Development Director.
7. In the event the proposed subdivision results in lots smaller than required in Title 20, the Planning and Economic Development Director has the authority to approve the short subdivision if the resulting new lots are larger than those previously existing.
8. All short subdivisions shall comply with the provisions of the ordinances of the City relating to drainage, and development of land within the flood plains of the City. (Ordinance 8827)
9. In the event the land to be subdivided has a slope or slopes of more than 20% and/or has rock or unstable soil conditions, the subdivider shall furnish soils data to the City Engineer. If conditions warrant control measures to correct slide, erosion or other similar problems, the subdivider shall be responsible for the design, installation and expense of any device or corrective measure, subject to approval of the City Engineer.
10. After preliminary approval is received from the City, the applicant shall provide a document of mylar quality or better which has been prepared by a State of Washington licensed land surveyor based upon a record of survey. Said mylar shall be 18 inches square, clearly indicate the new lot lines, be signed by all property owners in whom title is vested and shall be notarized. A space shall be reserved for legal descriptions, and authorized signatures of the land surveyor, Public Works Department, Planning and Economic Development Department, Whatcom County Health Department, if necessary, and Auditor's office. A reproducible copy of the recorded mylar shall be submitted to the City for their records on the day of recording. (Ordinance 9390 and 9550)
11. A plat certificate shall be required to be submitted with the checkprints of the mylar. (Ordinance 9550)
12. Permanent control monuments shall be established at each and every controlling corner on the boundaries of the parcel of land being subdivided, and in the centers of all intersecting streets. Additional monuments shall be installed if requested. (Ordinance 9390)
13. For short subdivisions consisting of 5 or more lots, the application shall be accompanied by a notarized list of all property owners and their mailing address who own land within 300 feet of the boundaries of the property being proposed to be subdivided. The list of all such property owners shall be obtained from the latest available records of the Whatcom County Assessor's Office. No responsibility will be assumed by the applicant in the event the County Assessor's records contain inaccurate or incomplete information. (Ordinance 9390)
    The Planning and Economic Development Department shall send notice to all persons on the list informing them of the proposed short subdivision and invite comments to be made in writing within 20 calendar days of said notice. (Ordinance 9390)
14. For short subdivision and preliminary plats adjacent to the right-of-way of a State highway or within 2 miles of the boundary of a state or municipal airport, written notice including a legal description of the

short subdivision and a location map shall be sent to the Secretary of Transportation. The Secretary shall respond within 15 days of said notice as to the effect that the proposed subdivision will have on the state highway or the state or municipal airport. Notice of intent to short subdivide shall also be sent to the local airport authority.

13-4.02 Lot Requirements - Design Standards

Implemented: 10/08/2001 Revised: 01/01/1990

All lots created by a short subdivision shall abut upon a dedicated or deeded street and such street to have no less than 60 feet of right-of-way width if a through street, or 50 feet of width if a cul-de-sac; in the event the abutting street does not meet these minimum width standards, additional right-of-way shall be required prior to approval of a short subdivision provided that this requirement may be waived if, in the opinion of the Planning and Economic Development Director and City Engineer, such additional

right-of-way will not be necessary for the future traffic circulation of the City.

Short subdivisions that contain a dedication of land to the public shall be surveyed, monumented and recorded with the County Auditor. The monumentation requirement may be waived, if the centerline of the right-of-way is already monumented.

All lots created by a short subdivision shall meet the design standards specified in Section 13-10; however, the Planning and Economic Development Director may approve a division of land less than the required standards, provided such division of property results in better lot design than previously existed. Better lot design is defined as meaning such items as larger in area, more practical site because of topography or nearer to conformance to required standards.

For short subdivisions consisting of 5 or more lots, the cluster provision of Section 13-9 shall not be utilized. (Ordinance 9390)

13-4.03 Required Improvements

Implemented: 10/08/2001 Revised: 01/01/1990

1. Prior to granting approval for any short subdivision, the Planning and Economic Development Director shall ascertain the following improvements have been made or installed for each parcel created by the division of land:
   A. City water.
   B. Sanitary sewer or Health Department approval of septic tanks.
   C. Appropriate dedications or easements made, if required.
2. All improvements shall be constructed in accordance with a contract between the subdivider and the City, providing at least:
   A. Terms and conditions satisfactory to the City, including design and construction standards;
   B. Requiring a permit to be issued before commencement of construction; and
   C. In the discretion of the Director of Public Works, appropriate security may be required, covering construction performance and guaranteeing the construction after completion for a period of one year.
3. Streets, Curbs, Gutter, Sidewalks (Ordinance 9390)
   A. For short subdivisions consisting of 4 or fewer lots:
      i. When the principal frontage street providing access to a newly-created lot is below the standard for an existing street, the installation of a street is required prior to approval of a short subdivision. The newly-installed street shall have a minimum traveled way brought to line and grade of not less than 20 feet of width with 4-foot shoulders on each side. The

surface shall be at least of asphaltic concrete quality and there shall be adequate provision for storm drainage.

ii. In the event the principal frontage street is not currently improved and is being created by full-width dedication by the short division then a street constructed to full-neighborhood standards shall be required.

B. For short subdivisions consisting of 5 to 9 lots:

i. All abutting street rights-of-way shall be constructed to neighborhood standards or 3/4 full City standards, whichever is the lesser standard.

ii. All interior streets shall be constructed to neighborhood standards.

iii. At least one street providing access to the short subdivision shall be improved to minimum City standards.

iv. Appropriate security to ensure completion may be accepted in lieu of actual installation of the required improvements, if acceptable to the Director of Public Works. (Ordinance 8827)

v. For all short subdivisions, when an extension to electric power and communication facilities is necessary all such extensions shall be placed underground. (Ordinance 9390)

vi. For all short subdivisions, Staff shall have the authority to impose reasonable improvements to control storm drainage runoff and to address any prerequisite consideration and special conditions identified in the applicable section of the Comprehensive Plan. (Ordinance 9390)

13-4.04 Building Permit Issuance Restrictions

Implemented: 10/08/2001 Revised: 01/01/1990

No Building Permit shall be issued for construction of any kind unless:

1. Such lot was of record prior to August 17, 1964; or
2. Such lot is a division of a recorded subdivision; or
3. Such lot was created with approval of the City in accordance with Ordinance 7483 and/or 7995; or
4. Such lot was created in compliance with the provisions of this section.

It shall be the responsibility of the property owner to establish the status of the lot as it pertains to this section.

13-4.05 Resubdivision Restricted

Implemented: 10/08/2001 Revised: 01/01/1990

Any short subdivision or land involved in a short subdivision shall not be resubdivided for a period of 5 years from the date of approval of the short subdivision without the submission and approval of a final plat done in accordance with Section 13-6.

13-4.06 Inspection Fee

Implemented: 10/08/2001 Revised: 01/01/1990

(Ordinance 8724, amended by Ordinance 9630)

Any person making application for a short subdivision permit, shall at the time of application pay a base fee of $100.00. The filing fee of $25.00 per lot shall be collected prior to recording with the County Auditor. Such fees shall be nonrefundable, unless such obligation is specifically waived by the City Council.

13-5 Preliminary Plats

Implemented: 10/08/2001 Revised: 01/01/1990

Any property owner who wishes to divide land into 10 or more lots shall conform to the regulations hereafter stated as they pertain to preliminary plats, subdivision design, improvements and final plats. These regulations also pertain to land that has had an approved short subdivision during the previous 5 years and also to lots being replatted due to street vacations.

13-5.01 Contents

Implemented: 10/08/2001 Revised: 01/01/1990

A preliminary plat submitted for approval shall contain the following items and information:

1. Name of plat;
2. Name, address and phone number of subdivider (owner) and the land surveyor;
3. All lots, rights-of-way, open space, existing easements, and other features affecting the design of the plat;
4. Topography lines at 5-foot intervals;
5. All parcels of land intended to be dedicated or temporarily reserved for public use and the conditions attached thereto accurately indicated.
6. A vicinity sketch at a scale of not more than 800 feet to the inch showing the proposed plat in relation to surrounding land; all platted rights-of-way for a distance of at least a quarter of a mile, and additional area, if necessary, to show connecting streets or arterials.
7. An accurate and complete legal description of the area being platted;
8. Source of water supply, method of sewage disposal and method of surface water disposal;
9. The land use classification, both present and proposed;
10. All existing conditions shall be delineated. The location, width and names of all existing or prior platted streets or other public ways, railroad and utility rights-of-way, parks and other public open spaces, permanent buildings and structures, and section and municipal corporation lines within or adjacent to the tract shall be shown. In the case of a replat, the lots, blocks, streets, alleys, easements, and parks, of the original plat being vacated, shall be shown by dotted lines in their proper position in relation to the new arrangement of the plat; the new plat being clearly shown in solid lines so as to avoid ambiguity. Existing sewers and water lines, culverts or other underground facilities within the tract indicating pipe sizes, grades and exact location as obtained from public records shall be shown. Boundary lines of adjacent tracts of unsubdivided and subdivided land showing owners shall be indicated by dotted lines for a distance of three hundred feet. Existing zoning of the proposed subdivision and adjacent tracts shall be shown.
11. An environmental checklist shall be required in accordance with RCW 43.21C upon the submittal of a preliminary plat.

13-5.02 Preparation of Specifications

Implemented: 10/08/2001 Revised: 01/01/1990

The plat shall be prepared, drawn and certified by a land surveyor registered by the State of Washington. The horizontal scale shall be no less than 100 feet to the inch. The plat shall conform with the design standards governing plats as required by this ordinance. Sixteen copies of the plat shall accompany the application for plat approval to permit distribution to the necessary persons, agencies, and organizations. Any person making application for a preliminary plat approval shall at the time application is made pay a base fee of $500.00, plus $25.00 for each lot proposed to be created. The fee shall be nonrefundable, unless such obligation is specifically waived by the City Council. (Ordinance 8724)

13-5.03 Submission Time Limitation

Implemented: 10/08/2001 Revised: 01/01/1990

(Ordinance 8633)

Preliminary plats containing all of the information required by Sections 13-5.01 and 13-5.02 must be submitted to the Planning and Economic Development Department no less than 4 weeks prior to the Planning Commission meeting at which consideration is sought.

13-5.04 Public Hearing

Implemented: 10/08/2001 Revised: 01/01/1990

Upon receipt of a proposed preliminary plat, a public hearing before the Commission shall be scheduled. Notice of such hearing shall be given by publication of at least one notice not less than 10 days prior to the hearing in a newspaper in general circulation in the City. Three copies of the notice of hearing shall be posted in at least 3 conspicuous places on the boundaries of the proposed plat at least one week prior to the date of hearing. Individual notice shall be mailed to all property owners within 300 feet of any portion of the proposed plat or any other land owned by the applicant that is adjacent to the proposed plat not less than 10 days prior to the hearing. The actual cost of public notice, mailing and publication shall be borne by the applicant.

13-5.05 Notification of Affected Agencies

Implemented: 10/08/2001 Revised: 01/01/1990

Upon receipt of a preliminary plat for approval, the following agencies and organizations shall be notified of the date, place and hour of the public hearing and such notifications shall be accompanied by a copy of the proposed plat:

1. Department of Public Works
2. Fire Department
3. The electrical distribution company
4. The telephone company
5. The gas company
6. County Council (if plat adjoins City limits)
7. The Washington State Department of Transportation (if plat adjoins State right-of-way)
8. The television cable company

13-5.06 Technical Review Committee

Implemented: 10/08/2001 Revised: 01/01/1990

Upon receipt of a preliminary plat, the Technical Review Committee consisting of the Planning and Economic Development Director as Chairman, Public Works Director, Fire Chief, Traffic Superintendent, or an authorized representative of each, shall, within 2 weeks of receipt of the preliminary plat, conduct an informal meeting with the developer(s) for the purpose of reviewing and pointing out what, if any, corrections, additions, deletions, etc., should be made to the preliminary plat prior to the Commission public hearing. The recommendation of the Technical Review Committee shall be forwarded to the Commission, City Council, and developer(s).

13-5.07 Commission Action

Implemented: 10/08/2001 Revised: 01/01/1990

The Commission shall hold a public hearing on each preliminary plat and shall review such plat to ensure conformance with the policies as reflected by the Comprehensive Plan and with the planning standards and specification of the City, including the Comprehensive Utility Plan. The Commission shall make a recommendation to the City Council as to their findings with regard to determining if appropriate provisions have been made for drainage, streets, alleys, other public ways, water, sewer, parks, playgrounds, sites for schools, and any other relevant features necessary to serve the public interest.

Such recommendation shall be advisory only.

The recommendation of the Commission on a preliminary plat shall be submitted to the Council not later than 14 days following the recommending action.

13-5.08 Council Review and Approval

Implemented: 10/08/2001 Revised: 01/01/1990

Upon the receipt of the preliminary plat, the Council shall at its next regular public meeting set the date for a public meeting to be held to adopt or reject the recommendation of the Commission.

After considering the preliminary plat at the public meeting, the Council may adopt, change or reject the recommendation of the Commission. If the Council adopts the recommendation of the Commission, no further action is required of the Council or Commission relative to the Preliminary Plat. However, if the Council deems it necessary to change or reject the Commission's recommendation, a duly-advertised public hearing shall be held to consider the matter and thereafter the Council may adopt its own recommendations and approve or disapprove the preliminary plat.

Acting on the recommendations of the Commission, the Council shall determine if appropriate provisions have been made for drainage, streets, alleys and other public ways, water, sewer, parks, playgrounds, sites for schools and any other relevant features necessary to serve the public interest. They shall determine that the plat makes adequate provisions for the public health, safety and general welfare. After making the above determinations the Council may then approve the plat.

13-5.09 Time Limits

Implemented: 10/08/2001 Revised: 01/01/1990

(Ordinance 8860, amended by Ordinance 9550)

Approval of a preliminary plat shall expire 3 years from the date of Council approval. Upon application by the subdivider, the Commission with approval of the City Council, shall have the authority to grant an extension for one additional year. The applicant must file a written request with the Planning Commission at least 30 days before the expiration of the 3-year period. A one-year extension shall be granted upon a showing that the applicant has attempted in good faith to submit the final plat within the 3-year period.

The subdivider may apply for subsequent one-year extensions. In approving subsequent one-year extension requests, the City shall find that the proposed plat is still in conformance with the City's Comprehensive Plan. The extension shall be conditional upon the plat meeting all subdivision requirements which are in effect at the time the extension is granted.

In the event a portion of an approved preliminary plat is developed and recorded as a final plat and the remainder of the overall plat is left undeveloped for a period of 3 years from the date of the recording of

the divisions, then the approval of the preliminary plat shall expire. The time limit may be extended as provided for in this section.

13-5.10 Modification of Standards

Implemented: 10/08/2001 Revised: 01/01/1990

(Ordinance 8492)

Circumstances may exist so as to justify modification of established subdivision development standards. (See Ordinance 8192, Section 18.16 for requirements, procedure, and limitations.)

13-6 Final Plat

Implemented: 10/08/2001 Revised: 01/01/1990

13-6.01 Conformance with Ordinance Required

Implemented: 10/08/2001 Revised: 01/01/1990

Prior to submission of a final plat for approval, the plat shall conform in all respects to the design standards and improvements requirements specified in the ordinance. Submission of the final plat, together with all required data shall be submitted to the Planning and Economic Development Director at least one month prior to the date of consideration by the City Council.

13-6.02 Conformance With Preliminary Plat

Implemented: 10/08/2001 Revised: 01/01/1990

The final plat shall conform to the preliminary plat design; however, slight deviations may be allowed by the Technical Review Committee if they determine such deviations are necessary because of unforeseen technical problems and that the change will result in a better plat.

13-6.03 Legal Description

Implemented: 10/08/2001 Revised: 01/01/1990

A complete legal description shall be shown in its entirety on the face of the plat. The plat shall be accompanied by a complete survey of the section or sections in which the plat or replat is located, or as much thereof as may be necessary to properly orient the plat within such section or sections, and showing relationship to abutting plats and properties. The plat and section survey shall be submitted with descriptions of the same and the actual traverse showing errors of closure and method of balancing. A work sheet showing all distances, bearings, and other related calculations required to determine corners and distances of the plat shall accompany this data. The allowable plat map error of closure shall not exceed one foot in 10,000 feet. Basis of bearing shall be shown based upon a line between two found monuments, and they shall be shown on the plat, together with description of found monuments and bearing distance between them. Bearings shall be listed to nearest second (01") and distances to be listed to nearest hundredth of a foot.

For every existing monument used in control for plat boundary, and new plat monuments on existing street rights-of-way, there shall be a minimum of 3 direct measurement distances to substantial reference points (nail and shiner, iron pipe, etc.) These measurements may be submitted on 3 by 5 inch tie cards furnished by the City.

13-6.04 Covenants

Implemented: 10/08/2001 Revised: 01/01/1990

A copy of any covenants which are drafted in conjunction with, or as a result of a plat, shall accompany the final plat and shall become a part of it. Said covenants shall be recorded with the final plat

13-6.05 Plat Certificate

Implemented: 10/08/2001 Revised: 01/01/1990

A current plat certificate by a recognized title company shall accompany the final plat upon submission to the City Council for approval. Current shall be construed as no older than 7 days.

13-6.06 Dedication of Public Lands

Implemented: 10/08/2001 Revised: 01/01/1990

The face of the plat shall contain a dedication of all lands to be conveyed to the public, which shall be signed by the legal property owners. The signatures of the owners shall be acknowledged by a notary public.

13-6.07 Land Surveyor Seal

Implemented: 10/08/2001 Revised: 01/01/1990

The survey of the proposed subdivision and preparation of the plat shall be made by or under the supervision of a registered land surveyor who shall certify on the plat that it is a true and correct representation of the lands actually surveyed.

13-6.08 Health Department Approval

Implemented: 10/08/2001 Revised: 01/01/1990

The plat shall be accompanied by a recommendation from the local Health Department and/or the City Public Works Department as to the adequacy of the proposed means of sewage disposal and water supply.

13-6.09 City Engineer Approval

Implemented: 10/08/2001 Revised: 01/01/1990

Each final plat shall be checked and approved by the City Engineer. If the final plat contains more than one sheet, there shall be a City Engineer's certificate on each sheet.

13-6.10 Inspection Fee

Implemented: 10/08/2001 Revised: 01/01/1990

(Ordinance 8724)

A basic fee of $50.00, plus $110.00 per lot, is hereby imposed to defray the City's costs of field checking, plan review, and public service inspection of sewer mains, water mains, street installation, and other required public work improvements.

13-6.11 Finance Director Approval

Implemented: 10/08/2001 Revised: 01/01/1990

Each plat shall contain the certification of the City Finance Director that all filing fees, City taxes, and assessments and other fees for which the property may be liable have been paid. Also, in order to keep the capital improvements costs of the City's utility systems current, the following estimated or actual costs will be submitted to the City's Accounting Division before the City Treasurer shall approve the final plat:

1. Water Mains - total costs, labor, equipment, materials with size and number of feet.
2. Hydrants - give number put in, size and cost.
3. Storm Sewer - total cost with size and number of feet.
4. Sanitary Sewer - total cost with size and number of feet.
5. Streets - total cost and number of feet put in.
6. Sidewalks and Curbs - total cost.

13-6.12 Director of Planning and Economic Development Action

Implemented: 10/08/2001 Revised: 01/01/1990

The Planning and Economic Development Director shall review the final plat for conformance with the approved preliminary plat, for completion of all the requirements contained in the subdivision ordinance, and for conformance with other standards or codes which pertain to the plat. Upon determination that platting requirements have been satisfied, the Planning and Economic Development Director shall approve the plat by signature and forward the plat to the City Council for action.

13-6.13 Council Review and Approval

Implemented: 10/08/2001 Revised: 01/01/1990

The City Council shall review the final plat and if the Council finds that the public use and interest will be served by the proposed plat, and that said plat meets the requirements of the subdivision ordinance and any other state or local ordinances pertaining thereto, it shall suitably inscribe and execute its approval on the face of the plat.

13-6.14 Filing With County Auditor

Implemented: 10/08/2001 Revised: 01/01/1990

The final approved plat shall be filed for record with the County Auditor in compliance with state and county laws and regulations.

13-6.15 Copy Furnished by Subdivider

Implemented: 10/08/2001 Revised: 01/01/1990

In accordance with the state law and with regulations of the subdivision ordinance the subdivider shall, without cost to the City, furnish copy, mylar or better quality, of the final plat as filed.

13-7 Site Plan for Land Divisions for Lease

Implemented: 10/08/2001 Revised: 01/01/1990

Binding Site Plan, Ordinance 8512

13-7.01 Applicability

Implemented: 10/08/2001 Revised: 01/01/1990

This section applies to divisions of land for the purpose of lease when no trailers or accessory, security, or managerial quarters are permitted to be placed upon the land.

13-7.02 Submission Requirements

Implemented: 10/08/2001 Revised: 01/01/1990

1. The following information shall be used in mandatory preliminary design discussions with the Department of Planning and Economic Development. Such information shall be prepared by the applicant.
   A. Map of the topography of the site at 5-foot contour intervals (based on City datum) and identification of the existing drainage pattern.
   B. All existing rights-of-way, easements, utilities, and other existing public improvements.
   C. All parcels of land intended to be dedicated or reserved for public use, proposed public and/or private streets and open spaces.
2. Submission requirements listed in Subsections 1 A-C of this section shall be included on a single map which shall be prepared by a registered architect, civil engineer, or land surveyor.
3. The horizontal scale ratio of the preliminary site plan shall be no more than 1:2400 (1" = 200'). The map shall include the property included in the proposed plan and adjacent lands for a distance of 300 feet.

13-7.03 Preliminary Plan Approval

Implemented: 10/08/2001 Revised: 01/01/1990

The applicant shall submit 10 copies of the preliminary plan which clearly shows all items set forth in Section 13-7.02. In addition, the following information shall be submitted:

1. An accurate and complete legal description with area in acres together with a plat certificate dated within 7 days of the preliminary plat submittal. Copies of all deeds and easements referred to in the plat certificate shall be furnished with the submittal.
2. The name, addresses, and telephones number of the owner and the professional preparing the plan.
3. Calculations of cumulative pre-development and post-development storm water runoff volumes and proposed methods of controlling post-development runoff rates.
4. At least one map at a scale of 1" = 200' depicting items listed above.
5. A completed environmental checklist as supplied by the Department of Planning and Economic Development.

Following receipt of a properly-prepared preliminary plan, the Planning and Economic Development Department shall schedule a meeting of the Technical Review Committee. Such meeting shall be scheduled no less than 10 days nor more than 30 days from the date of receipt of said preliminary plan. The applicant and the professional preparing the plan shall be notified of the date, time, and location of said meeting.

All conditions, requirements, or alterations in the proposed site plan resulting from review of the Technical Review Committee shall be transmitted, in writing to the applicant and/or their representative.

13-7.04 Required Improvements

Implemented: 10/08/2001 Revised: 01/01/1990

Prior to granting approval for any binding site plan, the Department of Public Works shall ascertain that City water and sanitary sewer improvements, plus appropriate dedications or easements, have been provided or will be provided. Performance bonds may be accepted in lieu of installation of the required improvements subject to approval of the Department of Public Works. If the development of the site is to be done in phases, the applicant shall submit a schedule of installation of required improvements to coincide with development phasing. Such improvement schedule is subject to approval of the Director of Public Works.

13-7.05 Street Installations

Implemented: 10/08/2001 Revised: 01/01/1990

In the event the principal frontage street providing access to the binding site plan is below the standard for an existing street, the installation of a street may be required prior to approval. If required, the street shall have a minimum traveled way brought to line and grade of not less than 20 feet of width with 4-foot shoulders on each side. The surface shall be at least of asphalt concrete quality and there shall be adequate provision for storm drainage. In addition, the applicant shall be required to sign a commitment to support a local improvement district (LID) for the future installation of a full-standard street.

All streets providing access to the binding site plan shall have a right-of-way width of no less than 60 feet, if a through street, or 50 feet if a cul-de-sac. In the event the abutting street does not meet these minimum standards, additional right-of-way shall be required. This requirement may be waived if, in the opinion of the Planning and Economic Development Director and the City Engineer, such additional right-of-way is not necessary for the future traffic circulation of the City.

13-7.06 Contents and Specifications

Implemented: 10/08/2001 Revised: 01/01/1990

The applicant shall submit to the Planning and Economic Development Department the final binding site plan, in reproducible form, depicting all improvements required by the Technical Review Committee. The final plan shall conform to the following technical standards, and shall be prepared by a registered land surveyor.

1. It shall be a plan legibly drawn, printed, or reproduced by a process guaranteeing a permanent record on polyester-base film and shall include all required certificates.
2. The size of each sheet shall be 18 inches by 18 inches. A border line shall be drawn around each sheet, with a blank margin of 1 inch on each edge. The scale of the plan shall be at least 1:1200 (1" = 100') but not larger than 1:240 (1" = 20') and shall show all details accurately and clearly. Sufficient sheets shall be used to accomplish this. The particular number of the sheet and the total number of sheets comprising the plan shall be stated on each of the sheets, and its relation to each adjoining sheet shall be clearly shown.
3. The exterior boundary of the binding site plan shall be indicated by a heavy border.
4. The following shall be shown: North Arrows, plat drawing scale, i.e., 1:600 (1" = 50') (graphically and feet per inch); included, if any with original block and lot numbers.
5. Each binding site plan shall have a distinct name, and a number assigned by the City.
6. Proper street names, and right-of-way widths and adjacent block lines shall be shown. If street dedications, or additional right-of-way purchases have been made after the original plat filing date, the Auditor's file number or deed number shall be shown in the area of the affected street right-of-way. If the binding site plan includes a portion of a vacated street, the City vacation ordinance number shall be shown within the vacated portion of the street.
7. A complete and accurate legal description of the total parcel included within the binding site plan shall be shown. If a metes and bounds description is used, the basis of bearings shall be shown with

bearing and distance between them. The area of the total site and of each lot or parcel shall be shown to nearest square foot on the plan.

8. All easements, whether public or exclusive, which affect the binding site plan shall be shown graphically on the plan.

13-7.07 Attachment of Covenants, Limitations and Conditions

Implemented: 10/08/2001 Revised: 01/01/1990

A copy of any and all covenants, limitations and conditions which are drafted in conjunction with, or as a result of a binding site plan, shall accompany the binding site plan and shall become part of it. Said covenants, limitations and conditions shall either be shown on the face of the plan, or shall be recorded at the County Auditor's office with the binding site plan.

13-7.08 Certifications and Dedications

Implemented: 10/08/2001 Revised: 01/01/1990

The following certifications shall appear on every binding site plan:

1. Land Surveyor Certification
2. Director of Public Works
3. Department of Planning and Economic Development
4. Covenants, Limitations and Conditions
5. County Auditor's Certificate

In accordance with state statutes, and regulations of this ordinance the land surveyor shall, at no cost to the City, furnish the Department of Planning and Economic Development with one permanent mylar original of the recorded binding site plan the same day as recording. The land surveyor shall also furnish one reduced vellum or mylar copy of the binding site plan at a scale ratio of 1:2400 (1" = 200').

13-7.09 Restrictions Upon Issuance of Building Permits

Implemented: 10/08/2001 Revised: 01/01/1990

No building permit shall be issued for construction of any kind upon the property in question unless such parcel, tract, or lot was created under the provisions of the chapter such building permit application is accompanied by a detailed plot plan clearly showing relationship of proposed structure, parking facilities, landscaping and drainage to the parcel lease boundary.

It is the responsibility of the building permit applicant to furnish the required information, and to establish the status of the parcel, tract or lot as it pertains to this chapter.

13-8 General Improvement Standards

Implemented: 10/08/2001 Revised: 01/01/1990

13-8.01 Drawings Required

Implemented: 10/08/2001 Revised: 01/01/1990

The developer shall submit to the City Engineer profiles of the proposed streets, drainage plans, and right-of-way section drawings, including utility line placement, for approval before any ground work is begun. All design drawings shall be prepared by a State of Washington registered professional engineer.

Because "as built" underground utility locations sometimes differ significantly from original designs, the developer shall submit to the City Engineer "as built" drawings of all underground utility placements upon completed installations of said utilities.

13-8.02 Installations Prior to Final Plat Approval

Implemented: 10/08/2001 Revised: 01/01/1990

Prior to the submission of a final plat for approval, all streets, alleys, sidewalks, storm drainage, utilities, monumentation, streetlights, street trees, and any other improvements specified hereunder shall be installed and completed by the subdivider to the satisfaction of the Public Works Director. Such improvements shall meet the standards specified in the ordinance; provided that a performance bond in the amount of 150% of the value of the incomplete required improvements may be posted in lieu of installation of improvements, and further provided that such bond is recommended by the Public Works Director and approved by the City Council. The performance bond shall specify exactly what improvements are covered and a time schedule for completion; however, at no time should the bond be for more than a one-year period.

13-8.03 Contact Required for Dedicated Improvements

Implemented: 10/08/2001 Revised: 01/01/1990

(Ordinance 8792, amended)

All improvements constructed by a subdivider, which are to be dedicated to the City, shall be constructed in accordance with a contract between the subdivider and the City. The contract shall provide terms and conditions satisfactory to the City and a permit is required to be issued before commencement of construction. At the discretion of the Director of Public Works, appropriate security may be required, covering construction performance and guaranteeing the construction after completion for a period of one year. The security requirement cannot be waived, however, if lots are to be sold before the construction is completed.

13-8.04 Street and Roadway Standards

Implemented: 10/08/2001 Revised: 01/01/1990

All existing streets adjacent to a subdivision shall be brought to no less than the 3/4 standard specified in Ordinance 8027 and 8040, as amended. All new streets and alleys within the subdivision shall be of the width and quality to meet the full standards of the City.

13-8.05 Sidewalks

Implemented: 10/08/2001 Revised: 01/01/1990

Sidewalks shall be installed on both sides of each street. The minimum sidewalk width shall be 5 feet. Sidewalks shall be required in dead end and cul-de-sac.

13-8.06 Pedestrian Ways

Implemented: 10/08/2001 Revised: 01/01/1990

Pedestrian ways may be required where blocks are exceptionally large or where there is a need for pedestrian access in areas other than along streets. Such ways shall be at least 3 feet in width and shall be surfaced with hard, dust-free, level material acceptable for walking.

13-8.07 Driveway Entrances

Implemented: 10/08/2001 Revised: 01/01/1990

The subdivider and/or developer shall predetermine the location of all driveway entrances prior to approval of construction plans and driveway indentations shall be made at the same time the sidewalks are constructed.

13-8.08 General Utility Installation

Implemented: 10/08/2001 Revised: 01/01/1990

All utilities (water, sewer, electrical, gas, and cable) shall be installed to the property line prior to acceptance of public improvements.

13-8.09 Easements

Implemented: 10/08/2001 Revised: 01/01/1990

The subdivider shall reserve a strip of land 5 feet in width lying adjacent to each exterior side of all dedicated public rights-of-way included in any plat. Said lands shall be recorded as public easements and shall be used primarily for the installation of required service utilities. Any and all franchised utilities, including City utilities, shall rightfully have access to and may use easements. Exclusive use rights cannot be granted to any single or combination of utilities.

13-8.10 Water System

Implemented: 10/08/2001 Revised: 01/01/1990

A complete water distribution system shall be installed. Such system shall be adequate to serve the area being platted. Each lot shall be connected to the water main by a service pipe extending at right angles from the main to the property line and including a stopcock placed on the street side 5 feet out from the property line. The connection to each lot shall be maintained by and kept within the exclusive control of the City.

All water lines and services shall be placed prior to improvement of the streets and shall be constructed in accordance with the appropriate codes and standards of the City of Bellingham. The developer shall pay the flat-rate charge for water services at the time the completed services are installed.

13-8.11 Sanitary Sewer

Implemented: 10/08/2001 Revised: 06/01/1996

A sanitary sewer system shall be installed in such a manner where each and every building in which people live, congregate, or are employed shall have a separate connection to the public sewer. Each connection and each fixture emptying into and through the connection shall be installed in the manner prescribed in the Plumbing Code of the City of Bellingham. All sewer mains in the subdivision shall be constructed in conformance with all appropriate codes and standards.

13-8.12 Storm Drainage and Surface Water Runoff

Implemented: 10/08/2001 Revised: 06/01/1996

(Ordinance 10633)

Drainage facilities for controlling storm drainage and surface water runoff shall comply with the ordinances of the City relating to drainage, including but not limited to, the submission and approval of plans, and the construction of drainage facilities.

13-8.13 Electrical and Communication Facilities

Implemented: 10/08/2001 Revised: 06/01/1996

In all subdivisions, adequate and satisfactory installation of electric power and communication facilities shall be required. All such facilities shall be installed underground except for the following:

1. Electric utility substations, pad-mounted transformers and switching facilities.
2. Electric transmission systems of a voltage of 55 KV or more.
3. TV cable amplifiers.
4. Telephone pedestals, cross-connect terminals, repeaters and cable warning signs.
5. Streetlighting standards.
6. Traffic-control equipment.
7. Temporary services for construction.

13-8.14 Streetlights and Name Signs

Implemented: 10/08/2001 Revised: 01/01/1990

The subdivider shall install at his expense streetlights and street name signs to the satisfaction of the Technical Review Committee, and such facilities shall conform to the standards of the City of Bellingham.

13-8.15 Street Naming

Implemented: 10/08/2001 Revised: 01/01/1990

All street names shall be subject to approval of the Planning Commission. The Planning Commission reserves the right to name or rename any street in any subdivision.

13-8.16 Flood Control

Implemented: 10/08/2001 Revised: 01/01/1990

Land which the Planning Commission has found to be unsuitable due to flooding, bad drainage or swamp conditions likely to be harmful to the safety, welfare and general health of future residents, and the Planning Commission considers inappropriate for development, shall not be subdivided unless adequate means of control have been formulated by the subdivider and approved by the City Engineer.

13-8.17 Erosion and Slide-Corrective Measures

Implemented: 10/08/2001 Revised: 01/01/1990

In the event the land to be subdivided has a slope or slopes of more than 20% and/or has rock or unstable soil conditions, the subdivider shall furnish soils data to the City Engineer. If conditions warrant control measures to correct slide, erosion or other similar problems, the subdivider shall be responsible for the design, installation and expense of any device or corrective measure subject to approval of the City Engineer.

13-8.18 Monumentation

Implemented: 10/08/2001 Revised: 01/01/1990

Permanent-control monuments shall be established at each and every controlling corner on the boundaries of the parcel of land being subdivided, and in the centers of all intersecting streets. Additional monuments shall be installed if requested by the City Engineer.

13-8.19 Connection to Accepted Street

Implemented: 10/08/2001 Revised: 01/01/1990

All subdivisions shall be required to be connected to an accepted City street.

13-8.20 Street Trees

Implemented: 10/08/2001 Revised: 01/01/1990

Street trees shall be provided by the subdivider in all subdivisions within the dedicated public utility easements adjacent to the street. There shall be a minimum of 2 trees per lot and street trees shall be selected, installed and maintained in accordance with the standard engineering specifications.

13-8.21 Preservation of Existing Vegetation

Implemented: 10/08/2001 Revised: 01/01/1990

The subdivision shall be so designed as to preserve the greatest amount of existing on-site vegetation, including trees with trunk diameter of 6 inches or greater, and other natural ground cover. Tree removal shall be replaced where practical.

13-9 Cluster Subdivisions

Implemented: 10/08/2001 Revised: 01/01/1990

This section is applicable and can be utilized at the subdivider's option in residential-single areas which have a "cluster," "cluster detached," or "cluster attached," use qualifier as part of the land use classification of the City's Comprehensive Plan.

The purpose of this chapter is to allow variation in the required minimum lot size, provided the same overall density is maintained, so as to preserve open space, tree cover, recreation areas or scenic vistas or to reduce the amount of streets and utilities where appropriate.

13-9.01 Maximum Number of Lots

Implemented: 10/08/2001 Revised: 01/01/1990

The maximum number of lots which can be created utilizing this procedure can be determined by dividing the total property size by the specified density found in the land use classification within the Neighborhood Plan.

13-9.02 Reduction of Lot Size and Frontage

Implemented: 10/08/2001 Revised: 01/01/1990

Pursuant to this chapter, the minimum lot size and frontage requirements may be reduced provided that at least 15% of the property's total property size is set aside for common open space.

13-9.03 Findings Prior to Approval

Implemented: 10/08/2001 Revised: 01/01/1990

Prior to cluster subdivision approval, the City must find that continued orderly development of adjacent property will not be unduly jeopardized from the concentration of streets and utilities within the proposed cluster subdivision, or cannot be reasonably serviced from the proposed cluster subdivision due to extreme environmental conditions.

13-9.04 Open Space

Implemented: 10/08/2001 Revised: 01/01/1990

The area designated as open space shall either be held in common among owners of the lots within the subdivision or dedicated to the City if appropriate. However, if held in private ownership, all development rights other than recreational in nature, shall be extinguished in the form of a recorded agreement. The common private open space shall be clearly identified on the final plat. A homeowner's association agreement shall be recorded after review by the Planning and Economic Development Department. Said agreement shall clearly set out the rights, obligations and responsibilities of the owners of property designated as common open space.

13-10 Lots and Blocks

Implemented: 10/08/2001 Revised: 01/01/1990

13-10.01 Through Lots

Implemented: 10/08/2001 Revised: 01/01/1990

Through lots shall not be allowed; however, if the subdivision abuts an arterial street, the lots on such streets may be through lots provided the Planning Commission determines such a layout to be in the best interests of safety and general welfare.

13-10.02 Lot Design

Implemented: 10/08/2001 Revised: 01/01/1990

All lots shall be of sufficient size to meet the site area requirements specified within the area's land use designation under "density" found within the applicable Neighborhood Plan in which the property is located; provided, however, that this minimum shall not be required in the following instances:

1. When there exists no specified minimum lot size in the subject area land use designation, in which case the lot size shall be determined by the subdivider subject to any other applicable codes or requirements;
2. Cluster lots which meet the requirements specified in Section 13-9;
3. Lot line adjustments pursuant to Section 13-3.01 for lots presently having less site area than the required minimum lot size;
4. For existing lots of record under single ownership having a total site area in excess of the required neighborhood density in which the case the number of possible lots shall be determined by dividing the total amount of site area by the specified neighborhood density and rounding to the nearest whole

number. One-half shall be rounded to the higher whole number. All lots proposed under this provision shall be as equal in site area as is practical.

Each lot shall have not less than 30 feet of frontage on a deeded or dedicated right-of-way. This width shall be a consistent 30 feet or more from the right-of-way to the building setback line. The minimum lot width at the building setback line shall be not less than 60 feet for interior lots and 70 feet for corner lots. Lots utilizing less than a 40-foot frontage standard, with the exception of pipe-stem lots, shall have the front yard setback line increased to 30 feet from the property line. (Ordinance 9550)

Pipe-stem lots shall only be permitted in a residential subdivision and short subdivision if the following are met:

1. The minimum width of the minor or access portion of the lot shall be 30 feet; the lot width standard is 60 feet;
2. The access portion of the lot shall not be included in computations for meeting minimum density requirements of the Neighborhood Plans;
3. A 5-foot setback from property lines for driveways in the access portion of the lot shall be recorded on the face of the plat unless, in the judgment of the Planning and Economic Development Director, such a requirement would be unfeasible due to topographical conditions;
4. No pipe-stem lot shall be permitted in short subdivisions where the ownership is common with adjacent property;
5. Side-by-side pipe-stems in short subdivisions and subdivisions shall not be permitted unless, in the judgment of the Planning and Economic Development Director in consultation with the City Engineer, the design is necessary due to site conditions. Joint access may be required.
6. Joint access for pipe-stem and adjacent lots under common ownership at the time of division of property shall be required. An access easement shall be recorded on the face of the plat. (Ordinance 9550)

Pipe-stem lots in commercial and industrial subdivisions shall be permitted only if the following are met:

1. The minimum width of the minor or access portion of the lot shall be 40 feet; the lot width standard is 60 feet. Minimum width of the minor or access portion may be decreased to 30 feet if joint access with adjacent property is maintained and in the judgment of the City Engineer, no adverse traffic impacts will result.
2. The access portion of the lot shall not abut property with a residential land use designation.
3. No pipe-stem lot shall be permitted in short subdivisions where the ownership is common with adjacent property.
4. Side-by-side pipe-stems are permitted only if joint access is granted. Joint access for pipe-stem and adjacent lots under common ownership at the time of division of property shall be required. An access easement shall be recorded on the face of the plat. (Ordinance 9550)

13-10.03 Block Design

Implemented: 10/08/2001 Revised: 01/01/1990

The maximum length of a block is 1,320 feet. The maximum width is 500 feet. Where blocks exceed 500 feet in length, pedestrian easements may be required if deemed necessary.

13-11 Parks, Open Space, and Public Areas

Implemented: 10/08/2001 Revised: 01/01/1990

13-11.01 Provisions for Parklands

Implemented: 10/08/2001 Revised: 01/01/1990

In each subdivision, appropriate provisions shall be made for parks, playgrounds, open space and other public areas. Provision of such areas may be made in one of the two following ways:

1. A minimum of 100 square feet of ground area per lot shall be provided in a location predetermined by the City Park Plan.
2. In the event no proposed park or planned expansion of an existing park is located within the boundaries of a subdivision, then the developer shall pay into a Special Park Site Acquisition Fund the sum of $50.00 per lot. Such fund is to be used to acquire land for parks, playgrounds, open space or greenbelts in areas deemed appropriate by the City Council.

13-11.02 Substitution of Greenbelts for Required Park Lands

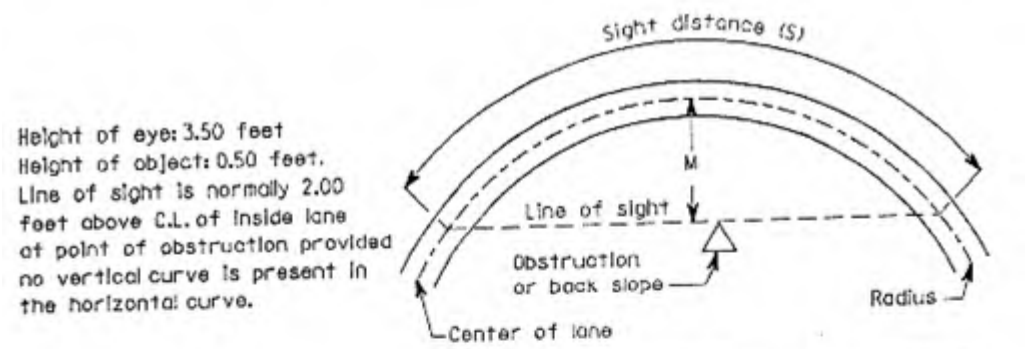
Implemented: 10/08/2001 Revised: 01/01/1990

The developer may substitute open space or greenbelts for the above required park lands if, in the opinion of the City Council, such areas are necessary for public welfare or safety. Open spaces or greenbelts need not be dedicated to and maintained by the public and any substituted in lieu of park lands shall be a continuing obligation of the owners of the subdivision.

Section 14. Figures

Figure 4-1 Horizontal Stopping Sight Distance

Implemented: 10/10/2001 Revised: 01/01/1990



Height of eye: 3.50 feet
Height of object: 0.50 feet.
Line of sight is normally 2.00 feet above C.L. of inside lane at point of obstruction provided no vertical curve is present in the horizontal curve.

$$M = R\left[\text{VERS}\left(\frac{28.65S}{R}\right)\right] = R\left(1 - \cos\frac{28.65S}{R}\right)$$

$$S = \frac{R}{28.65}\left[\cos^{-1}\left(\frac{R-M}{R}\right)\right]$$

S = Length of curve
Angle is expressed in degrees

DESIGN SPEED (MPH)	STOPPING SIGHT DISTANCE (FT)	
	DESIRABLE MIN	MINIMUM **
25	150	—
30	200	—
35	250	225
40	325	275
50	475	400
60	650	525
70	850	625

** Headquarters approval required

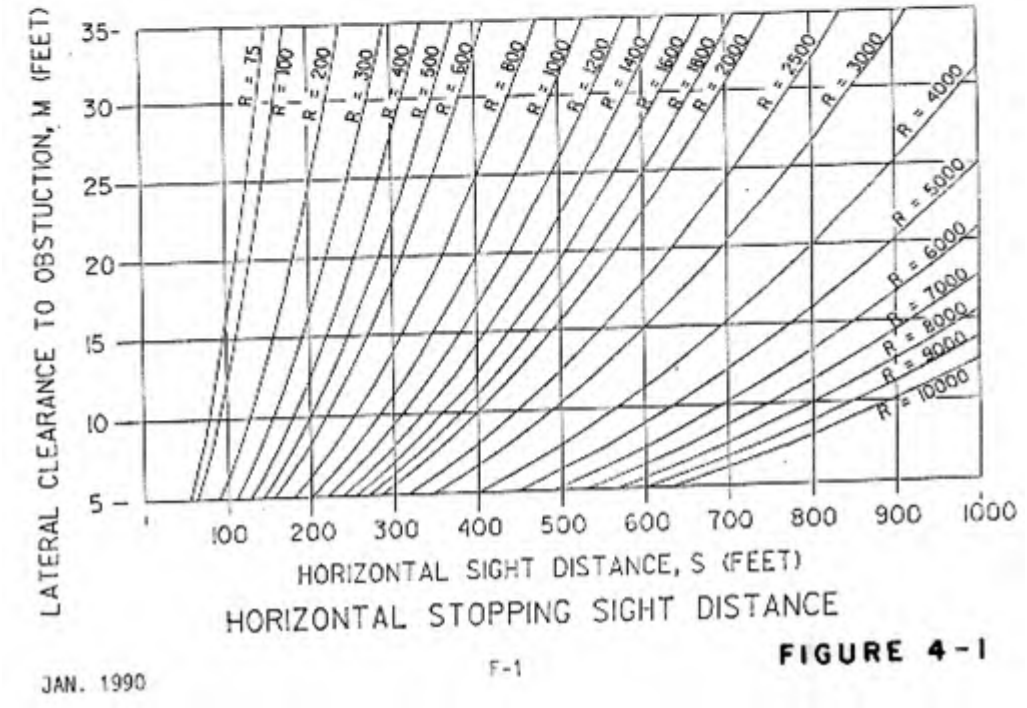
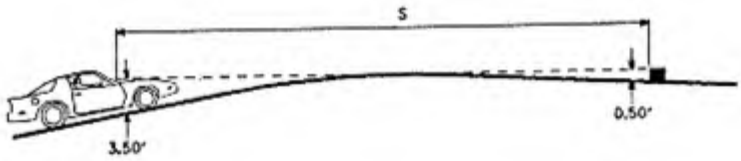


Figure 4-2 Stopping Sight Distance for Crest Vertical Curves

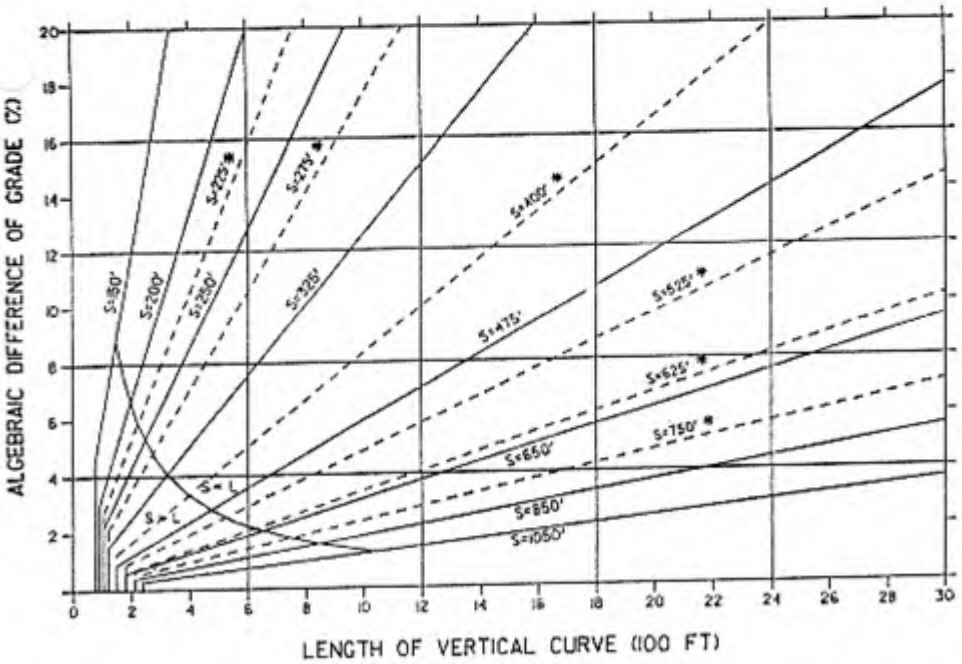
Implemented: 10/10/2001 Revised: 01/01/1990



WHEN S < L	WHEN S > L
$L = 2S - \frac{1329}{A}$	$L = \frac{AS^2}{1329}$
L = Curve Length (Feet) A = Algebraic Grade Difference (Percent) S = Sight Distance (Feet)	

DESIGN SPEED (MPH)	DESIRABLE MINIMUM STOPPING DISTANCE (FEET)	MIN. STOPPING DISTANCE (FEET) *	MIN. L (FEET)
25	150	-	75
30	200	-	90
35	250	225	105
40	325	275	120
50	475	400	150
60	650	525	180
70	850	625	210
80	1050	750	240

* Headquarters approval required.



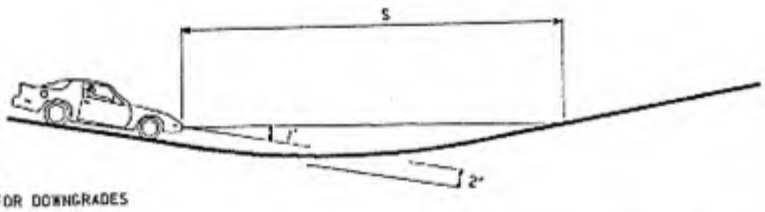
STOPPING SIGHT DISTANCE FOR CREST VERTICAL CURVES

FIGURE 4-2

JAN. 1990 F-2

Figure 4-3 Stopping Sight Distance for Sag Vertical Curves

Implemented: 10/10/2001 Revised: 01/01/1990



INCREASE FOR DOWNGRADES

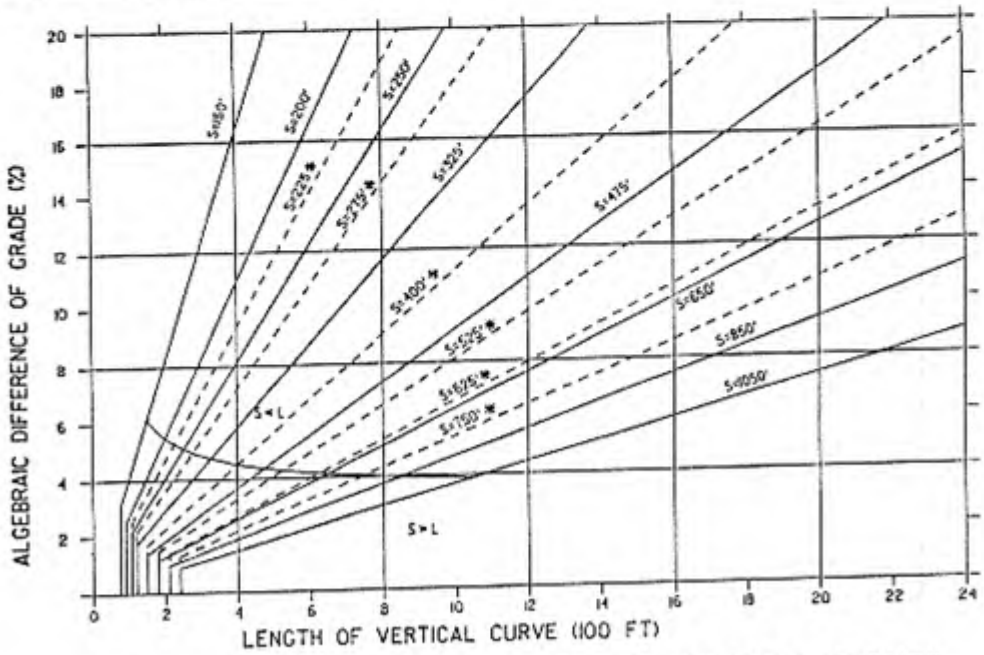
DESIGN SPEED (MPH)	CORRECTION DISTANCE (FT) 3%	6%	9%
30	10	20	30
40	20	40	70
50	30	70	—
60	50	110	—
70	70	160	—

DESIGN SPEED (MPH)	DESIRABLE MINIMUM STOPPING DISTANCE (FEET)	MIN. STOPPING DISTANCE (FEET) *	MIN. L (FEET)
25	150	-	75
30	200	-	90
35	250	225	105
40	325	275	120
50	475	400	150
60	650	525	180
70	850	625	210
80	1050	750	240

* Headquarters approval required

WHEN S < L	WHEN S > L
$L = 2S - \frac{400 + 3.5S}{A}$	$L = \frac{AS^2}{400 + 3.5S}$

L = Curve Length (Feet)
A = Algebraic Grade Difference (Percent)
S = Sight Distance (Feet)



STOPPING SIGHT DISTANCE FOR SAG VERTICAL CURVES

JAN. 1990 F-3 **FIGURE 4-3**

Figure 4-4 Guard Rail Warrant Chart for Fill Section Embankments

Implemented: 10/10/2001 Revised: 01/01/1990

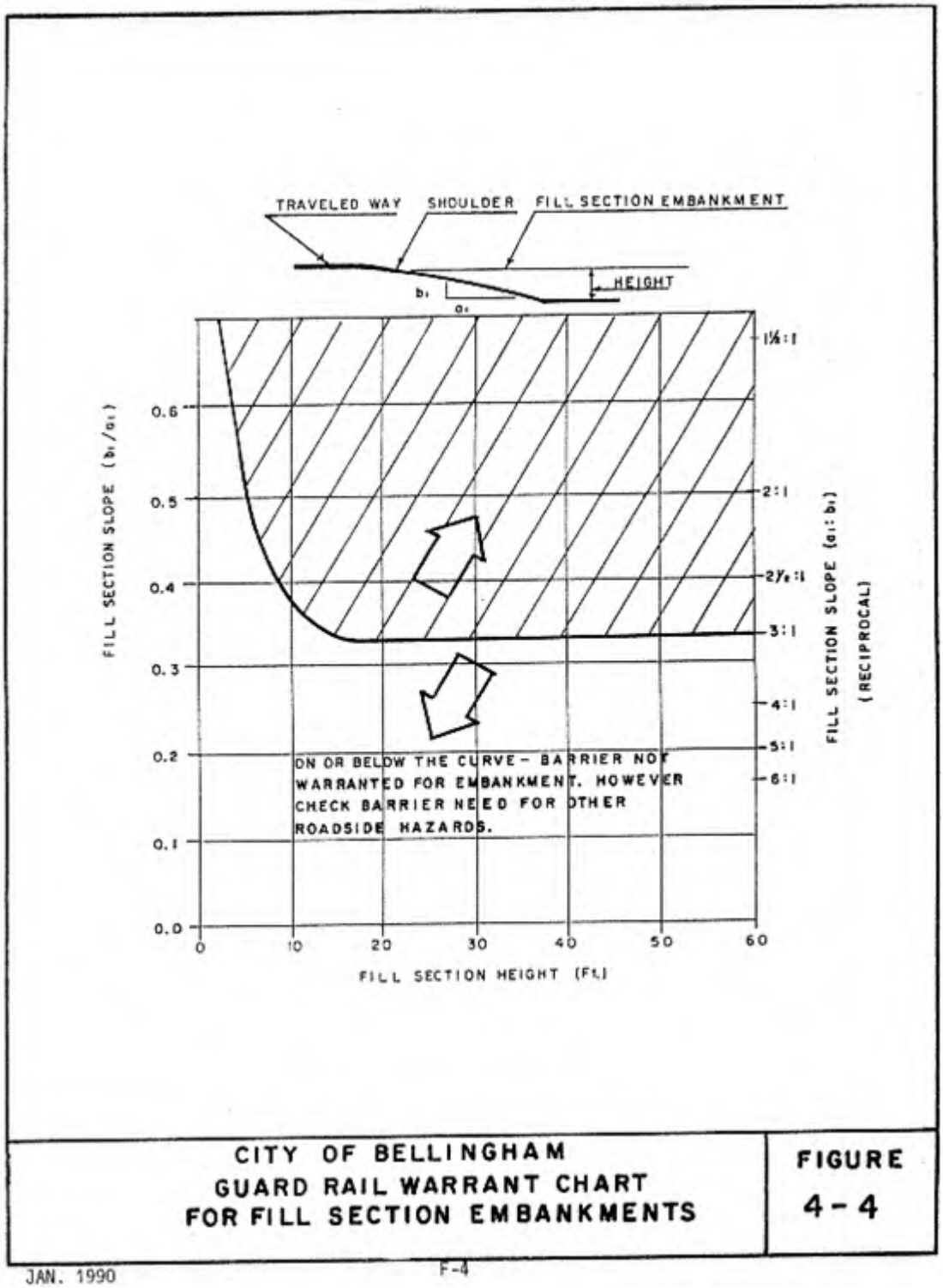
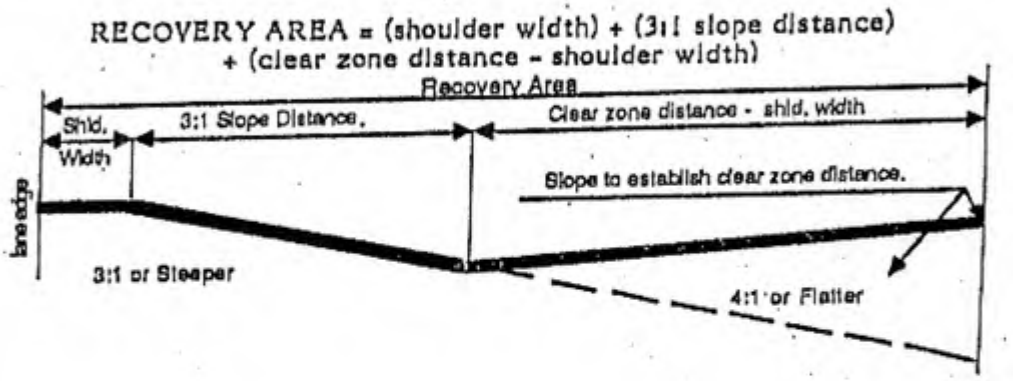


Figure 4-5 Recovery Area

Implemented: 10/10/2001 Revised: 01/01/1990

*When the fill section slope is 3:1 or steeper, the clear zone distance is called a recovery area and is calculated using the recovery area formula. The basic philosophy behind the recovery area formula is that a vehicle can transverse a 3:1 slope but cannot recover (control steering) and, therefore, the formula does not allow a credit toward the recovery area for the 3:1 horizontal slope distance. The diagram below is intended to clarify the use of the recovery area formula.



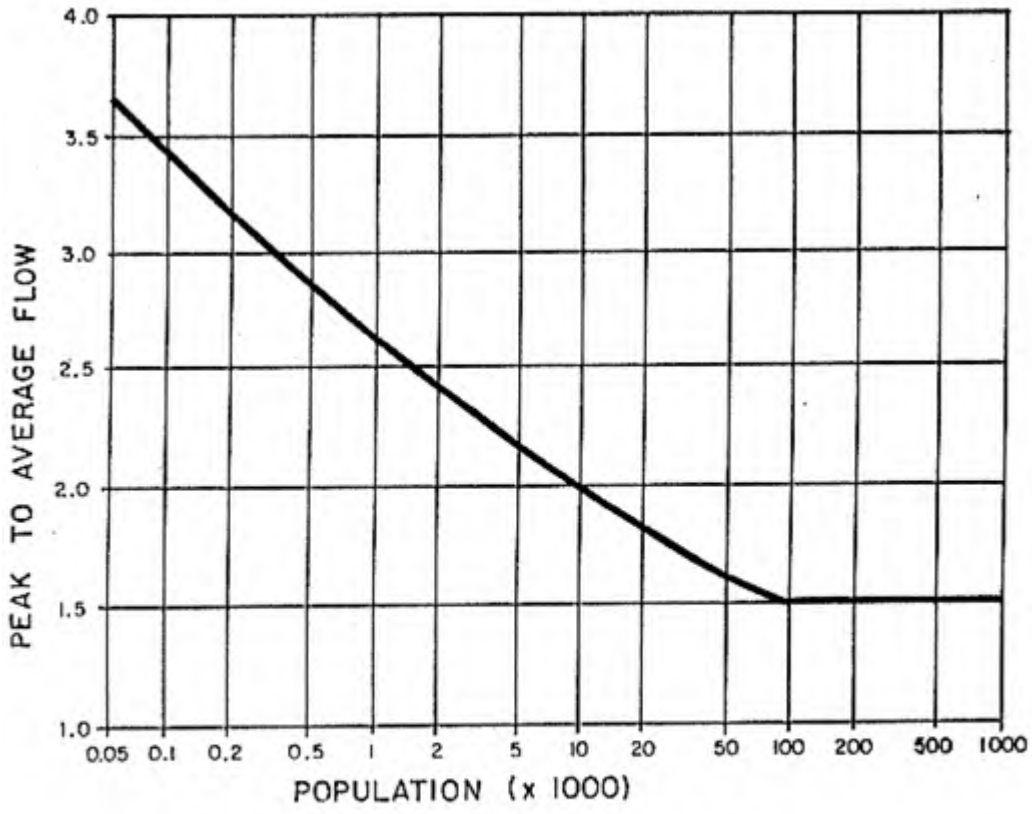
RECOVERY AREA

FIGURE 4-5

JAN. 1990 F-5

Figure 5-1 Peaking Factor Versus Population

Implemented: 10/10/2001 Revised: 03/01/1993



PEAKING FACTOR VERSUS POPULATION

FIGURE
5-1

Figure 12-1 Driveway Width

Implemented: 10/10/2001 Revised: 03/01/1993

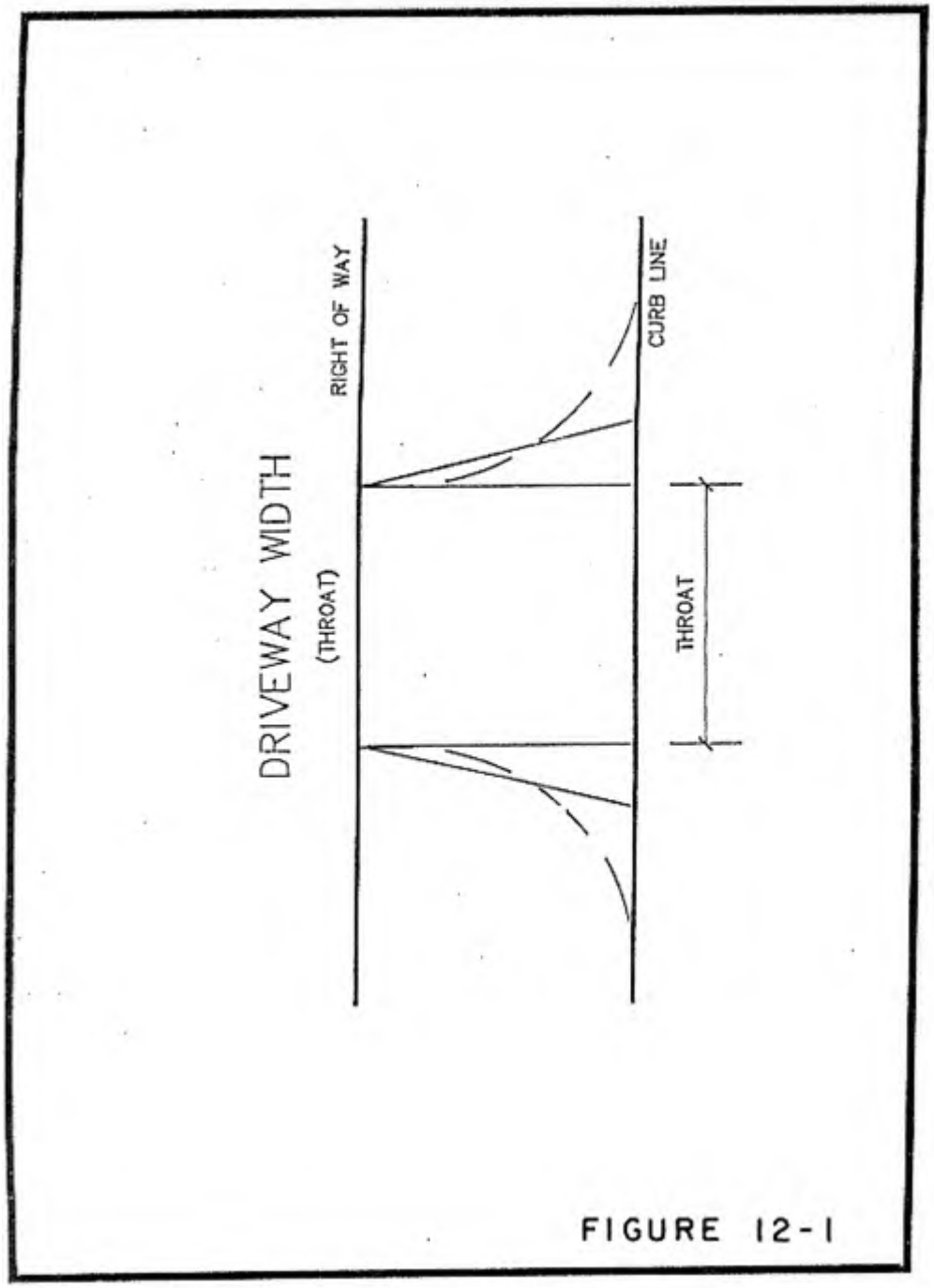


Figure 12-2 Distance from Intersections

Implemented: 10/10/2001 Revised: 03/01/1993

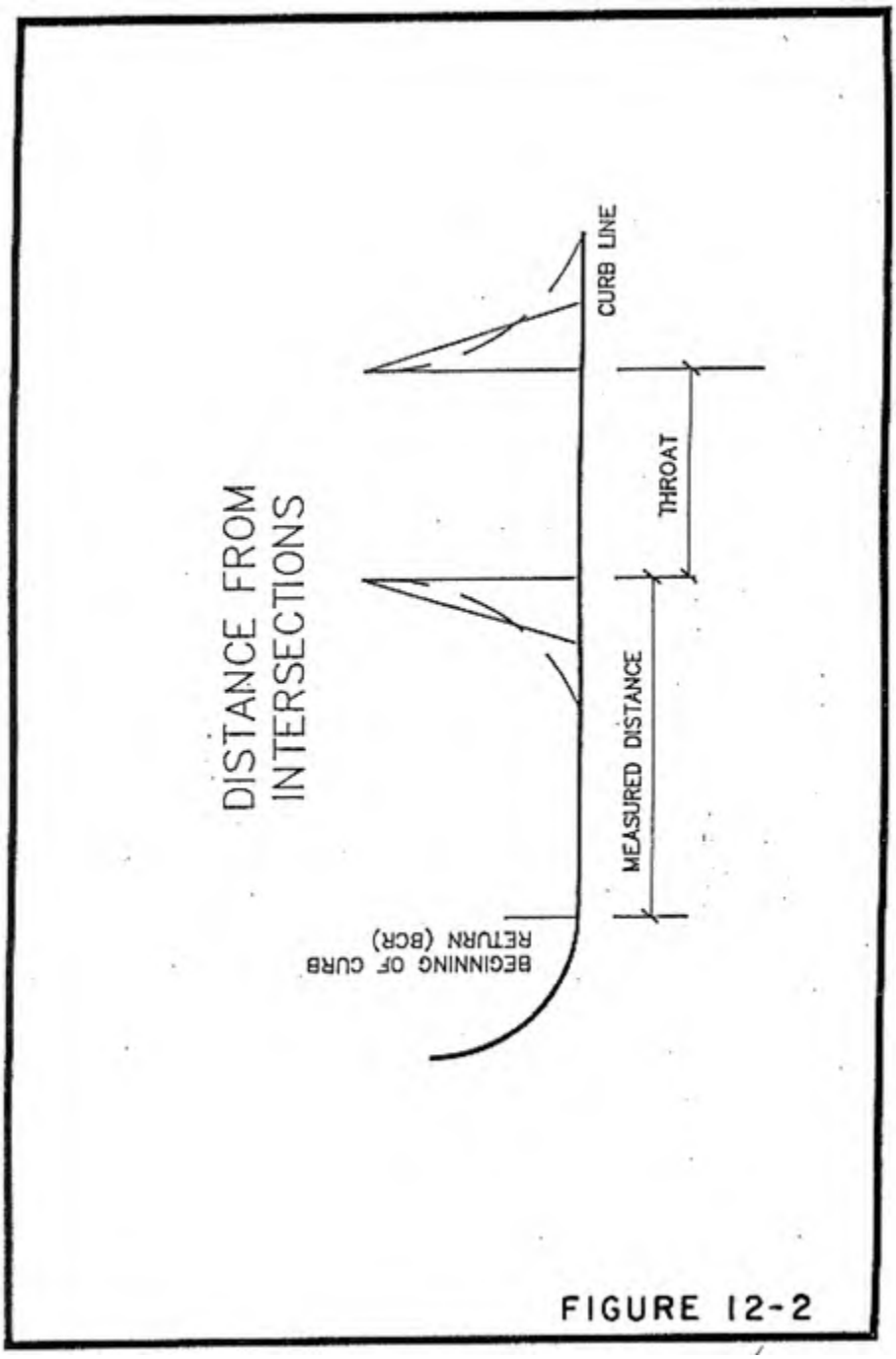
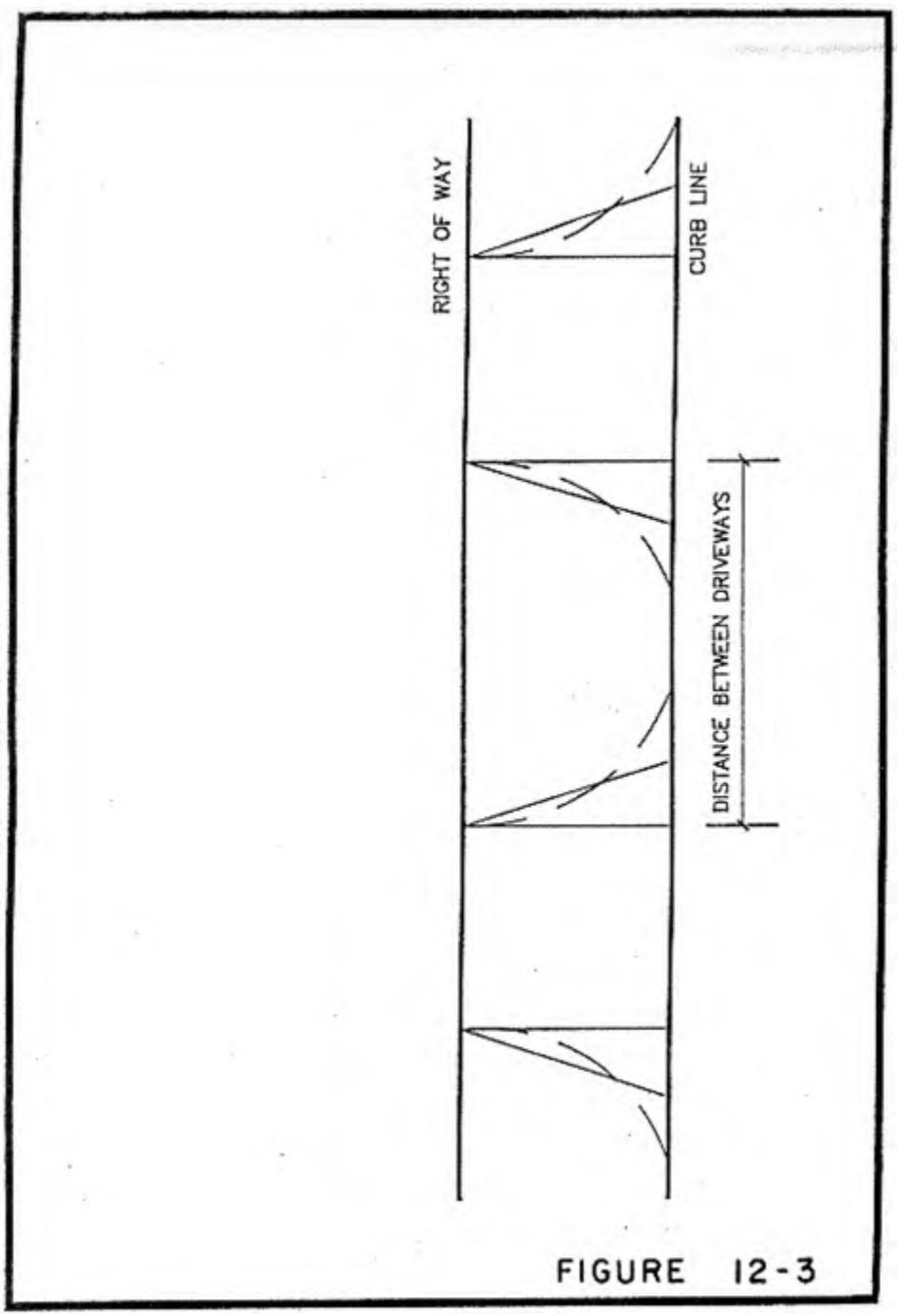


Figure 12-3 Distance Between Driveways

Implemented: 10/10/2001 Revised: 03/01/1993



Appendices

Appendix 1: Thresholds for requiring traffic studies

Implemented: 10/10/2001 Revised: 11/10/1997

LAND USE	UNIT OF MEASUREMENT	THRESHOLD
Residential		
Single-Family Detached Housing	D.U.	50 Units
Apartment, General	D.U.	50 Units
Low-Rise Apartment (1-2 stories)	D.U.	50 Units
High-Rise Apartment (3-plus stories)	D.U.	50 Units
Mobile Home	D.U.	50 Units
Retirement Community	D.U.	50 Units
Townhouse	D.U.	50 Units
Condominium	D.U.	50 Units
Lodging		
Hotel (convention oriented)	Room	75 Rooms
Motel	Room	75 Rooms
Resort Hotel	Room	75 Rooms
Recreational		
Golf Course	Parking Space	100 spaces
Racquet Clubs	1,000 Sq. Ft.	15,000 Sq. Ft.
Athletic Club	1,000 Sq. Ft.	10,000 Sq. Ft.
Institutional		
Elementary-Intermediate	Student	150 Students
High School	Student	150 Students
Junior/Community College	Student	150 Students
University	Student	200 Students
Library	1,000 GSF	7,500 Sq. Ft.
Day Care Center	Children	50 Children
Nursing Home	Bed	100 Beds
Medical		
Hospital	Bed	100 Beds
Clinic (Diagnostic/Out Patient)	1,000 Sq. Ft.	5,000 Sq. Ft.
Drug Store	1,000 Sq. Ft.	5,000 Sq. Ft.
Medical Office	1,000 Sq. Ft.	5,000 Sq. Ft.
Dental Lab	Employee	50 Employees
Office		
Office Buildings	1,000 Sq. Ft.	50,000 Sq. Ft.
Office Park	1,000 Sq. Ft.	50,000 Sq. Ft.
Research Center	1,000 Sq. Ft.	50,000 Sq. Ft.
Post Office	1,000 Sq. Ft.	2,500 Sq. Ft.
Retail		
Specialty Retail Center	1,000 Sq. Ft.	10,000 Sq. Ft.
Discount Stores	1,000 Sq. Ft.	7,500 Sq. Ft.
Hardware/Paint Stores	1,000 Sq. Ft.	7,500 Sq. Ft.
Barber Shop	Chair	10 Chairs
Cleaners	1,000 Sq. Ft.	5,000 Sq. Ft.
Shopping Center	1,000 Sq. Ft.	5,000 Sq. Ft.
New/Used Car Sales	1,000 Sq. Ft.	10,000 Sq. Ft.
Supermarket	1,000 GSF	10,000 Sq. Ft.
Convenience Market - 24 Hour	1,000 GSF	3,000 Sq. Ft.
Convenience Market- 15 - 16 Hour	1,000 GSF	3,000 Sq. Ft.
Delicatessen Market	1,000 Sq. Ft.	5,000 Sq. Ft.

LAND USE	UNIT OF MEASUREMENT	THRESHOLD
Services		
Bank - Walk-In	1,000 GSF	5,000 Sq. Ft.
Bank - Drive-In	1,000 Sq. Ft. (Lobby)	2,000 Sq. Ft.
Savings & Loan - Walk-In	1,000 GSF	5,000 Sq. Ft.
Savings & Loan - Drive-In	1,000 GSF	4,000 Sq. Ft.
Restaurant		
Quality Restaurant	Seat 1,000 Sq. Ft	100 Seats 5,000 Sq. Ft.
High-Turnover, Sit-Down	Seat 1,000 Sq. Ft.	75 Seats 2,000 Sq. Ft.
Fast-Food Restaurant	Seat	50 Seats
With Drive-Through Service	1,000 Sq. Ft.	1,000 Sq. Ft.
Automotive Services		
Service Station	Pump	10 Pumps
Auto Upholstery Shop	1,000 Sq. Ft.	25,000 Sq. Ft.
Auto Parts	1,000 Sq. Ft.	5,000 Sq. Ft.
Auto Repair & Body Parts	1,000 Sq. Ft.	50,000 Sq. Ft.
Transmission Shop	1,000 Sq. Ft.	50,000 Sq. Ft.
Car Wash	Bays	5 Bays
Wholesale Stores		
Wholesale	1,000 GSF	50,000 Sq. Ft.
Produce Market	1,000 Sq. Ft.	10,000 Sq. Ft.
Churches		
Church	Member	250 Members
Warehouse		
Industrial - Warehouse - Manufacturer	1,000 Sq. Ft.	25,000 Sq. Ft.
Mini Warehouse	Units	200 Units
Industrial Park	1,000 Sq. Ft.	25,000 Sq. Ft.
Entertainment		
Movie Theaters	Screen	2 Screens

Appendix 2: Traffic study requirements and study outline

Implemented: 10/10/2001 Revised: 01/01/1990

Typical Study Contents:

1. Introduction
    1. Land Use, Site and Study Area Boundaries (provide map)
    2. Existing and Proposed Site Uses
    3. Existing and Proposed Uses in Vicinity of Site (provide map)
    4. Existing and Proposed Roadways and Intersections (provide map)
2. Trip Generation and Design-Hour Volumes (provide table)
3. Trip Distribution (provide figure)
4. Trip Assignment (provide figure)
5. Existing and Projected Traffic Volumes (provide figure for each item)
    1. AM Peak-Hour Site Traffic (including turning movements)
    2. PM Peak-Hour Site Traffic (including turning movements)
    3. AM Peak-Hour Total Traffic (including site-generated traffic and projected traffic)
    4. PM Peak-Hour Total Traffic (including site-generated traffic and projected traffic)
    5. Any Other Peak Hour Necessary for Complete Analysis
    6. Total Daily Existing Traffic for Street System in Study Area
    7. Total Daily Existing Traffic for Street System in Study Area and New Site Traffic
    8. Total Daily Existing Traffic for Street System in Study Area Plus New Site Traffic and Projected Traffic from Build-Out of Study Area Land Uses
6. Capacity Analysis (provide analysis sheets in appendices)
7. Traffic Signals (provide analysis sheets in appendices)
8. Traffic Accidents (optional) (provide collision diagrams and accident rate)
9. Conclusions
10. Recommendations
    1. Proposed Recommended Improvements (provide sketches of improvements)
    2. Volume/Capacity Analysis at Critical Points (provide analysis sheets in appendices)
    3. Traffic Volume Proportions

NOTE: Information required on figures may be combined, provided that the information is clearly legible.

Appendix 3: Level of service ranges for planning applications for signalized intersections

Implemented: 10/10/2001 Revised: 01/01/1990

Maximum Sum of Critical Volumes (VPH)

Level of Service	Two Phase	Three Phase	Four or More Phases	V/C Ratio
A	900	855	835	0.00 – 0.60
B	1050	1000	965	0.61 – 0.70
C	1200	1140	1100	0.71 – 0.80
D	1350	1275	1225	0.81 – 0.90
E	1500	1425	1375	0.91 – 1.00
F	N/A	N/A	N/A	Variable

NOTE: To determine level of service, first complete the planning analysis form to obtain the critical volume sum. Then use this number to enter the table under the appropriate signal-phase column. The next higher number is then used to determine the level of service on the left.

As an example, if the planning analysis for a three-phase intersection yielded a critical volume sum of 1280, then the next higher number of the three-phase column, or 1425, would be used for level of service. In this example, the resultant level of service would be "E."

Appendix 4: Traffic Study Requirements Form

Implemented: 10/10/2001 Revised: 11/10/1997

APPENDIX 4

TRAFFIC STUDY REQUIREMENTS FORM

DATE: _____

SUBJECT NAME _____ LOCATION _____

	DEVELOPER	TRAFFIC CONSULTANT	CITY	APPROVAL PROCESS
COMPANY	----------	----------	----------	CITY ---
CONTACT	---------- P.E.	---------- P.E.	----------	W.S.D.O.T. ---
PHONE	----------	----------	----------	OTHER ---

TRAFFIC STUDY FOR:		CONTENT OF REPORT TO INCLUDE			METHOD
Zoning		Land Use Description	Study Area Impacts	Site Impacts	
Annexation		Trip Gen. (+Reduct Factor)			
Tentative Map		Trip Dist./Trip Assignmnt			
Access Permit		Parking Anal. +Shrd Parking			
		Accident Analysis			
		Traffic Signal Progressn.			

Intersection Capacities to be Analyzed *	Peak Periods				Street N.T.D.S. to be Provided		Projection	
	A.M.	Noon	P.M.	Other		Exist	Build Out	20 Yr.

* On existing and build out conditions:
Traffic Consultants must meet with City staff to complete form.
Traffic studies submitted without form being completed prior to study may not be accepted. All studies must conform to City Ordinance.
Study Area Definition: _____

JAN. 1990 A-6

Appendix 5: Document Revision History

Date	Changes
10/10/2014	Converted existing guidelines from Lotus Notes to Microsoft Word and Adobe PDF for public access
11/10/2014	Add Standard Drawing WA-826 Optional Dual Water Service Detail Add WA-826 to Standard Drawing Table of Contents Add reference to WA-826 to Section 6-3.03.6 Water Service Transfers
12/12/2014	Update Drawings: • ST-170 Monument in Pavement New or Existing • ST-173 Concrete Monument Outside Pavement Add Drawings: • ST-171 Monument in Concrete (PCC) Street • ST-172 PVC Monument in Pavement for Overlay • ST-174 Core Monument in Pavement New or Existing Update Standard Drawing references for 'Monument' in Section 1 - Glossary of Terms
04/30/2015	Add Standard Drawing TC-316 - Shared Lane Marking Standard Update Standard Drawing Table of Contents for TC-316
05/05/2015	Update Standard Drawing TC-315 - Bicycle Lane Standards Add Standard Drawing TC-317 - Bicycle Detector Pavement Marking Standard Update Standard Drawing Table of Contents for TC-315 & TC-317
05/15/2015	Add Standard Drawing EL-464 - Bicycle Detector Pavement Marking Locations on Detector Loops Update Standard Drawing Table of Contents for EL-464
06/13/2016	Update Standard Drawing ST-155 - Bus Turnout Detail
06/15/2016	Update Standard Drawings: • CG-218 Pavement Repair (Curb Replacement) • WA-865 Reverse Thrust Blocking for Cross with Valves • MS-1050 Mailbox Standards Plat/Commercial
08/11/2016	Add Standard Drawing WA-803 Sample Tap Installation
08/30/2016	Update Standard Drawing WA-830 1" Single Water Service in Meter Box
09/12/2016	Update Standard Drawings: • CG-208 Type "E" Barrier Curb • CG-232 City Center / Urban Village Sidewalk • CG-235 Porous Concrete Sidewalk • CG-246 Sidewalk Ramp Types 1A, 1B, 1C, & 1D • WA-820 Water Pipe Bedding Details Remove Standard Drawings: • CG-248 Sidewalk Ramp Types 2A, 2B • CG-250 Sidewalk Ramp Type 4B
4/26/2017	Add Standard Drawings: • WA-872 Water Tap Excavation 4” and Larger • WA-874 Water Tap Excavation Under 4” Modify Standard Drawings: • WA-817 Typical Vacuum / Air Release Valve – Above Ground • WA-818 Typical Vacuum / Air Release Valve – Below Ground • WA-802 Hydrant Installation • WA-844 5/8”-3/4” Meter Assembly • CG-200 Type ‘A’ Modified Curb and Gutter
5/26/2017	Modify Standard Drawings: • ST-170; ST-171; ST-173; ST-174
6/13/2018	Add Standard Drawing: • ST-106 Minimum Standard Alley, Gravel Modify Standard Drawings: • ST-100; ST-104; MS-1040

Forms

Public Facilities Construction Application

LINK – PREVIEW



PUBLIC FACILITIES CONSTRUCTION APPLICATION

TO BE COMPLETED BY STAFF

Project Identifier & Name: _____

Date Application Received: _____ Date Application Accepted: _____

Assigned Project Manager: _____

The following items **must be included with this completed form** to constitute a complete application:

☐ Electronic Civil Design Plans prepared in conformance with the City's Development Guidelines and Improvement Standards.

Stormwater Pollution Plan, Stormwater Site Plan, and/or Stormwater Report, see Stormwater Submittal Requirements for more information.

Application deposit for 1.5% of the stamped engineer cost estimate.

LATECOMER AGREEMENT

IMPORTANT NOTICE OF CHANGE IN THE LAW

Per BMC 14.02.040 any developer using private funds to construct street improvements and/or utility system improvements in the city may apply to the city for a latecomer agreement in order obtain partial cost recovery from other property owners that will later connect to or use the street and/or utility system improvements made by the developer. However, then the assessment reimbursement area and amount must be determined, a latecomer agreement executed and recorded against the benefited properties, **prior to commencement of construction of the improvements**. Failure to timely file a Latecomer Application results in waiver of the latecomer process. To avoid inadvertent waiver and/or unnecessary delay, applicant is strongly encouraged to file his or her latecomer application simultaneously with the filing of this Application for Public Facilities Construction. The latecomer process takes time, so applicant should planaccordingly.

I intend to pursue a latecomer agreement: YES, Separate Application is Required NO

Page 1 of 4

Revised 7/18/2017

Web Sites

WSDOT Standards Website Link

http://www.wsdot.wa.gov/Design/Standards/default.htm

Standard Plans Table of Contents

Plan No.	Plan Title	Approval Date	Ref No.
Section ST - 100 Streets			
ST-100	Minimum Standard Alley, Cross Section 1	5/29/2018	ST-1
ST-104	Minimum Standard Alley, Cross Section 2	5/29/2018	ST-2
ST-106	Minimum Standard Alley, Gravel	5/29/2018	
ST-108	Minimum Standard ACC Street Section	11/29/2004	ST-18
ST-112	Minimum Standard Residential Concrete Street	01/11/2005	ST-19
ST-116	Minimum Residential Street, Lake Whatcom Watershed Very Low Volume	01/11/2005	ST-19A
ST-120	Standard ACC Section Residential Access Street	11/06/2008	ST-20
ST-124	Standard Residential Concrete Street	11/06/2008	ST-21
ST-128	Standard Residential Street, Lake Whatcom Watershed Very Low Volume	01/11/2005	ST-20A
ST-132	Standard Street Section Collector, Secondary or Principal Arterial	11/06/2008	ST-22
ST-150	Pocket Parking Detail	11/06/2008	ST-52
ST-155	Bus Turnout Detail	06/13/2016	ST-40
ST-157	Speed Hump Detail	05/20/2009	
ST-160	70' Diameter Cul-De-Sac	11/06/2008	
ST-165	Railroad Crossing Improvement	11/29/2004	ST-34
ST-170	Monument In Pavement New or Existing	05/26/2017	
ST-171	Monument in Concrete (PCC) Street	05/09/2017	
ST-172	PVC Monument in Pavement for Overlay	12/12/2014	
ST-173	Concrete Monument Outside of Pavement	05/26/2017	
ST-174	Core Monument in Pavement New or Existing	05/26/2017	
ST-180	Horizontal Pavement Repair (Street Crossing)	12/10/2009	ST-3
ST-182	Longitudinal Pavement Repair	12/10/2009	
ST-183	Adjusting Castings To Finish Grade	03/19/2009	
ST-184	Tree Planting Detail Planting Strip	01/28/2013	
ST-185	Tree Planting Detail Behind Sidewalk	11/07/2007	
Section CG - 200 Curbs, Gutters, and Sidewalk			
CG-200	Type "A" Modified Curb and Gutter	04/26/2017	ST-6
CG-202	Type "C" Traffic Curb	05/28/2009	
CG-204	Rolled Curb and Gutter	11/06/2008	ST-46
CG-208	Type "E" Barrier Curb	11/29/2004	ST-7
CG-212	Extruded Cement Concrete Curb	11/29/2004	ST-6-A

Plan No.	Plan Title	Approval Date	Ref No.
CG-216	Extruded Asphalt Concrete Sections	11/29/2004	ST-39
CG-218	Pavement Repair (Curb Replacement)	06/15/2016	
CG-220	Gutter Treatment at Catch Basin	01/11/2011	ST-13
CG-230	Sidewalk	10/19/2009	ST-14
CG-232	Down Town Art's District / Urban Village Sidewalk	11/11/2011	
CG-235	Porous Concrete Sidewalk	01/06/2009	
CG-238	Parkway Sidewalk	10/19/2009	ST-15
CG-242	Brick Paving Enlargement	12/28/2004	ST-33
CG-246	Sidewalk Ramps Type 1A, 1B, 1C, & 1D	09/12/2016	WSDOT
CG-260	Driveway Sections	02/22/2013	ST-10
CG-265	Typical Driveway Examples	02/22/2013	ST-10
CG-270	Driveway Restoration	11/29/2004	ST-11
Section TC - 300 Traffic Channelization and Controls			
TC-300	Abatement Sight Clearance Distances	09/27/2006	
TC-305	Pavement Marking Details	11/29/2004	ST-50
TC-310	Continental Crosswalk Detail	05/26/2009	ST-53
TC-315	Bicycle Lane Standards	05/05/2015	
TC-316	Shared Lane Marking Standard	04/30/2015	
TC-317	Bicycle Detector Pavement Marking Standard	05/05/2015	
TC-320	Street Sign Post Detail	11/09/2005	ST-51
TC-325	Type 3 Barricade	11/29/2004	ST-48
TC-330	Flagger Control for Lane Closure	01/11/2005	ST-24
TC-340	Street Closure for Community Events	06/07/2010	
Section EL - 400 Electrical, Lighting, and Signals			
EL-400	Residential Street Light and System Fusing	11/29/2004	ST-42
EL-404	Arterial Signal and Luminaire Pole	11/29/2004	ST-43
EL-408	Arterial Alternate Luminaire Pole	11/29/2004	ST-43A
EL-420	Signal Head Mounting Detail	11/29/2004	TR-7
EL-424	Recessed Terminal Compartment	11/29/2004	TR-6
EL-428	Terminal Block	01/11/2005	TR-6
EL-432	Foundation Detail	09/15/2010	TR-3
EL-436	Type "P" Signal Cabinet Base Detail	11/29/2004	TR-4A
EL-440	Type "K" Signal Cabinet Base Detail	11/29/2004	TR-4B
EL-444	Contactor & Service Cabinet	11/29/2004	ST-45

Plan No.	Plan Title	Approval Date	Ref No.
EL-448	20 Conductor Signal Cable	11/29/2004	TR-5
EL-452	Quazite Service Box	11/29/2004	TR-8
EL-460	Type 1 Induction Loop	08/06/2010	TR-2
EL-462	Type 2 Induction Loop	08/06/2010	TR-2A
EL-464	Bicycle Detector Pavement Marking Locations on Detector Loops	05/15/2015	
Section DR - 500 Drainage, Storm and Surface Water			
DR-500	Thru-Curb Inlet Frame and Grate with Vertical Curb Installation	05/29/2014	ST-12
DR-502	Herringbone Gate for Catch Basins and Inlets	05/29/2014	
DR-505	Thru-Curb Inlet Frame	05/29/2014	ST-13A
DR-510	Rolled Curb Frame and Grate	02/26/2009	ST-47
DR-515	Type 60A and 60B Outlet Trap	11/29/2004	ST-12A
DR-520	Cut Section Sidewalk Drain	11/29/2004	ST-16
DR-525	Residential Sidewalk Drain	11/29/2004	ST-17
DR-530	Storm Drain Side Service	04/28/2005	
DR-538	PVC Pipe Bedding Details	11/08/2007	
DR-539	Pipe Bedding Details for 2' or Less of Cover	11/08/2007	
DR-540	Storm Pipe End Section	11/29/2004	ST-27
DR-542	Restrictor Catch Basin Viewpoint Detail	10/26/2006	
Section EC - 600 Erosion Control			
EC-600	Temporary Construction Exit - Plat/Commercial	11/29/2004	EC-1
EC-605	Temporary Construction Exit - Single Family	11/29/2004	EC-2
EC-610	Tire and Concrete Wash - Plat/Commercial	11/29/2004	EC-3
EC-612	Tire Wash Sump Details	12/28/2004	
EC-615	Reinforced Silt Fence	11/29/2004	EC-4
EC-620	Catch Basin Insert	11/29/2004	EC-5
EC-625	Temporary Sediment Pond - Type A	11/29/2004	EC-6
EC-630	Temporary Sediment Pond - Type B	11/29/2004	EC-7
EC-635	Rock Check Dam	11/29/2004	EC-8
EC-640	Semi-pervious Check Dam	11/29/2004	EC-9
EC-645	Erosion Control Check Dam Detail	11/29/2004	EC-12
EC-650	Plastic Covering for Slopes and Stockpiles	11/29/2004	EC-10
EC-655	Straw Rolls	11/29/2004	EC-11
Section SS - 700 Sanitary Sewer			
SS-700	Manhole Standard	03/11/2010	SE-6

Plan No.		Plan Title	Approval Date	Ref No.
	SS-704	Manhole Standard Ring and Cover	09/08/2011	SE-6A
	SS-715	Inside Drop Sewer Manhole Connection	11/29/2004	SE-5
	SS-716	Ductile Iron Outside Drop Sewer Manhole Connection	03/11/2010	
	SS-717	Concrete Encased Outside Drop Sewer Manhole Connection	03/17/2010	
	SS-720	8" Clean Out	05/29/2014	SE-1
	SS-730	Sanitary Side Sewer	05/29/2014	
	SS-735	Side Sewer Clean-Out Lid	05/29/2014	
	SS-740	Sanitary Banded Tapping Tee	04/15/2009	SE-2
	SS-750	PVC Pipe Bedding Detail	04/22/2010	SE-4
	SS-760	Pipe Anchor	11/29/2004	SE-7
	SS-790	Typical Sewer Drawing of Record (Including Services)	01/11/2005	SE-3
Section WA - 800 Water Distribution				
	WA-802	Hydrant Installation	04/20/2017	WA-1
	WA-803	Sample Tap Installation	08/11/2016	
	WA-804	Fire Hydrant Bollard Detail	12/28/2004	
	WA-810	Blow-Off for Future Water Main Extensions	02/03/2010	WA-3
	WA-814	2" Blow-Off, No Further Extension	02/03/2010	WA-4
	WA-817	Typical Vacuum/Air Release Valve - Above Ground	11/30/2011	
	WA-818	Typical Vacuum/Air Release Valve - Below Ground	11/30/2011	
	WA-820	Water Pipe Bedding Details	03/01/2011	
	WA-824	1" Single Water Service Detail	02/07/2014	WA-9
	WA-826	Optional Dual Water Service Detail	11/10/2014	
	WA-828	Typical Water Service on Private Property	12/28/2004	WA-7
	WA-830	3/4" and 1" Single Water Service In Meter Box	02/03/2010	
	WA-834	Temporary Construction Water With Yard Hydrant	05/26/2009	
	WA-836	Temporary Construction Water With Hose Bibb	05/26/2009	
	WA-840	1 1/2" Meter Assembly	12/28/2004	WA-10
	WA-842	2" Meter Assembly	12/28/2004	WA-11
	WA-844	5/8" - 3/4" Meter Assembly	04/20/2017	
	WA-846	Number 2 Meter Box	05/17/2005	WA-12
	WA-848	Number 2 Meter Box Modifications	09/17/2007	WA-12
	WA-850	Number 3 Flat Top Meter Box	07/19/2012	WA-9
	WA-858	Pressure Test Charge Manifold	03/19/2012	WA-2
	WA-860	Thrust Block - Elbow	01/11/2005	WA-5

Plan No.		Plan Title	Approval Date	Ref No.
	WA-862	Thrust Block - Tee	01/11/2005	WA-5
	WA-865	Thrust Blocking For Cross With Valves	06/15/2016	
	WA-870	Existing Water Service Transfer Detail	02/03/2010	
	WA-872	Water Tap Excavation 4” and Larger	04/26/2017	
	WA-874	Water Tap Excavation Under 4”	04/26/2017	
	WA-880	Approved Restraints	09/17/2007	
	WA-882	Approved Restraints	09/17/2007	
	WA-883	Fireline Restraints at Foundation	05/26/2009	
	WA-884	Approved Restraints	09/17/2007	
	WA-885	Fireline Restraints at Property Line	06/25/2008	
	WA-890	3" 4" 6" 8" Meter Vault	11/30/2011	
	WA-897	Typical Water Main Drawing of Record (including services)	12/28/2004	WA-8
Section MS - 1000 Miscellaneous Construction				
	MS-1000	Rock Wall Details	11/12/2008	ST-44
	MS-1005	Low Retaining Wall	11/29/2004	ST-8
	MS-1010	Barrier Wall with Rail	11/29/2004	ST-30-1
	MS-1012	Barrier Wall with Rail	11/29/2004	ST-30-2
	MS-1014	Barrier Wall with Rail	11/29/2004	ST-30-3
	MS-1020	Pedestrian Handrail	11/29/2004	
	MS-1025	Barrier Rail	11/29/2004	ST-31
	MS-1040	Bicycle Parking Standards	06/07/2018	ST-54
	MS-1050	Mailbox Standards, Plat/Commercial	06/15/2016	ST-26
	MS-1060	Direct Burial Meter Post Installation Detail	05/01/2007	

APPENDIX AA CIP PROJECTS

City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-01
Project Title: Lincoln Street Upsize
Facility Type: Distribution Piping
Pressure Zone: North

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 1,450 LF of piping is being upgraded from 8-inch to 12-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 2,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	1,450	LF	$ 366	$ 531,419	$ 185,997	$ 358,585	$ 1,076,000
Total Anticipated Project Cost							$ 1,076,000

Notes on Cost Estimation:

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	100%	$ 1,076,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 1,076,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 1,076,000
Total Anticipated Project Cost		$ 1,076,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-02
Project Title: Orleans Street Upsize
Facility Type: Distribution Piping
Pressure Zone: North

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 1,000 LF of piping is being upgraded from 6-inch to 12-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 1,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	1,000	LF	$ 366	$ 366,496	$ 128,274	$ 247,231	$ 742,000
Total Anticipated Project Cost							$ 742,000

Notes on Cost Estimation:

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	50%	$ 371,000
Repair and Replacement	50%	$ 371,000
General	0%	$ -
Total Anticipated Project Cost	100%	$ 742,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 742,000
Total Anticipated Project Cost		$ 742,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-03
Project Title: Whatcom Street Upsize
Facility Type: Distribution Piping
Pressure Zone: Dakin & Yew

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 1,587 LF of piping is being upgraded from 8-inch to 12-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 1,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	1,587	LF	$ 366	$ 581,629	$ 203,570	$ 392,801	$ 1,178,000
Total Anticipated Project Cost							$ 1,178,000

Notes on Cost Estimation:

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	100%	$ 1,178,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 1,178,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 1,178,000
Total Anticipated Project Cost		$ 1,178,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-04
Project Title: Squallicum Harbor Upsize
Facility Type: Distribution Piping
Pressure Zone: North

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 322 LF of piping is being upgraded from 6-inch to 8-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 2,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	322	LF	$ 278	$ 89,494	$ 31,323	$ 60,183	$ 181,000
Total Anticipated Project Cost							$ 181,000

Notes on Cost Estimation:

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	50%	$ 90,500
Repair and Replacement	50%	$ 90,500
General	0%	$ -
Total Anticipated Project Cost	100%	$ 181,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 181,000
Total Anticipated Project Cost		$ 181,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-05
Project Title: Birchwood Ave Upsize
Facility Type: Distribution Piping
Pressure Zone: North

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 590 LF of piping is being upgraded from 6-inch and 8-inch to 12-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 2,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	590	LF	$ 366	$ 216,233	$ 75,681	$ 146,086	$ 438,000
Total Anticipated Project Cost							$ 438,000

Notes on Cost Estimation:

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Cost Allocation:

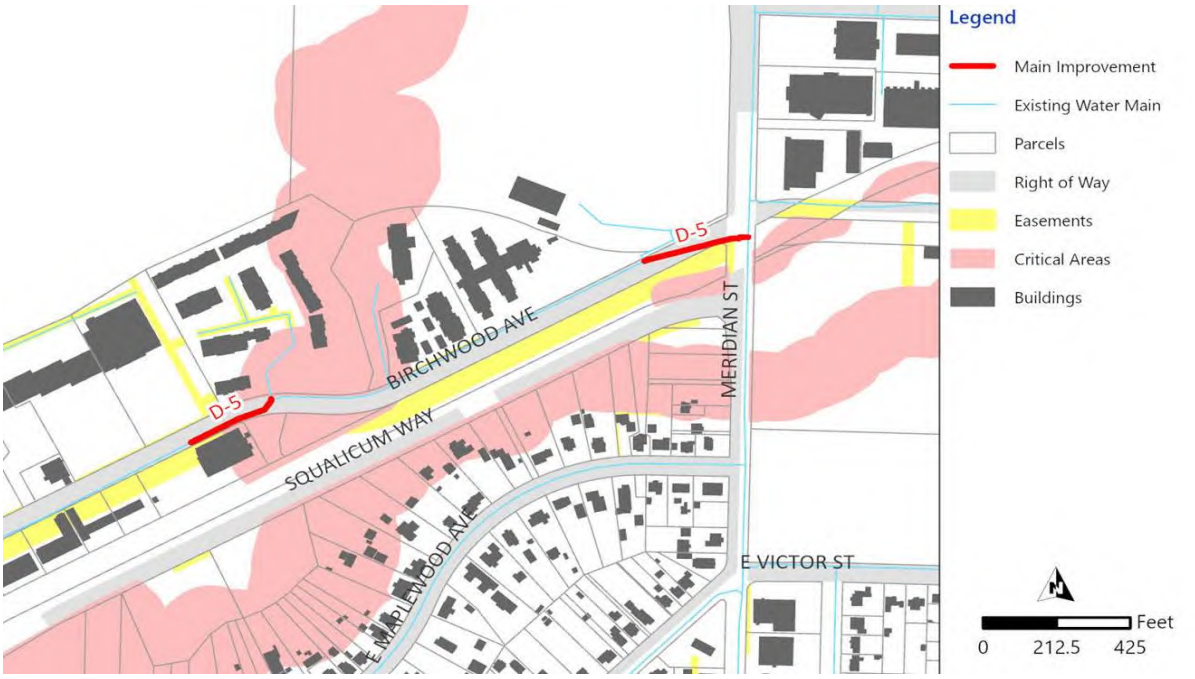
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	100%	$ 438,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 438,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 438,000
Total Anticipated Project Cost		$ 438,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-06
Project Title: N Park Drive Upsize
Facility Type: Distribution Piping
Pressure Zone: North

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 1,050 LF of piping is being upgraded from 4-inch to 8-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 1,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	1,050	LF	$ 278	$ 291,828	$ 102,140	$ 197,033	$ 591,000
Total Anticipated Project Cost							$ 591,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

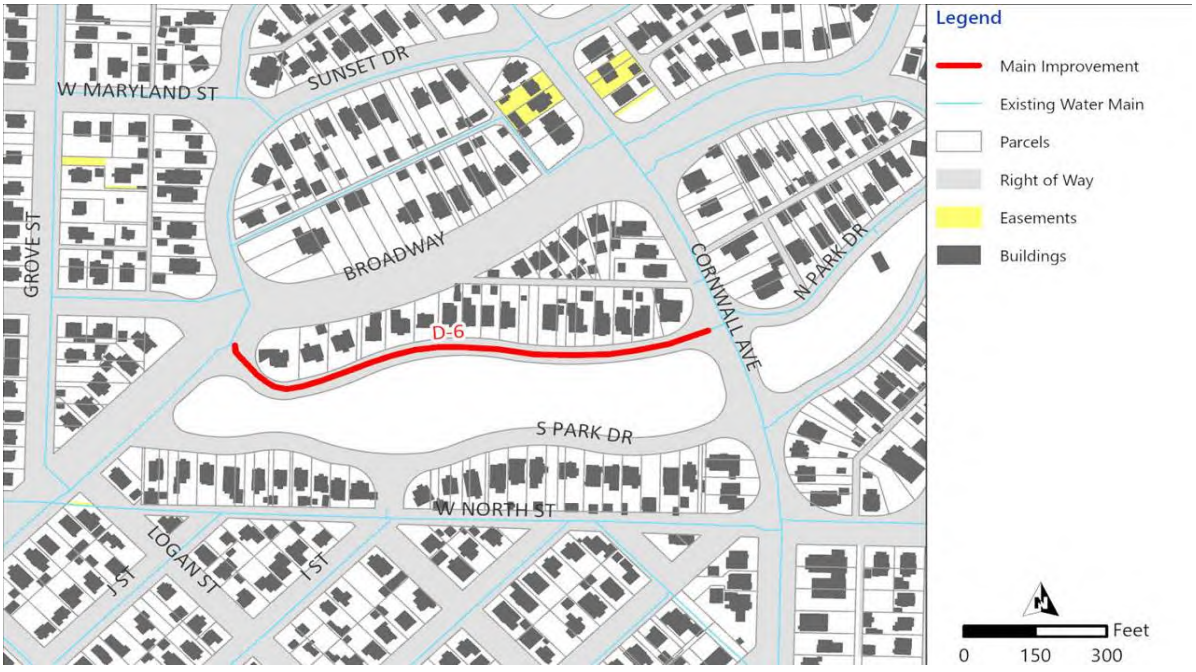
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	50%	$ 295,500
Repair and Replacement	50%	$ 295,500
General	0%	$ -
Total Anticipated Project Cost	100%	$ 591,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 591,000
Total Anticipated Project Cost		$ 591,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-07
Project Title: W Oregon Street Upsize
Facility Type: Distribution Piping
Pressure Zone: North

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 1,400 LF of piping is being upgraded from 4-inch to 8-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 1,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	1,400	LF	$ 278	$ 389,103	$ 136,186	$ 262,710	$ 788,000
Total Anticipated Project Cost							$ 788,000

Notes on Cost Estimation:

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	50%	$ 394,000
Repair and Replacement	50%	$ 394,000
General	0%	$ -
Total Anticipated Project Cost	100%	$ 788,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 788,000
Total Anticipated Project Cost		$ 788,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-08
Project Title: Tull Road Upsize
Facility Type: Distribution Piping
Pressure Zone: Cordata

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 1,173 LF of piping is being upgraded from 4-inch to 8-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 2,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	1,173	LF	$ 278	$ 326,013	$ 114,105	$ 219,882	$ 660,000
Total Anticipated Project Cost							$ 660,000

Notes on Cost Estimation:

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	100%	$ 660,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 660,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 660,000
Total Anticipated Project Cost		$ 660,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-09
Project Title: Along Guide Meridian Road Upsize
Facility Type: Distribution Piping
Pressure Zone: Cordata, North

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 3,651 LF of piping is being upgraded from 16-inch to 20-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 3,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	3,651	LF	$ 991	$ 3,617,995	$ 1,266,298	$ 2,441,707	$ 7,326,000
Total Anticipated Project Cost							$ 7,326,000

Notes on Cost Estimation:

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Cost Allocation:

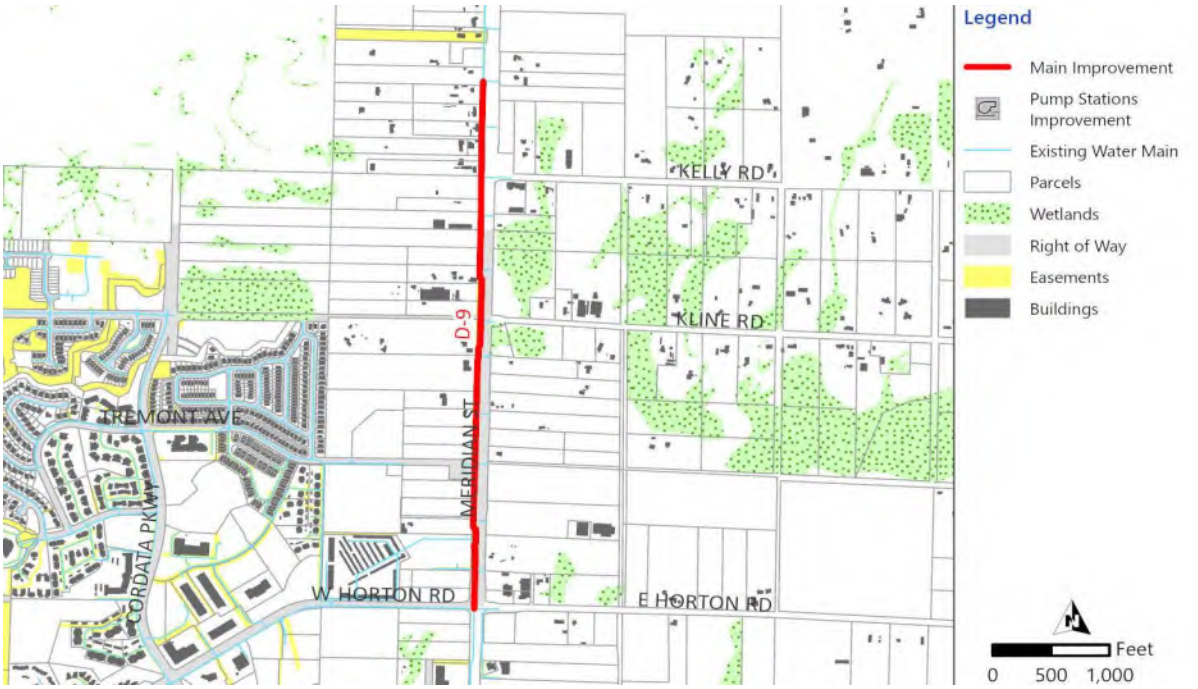
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	100%	$ 7,326,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 7,326,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 7,326,000
Total Anticipated Project Cost		$ 7,326,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-10
Project Title: Spring Brook Street New Pipe
Facility Type: Distribution Piping
Pressure Zone: Cordata

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 400 LF of 8-inch piping is being added in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 2,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	400	LF	$ 278	$ 111,172	$ 38,910	$ 74,917	$ 225,000
Total Anticipated Project Cost							$ 225,000

Notes on Cost Estimation:

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	100%	$ 225,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 225,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 225,000
Total Anticipated Project Cost		$ 225,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-11
Project Title: Green Vista Way Upsize
Facility Type: Distribution Piping
Pressure Zone: Cordata

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 791 LF of piping is being upgraded from 8-inch to 12-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 2,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	791	LF	$ 366	$ 289,898	$ 101,464	$ 195,637	$ 587,000
Total Anticipated Project Cost							$ 587,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

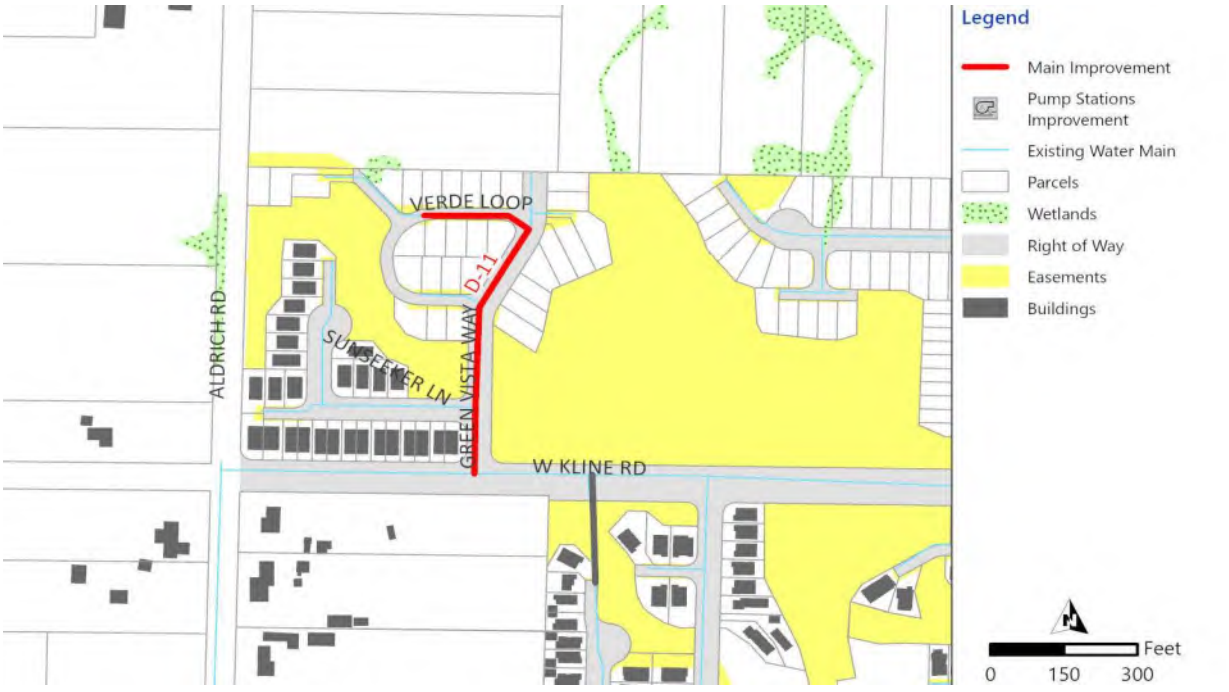
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	100%	$ 587,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 587,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 587,000
Total Anticipated Project Cost		$ 587,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-12
Project Title: Meador Ave New Pipe
Facility Type: Distribution Piping
Pressure Zone: North

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 100 LF of 12-inch piping is being added in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 3,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	100	LF	$ 366	$ 36,650	$ 12,827	$ 24,523	$ 74,000
Total Anticipated Project Cost							$ 74,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	100%	$ 74,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 74,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 74,000
Total Anticipated Project Cost		$ 74,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-13
Project Title: Moore Street Upsize
Facility Type: Distribution Piping
Pressure Zone: North

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 413 LF of piping is being upgraded from 6-inch to 12-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 3,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	413	LF	$ 366	$ 151,363	$ 52,977	$ 102,660	$ 307,000
Total Anticipated Project Cost							$ 307,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	50%	$ 153,500
Repair and Replacement	50%	$ 153,500
General	0%	$ -
Total Anticipated Project Cost	100%	$ 307,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 307,000
Total Anticipated Project Cost		$ 307,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-14
Project Title: Virginia Street Upsize
Facility Type: Distribution Piping
Pressure Zone: North

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 36 LF of piping is being upgraded from 4-inch to 8-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 3,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	36	LF	$ 278	$ 10,006	$ 3,502	$ 6,493	$ 20,000
Total Anticipated Project Cost							$ 20,000

Notes on Cost Estimation:

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Cost Allocation:

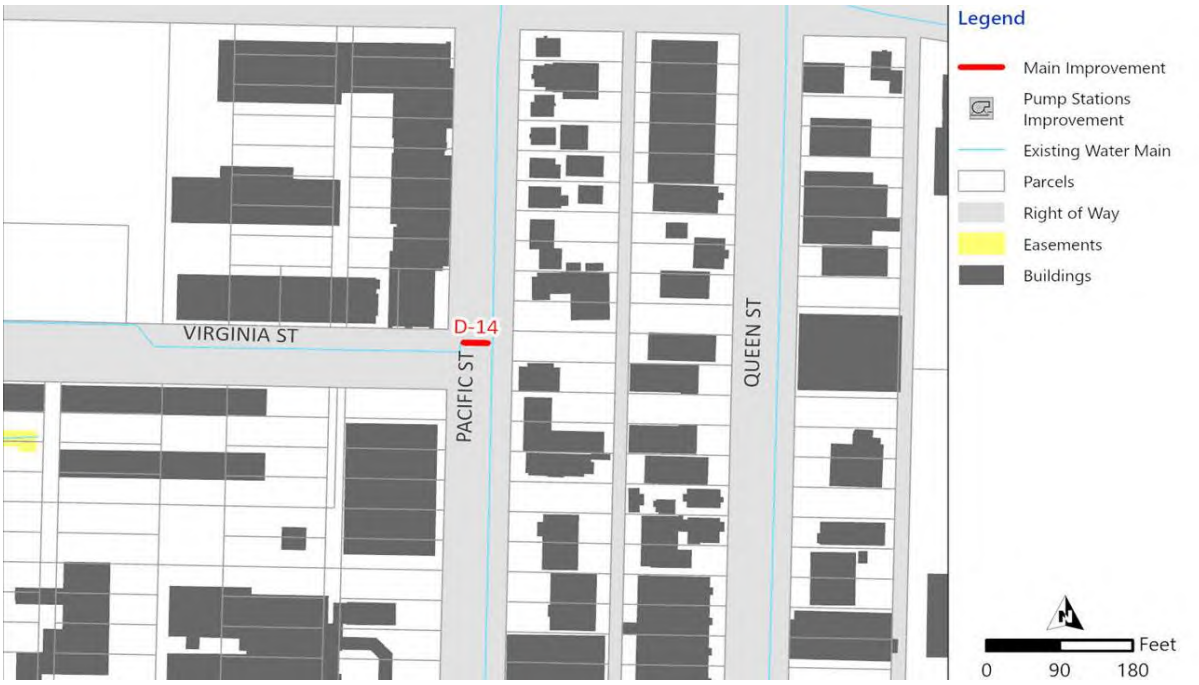
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	100%	$ 20,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 20,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 20,000
Total Anticipated Project Cost		$ 20,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-15
Project Title: E North Street Upsize
Facility Type: Distribution Piping
Pressure Zone: North

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 309 LF of piping is being upgraded from 8-inch to 12-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 1,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	309	LF	$ 366	$ 113,247	$ 39,637	$ 76,116	$ 229,000
Total Anticipated Project Cost							$ 229,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	50%	$ 114,500
Repair and Replacement	50%	$ 114,500
General	0%	$ -
Total Anticipated Project Cost	100%	$ 229,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 229,000
Total Anticipated Project Cost		$ 229,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-16
Project Title: Valhalla Street Upsize
Facility Type: Distribution Piping
Pressure Zone: North

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 850 LF of piping is being upgraded from 6-inch to 12-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 1,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	850	LF	$ 366	$ 311,521	$ 109,032	$ 210,446	$ 631,000
Total Anticipated Project Cost							$ 631,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	100%	$ 631,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 631,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 631,000
Total Anticipated Project Cost		$ 631,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-17
Project Title: E Indiana Street Upsize
Facility Type: Distribution Piping
Pressure Zone: North

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 807 LF of piping is being upgraded from 4-inch to 12-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 2,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	807	LF	$ 366	$ 295,762	$ 103,517	$ 199,721	$ 599,000
Total Anticipated Project Cost							$ 599,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	100%	$ 599,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 599,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 599,000
Total Anticipated Project Cost		$ 599,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-18
Project Title: Near E Sunset Drive Upsize
Facility Type: Distribution Piping
Pressure Zone: North

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 1,700 LF of piping is being upgraded from 8-inch to 12-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 2,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	1,700	LF	$ 366	$ 623,043	$ 218,065	$ 420,892	$ 1,262,000
Total Anticipated Project Cost							$ 1,262,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	50%	$ 631,000
Repair and Replacement	50%	$ 631,000
General	0%	$ -
Total Anticipated Project Cost	100%	$ 1,262,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 1,262,000
Total Anticipated Project Cost		$ 1,262,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-19
Project Title: Orchard Drive Upsize
Facility Type: Distribution Piping
Pressure Zone: North

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 959 LF of piping is being upgraded from 8-inch to 12-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 3,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	959	LF	$ 366	$ 351,469	$ 123,014	$ 237,516	$ 712,000
Total Anticipated Project Cost							$ 712,000

Notes on Cost Estimation:

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	100%	$ 712,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 712,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 712,000
Total Anticipated Project Cost		$ 712,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-20
Project Title: Beal Street Upsize
Facility Type: Distribution Piping
Pressure Zone: North

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 1,500 LF of piping is being upgraded from 4,6, and 8-inch to 12-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 3,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	1,500	LF	$ 366	$ 549,744	$ 192,410	$ 370,846	$ 1,113,000
Total Anticipated Project Cost							$ 1,113,000

Notes on Cost Estimation:

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	100%	$ 1,113,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 1,113,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 1,113,000
Total Anticipated Project Cost		$ 1,113,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: D-21
Project Title: Stuart Road Upsize
Facility Type: Distribution Piping
Pressure Zone: Cordata

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning 399 LF of piping is being upgraded from 8-inch to 12-inch in order to alleviate a fire flow deficiency in this area. The fire flow requirement is 3,500 gpm.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Pipe	399	LF	$ 366	$ 146,232	$ 51,181	$ 98,587	$ 296,000
Total Anticipated Project Cost							$ 296,000

Notes on Cost Estimation:

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	100%	$ 296,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 296,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 296,000
Total Anticipated Project Cost		$ 296,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: PZ-01
Project Title: North to Cordata PZ 1
Facility Type: Pressure Zone Rezoning
Pressure Zone: North/ Cordata

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Low Pressures

Reasoning This project involves opening an isolation valve and adding a closed isolation valve in order to incorporate an area in North PZ into the Cordata PZ.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Valves	1		$ 15,000	$ 15,000	$ 5,250	$ 9,750	$ 30,000
Total Anticipated Project Cost							$ 30,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

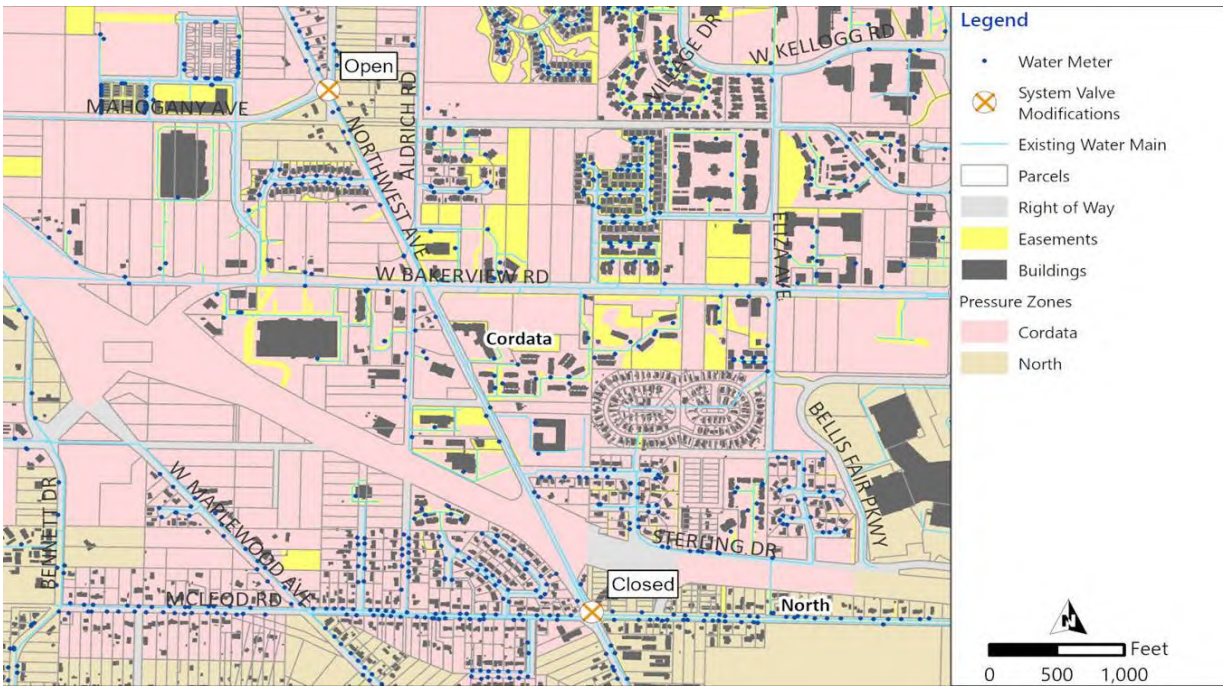
Project Type	Percent	Cost
Improvement:	50%	$ 15,000
Capacity:	50%	$ 15,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 30,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 30,000
Total Anticipated Project Cost		$ 30,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: PZ-02
Project Title: North to Cordata PZ 2
Facility Type: Pressure Zone Rezoning
Pressure Zone: North/Cordata

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Low Pressures

Reasoning This project rezones customers from North to Cordata to address low pressure nodes by adding three open valves along E Bakerview Rd and one closed isolation valve.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Valves	3		$ 15,000	$ 45,000	$ 15,750	$ 30,250	$ 91,000
Total Anticipated Project Cost							$ 91,000

Notes on Cost Estimation:

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Cost Allocation:

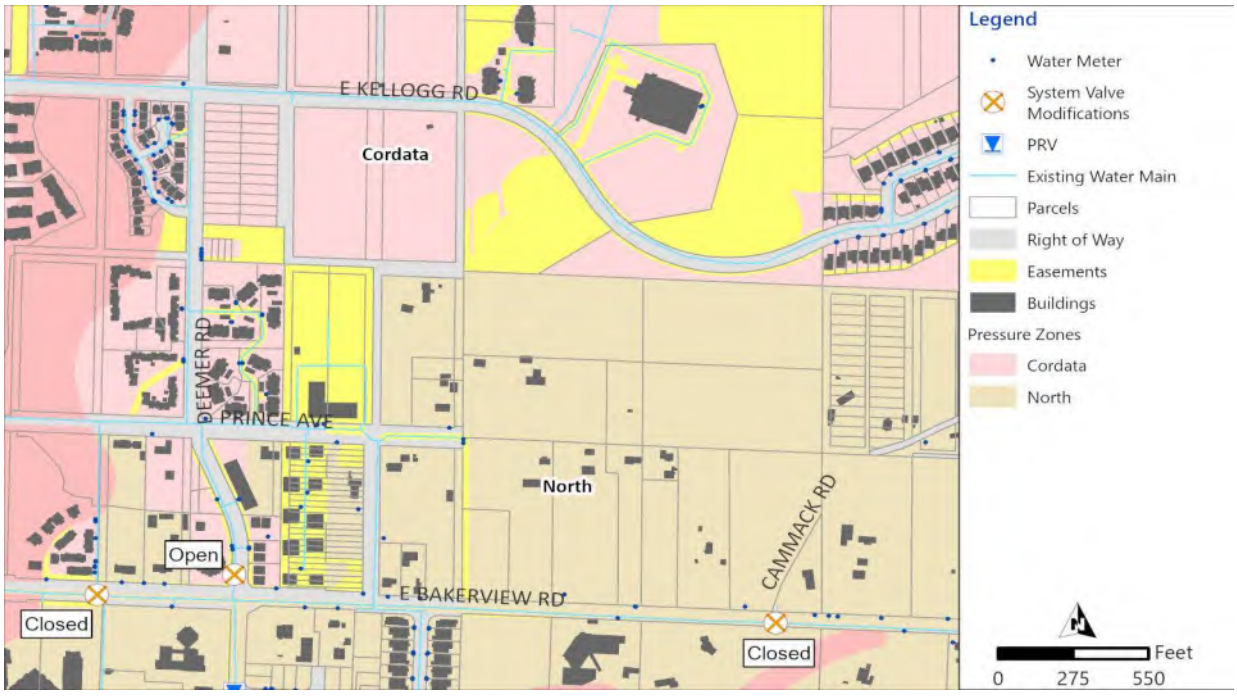
Project Type	Percent	Cost
Improvement:	50%	$ 45,500
Capacity:	50%	$ 45,500
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 91,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 91,000
Total Anticipated Project Cost		$ 91,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: P-01
Project Title: General SFR Dead-end fire flow program
Facility Type: Annual Repair and Replacement Programs
Pressure Zone: System-wide
Priority: Annual
Project Status (Completed?): N

Go to CIP Summary Table

Project Description:

Project Description: Fire flow deficiency

Reasoning Hydrants are unable to supply 750 gpm fire flow requirement in dead end pipes. This program is to move hydrants from dead end pipes to main line pipes. The City's goal is to review 265 LF/year for 20 years.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Program	5,294	LF	$ 366	$ 1,940,229	$ 679,080	$ 1,309,691	$ 3,929,000
Total Anticipated Project Cost							$ 3,929,000

Notes on Cost Estimation:

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	33%	$ 1,309,667
Capacity:	33%	$ 1,309,667
Repair and Replacement	33%	$ 1,309,667
General	0%	$ -
Total Anticipated Project Cost	100%	$ 3,929,000

Project Timing:

Project Element	Timing	Cost
Entire Project	Annual	$ 3,929,000
Total Anticipated Project Cost		$ 3,929,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: P-02
Project Title: SFR Dead End fire flow program

Facility Type: Annual Repair and Replacement Programs
Pressure Zone: System-wide

Go to CIP Summary Table

Priority: Annual
Project Status (Completed?): N

Project Description:

Project Description: Fire flow deficiency

Reasoning Hydrants are unable to supply 750 gpm fire flow requirement in dead end pipes. This program is to move hydrants from dead end pipes to main line pipes. The City's goal is to review 500 LF/year for 5 years.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Program	23,919	LF	$ -	$ -	$ -	$ -	$ -
Total Anticipated Project Cost							$ -

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

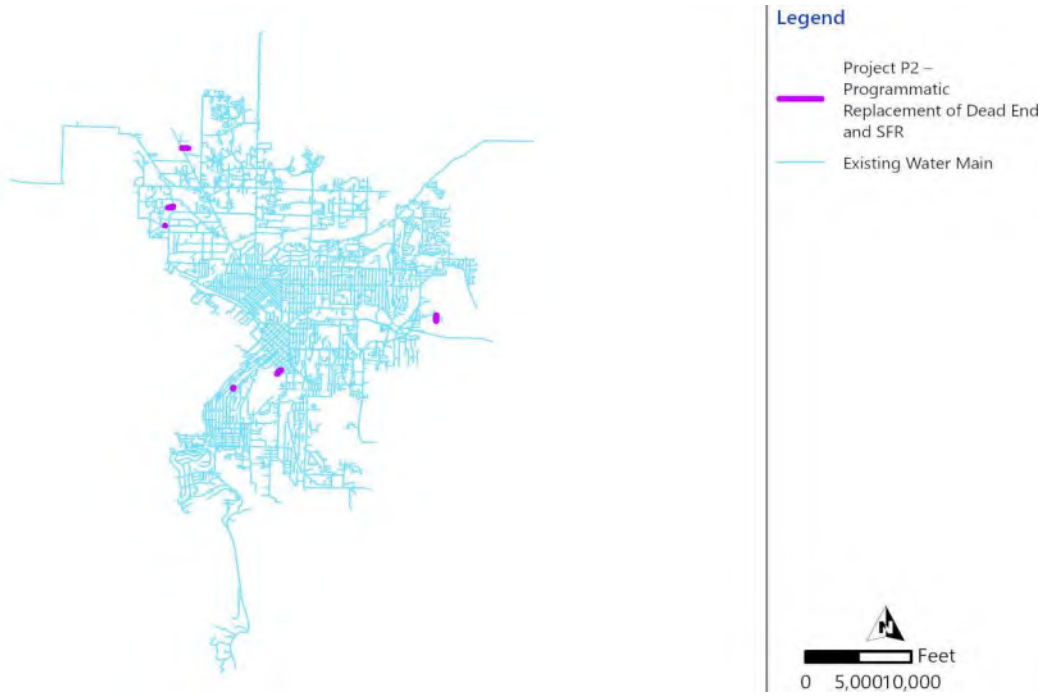
Project Type	Percent	Cost
Improvement:	33%	$ -
Capacity:	33%	$ -
Repair and Replacement	33%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ -

Project Timing:

Project Element	Timing	Cost
Entire Project	Annual	$ -
Total Anticipated Project Cost		$ -

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: P-03
Project Title: Pipeline Repair and Replacement Program
Priority: Annual
Facility Type: Annual Repair and Replacement Programs
Pressure Zone: System-wide
Project Status (Completed?): N

Go to CIP Summary Table

Project Description:

Project Description: Low Remaining Useful Life

Reasoning Project to replace pipes that have reached or will reach their remaining useful life in the planning period based on installation date and pipe material type.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Program	464,700	LF	$ -	$ 106,615,500	$ 37,315,425	$ 71,965,075	$ 215,896,000
Total Anticipated Project Cost							$ 215,896,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

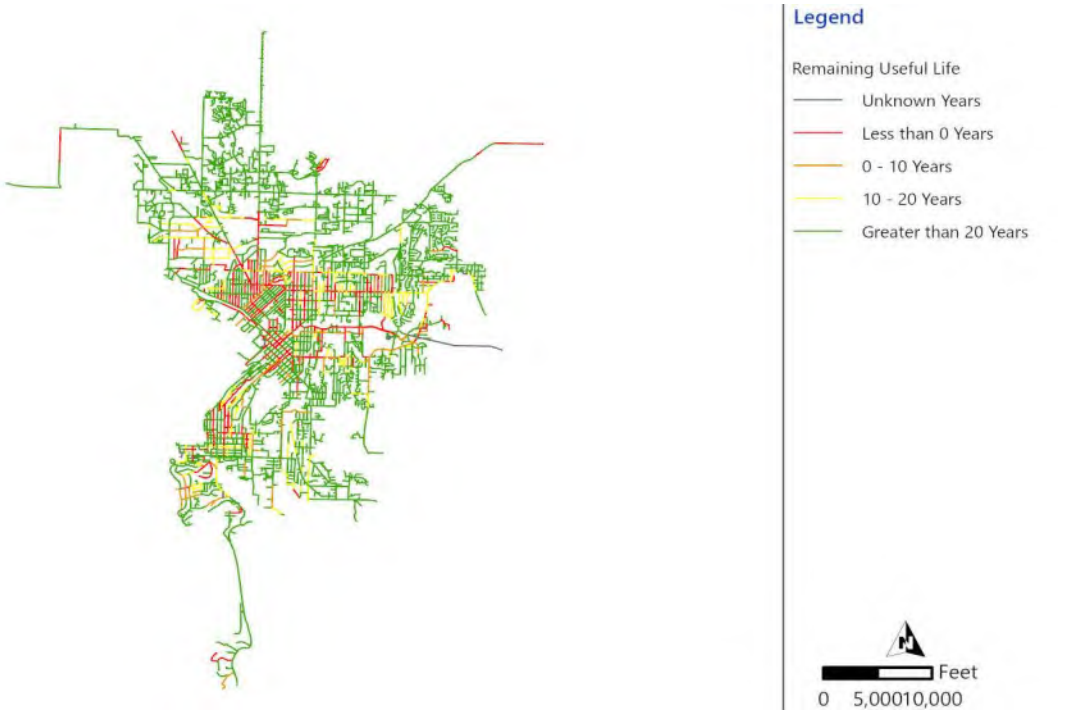
Project Type	Percent	Cost
Improvement:	33%	$ 71,965,333
Capacity:	33%	$ 71,965,333
Repair and Replacement	33%	$ 71,965,333
General	0%	$ -
Total Anticipated Project Cost	100%	$ 215,896,000

Project Timing:

Project Element	Timing	Cost
Entire Project	Annual	$ 215,896,000
Total Anticipated Project Cost		$ 215,896,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: PS-01
Project Title: Balsam Lane PS Recommendation
Facility Type: Pump Station
Pressure Zone: Alabama Hill

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow and demand growth

Reasoning Replace 2 pumps with 1,200 gpm or larger pumps due to fire flow deficiency

Anticipated Project Cost:

Project Element	Total Cost
Pump Station	$ 1,000,000
Total Anticipated Project Cost	$ 1,000,000

Notes on Cost Estimation:

Total cost is estimated based on the Pump Station Cost Curve.

Go to Assumptions Tab

Cost Allocation:

Project Type	Percent	Cost
Improvement:	50%	$ 500,000
Capacity:	50%	$ 500,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 1,000,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 1,000,000
Total Anticipated Project Cost		$ 1,000,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: PS-02
Project Title: Reveille PS Recommendation
Facility Type: Pump Station
Pressure Zone: Reveille

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow and demand growth

Reasoning 2 additional pumps with 1,500 gpm or larger pumps due to fire flow deficiency

Anticipated Project Cost:

Project Element	Total Cost
Pump Station	$ 4,700,000
Total Anticipated Project Cost	$ 4,700,000

Notes on Cost Estimation:

Total cost is estimated based on the Pump Station Cost Curve.

Go to Assumptions Tab

Cost Allocation:

Project Type	Percent	Cost
Improvement:	50%	$ 2,350,000
Capacity:	50%	$ 2,350,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 4,700,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 4,700,000
Total Anticipated Project Cost		$ 4,700,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: PS-03
Project Title: Huntington PS Recommendation
Facility Type: Pump Station
Pressure Zone: Huntington

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Fire flow and demand growth

Reasoning 2 additional pumps with 700 gpm or larger pumps due to fire flow deficiency

Anticipated Project Cost:

Project Element	Total Cost
Pump Station	$ 4,000,000
Total Anticipated Project Cost	$ 4,000,000

Notes on Cost Estimation:

Total cost is estimated based on the Pump Station Cost Curve.

Go to Assumptions Tab

Cost Allocation:

Project Type	Percent	Cost
Improvement:	50%	$ 2,000,000
Capacity:	50%	$ 2,000,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 4,000,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 4,000,000
Total Anticipated Project Cost		$ 4,000,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: PS-04 **Facility Type:** Pump Station
Project Title: Samish Heights PS Recommendation **Pressure Zone:** Samish Highlands

Go to CIP Summary Table

Priority: 10-20 years **Project Status (Completed?):** N

Project Description:

Project Description: Fire flow and demand growth

Reasoning 2 additional pumps with 550 gpm or larger pumps due to fire flow deficiency

Anticipated Project Cost:

Project Element	Total Cost
Pump Station	$ 3,800,000
Total Anticipated Project Cost	$ 3,800,000

Notes on Cost Estimation:

Total cost is estimated based on the Pump Station Cost Curve.

Go to Assumptions Tab

Cost Allocation:

Project Type	Percent	Cost
Improvement:	50%	$ 1,900,000
Capacity:	50%	$ 1,900,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 3,800,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 3,800,000
Total Anticipated Project Cost		$ 3,800,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: PS-05
Project Title: Cordata Prkwy Indivudal Booster Pump Station
Priority: 0-10 years
Facility Type: Pump Station
Pressure Zone: North/Cordata
Project Status (Completed?): N

Go to CIP Summary Table

Project Description:

Project Description: Low Pressures

Reasoning This project involves installing 2 indivudal booster pump stations to serve low pressure customers.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Individual Booster Pump	2		$ 10,000	$ 20,000	$ 7,000	$ 14,000	$ 41,000
Total Anticipated Project Cost							$ 41,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

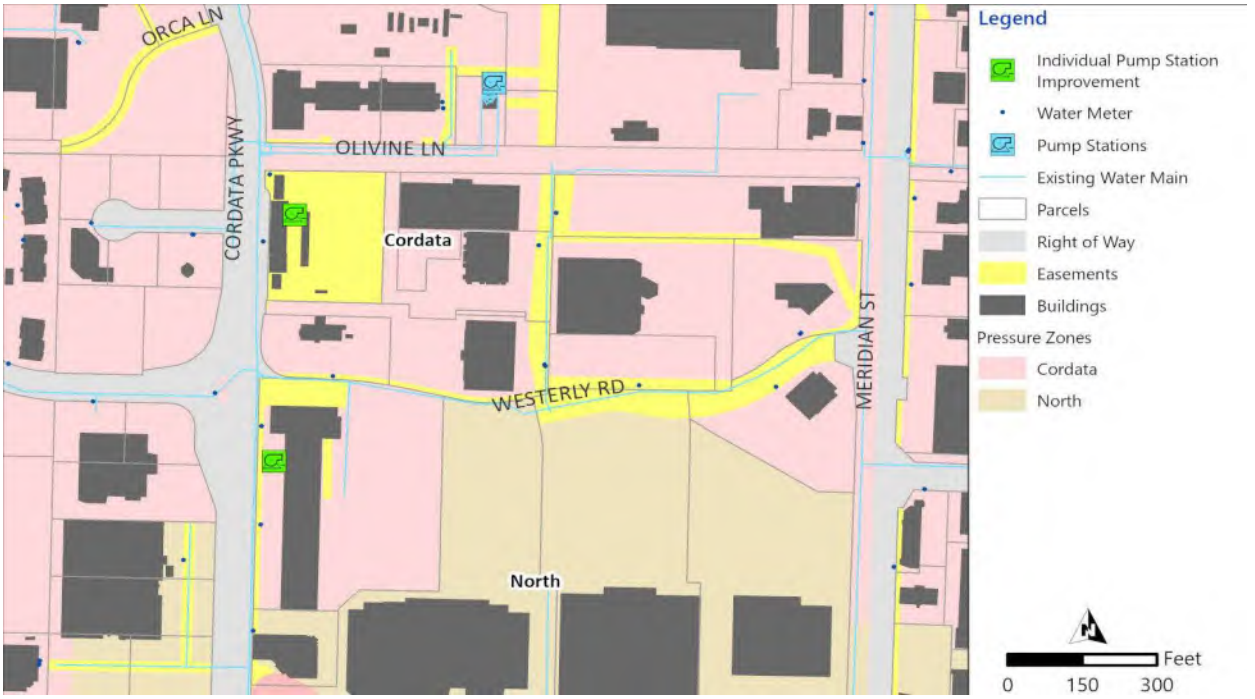
Project Type	Percent	Cost
Improvement:	50%	$ 20,500
Capacity:	50%	$ 20,500
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 41,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 41,000
Total Anticipated Project Cost		$ 41,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: PS-06
Project Title: Academy St Individual Booster Pump Station
Priority: 0-10 years
Facility Type: Pump Station
Pressure Zone: South/Alabama Hill
Project Status (Completed?): N

Go to CIP Summary Table

Project Description:

Project Description: Low Pressures

Reasoning This project involves installing 13 individual booster pump stations to serve low pressure customers.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Individual Booster Pump	13		$ 10,000	$ 130,000	$ 45,500	$ 87,500	$ 263,000
Total Anticipated Project Cost							$ 263,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

Project Type	Percent	Cost
Improvement:	50%	$ 131,500
Capacity:	50%	$ 131,500
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 263,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 263,000
Total Anticipated Project Cost		$ 263,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: PS-07
Project Title: Lakeway Dr Individual Booster Pump Station
Priority: 0-10 years
Facility Type: Pump Station
Pressure Zone: North/ Dakin & Yew
Project Status (Completed?): N

Go to CIP Summary Table

Project Description:

Project Description: Low Pressures

Reasoning This project involves installing 7 individual booster pump stations to serve low pressure customers.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Individual Booster Pump	7		$ 10,000	$ 70,000	$ 24,500	$ 47,500	$ 142,000
Total Anticipated Project Cost							$ 142,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

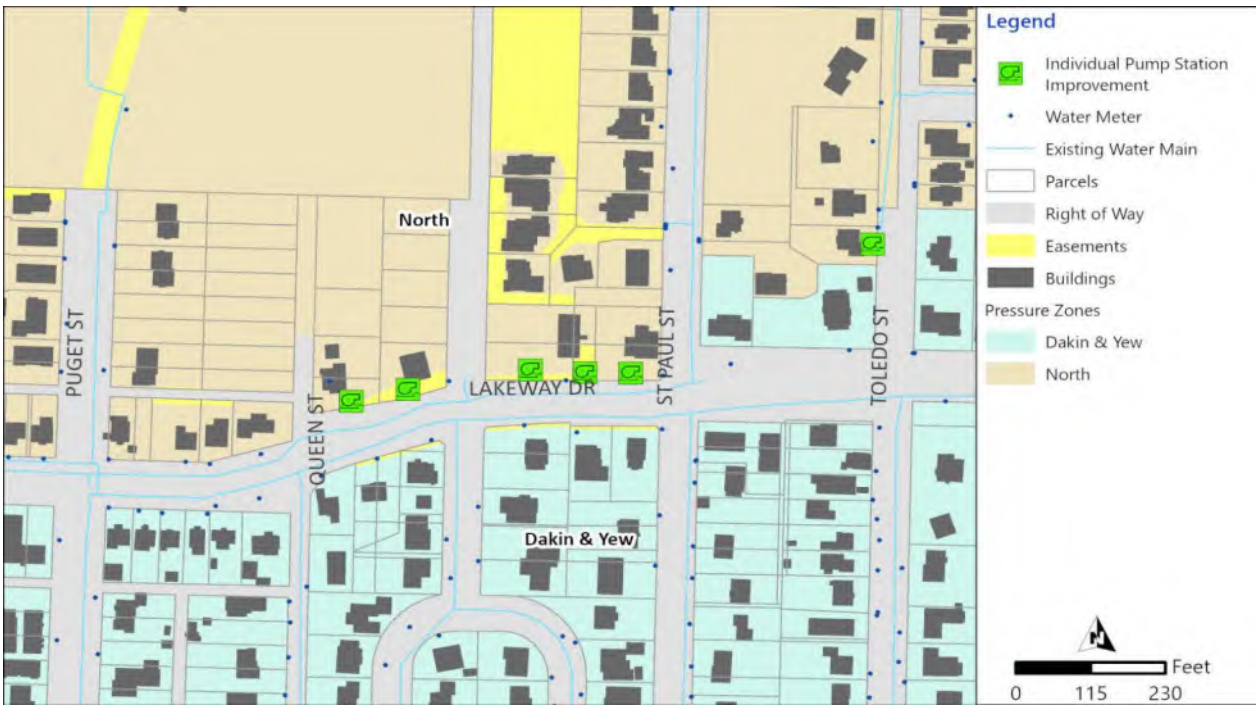
Project Type	Percent	Cost
Improvement:	50%	$ 71,000
Capacity:	50%	$ 71,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 142,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 142,000
Total Anticipated Project Cost		$ 142,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: PS-08
Project Title: Bass St Individual Booster Pump Station
Priority: 0-10 years
Facility Type: Pump Station
Pressure Zone: Padden Yew/Reveille
Project Status (Completed?): N

Go to CIP Summary Table

Project Description:

Project Description: Low Pressures

Reasoning This project involves installing 1 booster pump station to serve low pressure customers.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Individual Booster Pump	1		$ 10,000	$ 10,000	$ 3,500	$ 6,500	$ 20,000
Total Anticipated Project Cost							$ 20,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

Project Type	Percent	Cost
Improvement:	50%	$ 10,000
Capacity:	50%	$ 10,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 20,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 20,000
Total Anticipated Project Cost		$ 20,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: ST-01
Project Title: King Mountain Reservoir
Facility Type: Storage
Pressure Zone: New King Mountain PZ

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Storage needs

Reasoning Two 2.5 MG reservoirs in the new King Mountain Zone are recommended to address the Storage deficit in the Dakin & Yew Zone and part of the deficit in the North Zone. To ensure resilient storage between the zones a new transmission line is required as a part of this to connect from King Mountain to Dakin & Yew and King Mountain to Cordata. Each transmission line will be equipped with a PRV. A new PS, project PS-5, Lower King Mountain is also needed to reliably fill the new King Mountain Reservoir. These recommendations are aligned with the analysis performed in the King Mountain High Pressure Booster Pump Station, 2024 Report.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Reservoir	2.5	MG	$ 5	$ 11,250,000	$ 3,937,500	$ 7,593,500	$ 22,781,000
Reservoir	2.5	MG	$ 5	$ 11,250,000	$ 3,937,500	$ 7,593,500	$ 22,781,000
Pipe	5,700	LF	$ 773	$ 4,405,592	$ 1,541,957	$ 2,973,775	$ 8,921,000
Pipe	4,400	LF	$ 773	$ 3,400,808	$ 1,190,283	$ 2,295,545	$ 6,887,000
PRV	4		$ 300,000	$ 1,200,000	$ 420,000	$ 810,000	$ 2,430,000
New King Mountain Pump Station							$ 5,000,000
Storage Study							$ 250,000
Total Anticipated Project Cost							$ 69,050,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

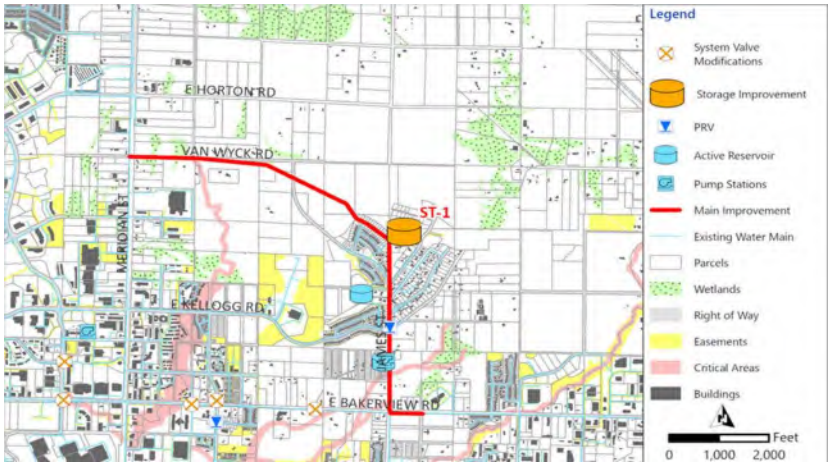
Project Type	Percent	Cost
Improvement:	67%	$ 46,033,329
Capacity:	17%	$ 11,508,333
Repair and Replacement	0%	$ -
General	17%	$ 11,508,333
Total Anticipated Project Cost	100%	$ 69,050,000

Project Timing:

Project Element	Timing	Cost
Reservoirs, Pipe (5,700 LF), PRV, Pump Station, Storage Study	0-10 years	$ 60,129,000
Pipe (4,400 LF)	10-20 years	$ 8,921,000
Total Anticipated Project Cost		$ 69,050,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: ST-02
Project Title: Sehome/Upper Yew Reservoir
Facility Type: Storage
Pressure Zone: New Upper Yew PZ

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Storage needs

Reasoning Two 2.8 MG reservoirs in the Governor Road Zone are recommended to address the Storage deficit in the remainder of the deficit in the North Zone, South Zone, Padden Yew Zone, and Governor Road Zone. To ensure resilient storage between the zones a new transmission line is required as a part of this to connect from Governor Road to South and Governor Road to Padden Yew. Each transmission line will be equipped with a PRV. These recommendations build off the analysis performed in the Yew Street Upper Reservoir Project, 2007 Report.

Anticipated Project Cost:

Project Element	Quantity	Unit	Unit Cost ($/Unit)	Subtotal	Construction 35%	General 50%	Total Cost
Reservoir	3.0	MG	$ 5	$ 13,500,000	$ 4,725,000	$ 9,113,000	$ 27,338,000
Pipe	16,970	LF	$ 773	$ 13,116,298	$ 4,590,704	$ 8,853,501	$ 26,561,000
PRV	1	4	$ 300,000	$ 1,200,000	$ 420,000	$ 810,000	$ 2,430,000

Total Anticipated Project Cost	$ 56,329,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

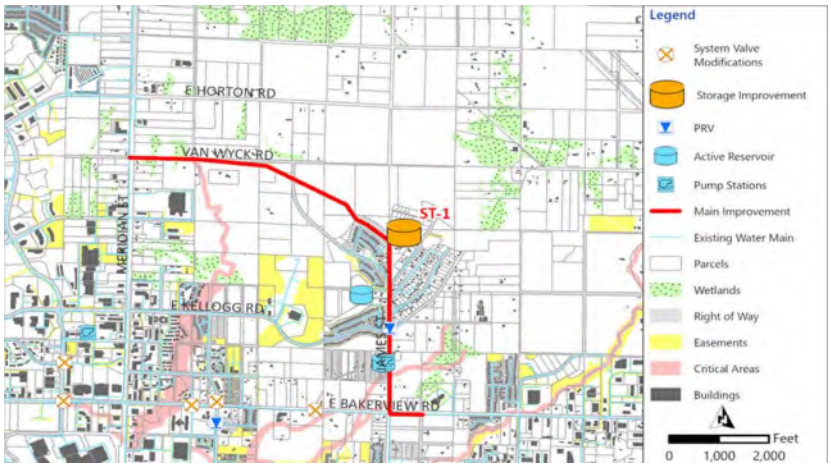
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	100%	$ 56,329,000
Repair and Replacement	0%	$ -
General	0%	$ -
Total Anticipated Project Cost	100%	$ 56,329,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 56,329,000
Total Anticipated Project Cost		$ 56,329,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: ST-03
Project Title: Padden Reservoir Rehabilitation
Facility Type: Storage
Pressure Zone: Padden Yew

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Storage rehab

Reasoning Exterior recoating, Interior recoating, Structural members are corroding, and Fall protection

Anticipated Project Cost:

Project Element	Total Cost
Storage Rehab	$ 1,053,000

Total Anticipated Project Cost	$ 1,053,000

Notes on Cost Estimation:

Total estimated cost is scaled using the July 2024 Seattle ENR value.

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 1,053,000
Total Anticipated Project Cost	100%	$ 1,053,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 1,053,000
Total Anticipated Project Cost		$ 1,053,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: ST-04
Project Title: Whatcom Falls I Reservoir Rehab
Facility Type: Storage
Pressure Zone: North

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Storage rehab

Reasoning Interior recoating, Structural members are corroding, and Lacks internal overflow

Anticipated Project Cost:

Project Element	Total Cost
Storage Rehab	$ 6,346,000

Total Anticipated Project Cost	$ 6,346,000

Notes on Cost Estimation:

Total estimated cost is scaled using the July 2024 Seattle ENR value.

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Cost Allocation:

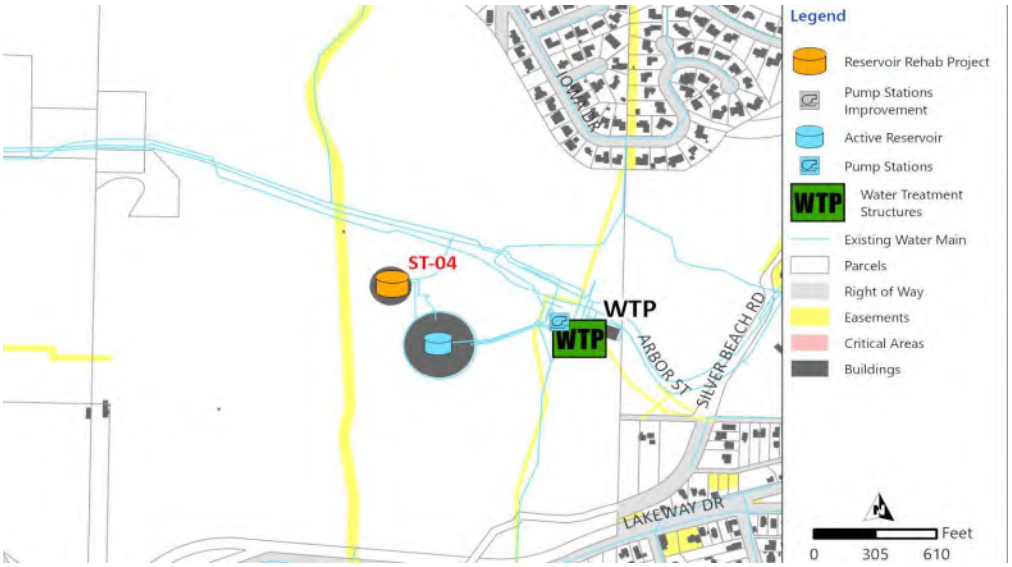
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 6,346,000
Total Anticipated Project Cost	100%	$ 6,346,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 6,346,000
Total Anticipated Project Cost		$ 6,346,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: ST-05
Project Title: Dakin II Reservoir Rehab
Facility Type: Storage
Pressure Zone: Dakin & Yew

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Storage rehab

Reasoning Parapet cracks, No overflow, Fall protection, and Poor site drainage

Anticipated Project Cost:

Project Element	Total Cost
Storage Rehab	$ 952,000

Total Anticipated Project Cost	$ 952,000

Notes on Cost Estimation:

Total estimated cost is scaled using the July 2024 Seattle ENR value.

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 952,000
Total Anticipated Project Cost	100%	$ 952,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 952,000
Total Anticipated Project Cost		$ 952,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: ST-06
Project Title: Kearney Reservoir Rehab
Facility Type: Storage
Pressure Zone: Cordata

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Storage rehab

Reasoning Poor site drainage

Anticipated Project Cost:

Project Element	Total Cost
Storage Rehab	$ 266,000

Total Anticipated Project Cost	$ 266,000

Notes on Cost Estimation:

Toal estimated cost is scaled using the July 2024 Seattle ENR value.

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 266,000
Total Anticipated Project Cost	100%	$ 266,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 266,000
Total Anticipated Project Cost		$ 266,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: ST-07
Project Title: Whatcom Falls II Reservoir Rehab
Facility Type: Storage
Pressure Zone: North

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Storage rehab

Reasoning Sediment accumulation on the floor, Piping configuration, Seismic risk, Tree Spacing, Site drainage, No internal overflow, and Fall protection

Anticipated Project Cost:

Project Element	Total Cost
Storage Rehab	$ 1,088,000

Total Anticipated Project Cost	$ 1,088,000

Notes on Cost Estimation:

Total estimated cost is scaled using the July 2024 Seattle ENR value.

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 1,088,000
Total Anticipated Project Cost	100%	$ 1,088,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 1,088,000
Total Anticipated Project Cost		$ 1,088,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: ST-08
Project Title: 40th Street Reservoir Rehab
Facility Type: Storage
Pressure Zone: Padden Yew

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Storage rehab

Reasoning Walls under-reinforced resulting in wall cracking, Seismic risk, and Fall protection

Anticipated Project Cost:

Project Element	Total Cost
Storage Rehab	$ 3,130,000

Total Anticipated Project Cost	$ 3,130,000

Notes on Cost Estimation:

Total estimated cost is scaled using the July 2024 Seattle ENR value.

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Cost Allocation:

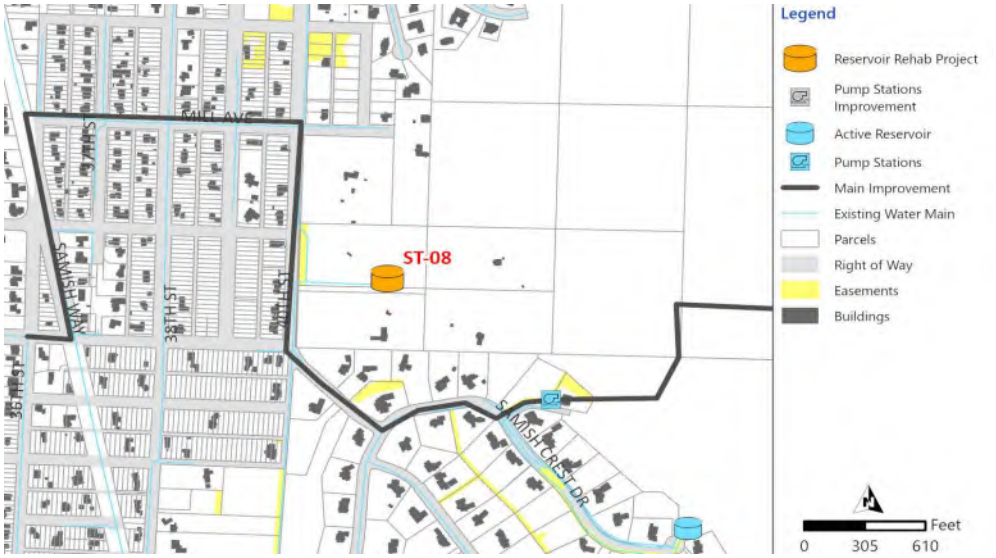
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 3,130,000
Total Anticipated Project Cost	100%	$ 3,130,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 3,130,000
Total Anticipated Project Cost		$ 3,130,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: ST-09
Project Title: College Way Reservoir Rehab
Facility Type: Storage
Pressure Zone: College Way

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Storage rehab

Reasoning Roof wall interface issues, Seismic risk, Poor site drainage, and Fall protection

Anticipated Project Cost:

Project Element	Total Cost
Storage Rehab	$ 1,448,000

Total Anticipated Project Cost	$ 1,448,000

Notes on Cost Estimation:

Total estimated cost is scaled using the July 2024 Seattle ENR value.

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 1,448,000
Total Anticipated Project Cost	100%	$ 1,448,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 1,448,000
Total Anticipated Project Cost		$ 1,448,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: ST-10
Project Title: Consolidation Reservoir Rehab
Facility Type: Storage
Pressure Zone: Padden Yew

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Storage rehab

Reasoning Interior recoating, Roof wall interface issues, Seismic risk, and Fall protection

Anticipated Project Cost:

Project Element	Total Cost
Storage Rehab	$ 1,442,000

Total Anticipated Project Cost	$ 1,442,000

Notes on Cost Estimation:

Total estimated cost is scaled using the July 2024 Seattle ENR value.

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 1,442,000
Total Anticipated Project Cost	100%	$ 1,442,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 1,442,000
Total Anticipated Project Cost		$ 1,442,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: ST-11
Project Title: Dakin I Reservoir Rehab
Facility Type: Storage
Pressure Zone: Dakin & Yew

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Storage rehab

Reasoning Roof wall interface issues, Seismic risk, Poor site drainage, and Fall protection

Anticipated Project Cost:

Project Element	Total Cost
Storage Rehab	$ 1,386,000

Total Anticipated Project Cost	$ 1,386,000

Notes on Cost Estimation:

Total estimated cost is scaled using the July 2024 Seattle ENR value.

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 1,386,000
Total Anticipated Project Cost	100%	$ 1,386,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 1,386,000
Total Anticipated Project Cost		$ 1,386,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: ST-12
Project Title: Reveille Reservoir Rehab
Facility Type: Storage
Pressure Zone: Padden Yew

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Storage rehab

Reasoning Interior recoating, Roof wall interface issues, Seismic risk, Poor site drainage, and Fall protection

Anticipated Project Cost:

Project Element	Total Cost
Storage Rehab	$ 1,622,000

Total Anticipated Project Cost	$ 1,622,000

Notes on Cost Estimation:

Total estimated cost is scaled using the July 2024 Seattle ENR value.

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 1,622,000
Total Anticipated Project Cost	100%	$ 1,622,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 1,622,000
Total Anticipated Project Cost		$ 1,622,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: ST-13
Project Title: Sehome Reservoir Rehab
Facility Type: Storage
Pressure Zone: South

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Storage rehab

Reasoning Replace Reservoir

Anticipated Project Cost:

Project Element	Total Cost
Storage Rehab	$ 4,384,000

Total Anticipated Project Cost	$ 4,384,000

Notes on Cost Estimation:

Total estimated cost is scaled using the July 2024 Seattle ENR value.

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Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 4,384,000
Total Anticipated Project Cost	100%	$ 4,384,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 4,384,000
Total Anticipated Project Cost		$ 4,384,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: ST-14
Project Title: Parkhurst Standpipe Rehab
Facility Type: Storage
Pressure Zone: Samish Hill

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Storage rehab

Reasoning Interior recoating and Fall protection

Anticipated Project Cost:

Project Element	Total Cost
Storage Rehab	$ 286,000

Total Anticipated Project Cost	$ 286,000

Notes on Cost Estimation:

Total estimated cost is scaled using the July 2024 Seattle ENR value.

Go to Assumptions Tab

Cost Allocation:

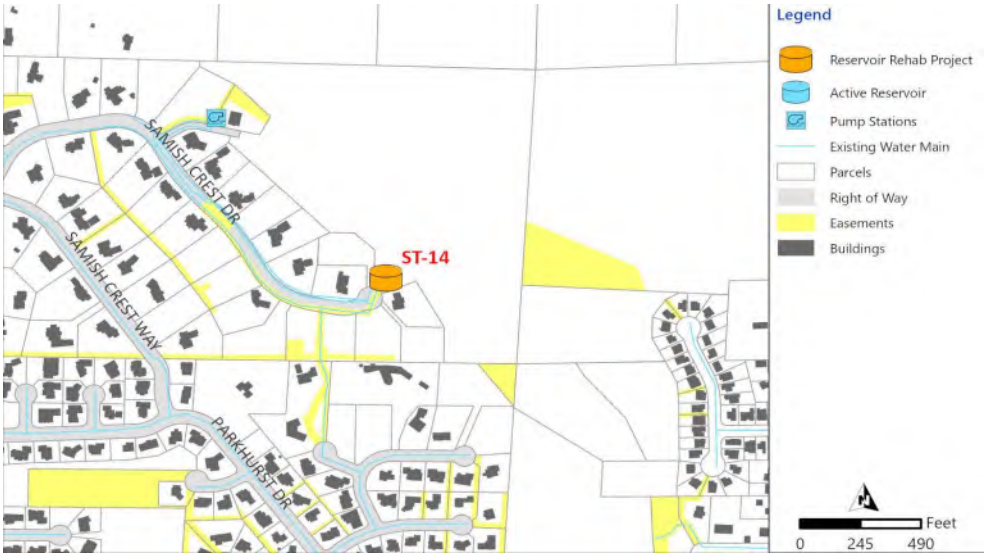
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 286,000
Total Anticipated Project Cost	100%	$ 286,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 286,000
Total Anticipated Project Cost		$ 286,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: WTP-01
Project Title: Raw Water Intake Rehabilitation Improvement
Priority: 0-10 years
Facility Type: Water Treatment Plant
Pressure Zone: n/a
Project Status (Completed?): N

Go to CIP Summary Table

Project Description:

Project Description: Treatment Plant Upgrades

Reasoning Complete rehabilitation projects on existing raw water intake pipeline identified in Intake Pipelines Condition Assessment Report (Jacobs 2024), including critical pipe needs that hold the intake pipeline together need replacement and concrete ballast weights need securing in 12 locations as soon as practical. During this effort, further inspection on pipe bands on buried portion of the intake pipe and metal fasteners is proposed.

Anticipated Project Cost:

Project Element	Total Cost
Treatment Plant Upgrades	$ 4,114,000

Total Anticipated Project Cost	$ 4,114,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

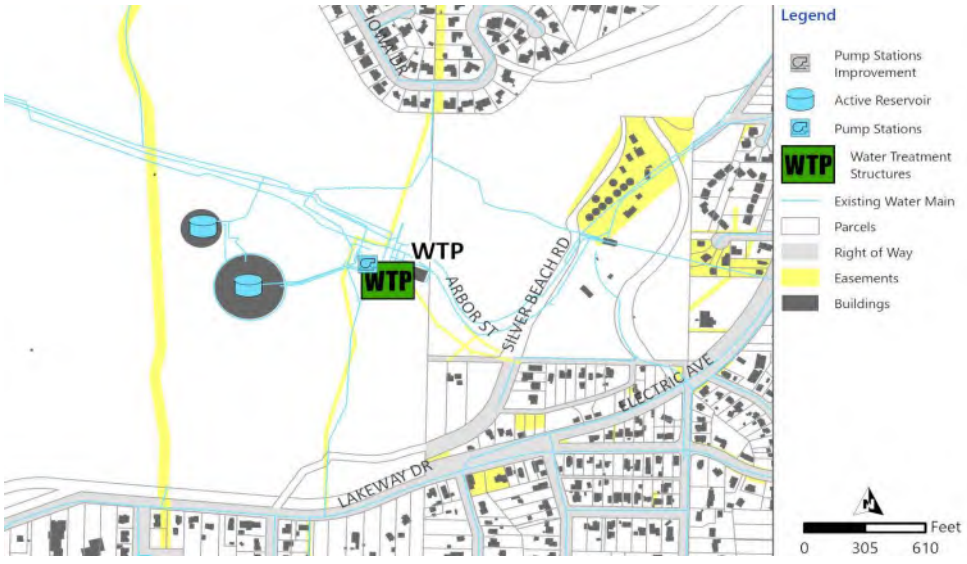
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	50%	$ 2,057,000
General	50%	$ 2,057,000
Total Anticipated Project Cost	100%	$ 4,114,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 4,114,000
Total Anticipated Project Cost		$ 4,114,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: WTP-02
Project Title: Redundant Raw Water Intake Feasibility Study
Priority: 0-10 years
Facility Type: Water Treatment Plant
Pressure Zone: n/a
Project Status (Completed?): N

Go to CIP Summary Table

Project Description:

Project Description: Treatment Plant Upgrades

Reasoning Conduct feasibility study to identify options to provide a redundant source of raw water to the WTP, including intake and raw water piping. Intake evaluation will include assessment of multi-level intake tower, fish screening requirements, water rights considerations, and other permitting implications. Feasibility study will include cost estimates and to determine viability. Cost for redundant intake and raw water pipeline is a placeholder.

Anticipated Project Cost:

Project Element	Total Cost
Treatment Plant Upgrades	$ 500,000

Total Anticipated Project Cost	$ 500,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

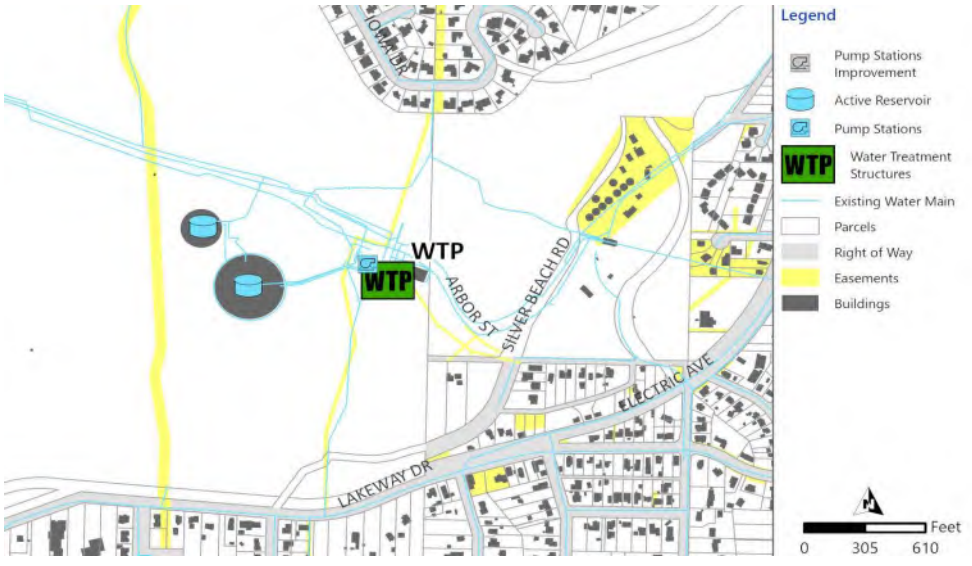
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 500,000
Total Anticipated Project Cost	100%	$ 500,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 500,000
Total Anticipated Project Cost		$ 500,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: WTP-03
Project Title: Redundant Raw Water Intake
Facility Type: Water Treatment Plant
Pressure Zone: n/a

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:

Project Description: Treatment Plant Upgrades

Reasoning Construct redundant raw water supply to the WTP site including intake and piping. Project extents and costs to be refined based on results of the feasibility study.

Anticipated Project Cost:

Project Element	Total Cost
Treatment Plant Upgrades	$ 100,000,000

Total Anticipated Project Cost	$ 100,000,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 100,000,000
Total Anticipated Project Cost	100%	$ 100,000,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 100,000,000
Total Anticipated Project Cost		$ 100,000,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: WTP-04
Project Title: Screenhouse Rehabilitation
Facility Type: Water Treatment Plant
Pressure Zone: n/a

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Treatment Plant Upgrades

Reasoning Project includes Reline / recoat three pipes in screenhouse, New gates / valves, New screen mechanism, Design / planning for the project to include evaluation of alternative delivery options to get contractor input on methods to keep WTP operational while portions of the raw water supply are out of service during project construction, Repairs to spalled concrete and corroded rebar at the pilaster on the second floor, Wet well protective coating system, stop log channel cleaning, slide gate replacement, Non-destructive investigation of structural defects on raw water tunnel, and develop alternative water intake strategy

Anticipated Project Cost:

Project Element	Total Cost
Treatment Plant Upgrades	$ 5,673,000

Total Anticipated Project Cost	$ 5,673,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

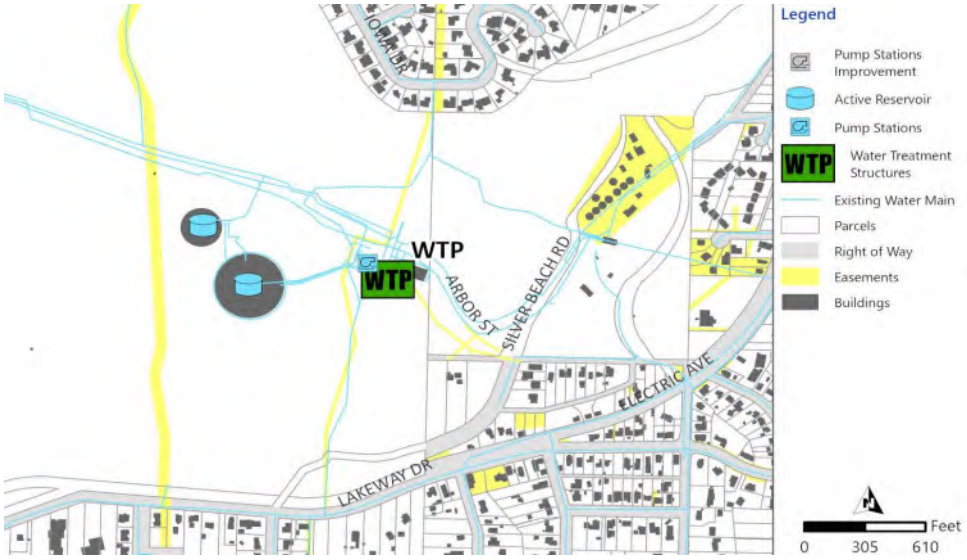
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	50%	$ 2,836,500
General	50%	$ 2,836,500
Total Anticipated Project Cost	100%	$ 5,673,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 5,673,000
Total Anticipated Project Cost		$ 5,673,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: WTP-05
Project Title: Filter Rehabilitation Project
Facility Type: Water Treatment Plant
Pressure Zone: n/a

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Treatment Plant Upgrades

Reasoning Replace filter media / backwash troughs, Underdrain inspection, and Handrail replacement and access improvements.

Anticipated Project Cost:

Project Element	Total Cost
Treatment Plant Upgrades	$ 4,637,000

Total Anticipated Project Cost	$ 4,637,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

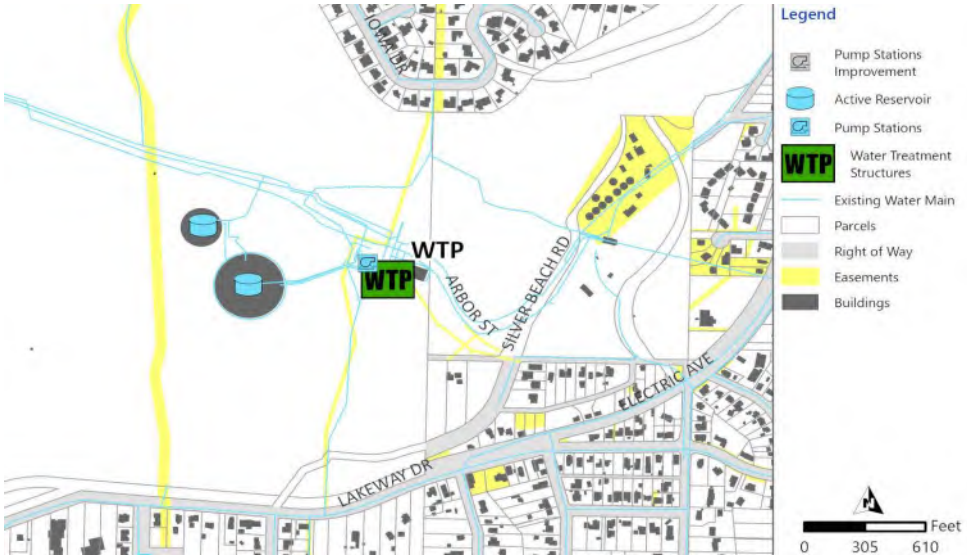
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	50%	$ 2,318,500
General	50%	$ 2,318,500
Total Anticipated Project Cost	100%	$ 4,637,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 4,637,000
Total Anticipated Project Cost		$ 4,637,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: WTP-06
Project Title: Soda Ash Feed System Replacement
Facility Type: Water Treatment Plant
Pressure Zone: n/a

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Treatment Plant Upgrades

Reasoning Replace mechanical equipment and infrastructure between silos and solution piping (feeders, solution mixers, etc.), Provide ability to feed soda ash from either silo, Clean soda ash silos, and Inspect condition of silo roofs.

Anticipated Project Cost:

Project Element	Total Cost
Treatment Plant Upgrades	$ 1,975,000

Total Anticipated Project Cost	$ 1,975,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

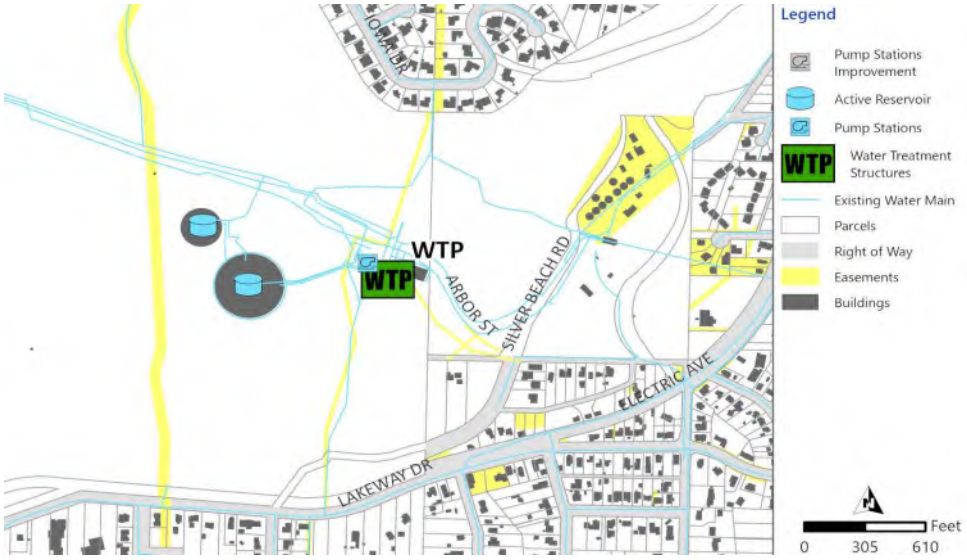
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 1,975,000
Total Anticipated Project Cost	100%	$ 1,975,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 1,975,000
Total Anticipated Project Cost		$ 1,975,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: WTP-07
Project Title: WTP Flow Metering Improvement Study
Priority: 0-10 years
Facility Type: Water Treatment Plant
Pressure Zone: n/a
Project Status (Completed?): N

Go to CIP Summary Table

Project Description:

Project Description: Treatment Plant Upgrades

Reasoning This project addresses issues with production data recorded by the gravity flow meter leaving the WTP site. This project will provide further evaluation of flow meter performance and options for replacement or improvements. Study will assess the accuracy of the existing meter and determine options for replacement if meter proves to be inaccurate. If meter replacement is recommended, evaluation will determine if existing meter can be replaced in the current location or if an alternative metering location or strategy is required.

Anticipated Project Cost:

Project Element	Total Cost
Treatment Plant Upgrades	$ 300,000

Total Anticipated Project Cost	$ 300,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

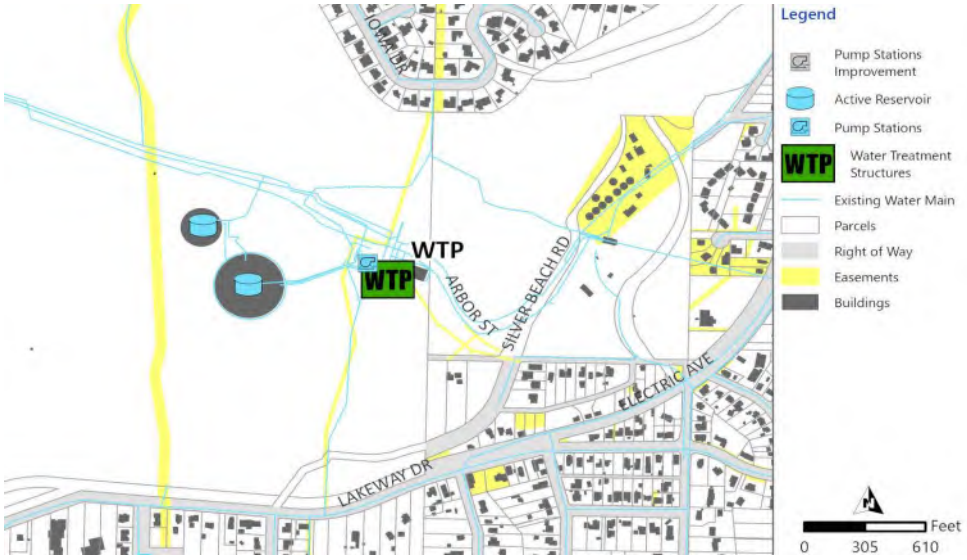
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 300,000
Total Anticipated Project Cost	100%	$ 300,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 300,000
Total Anticipated Project Cost		$ 300,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: WTP-08
Project Title: WTP Flow Metering Improvement Project
Priority: 0-10 years
Facility Type: Water Treatment Plant
Pressure Zone: n/a
Project Status (Completed?): N

Go to CIP Summary Table

Project Description:

Project Description: Treatment Plant Upgrades

Reasoning Improvement serves as a placeholder. Improvement project and costs to be developed and refined during evaluation study.

Anticipated Project Cost:

Project Element	Total Cost
Treatment Plant Upgrades	$ 3,000,000

Total Anticipated Project Cost	$ 3,000,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

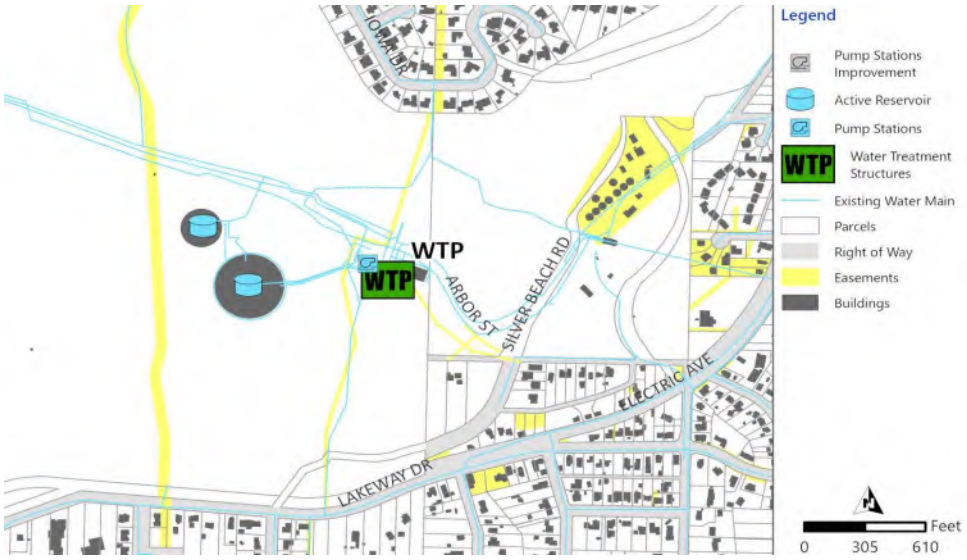
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 3,000,000
Total Anticipated Project Cost	100%	$ 3,000,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 3,000,000
Total Anticipated Project Cost		$ 3,000,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: WTP-09
Project Title: Alum System Replacement
Facility Type: Water Treatment Plant
Pressure Zone: n/a

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Treatment Plant Upgrades

Reasoning Replace alum storage tank and metering pumps that have exceeded their useful life. Metering pump replacement will include replacement of all mechanical equipment and instrumentation on individual pump discharge piping up to combined discharge piping from all three pumps.

Anticipated Project Cost:

Project Element	Subtotal	Construction 35%	General 50%	Total Cost
Treatment Plant Upgrades	$ 240,000	$ 84,000	$ 162,000	$ 486,000

Total Anticipated Project Cost	$ 486,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

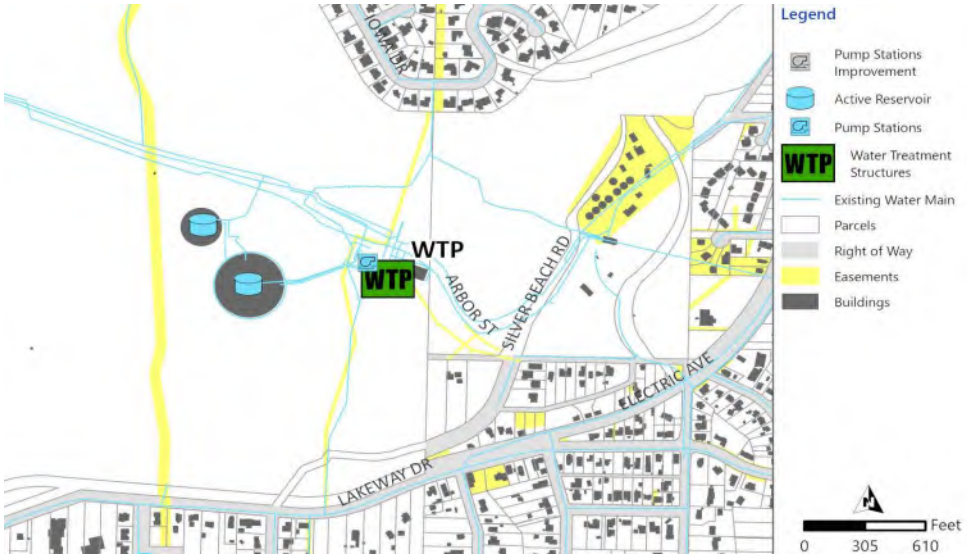
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	50%	$ 243,000
General	50%	$ 243,000
Total Anticipated Project Cost	100%	$ 486,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 486,000
Total Anticipated Project Cost		$ 486,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: WTP-10
Project Title: Powerhouse Demolition
Facility Type: Water Treatment Plant
Pressure Zone: n/a

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Treatment Plant Upgrades

Reasoning Demolish existing Powerhouse structure and restore diversion pipeline running through the Powerhouse site. Project timing to be coordinated with PSE disconnecting power from the site.

Anticipated Project Cost:

Project Element	Total Cost
Treatment Plant Upgrades	$ 250,000

Total Anticipated Project Cost	$ 250,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

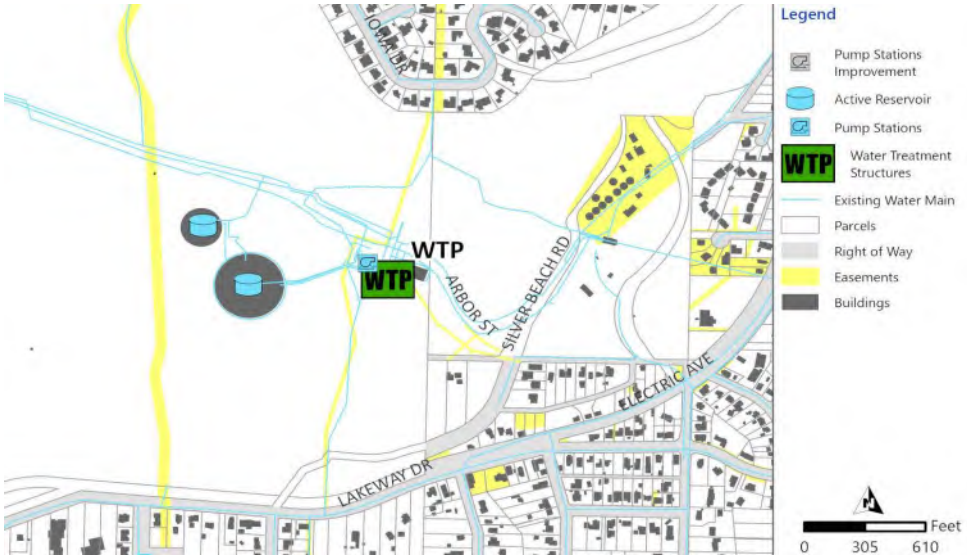
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	50%	$ 125,000
General	50%	$ 125,000
Total Anticipated Project Cost	100%	$ 250,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 250,000
Total Anticipated Project Cost		$ 250,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: WTP-11
Project Title: SCADA System Evaluation
Facility Type: Water Treatment Plant
Pressure Zone: n/a

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Treatment Plant Upgrades

Reasoning Complete evaluation of plant SCADA system. Identify improvements and software upgrades and Determine if improvements and software upgrades needed.

Anticipated Project Cost:

Project Element	Total Cost
Treatment Plant Upgrades	$ 200,000

Total Anticipated Project Cost	$ 200,000

Notes on Cost Estimation:

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Cost Allocation:

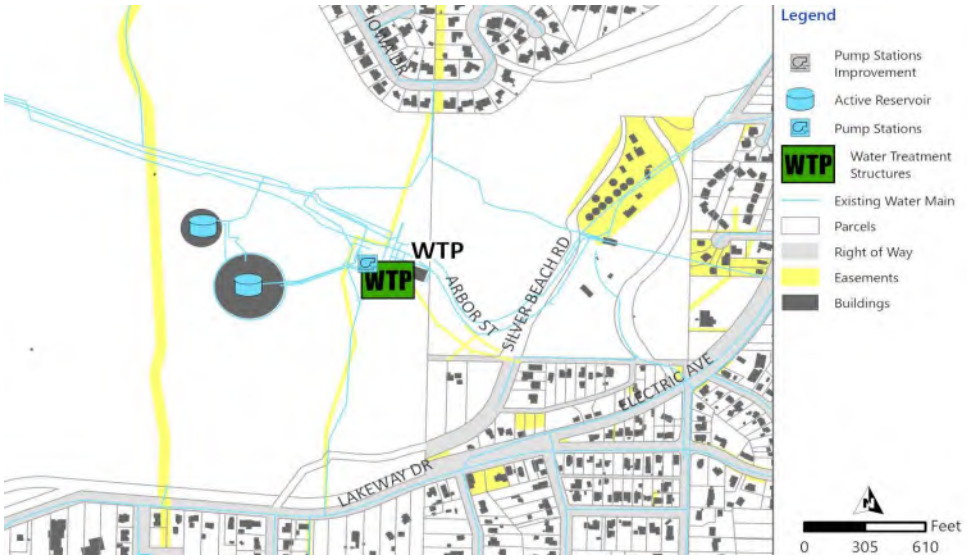
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 200,000
Total Anticipated Project Cost	100%	$ 200,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 200,000
Total Anticipated Project Cost		$ 200,000

Project Location Map:

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City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: WTP-12
Project Title: Polymer System Replacement
Facility Type: Water Treatment Plant
Pressure Zone: n/a

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Treatment Plant Upgrades

Reasoning Replace existing polymer feed system (mixing/batch tanks, mixers, feeds pumps) with modern polymer blend and feed system. Current system is over-sized for normal usage; new polymer system design will be optimized to match plant requirements. Design will evaluate alternatives to current drum-based system to address challenges with polymer age and procurement. Evaluation will consider tote-based feed and batch system and neat polymer feed system.

Anticipated Project Cost:

Project Element	Subtotal	Construction 35%	General 50%	Total Cost
Treatment Plant Upgrades	$ 100,000	$ 35,000	$ 115,000	$ 250,000

Total Anticipated Project Cost	$ 250,000

Notes on Cost Estimation:

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Cost Allocation:

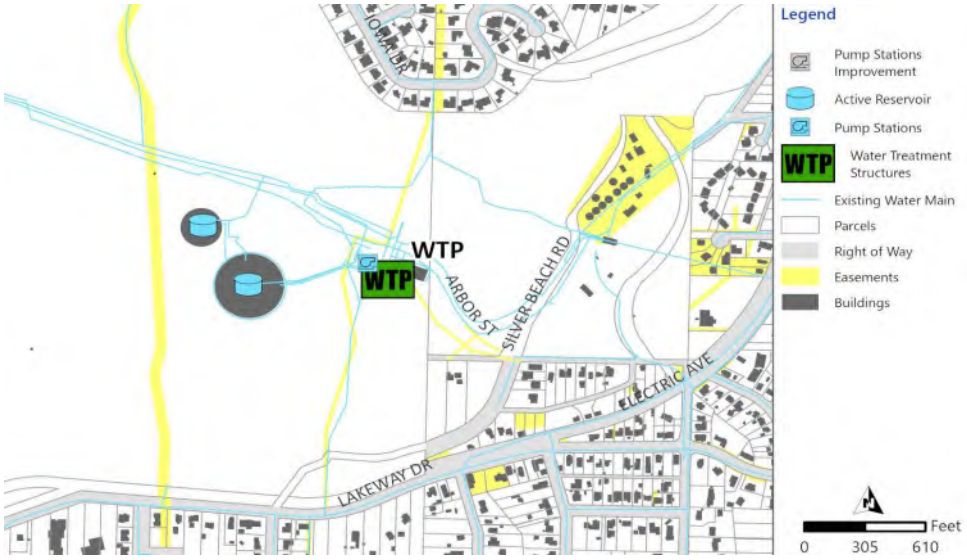
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 250,000
Total Anticipated Project Cost	100%	$ 250,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 250,000
Total Anticipated Project Cost		$ 250,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: WTP-13
Project Title: Filter Mechanical Equipment Replacement
Priority: 0-10 years
Facility Type: Water Treatment Plant
Pressure Zone: n/a
Project Status (Completed?): N

Go to CIP Summary Table

Project Description:

Project Description: Treatment Plant Upgrades

Reasoning Two backwash pumps are original to the plant and third backwash pump cannot meet sufficient summertime flows. Replace three existing backwash pumps and motors. Replace all filter valves and actuators. Project cost includes engineering services for design of mechanical equipment replacement and programming services to integrate new actuators into existing plant control system.

Anticipated Project Cost:

Project Element	Subtotal	Construction 35%	General 50%	Total Cost
Treatment Plant Upgrades	$ 2,740,000	$ 959,000	$ 1,850,000	$ 5,549,000

Total Anticipated Project Cost	$ 5,549,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

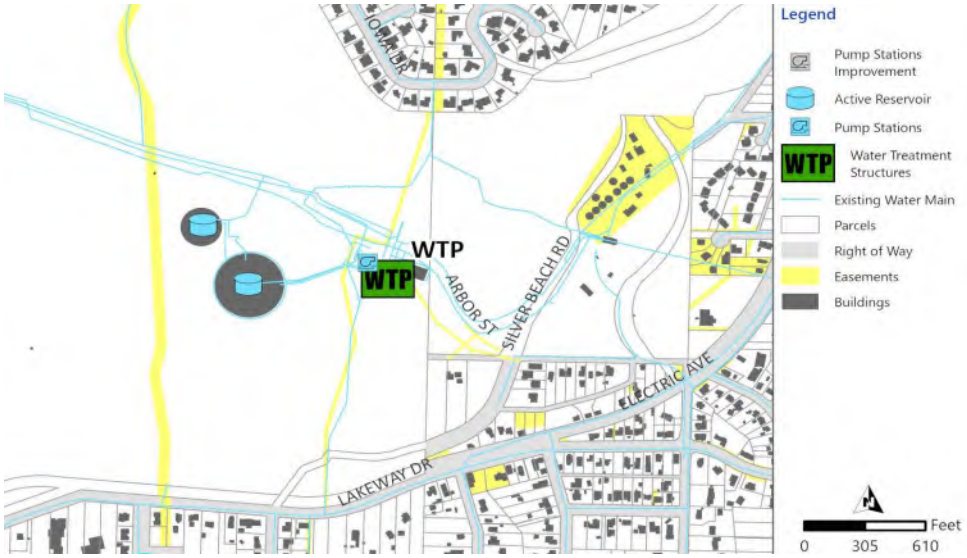
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	50%	$ 2,774,500
General	50%	$ 2,774,500
Total Anticipated Project Cost	100%	$ 5,549,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 5,549,000
Total Anticipated Project Cost		$ 5,549,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: WTP-14
Project Title: MCC Replacement
Facility Type: Water Treatment Plant
Pressure Zone: n/a

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:

Project Description: Treatment Plant Upgrades

Reasoning Replace existing MCCs 2 and 3 that are reaching end of useful life.

Anticipated Project Cost:

Project Element	Subtotal	Construction 35%	General 50%	Total Cost
Treatment Plant Upgrades	$ 310,000	$ 108,500	$ 209,500	$ 628,000

Total Anticipated Project Cost	$ 628,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

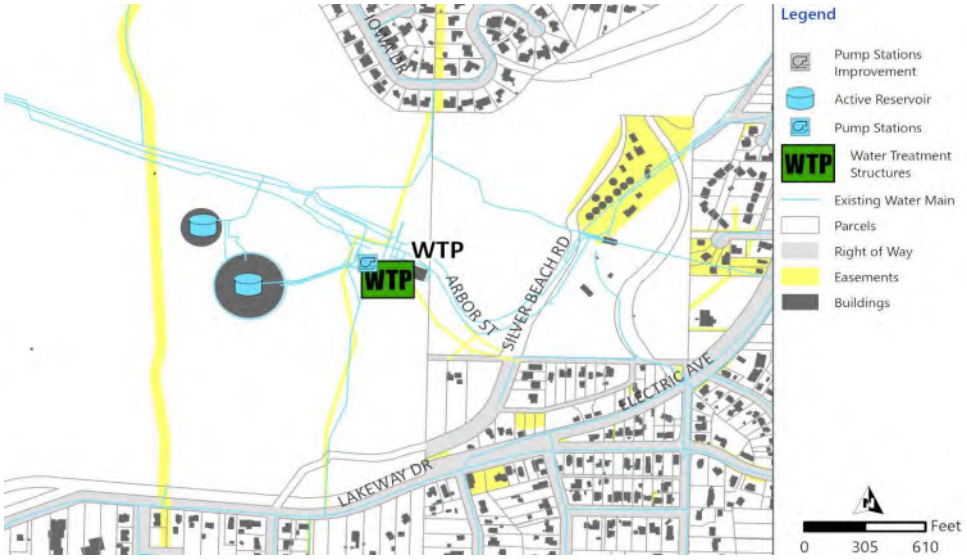
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	50%	$ 314,000
General	50%	$ 314,000
Total Anticipated Project Cost	100%	$ 628,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 628,000
Total Anticipated Project Cost		$ 628,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: WTP-15
Project Title: WTP Seismic Resilience and Life Safety Evaluation
Priority: 0-10 years
Facility Type: Water Treatment Plant
Pressure Zone: n/a
Project Status (Completed?): N

Go to CIP Summary Table

Project Description:

Project Description: Treatment Plant Upgrades

Reasoning Evaluate structural performance of Whatcom Falls WTP facilities during seismic hazard event. Conduct geotechnical hazard evaluation to develop seismic hazard maps encompassing full extent of WTP infrastructure. For WTP facilities, identify structural deficiencies and life-safety deficiencies in existing structures, structural connections, equipment anchors, mechanical / electrical systems, and other ancillary components. Evaluation to include assessment of clearwell baffles. For pipelines, identify areas of pipes subject to geohazards. Develop seismic risk mitigation plan to identify seismic retrofits or improvements.

Anticipated Project Cost:

Project Element	Total Cost
Treatment Plant Upgrades	$ 300,000

Total Anticipated Project Cost	$ 300,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

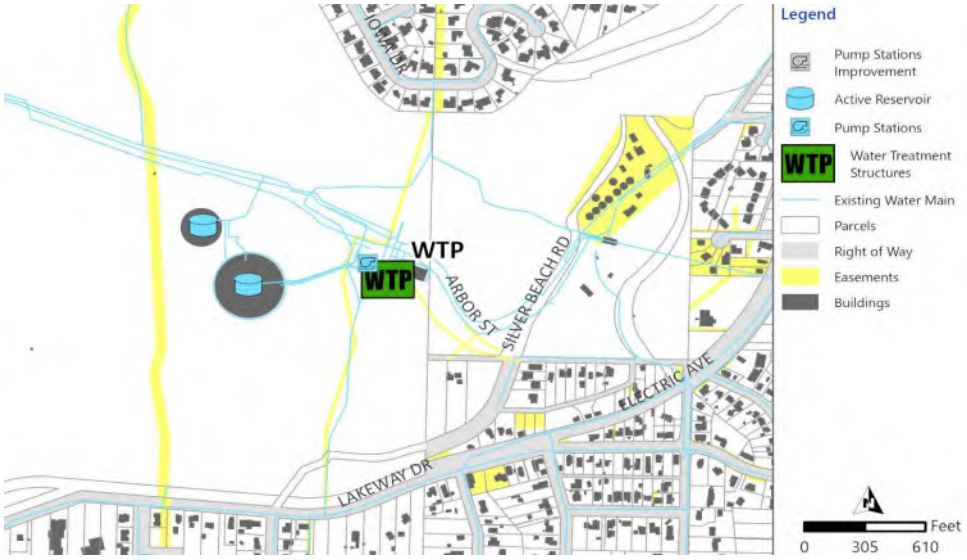
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 300,000
Total Anticipated Project Cost	100%	$ 300,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 300,000
Total Anticipated Project Cost		$ 300,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: WTP-16
Project Title: Whatcom Falls WTP HVAC System Improvements Study
Priority: 0-10 years
Facility Type: Water Treatment Plant
Pressure Zone: n/a
Project Status (Completed?): N

Go to CIP Summary Table

Project Description:

Project Description: Treatment Plant Upgrades

Reasoning During previous maintenance efforts, contractors recommended full replacement of the WTP HVAC system. Conduct assessment of existing HVAC system, identify improvements required, and develop design for improvements.

Anticipated Project Cost:

Project Element	Total Cost
Treatment Plant Upgrades	$ 200,000

Total Anticipated Project Cost	$ 200,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

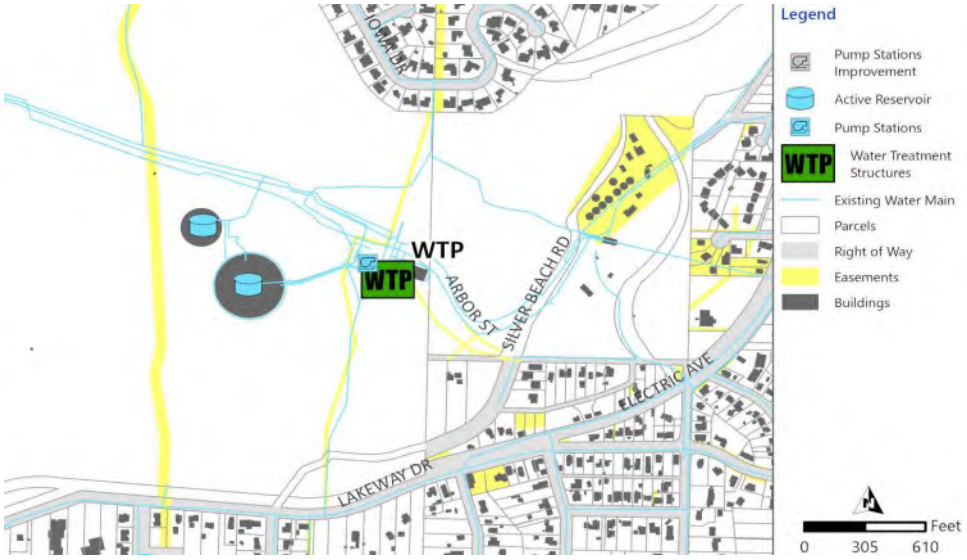
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 200,000
Total Anticipated Project Cost	100%	$ 200,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 200,000
Total Anticipated Project Cost		$ 200,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: WTP-17
Project Title: Whatcom Falls WTP HVAC System Improvements Project
Priority: 0-10 years
Facility Type: Water Treatment Plant
Pressure Zone: n/a
Project Status (Completed?): N

Go to CIP Summary Table

Project Description:

Project Description: Treatment Plant Upgrades

Reasoning Construct recommended improvements to HVAC system.

Anticipated Project Cost:

Project Element	Total Cost
Treatment Plant Upgrades	$ 500,000

Total Anticipated Project Cost	$ 500,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

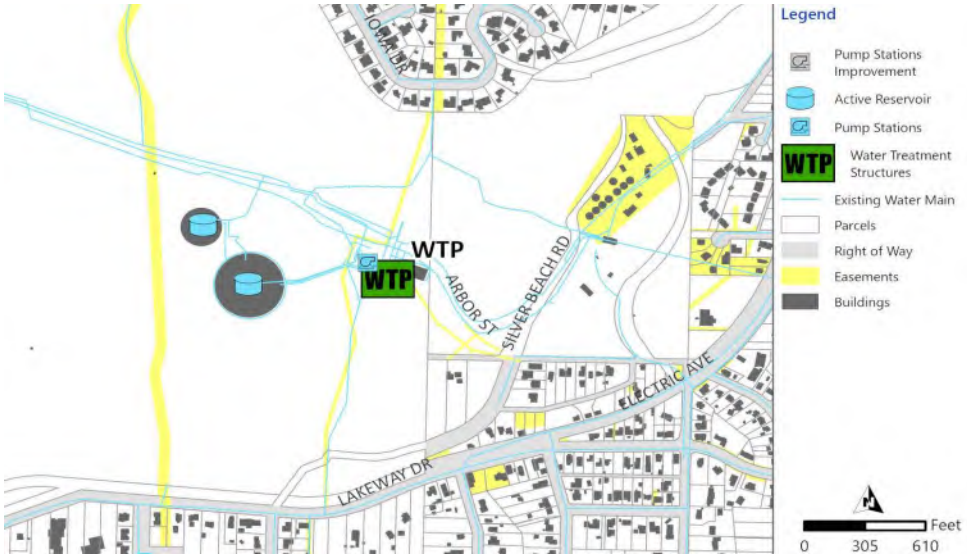
Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 500,000
Total Anticipated Project Cost	100%	$ 500,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 500,000
Total Anticipated Project Cost		$ 500,000

Project Location Map:

Go to Maps Tab



City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: G-01
Project Title: 2034 WSP
Facility Type: General
Pressure Zone: System-wide

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:
Project Description:

Reasoning 2034 WSP

Anticipated Project Cost:

Project Element	Total Cost
Water System Plan	$ 400,000
Total Anticipated Project Cost	$ 400,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 400,000
Total Anticipated Project Cost	100%	$ 400,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 400,000
Total Anticipated Project Cost		$ 400,000

Project Location Map:

Go to Maps Tab

City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: G-02
Project Title: 2044 WSP
Facility Type: General
Pressure Zone: System-wide

Go to CIP Summary Table

Priority: 10-20 years
Project Status (Completed?): N

Project Description:
Project Description:

Reasoning 2044 WSP

Anticipated Project Cost:

Project Element	Total Cost
Water System Plan	$ 400,000
Total Anticipated Project Cost	$ 400,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 400,000
Total Anticipated Project Cost	100%	$ 400,000

Project Timing:

Project Element	Timing	Cost
Entire Project	10-20 years	$ 400,000
Total Anticipated Project Cost		$ 400,000

Project Location Map:

Go to Maps Tab

City of Bellingham
Water System Plan
Capital Improvement Plan

Project ID: G-03
Project Title: General Fund for Studies
Facility Type: General
Pressure Zone: System-wide

Go to CIP Summary Table

Priority: 0-10 years
Project Status (Completed?): N

Project Description:
Project Description:

Reasoning General

Anticipated Project Cost:

Project Element	Total Cost
General Fund for Studies	$ 500,000
Total Anticipated Project Cost	$ 500,000

Notes on Cost Estimation:

Go to Assumptions Tab

Cost Allocation:

Project Type	Percent	Cost
Improvement:	0%	$ -
Capacity:	0%	$ -
Repair and Replacement	0%	$ -
General	100%	$ 500,000
Total Anticipated Project Cost	100%	$ 500,000

Project Timing:

Project Element	Timing	Cost
Entire Project	0-10 years	$ 500,000
Total Anticipated Project Cost		$ 500,000

Project Location Map:

Go to Maps Tab

APPENDIX BB

FUNDING PROGRAMS FOR DRINKING WATER AND WASTEWATER PROJECTS

Funding Programs for Drinking Water and Wastewater Projects

Updated 9-17-2024

Type of Program	Pages
Planning/ Pre-Construction	2 - 6
Pre-Construction Only	7 - 8
Construction	9 - 16
Emergency	17 - 19

You can find the latest version of this document at http://www.infrafunding.wa.gov/resources.html

Please contact Amie Smith at amie.smith@commerce.wa.gov if you would like to update your program information

PLANNING **Programs**	**Eligible Projects**	**Eligible Applicants**	**Funding Available**	**How To Apply**
DWSRF Drinking Water State Revolving Fund Planning and Engineering Loans Department of Health	Preparation of planning documents, engineering reports, construction documents, permits, cultural reports, environmental reports. Potential for grant subsidy for disadvantaged communities or those with high affordability rates.	Group A (private and publicly-owned) community and not-for-profit non-community water systems, but not federal or state-owned systems. Small systems serving fewer than 10,000 people.	Loan: $500,000 maximum per jurisdiction 0% annual interest rate 2% loan service fee 2-year time of performance 10-year repayment period	On-line applications accepted year-round until funding exhausted. Approximately $3 million available to award each year. **Contact:** Jocelyne Gray 564-669-4893 Jocelyne.gray@doh.wa.gov For information and forms visit: http://www.doh.wa.gov/DWSRF
DWSRF Drinking Water State Revolving Fund Consolidation Grant Department of Health	Development of a feasibility study, engineering evaluation, design of a infrastructure project to consolidated one or more Group A water systems	Group A not-for-profit community water system, county, city, public utility district, or water district in Washington State Tribal systems are eligible provided the project is not receiving other national set-aside funding for the project.	Grant: Up to $50,000 per project Minimum of $10,000 2-year time of performance	Online applications accepted year round until funding exhausted. **Contact:** Jocelyne Gray 564-669-4893 Jocelyne.gray@doh.wa.gov For information and forms visit: http://www.doh.wa.gov/DWSRF
DWSRF Drinking Water State Revolving Fund Lead Service Line Inventory Loan Department of Health	Develop lead service line inventory. Can include creating or updating a planning document. There is principal forgiveness for disadvantaged communities.	Group A (private and publicly-owned) community and not-for-profit non-community water systems, but not federal or state-owned systems.	Loan: Minimum $25,000 No maximum 0% annual interest rate 2% loan service fee 2-year time of performance 10-year repayment period First come, first served based on application submittal date.	Online applications available and accepted October 1 through November 30, 2024. **Contact:** Jocelyne Gray 564-669-4893 Jocelyne.gray@doh.wa.gov For information and forms visit: http://www.doh.wa.gov/DWSRF

PLANNING **Programs**	**Eligible Projects**	**Eligible Applicants**	**Funding Available**	**How To Apply**
DWSRF Drinking Water State Revolving Fund Drinking Water System Rehabilitation and Consolidation Grant Department of Health	<u>Rehabilitation</u> Planning and design of infrastructure to bring system into compliance. <u>Restructuring, Consolidation, Receivership Planning</u> Preconstruction to bring the water system into compliance. Purchase cost of the water system to be acquired. Establishment of a water program for any receiving city, town, or county.	<u>Rehabilitation</u> Group A water systems serving less than 10,000 people under a DOH compliance order. <u>Restructuring, Consolidation, Receivership</u> Group A publicly owned water system (city, town, county, public utility district, or water/sewer district), an approved Satellite Management Agency, or approved receiver.	Grant: Maximum $1.25 million 4-year time of performance	By invite only. **Contact:** Jocelyne Gray 564-669-4893 Jocelyne.gray@doh.wa.gov For information and forms visit: http://www.doh.wa.gov/DWSRF
SOURCE WATER PROTECTION GRANT PROGRAM Department of Health	Source water protection studies (watershed, hydrogeologic, feasibility studies). Eligible activities can lead to reducing the risk of contamination of a system's drinking water sources(s), or they can evaluate or build resiliency for a public water supply. They must contribute to better protecting one or more public water supply sources.	Non-profit Group A water systems. Local governments proposing a regional project. Project must be reasonably expected to provide long-term benefit to drinking water quality or quantity.	Grants: Funding is dependent upon project needs, but typically does not exceed $30,000.	Applications accepted anytime; grants awarded on a funds available basis. **Contact:** Deborah Johnson 253-433-4054 Deborah.Johnson@doh.wa.gov http://www.doh.wa.gov/CommunityandEnvironment/DrinkingWater/SourceWater/SourceWaterProtection.aspx Grant guidelines https://www.doh.wa.gov/Portals/1/Documents/Pubs/331-552.pdf

PLANNING **Programs**	**Eligible Projects**	**Eligible Applicants**	**Funding Available**	**How To Apply**
ECOLOGY: WATER QUALITY COMBINED FUNDING PROGRAM State Water Pollution Control Revolving Fund (SRF) Centennial Clean Water Fund Stormwater Financial Assistance Program (SFAP) Department of Ecology	Planning projects associated with publicly-owned wastewater and stormwater facilities. The integrated program also funds planning and implementation of nonpoint source pollution control activities.	Counties, cities, towns, conservation districts, or other political subdivision, municipal or quasi-municipal corporations, and federally recognized tribes	Loan: $10,000,000 reserved for preconstruction statewide Interest rates (SFY 2025) • 6-20 year loans: 1.2% • 1-5 year loans: 0.6% Preconstruction set-aside (Distressed Communities) 50% forgivable principal loan and 50% loan	Applications due October 15, 2024. **Contact:** Eliza Keeley 360-628-1976 Eliza.keeley@ecy.wa.gov https://ecology.wa.gov/About-us/How-we-operate/Grants-loans/Find-a-grant-or-loan/Water-Quality-grants-and-loans
RD PRE-DEVELOPMENT PLANNING GRANTS (PPG) U.S. Dept. of Agriculture Rural Development – Rural Utilities Service – Water and Waste Disposal Direct Loans and Grants	Water and/or sewer planning; environmental work; and other work to assist in developing an application for infrastructure improvements.	Low-income, small communities and systems serving areas under 10,000 population. Population determined by U.S. Census 2020. Income determined by the American Community Survey 2017-2021 (5-year).	Planning grant to assist in paying costs associated with developing a complete application for RD funding for a proposed project. Maximum $60,000 grant. Requires minimum 25% match.	Applications accepted year-round, on a fund-available basis. **Contact:** Koni Reynolds 360-704-7737 koni.reynolds@usda.gov http://www.rd.usda.gov/wa
RD 'SEARCH' GRANTS: SPECIAL EVALUATION ASSISTANCE FOR RURAL COMMUNITIES U.S. Dept. of Agriculture Rural Development – Rural Utilities Service – Water and Waste Disposal Direct Loans and Grants	Water and/or sewer planning; environmental work; and other work to assist in developing an application for infrastructure improvements.	Low-income, small communities and systems serving areas under 2,500 population. Population determined by U.S. Census 2020. Income determined by the American Community Survey 2017-2021 (5-year).	Maximum $30,000 grant. No match required.	Applications accepted year-round, on a fund-available basis. **Contact: :** Koni Reynolds 360-704-7737 koni.reynolds@usda.gov http://www.rd.usda.gov/wa

PLANNING **Programs**	**Eligible Projects**	**Eligible Applicants**	**Funding Available**	**How To Apply**
CERB PLANNING AND FEASIBILITY GRANTS Community Economic Revitalization Board – Project-Specific Planning Program	Project-specific feasibility and pre-development studies that advance community economic development goals for industrial sector business development.	Eligible statewide Counties, cities, towns, port districts, special districts. Federally recognized tribes Municipal corporations, quasi-municipal corporations w/ economic development purposes.	Grant: Up to $100,000 per project. Requires 20% (of total project cost) matching funds CERB is authority for funding approvals.	Applications accepted year-round. The Board meets six times a year. **Contact:** Janea Stark 360-252-0812 janea.stark@commerce.wa.gov
RCAC Rural Community Assistance Corporation Feasibility and Pre-Development Loans	Water, wastewater, stormwater, and solid waste planning; environmental work; and other work to assist in developing an application for infrastructure improvements.	Non-profit organizations, public agencies, tribes, and low-income rural communities with a 50,000 population or less, or 10,000 or less if proposed permanent financing is through USDA Rural Development.	Typically up to $50,000 for feasibility loan. Typically up to $350,000 for pre-development loan. Typically up to a 1-year term. 5.5% interest rate. 1% loan fee.	Applications accepted anytime. **Contact**: Jessica Scott 719-458-5460 jscott@rcac.org Applications available online at http://www.rcac.org/lending/environmental-loans/
Economic Development Administration (EDA) United States Department of Commerce **EDA Public Works & Economic Adjustment Assistance Program:** Planning, Feasibility Studies, Preliminary Engineering Reports, Environmental Consultation for distressed and disaster communities.	Drinking water infrastructure; including pre-distribution conveyance, withdrawal/harvest (i.e. well extraction), storage facilities, treatment and distribution. Waste water infrastructure; including conveyance, treatment facilities, discharge infrastructure and water recycling.	Indian Tribes; state, county, city, or other political subdivisions of a state; institutions of higher education; public or private non-profit organizations or associations acting in cooperation with officials of a political subdivision of a State	Grants: EDA investment share up to $500,000 Cost sharing required from applicant Standard grant rate of 50% of total project cost and up to 80%. o Up to 100% for Tribal Nations	Submit application through EDA Grants Management Experience "EDGE" Home (eda.gov) **Contact:** J. Wesley Cochran Economic Development Representative (206) 561-6646 jcochran@eda.gov

PLANNING **Programs**	**Eligible Projects**	**Eligible Applicants**	**Funding Available**	**How To Apply**
Public Works Board WA Department of Commerce Pre-construction program	Capital facilities planning (including small water system management plans, wastewater facility plans, transportation elements, etc.) Roads, streets and bridges, domestic water, sanitary sewer, stormwater, and solid waste/recycling/organics facilities.	Counties, cities, special purpose districts, and quasi-municipal organizations that meet certain requirements. Ineligible applicants: school districts, port districts, and tribes, per statute.	Pre-construction awarded quarterly until funds are exhausted. Up $1,000,000 per project. FY25 interest rate: 0.86%. 5 year loan term. Maximum award per jurisdiction per biennium across all PWB funding programs: $10 million Awards are typically 100% loans, but partial grant funding may be awarded to communities meeting Distressed or Severely Distressed criteria.	**Contact:** Sheila Richardson 564-999-1927 Sheila.richardson@commerce.wa.gov Check the Public Works Board website periodically at http://www.pwb.wa.gov to obtain the latest information on program details or to contact Public Works Board staff.

PRECONSTRUCTION ONLY Programs	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
ECOLOGY: WATER QUALITY COMBINED FUNDING PROGRAM State Water Pollution Control Revolving Fund (SRF) Centennial Clean Water Fund Stormwater Financial Assistance Program (SFAP)	Design projects associated with publicly-owned wastewater and stormwater facilities. The integrated program also funds planning and implementation of nonpoint source pollution control activities.	Counties, cities, towns, conservation districts, or other political subdivision, municipal or quasi-municipal corporations, and federally recognized tribes. Stormwater Financial Assistance Program (SFAP) is limited to cities, counties, and public ports.	Loan: $10,000,000 reserved for preconstruction statewide Interest rates (SFY 2025) • 6-20 year loans: 1.2% • 1-5 year loans: 0.6% Preconstruction set-aside (Distressed Communities) 50% forgivable principal loan and 50% loan	Applications due October 15, 2024. A cost effectiveness analysis must be complete at the time of application. **Contact:** Eliza Keeley 360-628-1976 Eliza.keeley@ecy.wa.gov https://ecology.wa.gov/About-us/How-we-operate/Grants-loans/Find-a-grant-or-loan/Water-Quality-grants-and-loans
Public Works Board PWB PRE-CON WA Department of Commerce Pre-Construction Program	Pre-construction activities to bring projects to a higher degree of readiness that prepare a specific project for construction. Roads, streets and bridges, domestic water, sanitary sewer, stormwater, and solid waste/recycling/organics facilities.	Counties, cities, special purpose districts, and quasi-municipal organizations that meet certain requirements. Ineligible applicants: school districts, port districts, and tribes, per statute.	Pre-construction awarded quarterly until funds are exhausted. Up $1,000,000 per project. FY25 interest rate: 0.86%. 5 year loan term. Maximum award per jurisdiction per biennium across all PWB funding programs: $10 million Awards are typically 100% loans, but partial grant funding may be awarded to communities meeting Distressed or Severely Distressed criteria.	**Contact:** Sheila Richardson 564-999-1927 Sheila.richardson@commerce.wa.gov Check the Public Works Board website periodically at http://www.pwb.wa.gov to obtain the latest information on program details or to contact Public Works Board staff.

PRECONSTRUCTION ONLY Programs	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
RCAC Rural Community Assistance Corporation Feasibility and Pre-Development Loans	Water, wastewater, stormwater, or solid waste planning; environmental work; and other work to assist in developing an application for infrastructure improvements.	Non-profit organizations, public agencies, tribes, and low-income rural communities with a 50,000 population or less, or 10,000 or less if proposed permanent financing is through USDA Rural Development.	Typically up to $50,000 for feasibility loan. Typically up to $350,000 for pre-development loan. Typically a 1-year term. 5.5% interest rate. 1% loan fee.	Applications accepted anytime. **Contact**: Jessica Scott 719-458-5460 jscott@rcac.org Applications available online at http://www.rcac.org/lending/environmental-loans/
Economic Development Administration (EDA) United States Department of Commerce **EDA Public Works & Economic Adjustment Assistance Program:** Design and/or Construction for distressed and disaster communities.	Drinking water infrastructure; including pre-distribution conveyance, withdrawal/harvest (i.e. well extraction), storage facilities, treatment and distribution. Waste water infrastructure; including conveyance, treatment facilities, discharge infrastructure and water recycling.	Indian Tribes; state, county, city, or other political subdivisions of a state; institutions of higher education; public or private non-profit organizations or associations acting in cooperation with officials of a political subdivision of a State.	Grants: EDA investment share up to $500,000 Cost sharing required from applicant Standard grant rate is 50% of total project cost, and up to 80%. ○ Up to 100% for Tribal Nations	Submit application through EDA Grants Management Experience "EDGE" Home (eda.gov) **Contact:** J. Wesley Cochran Economic Development Representative (206) 561-6646 jcochran@eda.gov

CONSTRUCTION AND DESIGN/CONSTRUCTION Programs	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
DWSRF Drinking Water State Revolving Fund Construction Loan Program Department of Health	Drinking water system infrastructure projects aimed at increasing public health protection. There is principal forgiveness for disadvantaged communities.	Group A (private and publicly-owned) community and not-for-profit non-community water systems, but not federal or state-owned systems. Tribal systems are eligible provided the project is not receiving other national set-aside funding for the project.	Loan: Maximum $15 million per jurisdiction. 2.25% annual interest rate (Final rate is set September 1, 2024). 1.0% loan service fee (water systems receiving subsidy are not subject to loan fees). 4-year time of performance, encouraged 2-year time of performance Loan repayment period: 20 years or life of the project, whichever is less. No local match required.	Online applications available and accepted year-round. Applications due November 30, 2024. **Contact:** Jocelyne Gray 564-669-4893 Jocelyne.gray@doh.wa.gov For information and forms visit: http://www.doh.wa.gov/DWSRF
DWSRF Drinking Water State Revolving Fund Lead Service Line (LSL) Replacement Loan Department of Health	Lead service line replacement. Galvanized service lines to be replaced per Lead and Copper Rule. Service water meters older than 1986 lead ban, as part of LSL replacement. There is principal forgiveness for disadvantaged communities.	Group A (private and publicly-owned) community and not-for-profit non-community water systems, but not federal or state-owned systems. Tribal systems are eligible provided the project is not receiving other national set-aside funding for the project.	Loan: Minimum $25,000 No maximum 2.25% annual interest rate (Final rate is set September 1, 2024). 1% loan service fee (water systems receiving subsidy are not subject to loan fees) 4-year time of performance, encouraged 2-year time of performance 20-year repayment period	Online applications available and accepted October 1 year-round. Applications due November 30, 2024. **Contact:** Jocelyne Gray 564-669-4893 Jocelyne.gray@doh.wa.gov For information and forms visit: http://www.doh.wa.gov/DWSRF

CONSTRUCTION AND DESIGN/CONSTRUCTION Programs	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
DWSRF Drinking Water State Revolving Fund Drinking Water System Rehabilitation and Consolidation Grant **Department of Health**	Rehabilitation Construction of infrastructure to bring water system into compliance. Restructuring, Consolidation, Receivership Planning Construction of infrastructure to bring water system into compliance.	Rehabilitation Group A water systems serving less than 10,000 people under a DOH compliance order. Restructuring, Consolidation, Receivership Group A publicly owned water system (city, town, county, public utility district, or water/sewer district), an approved Satellite Management Agency, or approved receiver.	Grant: Maximum $1.25 million 4-year time of performance	By invite only. **Contact:** Jocelyne Gray 564-669-4893 Jocelyne.gray@doh.wa.gov For information and forms visit: http://www.doh.wa.gov/DWSRF
ECOLOGY: Water Quality Combined Funding Program State Water Pollution Control Revolving Fund (SRF) Centennial Clean Water Fund Stormwater Financial Assistance Program (SFAP)	Construction projects associated with publicly-owned wastewater and stormwater facilities. The integrated program also funds planning and implementation of nonpoint source pollution control activities.	Counties, cities, towns, conservation districts, or other political subdivision, municipal or quasi-municipal corporations, and federally recognized tribes. Stormwater Financial Assistance Program (SFAP) is limited to cities, counties, and public ports. Hardship Assistance Jurisdictions listed above with a service area population of 25,000 or less.	Loan: $200,000,000 available statewide. Interest rates (SFY 2025) • 21-30 year loans: 1.6% • 6-20 year loans: 1.2% • 1-5 year loans: 0.6% Hardship assistance for the construction of wastewater treatment facilities may be available in the form of a reduced interest rate, and up to $5,000,000 grant or loan forgiveness. SFAP grant maximum award per jurisdiction: $10,000,000, with a required 15% match, with match reduced to 5% for hardship.	Applications due October 15, 2024. A cost effectiveness analysis must be complete at the time of application. **Contact:** Eliza Keeley 360-628-1976 Eliza.keeley@ecy.wa.gov https://ecology.wa.gov/About-us/How-we-operate/Grants-loans/Find-a-grant-or-loan/Water-Quality-grants-and-loans

CONSTRUCTION AND DESIGN/CONSTRUCTION Programs	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
PWB Public Works Board Construction Program	New construction, replacement, and repair of existing infrastructure for roads, streets and bridges, domestic water, sanitary sewer, stormwater, and solid waste/recycling/organics.	Counties, cities, special purpose districts, and quasi-municipal organizations. Ineligible applicants: school districts, port districts, and tribes, per statute.	FY26 Cycle: Pending appropriation FY25 interest rate: 1.71%. Loan term 20 years. Maximum award per jurisdiction per biennium across all PWB funding programs: $10 million Maximum project award: $10 million per jurisdiction per biennium. Awards are typically 100% loans, but partial grant funding may be awarded to communities meeting Distressed criteria. Construction is a competitive program with two cycles per biennium.	Typically opens in Spring Contact: Sheila Richardson 564-999-1927 Sheila.richardson@commerce.wa.gov Check the Public Works Board website periodically at http://www.pwb.wa.gov to obtain the latest information on program details or to contact Public Works Board staff.

CONSTRUCTION AND DESIGN/CONSTRUCTION Programs	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
RD U.S. Dept. of Agriculture Rural Development - Rural Utilities Service Water and Waste Disposal Direct Loans and Grants	Pre-construction and construction associated with building, repairing, or improving drinking water, wastewater, solid waste, and stormwater facilities.	Cities, towns, and other public bodies, tribes and private non-profit corporations serving rural areas with populations under 10,000. Population determined by U.S. Census 2020. Income determined by the American Community Survey 2017-2021 (5-year).	Loans; Grants in some cases Interest rates change quarterly; contact staff for latest interest rates. Up to 40-year loan term. No pre-payment penalty.	Applications accepted year-round on a fund-available basis. **Contact: :** Koni Reynolds 360-704-7737 koni.reynolds@usda.gov http://www.rd.usda.gov/wa
CERB Community Economic Revitalization Board Construction Program	Public facility projects required by private sector expansion and job creation. Projects must support significant job creation or significant private investment in the state. Bridges, roads and railroad spurs, domestic and industrial water, sanitary and storm sewers. Electricity, natural gas and telecommunications General purpose industrial buildings, port facilities. Acquisition, construction, repair, reconstruction, replacement, rehabilitation	Counties, cities, towns, port districts, special districts Federally-recognized tribes Municipal and quasi-municipal corporations with economic development purposes.	Maximum grant amounts: $2,000,000 for construction projects. $500,000 for housing rehabilitation programs. $250,000 for microenterprise assistance programs.	Applications accepted year-round. The Board meets six times a year. **Contact:** Janea Stark 360-252-0812 janea.stark@commerce.wa.gov

CONSTRUCTION AND DESIGN/CONSTRUCTION Programs	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
CDBG-GP Community Development Block Grant General Purpose Grants	Design and construction of community facility, wastewater, drinking water, stormwater and street/sidewalk projects. Infrastructure in support of affordable housing.	Projects must principally benefit low- to moderate-income people in non-entitlement cities and counties. List and map of local governments served by state CDBG program	Maximum grant amounts: $2,000,000 for construction projects. $500,000 for housing rehabilitation programs. $250,000 for microenterprise assistance programs.	Applications accepted year-round on a fund-available basis. **Contact:** Jon Galow 509-847-5021 Jon.galow@commerce.wa.gov Visit www.commerce.wa.gov/cdbg for more information.
RCAC Rural Community Assistance Corporation Intermediate Term Loan	Water, wastewater, solid waste and stormwater facilities that primarily serve low-income rural communities.	Non-profit organizations, public agencies, tribes, and low-income rural communities with a 50,000 population or less.	Typically up to $3 million with commitment letter for permanent financing Security in permanent loan letter of conditions Term matches construction period. 5.5% interest rate 1.125% loan fee	Applications accepted anytime. **Contact**: Jessica Scott 719-458-5460 jscott@rcac.org Applications available online at http://www.rcac.org/lending/environmental-loans/
RCAC Rural Community Assistance Corporation Construction Loans	Water, wastewater, solid waste and stormwater facilities that primarily serve low-income rural communities. Can include pre-development costs.	Non-profit organizations, public agencies, tribes, and low-income rural communities with a 50,000 population or less, or 10,000 populations or less if using USDA Rural Development financing as the takeout.	2023-2025 solicitation closed 9/25/2024 Longstanding program will likely be offered in the 2025-2027 biennium. Minimum match requirements will apply. Other State funds cannot be used as match.	Applications accepted anytime. **Contact**: Jessica Scott 719-458-5460 jscott@rcac.org Applications available online at http://www.rcac.org/lending/environmental-loans/

CONSTRUCTION AND DESIGN/CONSTRUCTION Programs	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
Energy Retrofits for Public Buildings Program: Energy Efficiency Grant Washington State Department of Commerce	Retrofit projects that reduce energy consumption (electricity, gas, water, etc.) and operational costs on existing facilities and related projects owned by an eligible applicant. Projects must utilize devices that do not require fossil fuels whenever possible.	Washington State public entities, such as cities, towns, local agencies, public higher education institutions, school districts, federally recognized tribal governments, and state agencies. Some percentage of funds are reserved for projects in small towns or cities with populations of 5,000 or fewer. Priority given to applicants who have not received funding previously, certain priority communities.	2023-25 solicitation closed 09/25/2024. Longstanding program will likely be offered in the 2025-27 biennium. Minimum match requirements will apply. Other State funds cannot be used as match.	**Contact:** Kristen Kalbrener 360-515-8112 energyretrofits@commerce.wa.gov For more information: https://www.commerce.wa.gov/growing-the-economy/energy/energy-efficiency-and-solar-grants/
Energy Efficiency and Conservation Block Grant Washington State Department of Commerce	Energy audits and energy conservation planning projects including financing, infrastructure, public education	Local governments (cities, counties, federally-recognized tribes) Priority for disadvantaged communities	Funding for the current biennium is depleted. Visit our website to sign up for updates. Future funding anticipated in Late Spring 2025.	**Contact:** Kristen Kalbrener 360-515-8112 energyretrofits@commerce.wa.gov
Energy Retrofits for Public Buildings: Solar Grants Washington State Department of Commerce	Purchase and installation of grid-tied solar photovoltaic (electric) arrays net metered with existing facilities owned by public entities. Additional points for 'Made in Washington' components.	Washington State public entities, such as cities, towns, local agencies, public higher education institutions, school districts, federally recognized tribal governments, and state agencies. See above.	Funding for the current biennium is depleted. Visit our website to sign up for updates. Future funding anticipated in Late Spring 2025.	**Contact:** EPICgrants@commerce.wa.gov **Visit:** https://www.commerce.wa.gov/growing-the-economy/energy/epic/clean-energy-grant-programs/ for more information.

CONSTRUCTION AND DESIGN/CONSTRUCTION Programs	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
Solar plus Storage for Resilient Communities Washington State Department of Commerce	The Solar plus Storage program funds solar and battery back-up power so community buildings can provide essential services when the power goes out, including both planning and installation grants.	Local governments, State governments, Tribal governments and their affiliates, Non-profit organizations and Retail electric utilities.	Funding for the current biennium is depleted. Visit our website to sign up for updates. Future funding anticipated in Late Spring 2025.	**Contact:** EPICgrants@commerce.wa.gov **Visit:** **https://www.commerce.wa.gov/growing-the-economy/energy/epic/clean-energy-grant-programs**
Dual Use Solar **Washington State Department of Commerce**	Constructions or planning projects that will lead to the creation of mixed use solar installation. Projects should including, but are not limited to, combining solar with: animal grazing, beekeeping, pollinator habitat, or other colocation uses.	Local governments, State governments, Tribal governments and their affiliates, Non-profit organizations, for-profit organizations, and Retail electric utilities.	Grants: EDA investment share up to $5,000,000. Cost sharing required from applicant Standard grant rate is 50% of total project cost, and up to 80%. Up to 100% for Tribal Nations	**Contact:** EPICgrants@commerce.wa.gov **Visit:** **https://www.commerce.wa.gov/growing-the-economy/energy/epic/clean-energy-grant-programs/**

CONSTRUCTION AND DESIGN/CONSTRUCTION Programs	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
Economic Development Administration (EDA) United States Department of Commerce **EDA Public Works & Economic Adjustment Assistance Program:** Design and/or Construction for distressed and disaster communities.	Drinking water infrastructure; including pre-distribution conveyance, withdrawal/ harvest (i.e. well extraction), storage facilities, treatment and distribution. Waste water infrastructure; including conveyance, treatment facilities, discharge infrastructure, water recycling.	Indian Tribes; state, county, city, or other political subdivisions of a state; institutions of higher education; public or private non-profit organizations or associations acting in cooperation with officials of a political subdivision of a State.	Loans may not exceed $200,000 or 75% of the total project cost, whichever is less. Applicants given credit for documented project costs prior to receiving the loan. Interest rates at the lower of the poverty or market interest rate as published by USDA RD RUS, with a minimum of 3% at time of closing. Maximum repayment period is 10 years. Additional ranking points for a shorter repayment period. The repayment period cannot exceed the useful life of the facilities.	Submit application through EDA Grants Management Experience "EDGE" Home (eda.gov) **Contact:** J. Wesley Cochran Economic Development Representative (206) 561-6646 jcochran@eda.gov
RURAL WATER REVOLVING LOAN FUND	Short-term costs incurred for replacement equipment, small scale extension of services, or other small capital projects that are not a part of regular operations and maintenance for drinking water and wastewater projects.	Public entities, including municipalities, counties, special purpose districts, Native American Tribes, and corporations not operated for profit, including cooperatives, with up to 10,000 population and rural areas with no population limits.	$55.5 million in total funds available in 2023-2025 biennium. $19.4 million specifically reserved for jurisdictions with a population of less than 150,000. $2,000,000 maximum award. Funds available as both grants and deferred loans.	Applications accepted anytime. **Contact**: Tracey Hunter Evergreen Rural Water of WA 360-462-9287 thunter@erwow.org Download application online: http://nrwa.org/initiatives/revolving-loan-fund/
Connecting Housing to Infrastructure Program (CHIP) Washington State Department of Commerce	Housing projects with at least 25% of units affordable for at least 25 years. Funding goes toward water, sewer, and stormwater infrastructure improvements for eligible projects, as well as toward system development charges and impact fees, which are waived to encourage affordable housing.	Cities, counties, and utility districts located in a jurisdiction which has a dedicated sales tax for affordable housing. The local jurisdiction will sponsor/ partner with a housing developer on the project.	$55.5 million in total funds available in 2023-2025 biennium. $19.4 million specifically reserved for jurisdictions with a population of less than 150,000. $2,000,000 maximum award. Funds available as both grants and deferred loans.	Contact: Mischa Venables 360-725-3088 Mischa.venables@commerce.wa.gov Visit www.commerce.wa.gov/CHIP

EMERGENCY Programs	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
ECOLOGY Water Quality Emergency Clean Water State Revolving Funding Program	Projects that may result from a natural disaster or an immediate and emergent threat to public health due to water quality issues resulting from unforeseen or unavoidable circumstances. Water quality-related projects considered to be an environmental emergency that meets the WAC 173-98-030(27)5 definition and has received a Declaration of Emergency from the local Government.	Only available to public bodies serving a population of 10,000 or less. Counties, cities, and towns, federally recognized tribes, water and sewer districts, irrigation districts, conservation districts, local health jurisdictions, port districts, quasi-municipal corporations, Washington State institutions of higher education	Loan: $5,000,000 maximum Interest rates (SFY25): 10-year loan, 0.0-1.6%	Available year round. Contact: Eliza Keeley 360-628-1976 Eliza.keeley@ecy.wa.gov https://ecology.wa.gov/About-us/How-we-operate/Grants-loans/Find-a-grant-or-loan/Water-Quality-grants-and-loans

EMERGENCY Programs	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
RD – ECWAG U.S. Dept. of Agriculture Rural Development Emergency Community Water Assistance Grants	Domestic water projects needing emergency repairs due to an incident such as: a drought; earthquake; flood; chemical spill; fire; etc. A significant decline in quantity or quality of potable water supply that was caused by an emergency.	Public bodies, tribes and private non-profit corporations serving rural areas with populations under 10,000. Population determined by U.S. Census 2020. Income determined by the American Community Survey 2017-2021 (5-year).	Grant; pending availability of funds. Water transmission line grants up to $150,000 to construct water line extensions, repair breaks or leaks in existing water distribution lines, and address related maintenance to replenish the water supply. Water source grants up to $1,000,000 for the construction of new wells, reservoirs, transmission lines, treatment plants, and/or other sources of water (water source up to and including the treatment plant).	Applications accepted year-round on a fund-available basis. **Contact:** Koni Reynolds 360-704-7737 koni.reynolds@usda.gov http://www.rd.usda.gov/wa
DWSRF Department of Health – Drinking Water State Revolving Fund Emergency Loan Program Department of Health	Will financially assist eligible communities experiencing the loss of critical drinking water services or facilities due to an emergency.	Publicly or privately owned (not-for-profit) Group A community water systems with a population of fewer than 10,000. Transient or non-transient non-community public water systems owned by a non-profit organization. Non-profit non-community water systems must submit tax-exempt documentation. Tribal systems are eligible provided the project is not receiving other national set-aside funding for the project.	Loan: Interest rate: 0%, no subsidy available Loan fee: 1.5% Loan term: 10 years $500,000 maximum award per jurisdiction. Time of performance: 2 years from contract execution to project completion date. Repayment commencing first October after contract execution.	To be considered for an emergency loan, an applicant must submit a completed emergency application package to the department. **Contact:** Jocelyne Gray 564-669-4893 Jocelyne.gray@doh.wa.gov For information and forms visit: http://www.doh.wa.gov/DWSRF

EMERGENCY Programs	Eligible Projects	Eligible Applicants	Funding Available	How To Apply
RURAL WATER REVOLVING LOAN FUND Disaster area emergency loans	Contact staff for more information on emergency loans.	Public entities, including municipalities, counties, special purpose districts, Native American Tribes, and corporations not operated for profit, including cooperatives, with up to 10,000 population and rural areas with no population limits.	90-day, no interest, disaster area emergency loans with immediate turn-around. Download application online: http://nrwa.org/initiatives/revolving-loan-fund/	Applications accepted anytime. **Contact**: Tracey Hunter Evergreen Rural Water of WA 360-462-9287 thunter@erwow.org
HAZARD MITIGATION GRANT PROGRAM FEMA/WA Emergency Management Division	Disaster risk-reduction projects and planning after a disaster declaration in the state.	Any state, tribe, county, or local jurisdiction (incl., special purpose districts) that has a current FEMA-approved hazard mitigation plan.	Varies depending on the level of disaster, but projects only need to compete at the state level. Local jurisdiction cost-share: 12.5%	Applications will be opened after a disaster declaration. **Contact**: Tim Cook State Hazard Mitigation Officer 253-512-7072 Tim.cook@mil.wa.gov
PUBLIC ASSISTANCE PROGRAM FEMA/WA Emergency Management Division	Construction, repair to, and restoration of publicly owned facilities damaged during a disaster. Debris-removal, life-saving measures, and restoration of public infrastructure.	State, tribes, counties, and local jurisdictions directly affected by the disaster.	Varies depending on the level of disaster and total damage caused.	Applications are opened after disaster declaration. **Contact:** Gary Urbas Public Assistance Project Manager 253-512-7402 Gary.urbas@mil.wa.gov
WASHINGTON STATE DEPARTMENT OF COMMERCE ERR - Emergency Rapid Response	Projects that provide continuity of essential community services/ lifelines that become diminished during an emergency and recovery assistance after an emergency event. Projects that restore service for a limited duration or through a temporary measure. These funds are not designated for long term recovery costs associated with the full re-establishment of lifeline services.	Tribes and local governments	Grant; pending availability of funds $5,000,000- $6,000,000 Period of performance state fiscal year July-June	Applications accepted year-round until funding exhausted. $5.5 to 6 million available to award each year. **Contact:** Nicole Patrick 206-713-6997 Nicole.patrick@commerce.wa.gov For information and application visit: EmergencyRapidResponse or https://deptofcommerce.box.com/s/skmab4hq3l4z55jazzc7qlsmbrsgermv

APPENDIX CC SCENARIO 2 FINANCIAL FORECAST

SCENARIO 2 FINANCIAL FORECAST

Revenue Requirement	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Revenues											
Rate Revenues Under Existing Rates	$ 27,452,309	$ 27,720,316	$ 27,991,003	$ 28,264,396	$ 28,540,524	$ 28,819,413	$ 29,101,090	$ 29,385,585	$ 29,672,924	$ 29,963,137	$ 30,256,252
Non-Rate Revenues	1,496,059	936,761	922,935	892,983	896,320	931,457	935,394	955,739	959,889	977,201	982,008
Total Revenues	**$ 28,948,368**	**$ 28,657,077**	**$ 28,913,938**	**$ 29,157,380**	**$ 29,436,844**	**$ 29,750,870**	**$ 30,036,484**	**$ 30,341,324**	**$ 30,632,814**	**$ 30,940,338**	**$ 31,238,260**
Expenses											
Cash Operating Expenses	$ 22,814,914	$ 23,180,963	$ 23,675,104	$ 24,287,529	$ 24,918,859	$ 25,569,741	$ 26,240,842	$ 26,932,856	$ 27,646,503	$ 28,382,527	$ 29,141,702
Existing Debt Service	1,787,375	2,015,401	1,558,493	1,548,958	1,537,174	1,528,202	1,515,605	1,505,758	1,494,585	1,484,951	1,474,354
New Debt Service	-	-	361,317	361,317	3,512,808	3,512,808	5,118,663	5,118,663	6,403,348	6,403,348	7,808,471
Total Expenses	**$ 24,602,289**	**$ 25,196,365**	**$ 25,594,914**	**$ 26,197,804**	**$ 29,968,841**	**$ 30,610,751**	**$ 32,875,110**	**$ 33,557,277**	**$ 35,544,436**	**$ 36,270,825**	**$ 38,424,527**
Net Surplus (Deficiency)	$ 4,346,079	$ 3,460,712	$ 3,319,023	$ 2,959,575	$ (531,997)	$ (859,881)	$ (2,838,626)	$ (3,215,954)	$ (4,911,622)	$ (5,330,487)	$ (7,186,267)
Additions to Meet Coverage	-	-	-	-	-	-	-	-	-	-	-
Total Surplus (Deficiency)	**$ 4,346,079**	**$ 3,460,712**	**$ 3,319,023**	**$ 2,959,575**	**$ (531,997)**	**$ (859,881)**	**$ (2,838,626)**	**$ (3,215,954)**	**$ (4,911,622)**	**$ (5,330,487)**	**$ (7,186,267)**
Annual Rate Increase		**3.10%**	**11.00%**	**11.00%**	**11.00%**	**11.00%**	**9.00%**	**9.00%**	**9.00%**	**9.00%**	**9.00%**
Cumulative Rate Increase		**3.10%**	**14.44%**	**27.03%**	**41.00%**	**56.51%**	**70.60%**	**85.95%**	**102.69%**	**120.93%**	**140.81%**
Revenues After Rate Increases	$ 27,452,309	$ 28,579,646	$ 32,033,183	$ 35,904,124	$ 40,242,925	$ 45,106,144	$ 49,646,237	$ 54,643,425	$ 60,143,739	$ 66,197,845	$ 72,861,515
Additional Taxes from Rate Increase	-	200,043	940,979	1,778,452	2,724,202	3,791,388	4,782,705	5,879,773	7,093,301	8,435,078	9,918,079
Net Cash Flow After Rate Increase	**$ 4,346,079**	**$ 4,119,999**	**$ 6,420,225**	**$ 8,820,851**	**$ 8,446,202**	**$ 11,635,462**	**$ 12,923,816**	**$ 16,162,114**	**$ 18,465,891**	**$ 22,469,143**	**$ 25,500,917**
Coverage After Rate Increase: Bonded Debt	16.49	17.25	27.16	33.49	4.22	5.20	4.08	4.75	4.35	4.99	4.64
Coverage After Rate Increase: Total Debt	4.09	3.81	5.11	6.33	2.93	3.63	3.15	3.67	3.53	4.05	3.91
Sample Monthly Residential Bill (5/8" Meter, x 7 ccf)	$45.71	$47.07	$52.25	$57.99	$64.37	$71.46	$77.89	$84.90	$92.54	$100.87	$109.94
Increase ($)		$1.36	$5.18	$5.75	$6.38	$7.08	$6.43	$7.01	$7.64	$8.33	$9.08

Fund Balance	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Operating Reserve											
Beginning Balance	$ 22,417,995	$ 5,625,595	$ 5,715,854	$ 5,887,023	$ 6,220,728	$ 6,582,899	$ 6,976,589	$ 7,405,207	$ 7,820,275	$ 8,266,753	$ 8,747,464
plus: Net Cash Flow after Rate Increase	4,346,079	4,119,999	6,420,225	8,820,851	8,446,202	11,635,462	12,923,816	16,162,114	18,465,891	22,469,143	25,500,917
less: Transfer of Surplus to Capital Fund	(21,138,479)	(4,029,740)	(6,249,056)	(8,487,145)	(8,084,032)	(11,241,772)	(12,495,197)	(15,747,046)	(18,019,414)	(21,988,432)	(24,982,874)
Ending Balance	**$ 5,625,595**	**$ 5,715,854**	**$ 5,887,023**	**$ 6,220,728**	**$ 6,582,899**	**$ 6,976,589**	**$ 7,405,207**	**$ 7,820,275**	**$ 8,266,753**	**$ 8,747,464**	**$ 9,265,507**
Actual Days of O&M	*90 days*	*90 days*	*90 days*	*90 days*	*90 days*	*90 days*	*90 days*	*90 days*	*90 days*	*90 days*	*90 days*
Minimum Balance Requirement	*$ 3,750,397*	*$ 3,810,569*	*$ 3,924,682*	*$ 4,147,152*	*$ 4,388,599*	*$ 4,651,059*	*$ 4,936,805*	*$ 5,213,517*	*$ 5,511,169*	*$ 5,831,643*	*$ 6,177,005*
Maximum Balance Requirement	*$ 5,625,595*	*$ 5,715,854*	*$ 5,887,023*	*$ 6,220,728*	*$ 6,582,899*	*$ 6,976,589*	*$ 7,405,207*	*$ 7,820,275*	*$ 8,266,753*	*$ 8,747,464*	*$ 9,265,507*
Capital Reserve											
Beginning Balance	$ 3,146,102	$ 24,043,259	$ 21,925,276	$ 21,412,821	$ 14,810,858	$ 42,883,038	$ 14,747,231	$ 31,804,427	$ 27,535,046	$ 33,930,078	$ 24,619,788
plus: Transfers from Operating Fund	21,138,479	4,029,740	6,249,056	8,487,145	8,084,032	11,241,772	12,495,197	15,747,046	18,019,414	21,988,432	24,982,874
plus: SDC Revenue	1,120,755	1,131,963	1,143,282	1,154,715	1,166,262	1,177,925	1,189,704	1,201,601	1,213,617	1,225,754	1,238,011
plus: Revenue Bond Proceeds	-	-	4,500,000	-	39,250,000	-	20,000,000	-	16,000,000	-	17,500,000
plus: Interest Earnings	62,922	420,757	328,879	214,128	148,109	428,830	147,472	318,044	275,350	339,301	246,198
Total Funding Sources	**$ 25,468,259**	**$ 29,625,718**	**$ 34,146,494**	**$ 31,268,810**	**$ 63,459,261**	**$ 55,731,566**	**$ 48,579,605**	**$ 49,071,118**	**$ 63,043,428**	**$ 57,483,563**	**$ 68,586,871**
less: Capital Expenditures	(1,425,000)	(7,700,442)	(12,733,672)	(16,457,952)	(20,576,223)	(40,984,335)	(16,775,178)	(21,536,072)	(29,113,350)	(32,863,776)	(48,076,522)
Ending Capital Fund Balance	**$ 24,043,259**	**$ 21,925,276**	**$ 21,412,821**	**$ 14,810,858**	**$ 42,883,038**	**$ 14,747,231**	**$ 31,804,427**	**$ 27,535,046**	**$ 33,930,078**	**$ 24,619,788**	**$ 20,510,349**
Combined Beginning Balance	**$ 25,564,098**	**$ 29,668,854**	**$ 27,641,130**	**$ 27,299,844**	**$ 21,031,586**	**$ 49,465,937**	**$ 21,723,819**	**$ 39,209,634**	**$ 35,355,321**	**$ 42,196,830**	**$ 33,367,252**
Combined Ending Balance	**$ 29,668,854**	**$ 27,641,130**	**$ 27,299,844**	**$ 21,031,586**	**$ 49,465,937**	**$ 21,723,819**	**$ 39,209,634**	**$ 35,355,321**	**$ 42,196,830**	**$ 33,367,252**	**$ 29,775,857**
Ending Total Days of Operating Expenditures	*475 days*	*432 days*	*405 days*	*295 days*	*653 days*	*270 days*	*461 days*	*393 days*	*443 days*	*331 days*	*278 days*

APPENDIX DD

457 ZONE CONVERSION REPORT – DECEMBER 2017

457 ZONE CONVERSION REPORT

City of Bellingham

December 2017

BLM 417.054.01.103

Prepared by:
RH2 Engineering, Inc.
22722 29th Drive SE, Suite 210
Bothell, WA 98021
(800) 720-8052

City of Bellingham
457 Zone Conversion Report
December 2017

Prepared by RH2 Engineering, Inc.

Prepared for City of Bellingham

Note: This 457 Zone Conversion Report was completed under the direct supervision of the following Licensed Professional Engineers registered in the State of Washington.

Sincerely,

RH2 ENGINEERING, INC.



12/11/2017



12/11/2017

City of Bellingham

457 Zone Conversion Report

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City of Bellingham
457 Zone Conversion Report

BACKGROUND

The City of Bellingham's (City) existing water main in Donovan Avenue has a history of significant main breaks that are likely attributed to its age (84 to 91 years old) and high operating pressure (over 140 pounds per square inch (psi)). The replacement of the Donovan Avenue water main between Old Fairhaven Parkway and 36th Street is currently underway, with the first phase scheduled to be installed in 2018. Once installed, the new water main will continue to experience extremely high operating pressures, although it will not be considered as high of a risk of failure.

Many other sections of water main on the south side of the City in the South 457 Zone are of similar age to the Donovan Avenue water main and operate under even higher pressures. These water main segments are at a high risk of similar failure experienced by the existing Donovan Avenue water main. Currently, 87 percent of the 457 Zone service area experiences high pressures. The water main in the lowest elevations of the pressure zone, near the Fairhaven industrial and commercial district and the Ferry Terminal, typically experience pressures in excess of 180 psi. Hydrants and valves in this area pose a significant safety concern and are difficult to operate at these high pressures.

The City requested RH2 Engineering, Inc., (RH2) to analyze the high pressures in the existing 457 Zone and recommend improvements to reduce pressures to safer levels. Analyses were also requested to confirm the proposed diameter of the Donovan Avenue water main replacement. The recommendations from the analyses were developed into a phased improvement plan to reduce the high system pressures.

EXISTING SOUTH 457 ZONE

The existing South 457 Zone provides water supply to the City's water service area generally located southwest of E Maple Street and west of Interstate 5, extending south along Chuckanut Drive to services south of the City limits. The South 457 Zone also surrounds the College Way 541 Zone, which serves the higher elevations of the Western Washington University campus.

The Otis Street Booster Pump Station (BPS) provides all water supply to the South 457 Zone from the North 276 Zone. The Sehome, Padden, and College Way Reservoirs all serve the South 457 Zone.

Water supply is transferred from the South 457 Zone to the College Way 541 Zone through the College Way BPS.

Water supply is also transferred from the South 457 Zone to the Padden Yew 696 Zone through the 38th Street BPS and indirectly to the Reveille 830 and Governor 873 Zones through other BPSs. The Reveille and 40th Street Reservoirs serve the Padden Yew 696 Zone. The Consolidation BPS also supplies the Padden Yew 696 Zone. The Consolidation BPS contains one pump that was installed in 1959 per the City's 2009 *Water System Plan* (2009 WSP). Due to the lack of redundancy and age, the Consolidation BPS was assumed to be offline for the purposes of these analyses. Therefore, for the purposes of the analyses described herein, all

supply to the Padden Yew 696 Zone was assumed to be transferred through the South 457 Zone facilities.

The location of the South 457 Zone and other adjacent pressure zones are shown in **Figure 1** and represented schematically in the hydraulic profile (**Figure 2**). The configuration of the South 457 and adjacent pressure zones requires that the South 457 Zone distribution system convey all water supply for the College Way 541 Zone and the Padden Yew 696 Zone. Therefore, the South 457 Zone analyses will consider supply requirements for these adjacent pressure zones.

DEMAND ANALYSIS

Historical and future year system demands were compiled for the purposes of these pressure zone analyses and are shown in **Table 1**. Historical water production data was obtained from the City's Annual Water Use Efficiency Reports submitted to the Washington State Department of Health (DOH) and indicate that system-wide demands have been declining since 2012. The year 2032 production rate was projected in the City's 2013 *Water System Plan Update* (2013 WSP).

Table 1
Historical and Projected Water Production

Year	Water Produced (gpm)
Historical	
2012	6,510
2013	6,058
2014	5,448
2015	5,883
2016	5,578
Projected	
2032	8,486

PRESSURE ZONE DEMANDS

Pressure zone specific demands for the South 457 Zone and College Way 541 Zone were evaluated based on facility supervisory control and data acquisition (SCADA) data provided by the City for 2012 and are shown in **Table 2**. A complete set of SCADA data was not available to evaluate pressure zone demands from more recent years. However, since 2012 was observed to be the highest production year as shown in **Table 1**, utilizing this year as a base year was considered conservative for the purposes of the existing system analyses. Average day demands (ADD) for pressure zones other than the South 457 and College Way 541 Zones were estimated based on the demand allocations presented in the 2013 WSP.

Table 2
Pressure Zone Demands

Pressure Zone		2012 ADD (gpm)	2012 MDD (gpm)	2012 PHD (gpm)
276	North	2,858	4,495	9,217
350	Cordata	788	1,239	2,541
457	South	1,419	2,231	4,576
460	King Mountain	9	14	28
519	Dakin & 660 Huntington	809	1,273	2,610
780	Birch	10	15	32
541	College Way	55	87	178
696	Padden Yew	276	435	891
730	Alabama	217	341	698
830	Reveille	17	26	54
873	Governor	52	82	167
Total		**6,510**	**10,237**	**20,992**

PEAKING FACTORS

The 2012 SCADA data also was utilized to calculate the peaking factors shown in **Table 3**. These peaking factors were applied to the pressure zone demands in **Table 2** to estimate the Maximum Day Demand (MDD) and Peak Hour Demand (PHD) for each pressure zone in 2012. Unlike typical pressure zones that experience peak water use during summer months, the peak day and peak hour demands in the South 457 and College Way 541 Zones occurred around the Memorial Day holiday weekend.

Table 3
Peaking Factors

Demand Condition	Peaking Factor	Date/Time
457 & 541 MDD/ADD (SCADA)	1.57	5/29/2012
457 & 541 PHD/MDD (SCADA)	2.05	5/27/2012, 12:00-13:00

FIRE FLOW DEMAND

The City's land use based planning-level fire flow requirements are presented in the 2009 WSP and reiterated in **Table 4**. These fire flow requirements were updated in the hydraulic model based on the current land use designations shown in **Figure 3**.

Table 4
Planning-level Fire Flow Requirements

Land Use	Planning-Level Fire Flow Requirement (gpm)	Required Fire Flow Duration (hours)
One- and Two-Family Units	750	2
Multi-Family	1,500	2
Institutional	2,000	2
Commercial	2,500	2
Industrial	3,500	2

Per Washington Administrative Code (WAC) 246-290-230, the required fire flow shall be provided under MDD conditions at a pressure of at least 20 psi at all points throughout the distribution system and under the condition where the designed volume of fire suppression and equalizing storage has been depleted. For pressure zones without direct water storage, fire flow requirements were evaluated under PHD conditions.

HYDRAULIC ANALYSIS

BASELINE ANALYSES

Baseline hydraulic analyses were performed to determine the existing level of service provided within and adjacent to the study area. The baseline pressure analyses were performed under 2012 PHD conditions with the operational and equalizing storage depleted in the reservoirs. The results of the pressure analyses are shown in **Figure 1** and **Table 5** and indicate that most of the South 457 Zone experiences pressures greater than 80 psi. Section 8 of the DOH *Water System Design Manual* states that "Distribution system pressure should not exceed 100 psi," and that "When a purveyor anticipates pressure in the mains will exceed 80 psi, the purveyor is responsible for recommending that customers install and maintain an individual pressure-reducing valve." No locations in the South 457 Zone experience pressures less than the DOH minimum of 30 psi.

Table 5
Distribution of High Pressures in Existing South 457 Zone Service Area

Pressure Range (% of Existing 457 Zone Nodes)	Existing	Phase 1 Donovan Ave Improvements	Phase 2 457 to 297 Zone Conversion	Phase 3 457 to 360 Zone Conversion
80-100 psi	13%	13%	17%	26%
100-120 psi	27%	27%	27%	12%
120-140 psi	23%	23%	16%	1%
140+ psi	25%	25%	5%	0%
Total % of Nodes 80+ psi	**87%**	**87%**	**65%**	**40%**

The following areas experience pressures greater than 140 psi, with a maximum of 188 psi near the Ferry Terminal.

- Ferry Terminal and adjacent industrial area.
- Fairhaven neighborhood.
- Adjacent to and south of Boulevard Park.
- Areas along Padden Creek and Old Fairhaven Parkway.
- Along Chuckanut Drive.

Figure 1 also highlights the location of older water main within the South 457 Zone distribution system. As with the Donovan Avenue water main that has experienced multiple main breaks, many areas that are served by water main installed over 70 years ago are operating under high service pressure.

Baseline fire flow analyses were performed to confirm that improvements recommended to resolve pressure deficiencies in the study area do not adversely impact the fire flow level of service. The fire flow analyses were based on 2012 MDD conditions in the South 457 Zone and Padden Yew 696 Zone, and 2012 PHD conditions in the College Way 541 Zone. The analyses simulated depletion of the operational, equalizing, and fire flow storage in the reservoirs. Every node in the study area was evaluated to determine the existing rate of fire flow that is available at a residual pressure of 20 psi in the water main adjacent to the hydrant and water velocities in the distribution system at 8 feet per second (fps) or less. The results of the existing fire flow analyses are shown in **Figure 4**. Most areas of the South 457 Zone are capable of meeting the planning-level fire flow requirement.

IMPROVEMENT ANALYSES

Improvement analyses were performed to reduce the areas of widespread high pressure in the South 457 Zone. The analyses considered the following.

- Expanding adjacent pressure zones or creating new pressure zone(s).
- Recommending new facilities, including water main, booster pump stations, reservoirs, pressure reducing valves (PRVs), individual PRVs, and check valves to facilitate the pressure zone conversion.
- Evaluating capacity needs of pressure zones directly or indirectly supplied by the South 457 Zone.
- Prioritizing projects that may provide additional benefit to the system that can be addressed concurrently with the conversion of the South 457 Zone (i.e., water main improvements needed to convey high quantities of fire flow to the industrial, commercial, and institutional land use areas served by the South 457 Zone).
- Maintaining or improving existing levels of available fire flow.
- Replacing existing water main or facilities that are nearing the end of their useful life were favored over new facilities.

To reduce project costs, alignments that are scheduled in the City's transportation, sewer, stormwater, or other Capital Improvement Plans were favored over other alignments.

Level of Service Goals

The results of the improvement analyses indicate that the study area would benefit from a pressure zone conversion involving portions of the South 457 Zone, College Way 541 Zone, Padden Yew 696 Zone, and North 276 Zone. The analyses identified improvements to accomplish a pressure zone conversion based on the following Level of Service (LOS) goals for the study area.

1. Eliminate pressures in excess of 140 psi.
2. Minimize the number of nodes with pressures in excess of 80 psi.
3. After the improvements are complete, where the available fire flow does not meet the planning-level fire flow requirement, the reduction in fire flow shall not exceed 100 gallons per minute (gpm).
4. The planning-level minimum pressure goal is 40 psi.
5. The minimum allowable pressure shall be 30 psi under normal and peak demand conditions.

Pressure Zone Conversion Description

The pressure zone conversion would expand the North 276 Zone south along State Street to include the highest pressure areas at the Ferry Terminal and adjacent industrial area, the Fairhaven neighborhood, and areas along Padden Creek, Old Fairhaven Parkway, and Donovan Avenue. A new 360 Zone would be created to encompass most of the remaining South 457 Zone adjacent to the North 276 Zone, as well as the Edgemoor neighborhood and the service area extending south along Chuckanut Drive. The pressure zone conversion can be accomplished by installing new water main and PRV stations, reconfiguring piping and valves at various intersections, and opening and closing isolation valves along pressure zone boundaries.

A phased approach was developed to accomplish the pressure zone conversion and associated improvements. The three recommended project phases are described in the following sections.

Phase 1 – Donovan Avenue Improvements

Phase 1 of the pressure zone conversion consists of improvements that are limited to the alignment in Donovan Avenue that was identified by the City for replacement in the near future. Once the full pressure zone conversion is complete, the water main in Donovan Avenue will convey fire flow supply from the higher pressure zones, west to Fairhaven and the adjacent industrial areas. A 16-inch water main will be required in Donovan Avenue from 15th Street to 36th Street for this purpose.

Other improvements in Donovan Avenue include parallel 12-inch water main from 30th Street to 32nd Street and a PRV station that will be needed to accomplish the full pressure zone conversion. When installed, the new water main will serve the South 457 Zone, as the existing water main along the alignment currently does. In subsequent phases, the parallel 12-inch water main will be converted to the proposed 360 Zone, and the new 16-inch water main in Donovan Avenue west of 32nd Street will be converted to the South 276 Zone. An inventory of the Phase 1 improvements is listed in **Table 6** and shown in **Figure 5**.

Table 6
Phased Improvement Summary and Planning-level Cost Estimates

	Phase 1 Donovan Ave Improvements		Phase 2 457 to 276 Zone Conversion		Phase 3 457 to 360 Zone Conversion		Donovan Ave Improvements + 457 Zone Conversion	
	Qty/LF	Estimated Planning-level Cost	Qty/LF	Estimated Planning-level Cost	Qty/LF	Estimated Planning-level Cost	Qty/LF	Estimated Planning-level Cost
Close Existing Zone Valve (Qty)	0	$0	13	$0	11	$0	24	$0
Install New Zone Boundary Isolation (Qty)	0	$0	6	$84,000	3	$42,000	9	$126,000
Open Existing Zone Valve (Qty)	0	$0	1	$0	2	$0	3	$0
Install New PRV (Qty)	1	$150,000	1	$150,000	5	$750,000	7	$1,050,000
Install New 8" DI Water Main (LF)	0	$0	2,650	$1,233,000	6,560	$3,051,000	9,210	$4,284,000
Install New 12" DI Water Main (LF)	800	$392,000	2,580	$1,265,000	1,460	$716,000	4,840	$2,373,000
Install New 16" DI Water Main (LF)	7,050	$3,561,000	200	$101,000	0	$0	7,250	$3,662,000
Total		**$4,103,000**		**$2,833,000**		**$4,559,000**		**$11,495,000**

DI = Ductile iron
LF = Linear feet

Table 6 also presents the planning-level approximate cost estimates for the improvements. The cost estimates include the estimated construction cost of the improvement, as well as indirect costs estimated at 35 percent of the construction cost for engineering preliminary design, final design, and construction management services, permitting, legal, and administrative services. The construction cost estimates also include a 10-percent contingency.

While the Phase 1 improvements will reduce the likelihood of additional water main failures along the Donovan Avenue alignment by replacing the existing aging water main, they will not resolve any pressure deficiencies. The Donovan Avenue water main will continue to operate under high pressure following Phase 1; however, the improvements will be required to prepare the system for the implementation of Phase 2.

As shown in **Table 5**, the results of pressure analyses with the completion of Phase 1 indicate that system pressures will remain unchanged with the Donovan Avenue improvements. Similarly, the available fire flow following the Phase 1 improvements will be similar to existing levels of service. This phase only meets LOS Goals 3, 4, and 5.

Phase 2 – 457 to 276 Zone Conversion

Phase 2 includes improvements necessary to expand the North 276 Zone into the highest pressure areas of the South 457 Zone service area. The area of the existing South 457 Zone along State Street, at the Ferry Terminal and adjacent industrial area, within the Fairhaven neighborhood, and areas along Padden Creek, Old Fairhaven Parkway, and Donovan Avenue will be converted to the South 276 Zone. The improvements include installing new water main and PRV stations, reconfiguring piping and valves at various intersections, and opening and closing isolation valves along pressure zone boundaries. An inventory of the Phase 2 improvements is listed in **Table 6** and shown in **Figure 6**.

Under Phase 2, the northeast portion of the remaining South 457 Zone will be connected to the southwest service areas of Edgemoor and Chuckanut Drive, with water main extensions along Old Samish Road and 14th Street to maintain existing levels of fire flow service (LOS Goal 3) following the completion of the Phase 2 zone conversion.

Primary supply for the expanded South 457 Zone would be along State Street, while emergency fire flow and some high peak demands will be supplied via two PRVs from the South 457 Zone.

Hydraulic analyses performed to evaluate the pressure and fire flow capacity of the study area following the completion of the Phase 2 improvements indicate that they will resolve some, but not all of the high pressure deficiencies. The system pressures with the Phase 2 improvements are presented in **Figure 6**. As shown in the figure and **Table 5**, LOS Goal 1 is not achieved under this phase, as 5 percent of nodes remain with pressures greater than 140 psi. The percentage of nodes that exceed 80 psi are reduced from 87 to 65 percent, but still represent two-thirds of the study area. This phase meets LOS Goals 3, 4, and 5, and improves the condition of the system, but does not meet LOS Goals 1 and 2.

Phase 3 – 457 to 360 Zone Conversion

Phase 3 will eliminate all high pressures greater than 140 psi and reduce by half all other high pressures in the study area. This phase will convert the majority of the remaining South 457 Zone to a new 360 Zone by installing new water main and PRV stations, reconfiguring piping and valves at various intersections, and opening and closing isolation valves along pressure zone boundaries. An inventory of the Phase 3 improvements is listed in **Table 6** and shown in **Figure 7**. A hydraulic profile of the water system following the Phase 3 improvements is shown in **Figure 8**.

The proposed 360 Zone will be supplied through PRVs from the South 457 Zone that will operate to provide normal demand and fire flow supply throughout the zone. Although there will be some inefficiency in pumping to a 457-foot hydraulic grade and pressure reducing supply to a 360-foot hydraulic grade, the Phase 2 conversion to the North 276 Zone will result in a net reduction in pumped volume to the South 457 Zone.

The existing 24-inch South 457 Zone water main in 32nd Street will be maintained in the zone to convey supply to the southern portion of the study area and maintain sufficient supply capacity to the Padden Yew 696 Zone through the 38th Street BPS.

With the conversion of the Edgemoor neighborhood to the proposed 360 Zone, there is a small area in the highest elevation that may not meet LOS Goal 4 of a 40 psi minimum pressure. As this area is not fully developed, it should be evaluated as development occurs and more detail can be provided on any proposed water system extensions to determine if a small booster station will be needed to serve this area at a higher hydraulic grade than the 360 Zone.

Hydraulic analyses performed to evaluate the pressure and fire flow capacity of the study area following the completion of the Phase 3 improvements indicate that this phase will meet all LOS goals. The system pressures following the completion of the Phase 3 improvements are shown in **Figure 7**. As shown in the figure and in **Table 5**, all pressures greater than 140 psi are eliminated with the Phase 3 improvements, and only 1 percent of the service area remains within a range of 120 to 140 psi. Overall, the total percentage of nodes greater than 80 psi are reduced from 87 to 40 percent.

CAPACITY ANALYSIS

Additional analyses were performed to evaluate the capacity of the South 457 Zone supply and storage facilities to support the change in demand distribution following the completion of the

pressure zone conversion. The approximate change in demand distribution in the study area is presented in **Table 7**. The demands in the table for the existing zone boundaries are based on the demand distributions shown in **Table 2** and scaled proportionately to the projected year 2032 demands shown in **Table 1**. The demand estimates after the Phase 3 zone conversion is complete are based on the demand distribution of the nodes in the model that were converted to a new zone.

Table 7
Pressure Zone Demands After Zone Conversion

	Year 2032 Existing Zone Boundaries			Year 2032 After Phase 3 Zone Conversion		
Pressure Zone	**ADD (gpm)**	**MDD (gpm)**	**PHD (gpm)**	**ADD (gpm)**	**MDD (gpm)**	**PHD (gpm)**
360 Proposed	---	---	---	*833*	*1,309*	*2,685*
276 North	3,726	5,860	12,016	4,208	6,618	13,571
457 South	1,850	2,909	5,965	531	835	1,713
541 College Way	72	113	232	76	119	244
696 Padden	360	566	1,162	360	566	1,162
830 Reveille	22	34	70	22	34	70
873 Governor	68	106	218	68	106	218
Total Study Area	**6,097**	**9,589**	**19,663**	**6,097**	**9,589**	**19,663**

As shown in the table, less than 30 percent of the South 457 Zone customer demands will remain in the pressure zone after the zone conversion. Because one-quarter of the South 457 Zone will be converted to the North 276 Zone, this will result in less pumping costs at the Otis Street BPS.

SUPPLY CAPACITY

The supply capacity requirements for the Otis Street BPS are shown in **Table 8** for the year 2032 demand conditions. The BPS capacity is evaluated based on MDD because the zone is served by reservoirs. The capacity of the BPS was based on data contained in the 2013 WSP. **Table 8** indicates that under an MDD demand condition, the zone conversion will reduce the pumping requirements by 758 gpm. On an annual basis, an energy savings will be realized, as 250 million gallons of water will not need to be pumped to the South 457 Zone.

Table 8
South 457 Zone Supply Capacity

	Year 2032	
	Existing Zone Boundaries	After Phase 3 Zone Conversion
Required Supply (gpm)		
457 South + 541 College Way MDD	3,022	954
Transfer to 696 Padden Yew and Higher Zones	707	707
Transfer to Proposed 360 Zone	---	1,309
Total Required Supply	**3,729**	**2,971**
Available Supply (gpm)		
Otis Street BPS Firm Capacity	5,500	5,500
Total Available Supply	**5,500**	**5,500**
Surplus or Deficient Supply (gpm)		
Surplus or Deficient Amount	**1,771**	**2,529**

STORAGE CAPACITY

A storage capacity analysis was performed for the South 457 Zone to evaluate the impact of the pressure zone conversion on the storage requirements of the pressure zone. The analyses were performed for the 2012 baseline system, the year 2032 demands with existing zone boundaries, and the year 2032 demands after the Phase 3 zone conversion. The capacity analysis included the storage requirements of the College Way 541 Zone since it does not have a storage facility and relies on storage in the South 457 Zone.

Analysis Criteria

Water storage is typically made up of the following components: operational storage; equalizing storage; standby storage; fire flow storage; and dead storage. A definition of each storage component and the criteria used to evaluate the capacity of the City's storage tanks is provided below.

Operational Storage – Volume of the reservoir used to supply the water system under normal conditions when the source or sources of supply are not delivering water to the system (i.e., sources are in the off mode). Operational storage is essentially the average amount of drawdown in the reservoir during normal operating conditions and was determined based on 2012 SCADA data and assumed to remain unchanged in the year 2032 analyses.

Equalizing Storage – Volume of the reservoir used to supply the water system under peak demand conditions when the system demand exceeds the total rate of supply of the sources. DOH requires that equalizing storage be stored above an elevation that will provide a minimum pressure of 30 psi at all service connections throughout the system under PHD conditions. Because the City's Otis Street PS primarily operates on a "call on demand" basis to fill the reservoirs, the equalizing storage requirements are determined using the standard DOH formula

that considers the difference between the system PHD and the combined capacity of the supply sources.

$$\mathbf{ES = (PHD - Q_S)(150\ minutes)}, \text{ but in no case less than zero}$$

Where:

ES = Equalizing Storage, in gallons

PHD = Peak Hour Demand, in gpm

Q_S = Sum of all installed and active sources, except emergency supply, in gpm.

The capacity of the Otis Street BPS is sufficient to meet the peak hour demand. Therefore, the equalizing storage requirement is zero.

Standby Storage – Volume of the reservoir used to supply the water system under emergency conditions when supply facilities are out of service due to equipment failures, power outages, loss of supply, transmission main breaks, and any other situation that disrupts the supply source. DOH requires that standby storage be stored above an elevation that will provide a minimum pressure of 20 psi at all service connections throughout the system. The criteria for determining the standby storage requirements for the City's system is based on the standard DOH formula that requires average day demand and supply source capacity. The amount required is sufficient to supply the system for a 48-hour period when the Otis Street BPS is out of service and the system is experiencing average day demands.

$$\mathbf{SB = (2\ days)[(ADD)(N) - t_m\ (Q_S - Q_L)]}$$

Where:

SB = Standby Storage, in gallons

ADD = Average Day Demand per Equivalent Residential Unit (ERU), in gallons per day per ERU

N = Number of ERUs

Q_S = Sum of all installed and continuously available sources, except emergency supply, in gpm

Q_L = The capacity of the largest source available to the system, in gpm

t_m = Time the remaining sources are pumped on the day when the largest source is not available, in minutes. Unless otherwise restricted, this value is 1,440 minutes.

DOH recommends that the minimum standby storage volume be no less than 200 gallons per ERU.

Fire Flow Storage – Volume of the reservoir used to supply water to the system at the maximum rate and duration required to extinguish a fire at the building with the highest fire flow requirement. The magnitude of the fire flow storage is based on the industrial planning level fire flow requirement shown in **Table 4**. DOH requires that fire flow storage be stored above an elevation that will provide a minimum pressure of 20 psi at all points throughout the distribution system under MDD conditions.

***Dead Storage* –** Volume of the reservoir that cannot be used because it is stored at an elevation that does not provide system pressures that meet the minimum pressure requirements established by DOH without pumping. There is no dead storage in the South 457 Zone operating area.

Storage Analyses Results

The results of the storage analyses, as shown in **Table 9**, indicate that there is an existing storage deficiency in the South 457 Zone. If the pressure zone boundaries remained unchanged, the storage deficiency would increase to 4.76 million gallons (MG) by 2032. However, if the Phase 3 zone conversion is implemented, the storage deficiency would be reduced to less than 1 MG by 2032. This represents a significant reduction in future storage improvement costs.

Table 9
South 457 Zone Storage Capacity

	Year 2012	Year 2032	
	Baseline	Existing Zone Boundaries	After Phase 3 Zone Conversion
Available/Usable Storage (MG)			
Maximum Storage Capacity	1.72	1.72	1.72
Dead (Non-usable Storage)	0.00	0.00	0.00
Total Available Storage	**1.72**	**1.72**	**1.72**
Required Storage (MG)			
Operational Storage	0.52	0.52	0.52
Equalizing Storage	0.00	0.00	0.00
Standby Storage	4.25	5.53	1.75
Fire Flow Storage	0.42	0.42	0.42
Totals	**5.19**	**6.48**	**2.69**
Surplus or Deficient Storage (MG)			
Surplus or Deficient Amt.	**-3.47**	**-4.76**	**-0.97**

The reduction in storage requirements is based on system changes that will be implemented with the Phase 2 improvements to convert a large portion of the South 457 Zone to the North 276 Zone. Therefore, the results of the Phase 3 storage analyses are also representative of Phase 2, but will also vary depending on the demands of the system at the time of implementation of the phase.

HYDRAULIC ANALYSES CRITERIA

A summary of the operational conditions used in the hydraulic model to perform the analyses is shown in **Table 10**.

Table 10
Hydraulic Analyses Criteria

Description	Baseline 2012		Projected 2032	
	Fire Flow Analysis	Pressure Analysis	Fire Flow Analysis	Pressure Analysis
Demands	2012 MDD	2012 PHD	2032 MDD	2032 PHD
North 276 Zone Reservoirs HGL (feet)	275.1	275.4	274.9	275.3
South 457 Zone Reservoirs HGL (feet)	448.0	452.0	448.0	452.0
Padden Yew 696 Zone Reservoirs HGL (feet)	688.2	692.7	687.7	692.2
Otis Street BPS	ON	ON	ON	ON
Consolidation BPS	OFF	OFF	OFF	OFF
38th Street BPS	ON	ON	ON	ON

HGL = Hydraulic Grade Level

CONCLUSION

Portions of the existing South 457 Zone are currently operating under hazardous high pressure conditions, and the majority of the pressure zone is not operating at a hydraulic grade that is appropriate for the service elevations. The proposed South 457 Zone pressure zone conversion will eliminate areas of extremely high pressures above 140 psi and greatly reduce the widespread areas of moderately high service pressure. The improvements also will reduce the storage deficiency of the service area significantly.

The pressure zone conversion improvements were divided into the following phases to support the implementation of the conversion process.

- **Phase 1**
    - *Description:* Install improvements in Donovan Avenue.
    - *Improvement Summary:* Install16-inch water main in Donovan Avenue from 15th Street to 36th Street, a parallel 12-inch water main in 30th Street to 32nd Street, and a PRV station at 32nd Street.
    - *Benefit:* This phase will not reduce distribution system pressures but will reduce the occurrence of recent water main failures in Donovan Avenue with the replacement of aging water main.
    - *Approximate Planning-level Cost Estimate:* $4.1 Million.
- **Phase 2**
    - *Description:* South 457 Zone to North 276 Zone Conversion.
    - *Improvement Summary:* Convert the South 457 Zone to the North 276 Zone along State Street, at the Ferry Terminal and adjacent industrial area, within the Fairhaven neighborhood, and at areas along Padden Creek, Old Fairhaven Parkway, and Donovan Avenue by installing new 8-, 12-, and 16-inch water main and PRV stations, reconfiguring piping and valves at various intersections, and opening and closing isolation valves along pressure zone boundaries.

  - *Benefit:* Reduce high pressures (80+ psi) from 87 to 65 percent of nodes. Reduce extremely high pressures (140+ psi) from 25 to 5 percent of nodes. Decrease energy usage and pumped volume from the Otis Street BPS. Reduce additional storage needs from 4.8 MG to 1.0 MG.
  - *Approximate Planning-level Cost Estimate:* $2.8 Million. Improvement costs should consider the cost benefit of eliminating 3.8 MG of additional reservoir needs.

- **Phase 3**
  - *Description:* South 457 Zone to Proposed 360 Zone Conversion.
  - *Improvement Summary:* Convert the South 457 Zone to the Proposed 360 Zone along the North 276 Zone boundaries, in the Edgemoor neighborhood, and along Chuckanut Drive by installing new 8- and 12-inch water main and PRV stations, reconfiguring piping and valves at various intersections, and opening and closing isolation valves along pressure zone boundaries.
  - *Benefit:* Reduce high pressures (80+ psi) from 65 to 40 percent of nodes. Eliminate extremely high pressures (140+ psi).
  - *Approximate Planning-level Cost Estimate:* $4.6 Million.

The analyses performed for this study were based on the City's existing hydraulic model and data available at the time of the evaluation. Additional analyses should be performed during the predesign phases of these projects to confirm the improvements as additional water system information becomes available. The following should be confirmed and evaluated to improve the accuracy of predesign level analyses.

- Update the model with developer extensions as they are installed, and confirm all water main is included in the model.
- Update the model to add nodes at all hydrant laterals.
- Confirm pressure needs for multi-story buildings at locations where pressure will be reduced.
- Update analyses if more recent SCADA data becomes available.
- When the system becomes fully metered, update the model's demand distribution to allocate actual customer metered water use to the representative node. Update the pressure zone conversion analyses based on the actual pressure zone demand distribution.

Figures

Legend

Existing Pressures

- Below 40 psi
- 40 - 80 psi
- 80 - 100 psi
- 100 - 140 psi
- Above 140 psi
- Reservoir
- Pump Station
- Railroads
- City Limits
- Urban Growth Area
- Water Bodies

Water Main Installation Year

- 1930 or earlier
- 1931 - 1950

Pressure Zone

- 873 Zone
- 830 Zone
- 696 Zone
- 541 Zone
- 519 Zone
- 457 Zone
- 276 Zone

Sehome Reservoir
0.7 MG Capacity
O.E. 457'

College Way PS

College Way Reservoir
0.5 MG Capacity
O.E. 541'

Otis Street PS

Consolidation PS

Consolidation 1 Reservoir
0.5 MG Capacity
O.E. 519'

Reveille PS

Reveille Reservoir
0.3 MG Capacity
O.E. 696'

40th Street Reservoir
0.5 MG Capacity
O.E. 696'

Parkhurst Reservoir
0.18 MG Capacity
O.E. 873'

Governor Road PS

38th Street PS

Padden Reservoir
0.5 MG Capacity
O.E. 457'

276 Zone

519 Zone

457 Zone

541 Zone

696 Zone

830 Zone

873 Zone

Bellingham Bay

Lake Padden

Chuckanut Bay

J:\DATA\BLM\417-054\GIS\MAPS\FIGURE 1 - EXISTING SYSTEM.MXD BY: GDAVIDSON PLOT DATE: DEC 8, 2017

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NORTH

1 inch = 1,000 feet

0 500 1,000 2,000 Feet

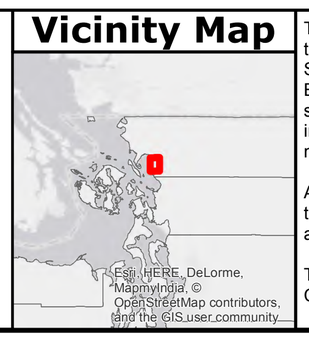
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CITY OF BELLINGHAM WASHINGTON

Figure 1
Existing Water System Pressures

City of Bellingham
South 457 Zone Conversion Study

Vicinity Map



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1000'
900'
800'
700'
600'
500'
400'
300'
200'
100'

873 Governor Road Zone

Parkhurst Reservoir
0.185 MG
Overflow Elev: 873'
Base Elev: 838'

Governor Road BPS
(1,460 gpm)

830 Reveille Zone

Reveille BPS
(300 gpm)

696 Padden Yew Zone

40th Street Reservoir
0.50 MG
Overflow Elev: 696'
Base Elev: 670'

Reveille Reservoir
0.30 MG
Overflow Elev: 696'
Base Elev: 673'

38th Street BPS
(1,900 gpm)

Consolidation BPS
(1,900 gpm)

541 College Way Zone

College Way BPS
(3,400 gpm)

519 Dakin & Yew Zone

457 South Zone

College Way Reservoir
0.50 MG
Overflow Elev: 457'
Base Elev: 433'

Seahome Reservoir
0.70 MG
Overflow Elev: 461'
Base Elev: 446'

New
457/360
PRV

Padden Reservoir
0.50 MG
Overflow Elev: 457'
Base Elev: 432'

Woburn Street BPS
(5,400 gpm)

Dakin &
Consolidation BPS
(7,500 gpm)

Future 360 Zone

Otis Street BPS
(7,000 gpm)

New
457/276
PRV

276 North Zone

Marietta Reservoir
3.0 MG
Overflow Elev: 275'
Base Elev: 225'

Whatcom Falls I Reservoir
4.0 MG
Overflow Elev: 275'

Whatcom Falls II Reservoir
16.0 MG
Overflow Elev: 275'

Figure 2
Existing Hydraulic Profile for the City of Bellingham
South 457 Zone Conversion Study

Date: August 25, 2017 Filename: BLM\417-054\CAD\BLM-HPX.DWG

Legend

- 276 North Zone
- Future 360 Zone
- 457 South Zone
- 519 Dakin & Yew Zone
- 541 College Way Zone
- 696 Padden Yew Zone
- 830 Reveille Zone
- 873 Governor Road Zone
- Booster Pump Station
- Pressure Reducing Station

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Bellingham Bay

Sehome Reservoir
0.7 MG Capacity
O.E. 457'

College Way PS

College Way Reservoir
0.5 MG Capacity
O.E. 541'

541 Zone

457 Zone

276 Zone

519 Zone

Otis Street PS

Consolidation PS

Consolidation Reservoir
0.5 MG Capacity
O.E. 519'

Reveille PS

Reveille Reservoir
0.3 MG Capacity
O.E. 696'

696 Zone

830 Zone

40th Street Reservoir
0.5 MG Capacity
O.E. 696'

Parkhurst Reservoir
0.18 MG Capacity
O.E. 873'

873 Zone

38th Street PS

Governor Road PS

Padden Reservoir
0.5 MG Capacity
O.E. 457'

Lake Padden

I-5

Legend

- Reservoir
- Pump Station
- Railroads
- City Limits
- Urban Growth Area
- Water Bodies

Land Use

- Industrial
- Commercial
- Institutional
- Public
- Single-Family Residential
- Multi-Family Residential
- Urban Residential Mixed Use
- Residential Transition

Water Main

- 276 Zone
- 457 Zone
- 519 Zone
- 541 Zone
- 696 Zone
- 830 Zone
- 873 Zone

\\RH2\DFS\BOTHELL\DATA\BLM\417-054\GIS\MAPS\BLM LAND USE.MXD BY: GDAVIDSON PLOT DATE: DEC 7, 2017

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NORTH

1 inch = 1,000 feet

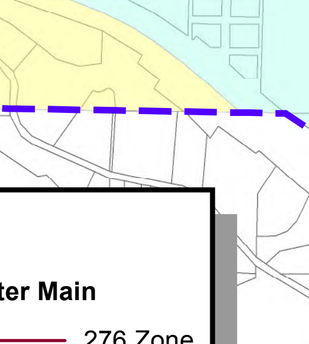
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CITY OF BELLINGHAM WASHINGTON

Figure 3
Land Use
City of Bellingham
South 457 Zone Conversion Study

Vicinity Map



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Bellingham Bay

Sehome Reservoir
0.7 MG Capacity
O.E. 457'

College Way PS

College Way Reservoir
0.5 MG Capacity
O.E. 541'

Otis Street PS

Consolidation PS

Consolidation Reservoir
0.5 MG Capacity
O.E. 519'

Reveille PS

Reveille Reservoir
0.3 MG Capacity
O.E. 696'

40th Street Reservoir
0.5 MG Capacity
O.E. 696'

Parkhurst Reservoir
0.18 MG Capacity
O.E. 873'

Governor Road PS

38th Street PS

Padden Reservoir
0.5 MG Capacity
O.E. 457'

Lake Padden

I-5

Legend

- Reservoir
- Pump Station
- Railroads
- City Limits
- Urban Growth Area
- Water Bodies

Available Fire Flow

- Less than 750 GPM
- 750 - 1500 GPM
- 1500 - 2500 GPM
- 2500 - 3500 GPM
- Greater than 3500 GPM

Water Main

- 2" Main
- 4" Main
- 6" Main
- 8" Main
- 10" Main
- 12" Main
- 14" Main
- 16" Main
- 20" Main
- 24" Main
- 30" Main
- 36" Main
- 42" Main
- 48" Main

Land Use

- Industrial (3,500 gpm req.)
- Commercial (2,500 gpm req.)
- Institutional (2,000 gpm req.)
- Public (750 gpm req.)
- Single-Family Residential (1,500 gpm req.)
- Multi-Family Residential (1,500 gpm req.)
- Urban Residential Mixed Use (750-2,500 gpm req.)
- Residential Transition (750-2,500 gpm req.)

\\RH2\DFS\BOTHELL\DATA\BLM\417-054\GIS\MAPS\FIGURE 5 - FF AVAILABILITY.MXD BY: GDAVIDSON PLOT DATE: DEC 7, 2017

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NORTH

1 inch = 1,000 feet

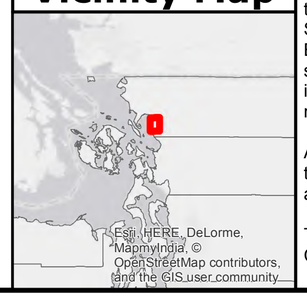
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DRAWING IS FULL SCALE WHEN BAR MEASURES 2”

CITY OF BELLINGHAM WASHINGTON

Figure 4
Existing Derated Fire Flow
City of Bellingham
South 457 Zone Conversion Study

Vicinity Map



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Legend

Existing Pressures

- Below 40 psi
- 40 - 80 psi
- 80 - 100 psi
- 100 - 140 psi
- Above 140 psi
- Reservoir
- Pump Station
- Railroads
- City Limits
- Urban Growth Area

- Water Bodies

Pressure Zone

- 873 Zone
- 830 Zone
- 696 Zone
- 541 Zone
- 519 Zone
- 457 Zone
- 276 Zone

Sehome Reservoir
0.7 MG Capacity
O.E. 457'

College Way PS

College Way
Reservoir
0.5 MG Capacity
O.E. 541'

Otis Street PS

Consolidation PS

Consolidation
Reservoir
0.5 MG Capacity
O.E. 519'

Reveille PS

Reveille
Reservoir
0.3 MG Capacity
O.E. 696'

40th Street
Reservoir
0.5 MG Capacity
O.E. 696'

Parkhurst
Reservoir
0.18 MG Capacity
O.E. 873'

38th
Street PS

Governor
Road PS

Padden
Reservoir
0.5 MG Capacity
O.E. 457'

Install 457/360 and 457/276 Zone PRV

Install 5,610' of 16" DI 276 Zone Water Main

Install 770' of 16" DI 457 Zone Water Main

Install 800' of 12" DI 360 Zone Water Main

Install 670' of 16" DI 457 Zone Water Main

276 Zone

519 Zone

457 Zone

541 Zone

696 Zone

830 Zone

873 Zone

Bellingham Bay

Lake Padden

Chuckanut Bay

Phase 1 Improvements Legend

- New PRVs

Water Main Improvements

- 12" Main
- 16" Main

J:\DATA\BLM\417-054\GIS\MAPS\FIGURE 5 - PHASE 1 MODIFICATIONS (DONOVAN AVE).MXD BY: GDAVIDSON PLOT DATE: DEC 8, 2017

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NORTH

1 inch = 1,000 feet

0 500 1,000 2,000 Feet

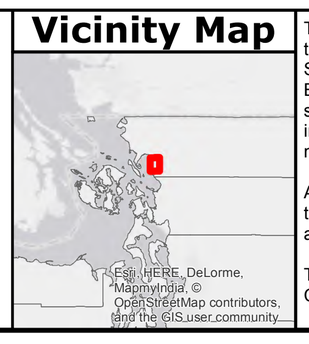
DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

CITY OF BELLINGHAM WASHINGTON

Figure 5
Phase 1 - Donovan Ave. Improvements

City of Bellingham
South 457 Zone Conversion Study

Vicinity Map



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Legend

Phase 2 Pressures

- Below 40 psi
- 40 - 80 psi
- 80 - 100 psi
- 100 - 140 psi
- Above 140 psi
- Reservoir
- Pump Station
- Railroads
- City Limits
- Urban Growth Area

- Water Bodies

Pressure Zone

- 873 Zone
- 830 Zone
- 696 Zone
- 541 Zone
- 519 Zone
- 457 Zone
- 276 Zone

Bellingham Bay

Chuckanut Bay

Lake Padden

276 Zone

519 Zone

Consolidation PS

Consolidation Reservoir
0.5 MG Capacity
O.E. 519'

Reveille PS

Reveille Reservoir
0.3 MG Capacity
O.E. 696'

696 Zone

830 Zone

Parkhurst Reservoir
0.18 MG Capacity
O.E. 873'

873 Zone

Governor Road PS

40th Street Reservoir
0.5 MG Capacity
O.E. 696'

Otis Street PS

38th Street PS

Padden Reservoir
0.5 MG Capacity
O.E. 457'

Sehome Reservoir
0.7 MG Capacity
O.E. 457'

College Way PS

College Way Reservoir
0.5 MG Capacity
O.E. 541'

457 Zone

541 Zone

Install 350' of 12" DI
276 Zone Water Main

Install 800' of 12" DI
276 Zone Water Main

Install 360/276
Zone PRV

Install 300' of 8" DI
276 Zone Water Main

Install 50' of 8" DI
360 Zone Water Main

Install 300' of 8" DI
360 Zone Water Main

Install 5,610' of 16" DI
276 Zone Water Main

Install 457/360
and 457/276
Zone PRV

Install 800' of 12" DI
360 Zone Water Main

Install 670' of 16" DI
457 Zone Water Main

Install 770' of 16" DI
457 Zone Water Main

Install 1,350' of 12" DI
360 Zone Water Main

Install 710' of 8" DI
457 Zone Water Main

Install 2,000' of 8" DI
360 Zone Water Main

Improvements Legend

- Phase 1 PRVs
- Phase 2 PRVs
- (1) New Closed Zone Valves
- (2) Install New Pressure Zone Boundary Isolation
- (3) Open Existing Normally Closed Zone Valve
- Phase 1 Water Main Improvements
- Phase 2 Water Main Improvements

J:\DATA\BLM\417-054\GIS\MAPS\FIGURE 6 - PHASE 2 IMPROVEMENTS.MXD BY: GDAVIDSON PLOT DATE: DEC 8, 2017

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NORTH

1 inch = 1,000 feet

0 500 1,000 2,000 Feet

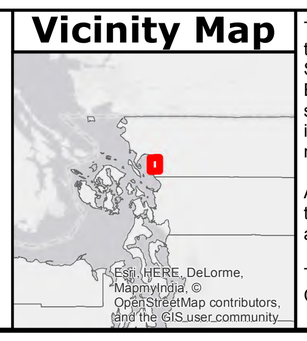
DRAWING IS FULL SCALE WHEN BAR MEASURES 2”

CITY OF BELLINGHAM WASHINGTON

Figure 6
Phase 2 - 457 to 276 Zone Conversion

City of Bellingham
South 457 Zone Conversion Study

Vicinity Map



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Legend

Phase 3 Pressures

- Below 40 psi
- 40 - 80 psi
- 80 - 100 psi
- 100 - 140 psi
- Above 140 psi
- Reservoir
- Pump Station
- Railroads
- City Limits
- Urban Growth Area

- Water Bodies

Pressure Zone

- 873 Zone
- 830 Zone
- 696 Zone
- 541 Zone
- 519 Zone
- 457 Zone
- 360 Zone
- 276 Zone

Bellingham Bay

Lake Padden

Sehome Reservoir
0.7 MG Capacity
O.E. 457'

College Way PS

College Way
Reservoir
0.5 MG Capacity
O.E. 541'

Otis Street PS

Consolidation PS

Consolidation
Reservoir
0.5 MG Capacity
O.E. 519'

Reveille PS

Reveille
Reservoir
0.3 MG Capacity
O.E. 696'

40th Street
Reservoir
0.5 MG Capacity
O.E. 696'

Parkhurst
Reservoir
0.18 MG Capacity
O.E. 873'

38th Street PS

Governor Road PS

Padden
Reservoir
0.5 MG Capacity
O.E. 457'

Install 350' of 12" DI 276 Zone Water Main

Install 170' of 8" DI 457 Zone Water Main

Install 457/360 Zone PRV

Install 320' of 12" DI 457 Zone Water Main

Install 300' of 12" DI 457 Zone Water Main

Install 457/360 Zone PRV

Install 110' of 8" DI 457 Zone Water Main

Install 519/457 Zone PRV

Install 696/457 Zone PRV

Install 310' of 8" DI 457 Zone Water Main

Install 800' of 12" DI 276 Zone Water Main

Install 480' of 8" DI 541 Zone Water Main

Install 550' of 8" DI 360 Zone Water Main

Install 250' of 8" DI 360 Zone Water Main

Install 800' of 8" DI 696 Zone Water Main

Install 541/457 Zone PRV

Install 40' of 8" DI 360 Zone Water Main

Install 360/276 Zone PRV

Install 300' of 8" DI 360 Zone Water Main

Install 50' of 8" DI 360 Zone Water Main

Install 770' of 16" DI 457 Zone Water Main

Install 670' of 16" DI 457 Zone Water Main

Install 300' of 8" DI 297 Zone Water Main

Install 800' of 12" DI 360 Zone Water Main

Install 300' of 8" DI 360 Zone Water Main

Install 5,610' of 16" DI 276 Zone Water Main

Install 700' of 8" DI 276 Zone Water Main

Install 457/360 and 457/276 Zone PRV

Install 1,350' of 12" DI 360 Zone Water Main

Install 620' of 8" DI 276 Zone Water Main

Install 1,120' of 8" DI 360 Zone Water Main

Install 710' of 8" DI 457 Zone Water Main

Install 400' of 8" DI 360 Zone Water Main

Install 840' of 12" DI 360 Zone Water Main

Install 2,000' of 8" DI 360 Zone Water Main

Potential Future 457 Zone

276 Zone

457 Zone

541 Zone

360 Zone

696 Zone

830 Zone

873 Zone

I-5

Improvements Legend

New Closed Zone Valve

- (1) Phase 2
- (1) Phase 3

Install New Pressure Zone Boundary Isolation

- (2) Phase 2
- (2) Phase 3

Open Existing Normally Closed Zone Valve

- (3) Phase 2
- (3) Phase 3

- Phase 1 PRV
- Phase 2 PRV
- Phase 3 PRV
- Phase 1 Water Main Improvements
- Phase 2 Water Main Improvements
- Phase 3 Water Main Improvements

J:\DATA\BLM\417-054\GIS\MAPS\FIGURE 7 - PHASE 3 MODIFICATIONS.MXD BY: GDAVIDSON PLOT DATE: DEC 8, 2017

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NORTH

1 inch = 1,000 feet

0 500 1,000 2,000 Feet

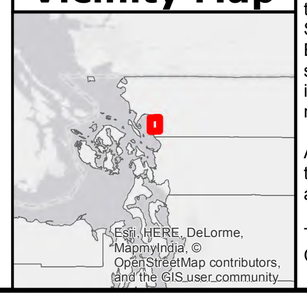
DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

CITY OF BELLINGHAM WASHINGTON

Figure 7
Phase 3 - 457 to 360 Zone Conversion

City of Bellingham
South 457 Zone Conversion Study

Vicinity Map



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1000'
900'
800'
700'
600'
500'
400'
300'
200'
100'

873 Governor Road Zone

Parkhurst Reservoir
0.185 MG
Overflow Elev: 873'
Base Elev: 838'

Governor Road BPS
(1,460 gpm)

830 Reveille Zone

Reveille BPS
(300 gpm)

696 Padden Yew Zone

40th Street Reservoir
0.50 MG
Overflow Elev: 696'
Base Elev: 670'

Reveille Reservoir
0.30 MG
Overflow Elev: 696'
Base Elev: 673'

Proposed
696/457
PRV

38th Street BPS
(1,900 gpm)

Consolidation BPS
(1,900 gpm)

541 College Way Zone

Proposed
541/457
PRV

College Way BPS
(3,400 gpm)

519 Dakin & Yew Zone

Proposed
519/457
PRV

457 South Zone

College Way Reservoir
0.50 MG
Overflow Elev: 457'
Base Elev: 433'

Seahome Reservoir
0.70 MG
Overflow Elev: 461'
Base Elev: 446'

Padden Reservoir
0.50 MG
Overflow Elev: 457'
Base Elev: 432'

Proposed
457/360
PRV

Proposed
457/360
PRV

Proposed
457/360
PRV

Woburn
Street BPS
(5,400 gpm)

Dakin &
Consolidation BPS
(7,500 gpm)

Proposed 360 South Zone

Proposed
360/276
PRV

Proposed
457/276
PRV

Otis Street BPS
(7,000 gpm)

276 North Zone

Marietta Reservoir
3.0 MG
Overflow Elev: 275'
Base Elev: 225'

Whatcom Falls I Reservoir
4.0 MG
Overflow Elev: 275'

Whatcom Falls II Reservoir
16.0 MG
Overflow Elev: 275'

Figure 8
Proposed System Hydraulic Profile
City of Bellingham
South 457 Zone Conversion Study

Date: August 25, 2017 Filename: BLM\417-054\CAD\BLM-HPX.DWG

Legend

- 276 North Zone
- 360 South Zone
- 457 South Zone
- 519 Dakin & Yew Zone
- 541 College Way Zone
- 696 Padden Yew Zone
- 830 Reveille Zone
- 873 Governor Road Zone
- Booster Pump Station
- Pressure Reducing Station

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