

## 2 Background

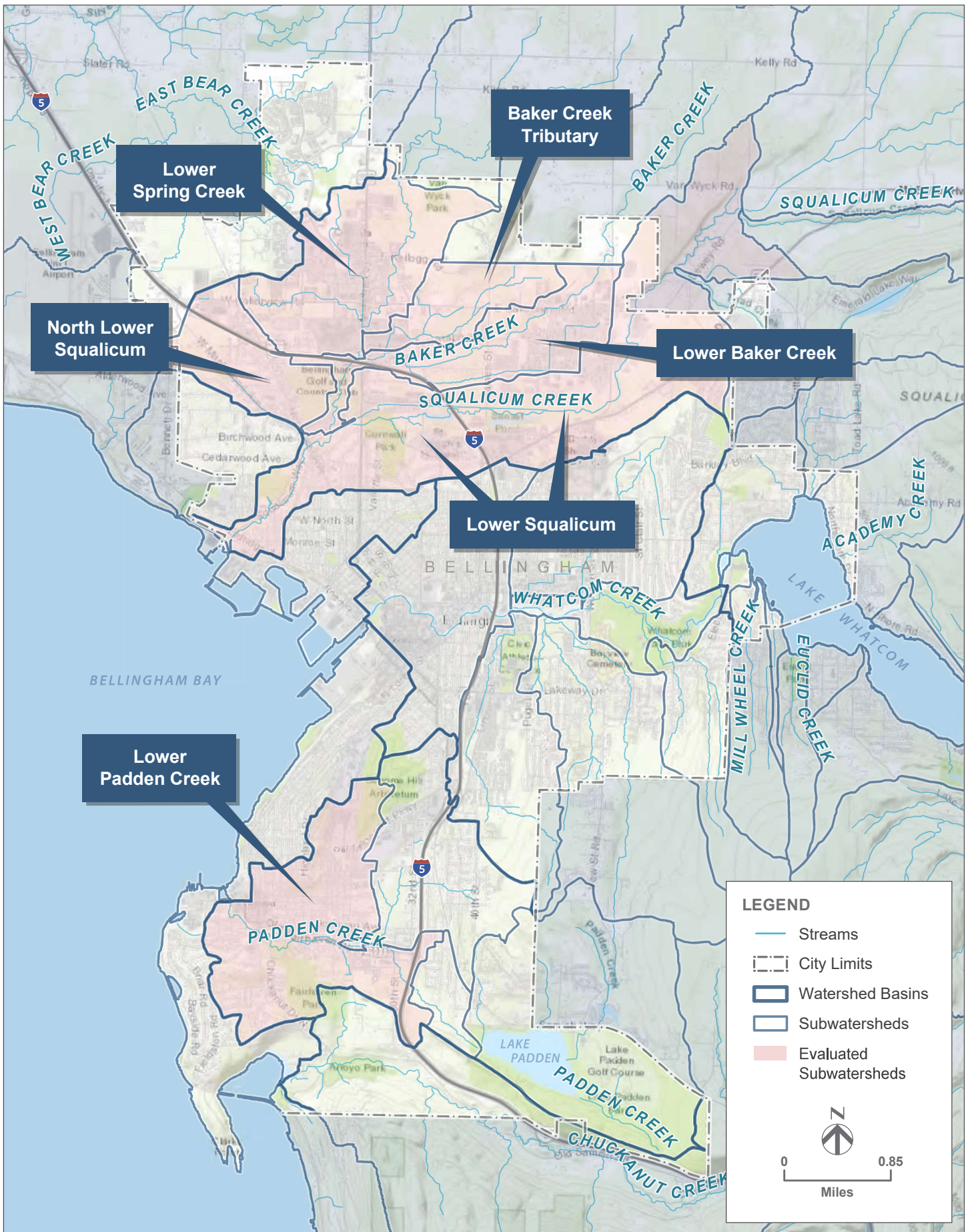
Stormwater runoff represents the portion of rain or melting snow that “runs off” across the land instead of seeping into the ground. The City’s stormwater system primarily manages this stormwater runoff, with the exception of groundwater connections per BMC 15.42.020. Stormwater follows topography from high points to low, crossing property boundary lines and even jurisdictional limits. As stormwater flows from one property owner to the next, each owner is responsible for receiving and conveying stormwater across his/her property downstream to the next. Similar to other urban planning challenges, comprehensive plans to manage stormwater runoff seek to provide the City with a forward-looking plan that promotes development without impacting the surrounding environment.

There is a direct relationship between runoff volume and impervious surface area. As natural landscapes are converted to impervious urbanized areas, infiltration of rainfall into the ground diminishes, resulting in more stormwater runoff. The challenge faced by the SSWU is to collect, treat, and convey stormwater runoff to nearby receiving waters safely and cost-effectively while minimizing adverse impacts to waterways, public infrastructure, and private property. The major watersheds in Bellingham where stormwater runoff flows to are (from north to south) Silver Creek, Little Squalicum Creek, Squalicum Creek, Whatcom Creek, Padden Creek, and Chuckanut Creek, plus shoreline areas draining directly to Bellingham Bay (see Figure 2-1).

This chapter provides an overview of the City’s watersheds and drainage systems that are the main elements of the SSWU. It includes a history of the city’s growth, a summary of the city’s built assets—drainage structures, pipes, and detention and water quality facilities—and a summary of two previous SSWCPs.

### 2.1 Population and Industry Growth

Demands for managing stormwater are directly correlated with population growth and urban development. Bellingham, located within Whatcom County along the shores of Bellingham Bay, is the northernmost large city in Washington State, about 21 miles south of the Canada-United States border. The area was incorporated in 1903 when Bellingham, Fairhaven, Sehome, and Whatcom combined into the City of Bellingham. Since 1996, around the time when the City prepared its first SSWCP, the city’s population has grown from around 60,000 residents to 90,655 in 2018 (U.S. Census Bureau 2020). Figure 2-2 below illustrates Bellingham’s population growth between 1996 and 2018. It is estimated that the city’s current population is about 120,000. Typical of most Puget Sound communities, Bellingham has experienced growth in its population and consequently in land development activity that has resulted in an increase in the amount of impervious surfaces, such as roads, driveways, rooftops, parking lots, and other hard surfaces to accommodate urban development.



**BELLINGHAM WATERSHEDS**

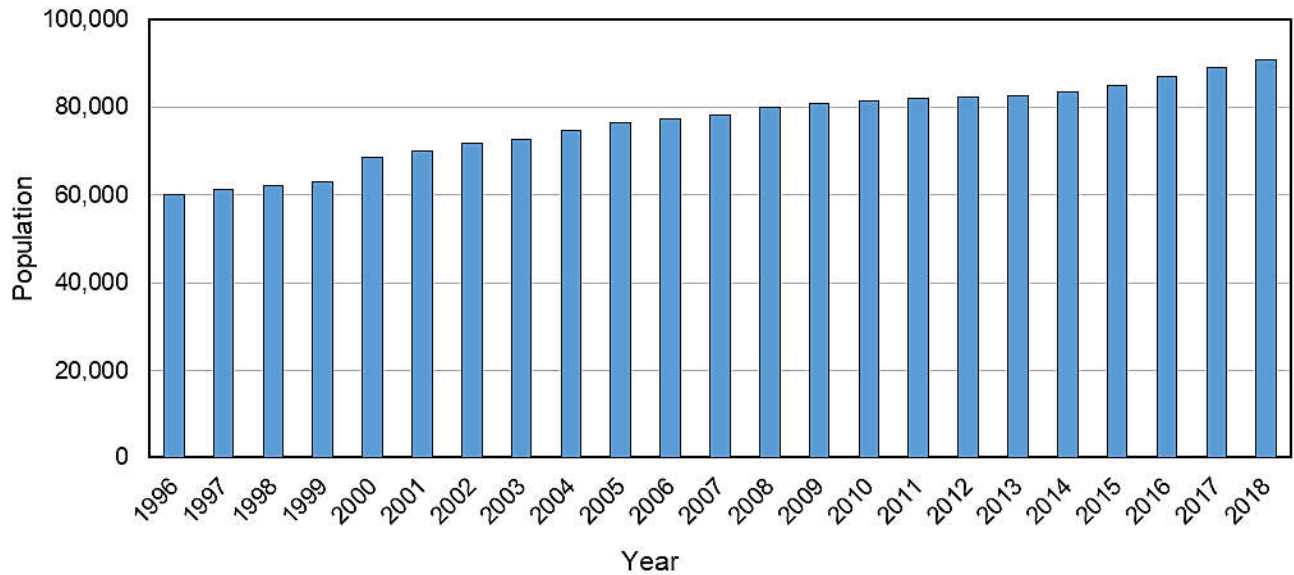
FIGURE 2-1

City of Bellingham

Surface and Stormwater Comprehensive Plan



City of Bellingham Population from 1996 - 2018



**Figure 2-2. U.S. Census Bellingham population, 1996–2018**

Bellingham’s downtown core has been a hub for commerce and business activities for more than a century. The core industries have centered around the Port of Bellingham, where coal and timber resources were historically exported. Beginning in the early 21st century, with the closure of the Georgia-Pacific pulp mill in 2007, the natural resource export industry yielded to 21st century urban development. As such, the built drainage system in downtown Bellingham has been in place for decades and one component of this 2020 SSWCP update is the evaluation of stormwater system “condition” upgrades in the downtown area, described in detail in Chapter 7. Bellingham’s growth in the last half of the 20th century is shown in a series of historical aerial photos from 1943 to 2018 (see Figure 2-3).



## Urban growth in Bellingham, WA



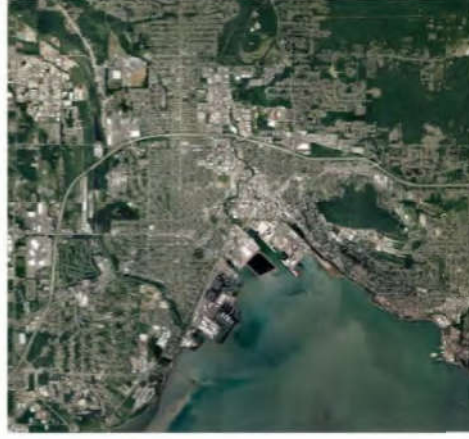
**1943**

The 1940 census shows that Bellingham's population was 29,000. The Bellingham Bay Coal Company shut down operations in 1955 after a century of extracting and shipping coal from the Squalicum Creek area. Bellingham Bay is fully developed with port operations supporting the natural resources industry. This photograph shows a well-developed urban area with development concentrated in the area west of the present-day I-5 corridor.



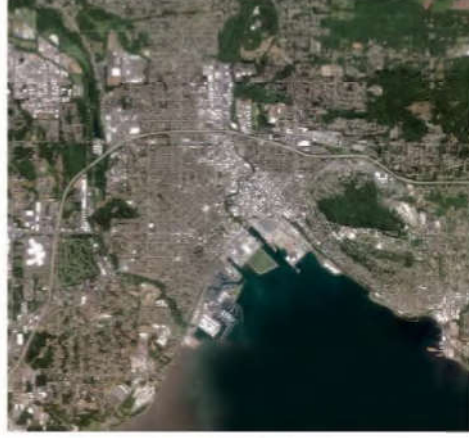
**1976**

Bellingham's census population in 1980 was 45,600. The primary industry was the operation of the Georgia-Pacific Pulp Mill located in Bellingham Bay. New development can be seen extending east along Lakeway Drive with neighborhood development being concentrated to the northeast. Interstate 5, which opened in 1969, bisects the city. Residential areas are abundant near the downtown core.



**1998**

Infill and commercial expansion of the business district surrounding Whatcom Creek is evident in this 1998 aerial view. New development outside the city limits is evident in most areas of the city. The large forested areas east of I-5 and south of Lakeway Drive is growing. The 2000 census population was 67,000.



**2018**

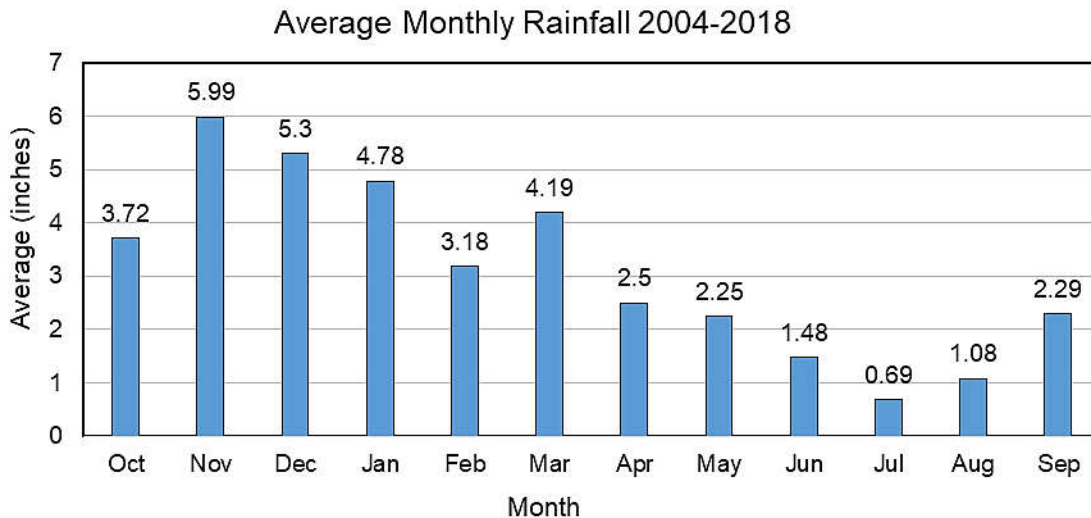
Present-day land cover in Bellingham reflects what has become a typical landscape throughout western Washington. The state's Growth Management Act encourages development to stay in existing population centers which helps keep stormwater impacts from spreading to other undeveloped areas. Bellingham is updating its stormwater management plan in 2020 to facilitate the City's continued growth and management of the utility.

**Figure 2-3. Historical aerial images of Bellingham, Washington**



## 2.2 Precipitation

Bellingham receives on average 37.4 inches of rainfall annually as reported at its City Center monitoring location (City 2020a). Seventy-two percent of the average annual precipitation occurs between November and April with the remainder occurring during the relatively dry summer and fall months. Figure 2-4 shows the average monthly rainfall for Bellingham at the City Center monitoring location from 2004 to 2018.



**Figure 2-4. City of Bellingham average monthly rainfall, 2004–2018**

Source: City 2020b.

The City has in place an Urban Streams Monitoring Program (USMP) that began in 1990 and monitors streams monthly for water quality at 18 sites in 10 streams. The City also collects flow data from four stream gage stations at various locations throughout the city, further explained in Chapter 3, Hydrology.

## 2.3 Built Stormwater Assets

Built stormwater assets are the man-made components of a drainage system. They consist of drainage structures, pipes, ditches, detention/retention facilities, and water quality facilities that function to collect, treat, and convey stormwater runoff from surfaces toward receiving waters. Built stormwater assets require both short- and long-term maintenance to increase longevity and maintain an appropriate level of service.

As recorded in the City’s current records, the City maintains the following assets:

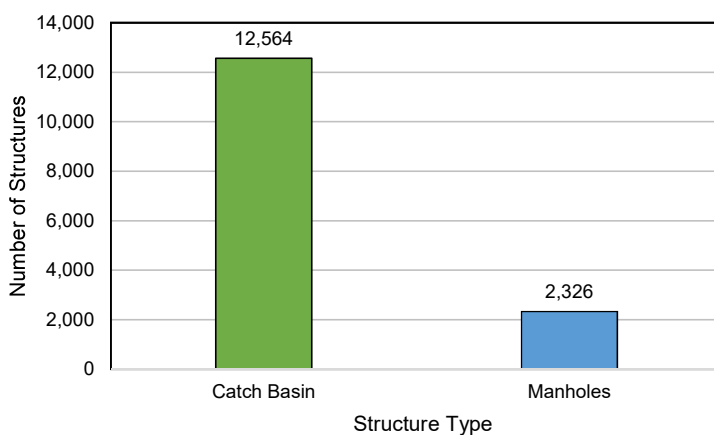
- More than 280 miles of stormwater pipe
- 754 facilities including 6 regional detention ponds
- 168 detention/water quality ponds, vaults, or pipes
- 98 bioswales (linear swales that act like a bioretention device)

- 100 rain gardens and bioretention facilities
- 45 infiltration/dispersion trenches
- 186 sand and media filters
- 10 hydrodynamic pretreatment structures
- 18 sections of permeable pavement (constituting more than 110,860 square feet [ft<sup>2</sup>])
- One stormwater treatment wetland
- 16 pollution control and oil/water separator structures
- 12,564 catch basins and 2,326 manholes

The City’s stormwater assets are tracked using a Hansen database software program as well as within its Geographic Information System (GIS). The City has recently switched to Cityworks™ asset management software by Azteca. The permitting software used is called TRAKiT™. Asset management software is tightly linked with GIS-centered databases to track maintenance activities and store attribute data such as invert elevations, pipe material, and pipe sizes. The City’s Phase II Permit requires the City to maintain records of inspections and maintenance activities, all of which is facilitated by TRAKiT™. The following sections summarize some of the City’s built drainage infrastructure.

### 2.3.1 Storm Drainage Structures

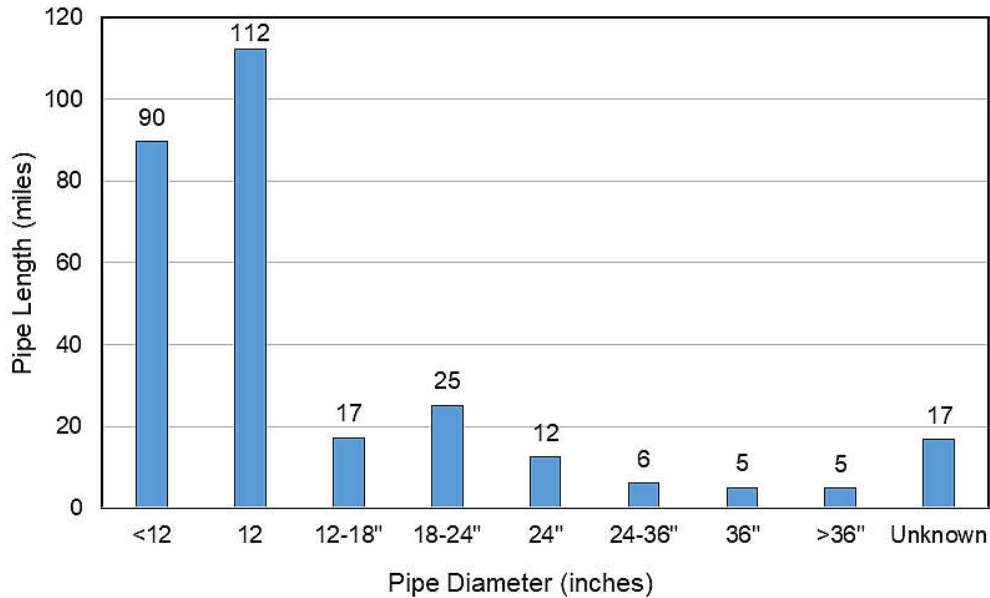
Typically, two types of structures are used in the City’s storm drainage network: manholes and catch basins. Manholes are more frequently used in sanitary sewers because they have a channelized section in the bottom to facilitate conveyance through the structure and down to the next pipe segment. Manholes in a stormwater system are used to change the direction of a pipe or change the size of the pipe without collecting additional surface runoff. Catch basins are more commonly used in storm sewer lines to intercept stormwater runoff and come equipped with a sump in the bottom to capture sediment deposits and to facilitate regular maintenance activities. The number of catch basin and manhole structures in the city is shown in Figure 2-5.



**Figure 2-5. Storm drainage structures and photo of catch basin**

### 2.3.2 Storm Drainage Pipe

The City owns about 280 miles of storm drain pipe. A breakout of pipe length by diameter is provided in Figure 2-6. Knowing the length of drain pipe by size and class is helpful for planning asset management renewal and replacement in building a sustainable O&M program.

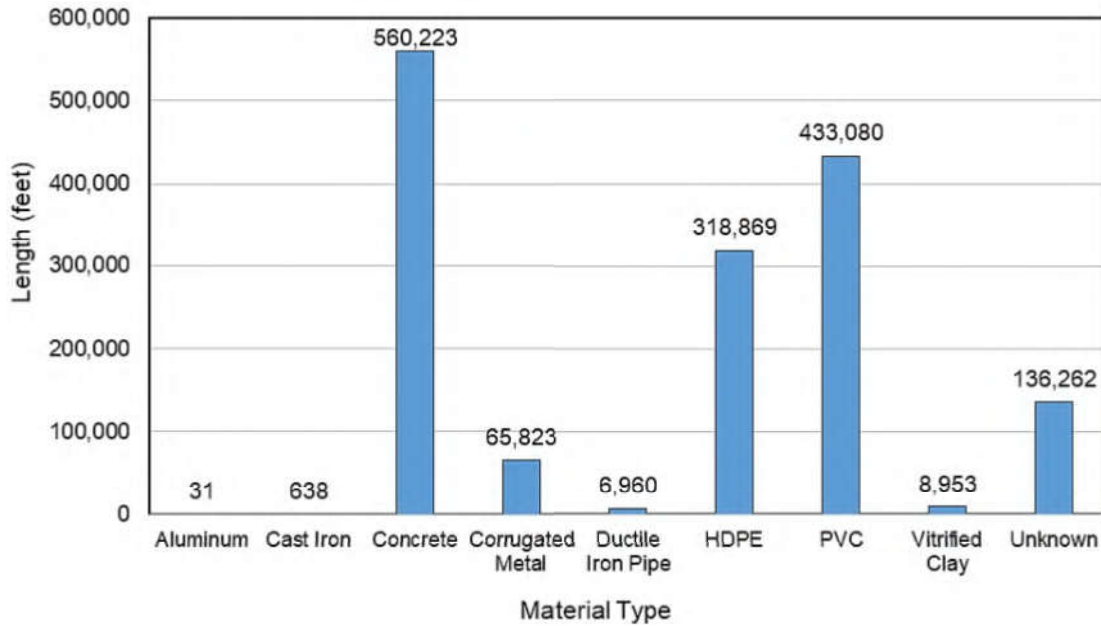


**Figure 2-6. Storm drain pipe length by diameter**

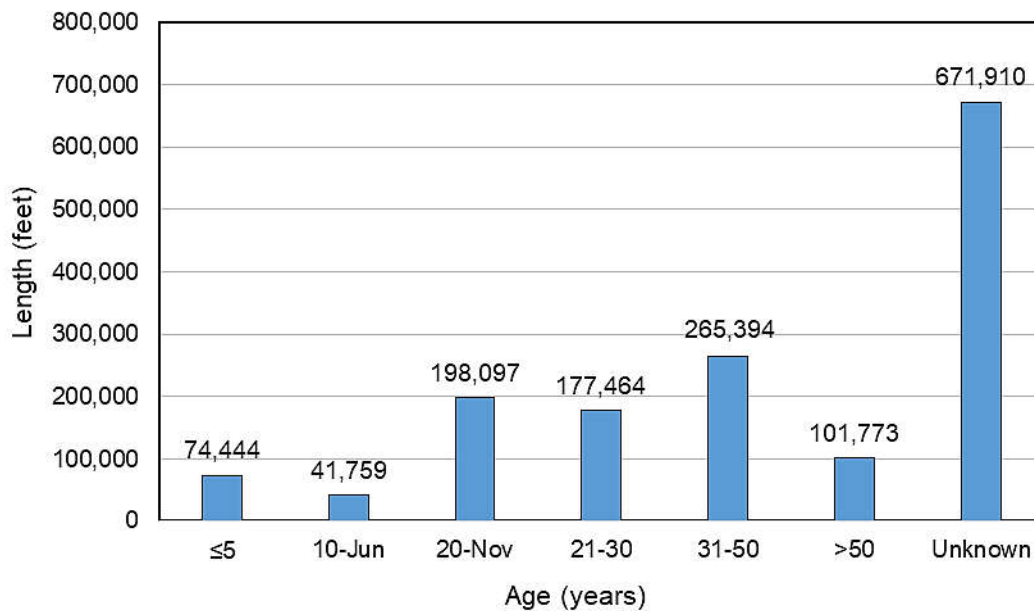
Collecting information or data on the existing system is an important element of a sustainable stormwater management plan. The City routinely performs data collection on the 280 miles of its piped system. Information is still needed for about 17 miles of pipe to support O&M program elements. Data within these tables reported as “unknown” refer to assets with missing information.

Pipe material is predominantly concrete, with most of the pipes being in place for more than 21 years. Pipe lengths are classified by material in Figure 2-7 and by age in Figure 2-8.





**Figure 2-7. Storm drain pipe length by material type**



**Figure 2-8. Storm drain pipe length by age**

## 2.4 Pollutant Loading

The nature and type of land use is an important factor in stormwater planning because of the range of pollutant concentrations that are typical of urban environments. Stormwater monitoring data from the National Stormwater Quality Database (NSQD) show average concentrations of a range of pollutants in urban runoff from areas of different land uses. The



NSQD contains a large data set from a representative number of municipal stormwater permit holders across the country and provides reliable information for stormwater planners. Much of the data may be used to characterize stormwater produced from specific land uses, such as industrial, commercial, low-density residential, high-density residential, and undeveloped open space. Preliminary statistical analysis of the NSQD found significant differences among land use categories for all pollutants, as shown in Table 2-1.

**Table 2-1. National Stormwater Quality Database average pollutant concentrations**

Pollutant	Unit	Residential	Commercial	Industrial	Freeways	Open space
Ammonia	mg/L	0.31	0.5	0.5	1.07	0.3
Biochemical oxygen demand	mg/L	9	11.9	9	8	4.2
Cadmium, total	µg/L	0.5	0.9	2	1	0.5
Cadmium, filtered	µg/L	ND	0.3	0.6	0.68	ND
Chemical oxygen demand	mg/L	55	63	60	100	21
Copper, total	µg/L	12	17	22	35	5.3
Copper, filtered	µg/L	7	7.6	8	10.9	ND
Fecal coliform	MPN/100 mL	7,750	4,500	2,500	1,700	3,100
Lead, total	µg/L	12	18	25	25	5
Lead, filtered	µg/L	3	5	5	1.8	ND
Nickel, total	µg/L	5.4	7	16	9	ND
Nickel, filtered	µg/L	2	3	5	4	ND
Nitrogen, NO <sub>2</sub> +NO <sub>3</sub>	mg/L	0.6	0.6	0.7	0.3	0.6
Nitrogen, total Kjeldahl	mg/L	1.4	1.6	1.4	2	0.6
Phosphorus, total	mg/L	0.3	0.22	0.26	0.25	0.25
Phosphorus, filtered	mg/L	0.17	0.11	0.11	0.2	0.08
Suspended solids, total	mg/L	48	43	77	99	51
Zinc, total	µg/L	73	150	210	200	39
Zinc, filtered	µg/L	33	59	112	51	ND

ND = not detected, or insufficient data to determine a value.

mg/L = milligrams per liter.

µg/L = micrograms per liter.

MPN = most probable number.

NO<sub>2</sub>+NO<sub>3</sub> = nitrogen dioxide plus nitrate.

WAC 173-201A sets forth surface water quality standards for marine and fresh waters. WAC surface water quality criteria exist for aquatic life and human health for both chronic and acute exposures with varying numerical standards for the pollutants shown in Table 2-1. The open-space category is a helpful reference to use as a comparison.

Land use in Bellingham is predominantly residential with a downtown business core plus the Fairhaven Urban Village. Like most cities in western Washington, Bellingham is growing with increasing density and increasing impervious areas. An analysis of the city's current land use shows that single-family residential property dominates the land use, but significantly large areas of commercial and industrial land use also exist. Bellingham's overall land use categories are shown in Table 2-2. Information for the sub-watersheds that were the subject of the retrofit analysis (see Chapter 7) are also shown.





**Table 2-2. Land use categories for city of Bellingham and studied sub-watershed**

Land use	City of Bellingham		Lower Padden Creek		Lower Squaticum Creek		Lower Baker Creek		Lower Spring Creek		Baker Creek tributary	
	Acres	Percent of total	Acres	Percent of total	Acres	Percent of total	Acres	Percent of total	Acres	Percent of total	Acres	Percent of total
Airport operations	1,024	4.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Commercial	1,530	6.4	14	1.1	133	5.5	78	11.2	419	40.9	36	9.2
Industrial	3,779	15.8	0	0.0	726	30.2	294	42.2	115	11.2	8	1.9
Multi-family residential	3,623	15.2	142	11.0	406	16.9	162	23.2	359	35.1	161	40.6
Single-family residential	8,968	37.6	717	55.7	772	32.1	163	23.4	60	5.9	191	48.2
Open space	139	0.6	212	16.5	267	11.1	0	0.0	1	0.1	0	0.0
Mixed use, commercial and residential	1,938	8.1	104	8.0	2	0.1	0	0.0	0	0.0	0	0.0
Institutional	2,851	12.0	99	7.7	96	4.0	0	0.0	69	6.8	0	0.0
<b>Total</b>	<b>23,854</b>	<b>100.0</b>	<b>1,289</b>	<b>100.0</b>	<b>2,402</b>	<b>100.0</b>	<b>696</b>	<b>100.0</b>	<b>1,025</b>	<b>100.0</b>	<b>395</b>	<b>100.0</b>

Calculations based on City of Bellingham GIS data.

## 2.5 Water Quality Facilities

Considering the available research and data documenting pollutant concentrations in stormwater runoff, the City has systematically designed and built numerous water quality treatment facilities since the previous SSWCP update. Figure 2-9 shows areas where stormwater runoff is treated. This figure is based on limited records on all projects (both public and private), with some data incomplete on the type of facility (shown as “unknown”), but does provide an indication of a diverse set of water quality strategies throughout the city. Some of the facilities were built by private developers and by the City (transportation projects) in response to stormwater regulations, while others were built as retrofit facilities by the City. Treatment areas and facility types are illustrated in Table 2-3. Water quality treatment types of notable area and size include dams, detention ponds, and sand filters.

**Table 2-3. Water quality treatment facilities in the city of Bellingham (GIS data from City)**

Treatment facility type	Treatment facility type	Treatment facility type
Bioretention <sup>a</sup>	Nutrient treatment	Sand filter
Dam	Oil/water separator	Unknown
Detention <sup>b</sup>	Other <sup>e</sup>	Water quality vault
Infiltration facility <sup>c</sup>	Permeable surface <sup>f</sup>	Wetland treatment
Media filter <sup>d</sup>	Swale <sup>g</sup>	

a. Includes rain gardens and rock plant filter.

b. Includes detention tanks, vaults, and ponds.

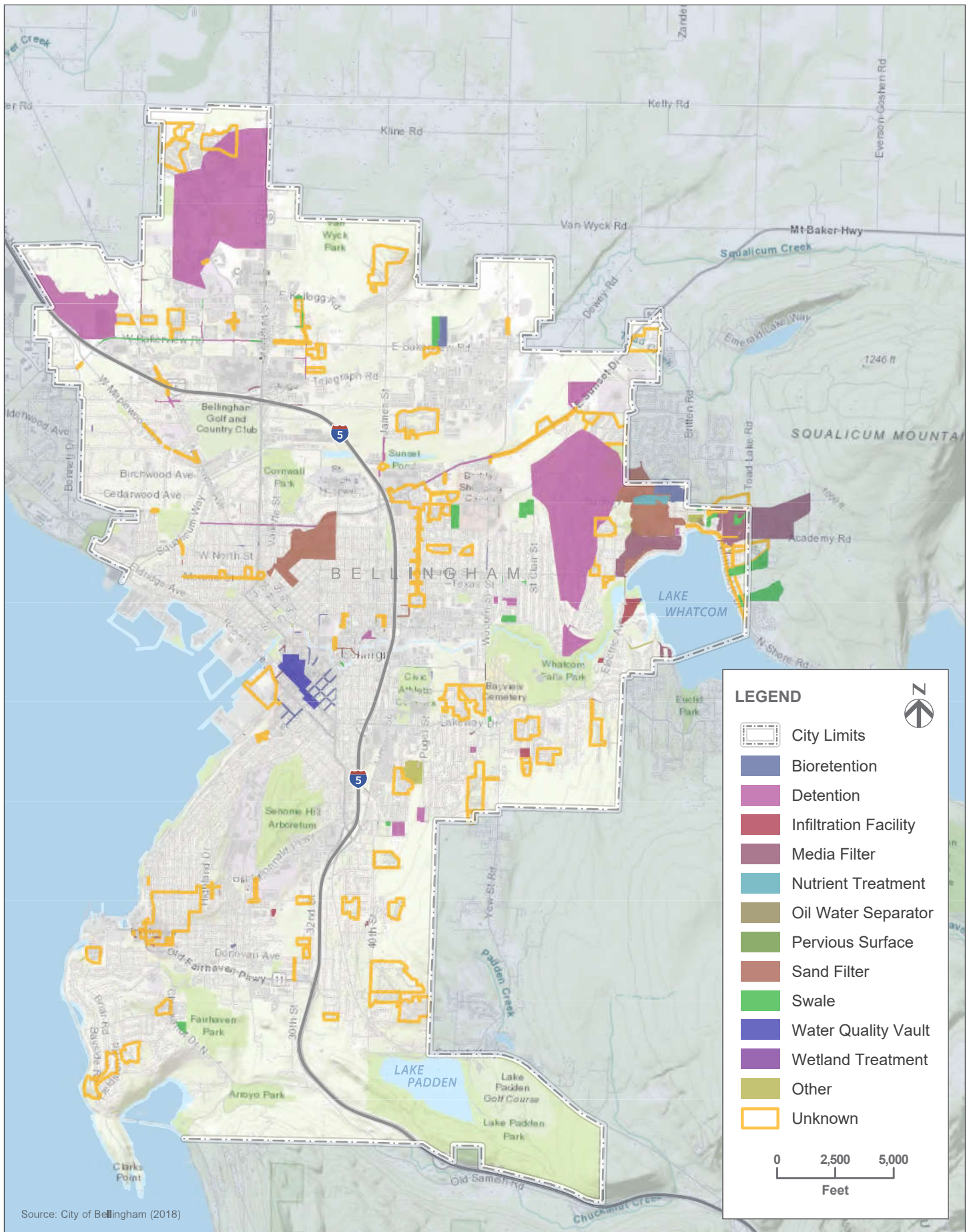
c. Includes infiltration trench and filter and infiltration BMP.

d. Includes Filterra, Modular Wetlands, storm filter, gravel filter.

e. Includes catch basin filter, re-vegetation, energy dissipator, pollution control structure, and groundwater collector.

f. Includes: permeable pavement, pervious concrete.

g. Includes bioswale.



**AREAS TREATED BY WATER QUALITY FACILITIES**

FIGURE 2-9

City of Bellingham

Surface and Stormwater Comprehensive Plan





## 2.6 Characteristics of the Study Area

For purposes of developing a 6-year CIP for the 2020 SSWCP update, stormwater retrofit evaluations were targeted in five sub-watersheds in the city as identified in the Habitat Restoration Assessment (ESA 2015). The five sub-watersheds are identified as top-tier sub-watersheds where improvements have the potential to benefit multiple habitats and functions. Stormwater retrofits are listed as recommended improvements in four of the five sub-watersheds. Stormwater retrofits would benefit the downstream receiving waters. Additionally, conveyance modeling was targeted in the shoreline basin areas. Development of the CIP also used information from past studies and the previous SSWCP. The details of these analyses are located in Chapter 7, Stormwater System Analysis.

The 2020 retrofit analysis leveraged the recommendations in the City's Habitat Restoration Assessment (ESA 2015) to create a stormwater retrofit plan. The Habitat Restoration Assessment (ESA 2015) identified restoration opportunities across the entire city, prioritizing all of the sub-watersheds into one of three categories for restoration opportunity (high-, medium-, and low-priority areas). The objective of the assessment was to focus habitat improvements in areas where restoration efforts would result in significant ecological uplift across multiple habitat groups (i.e., riverine, wetland, forest, and meadow/shrubs and in multiple functions). Among the many strategies identified for improving habitat was stormwater retrofit. The report identified four Tier 1 (high-scoring) sub-watersheds where stormwater retrofit was identified as a means for improving habitat (Table 41). For the purposes of this SSWCP, a fifth sub-watershed was added for inclusion by the City, Lower Squalicum Creek, given its high fish use rating. To that end, the following five sub-watersheds were targeted for the 2020 SSWCP retrofit analysis:

- **2.6.1:** Lower Padden Creek
- **2.6.2:** Lower Squalicum Creek
- **2.6.3:** Lower Baker Creek
- **2.6.4:** Lower Spring Creek
- **2.6.5:** Baker Creek Tributary

In addition to developing a stormwater retrofit plan, the 2020 SSWCP also uses the 2007 Stormwater Comprehensive Plan and hydrologic modeling information to evaluate conveyance capacities of stormwater mainlines that discharge directly to Bellingham Bay. The marine outfall conveyance analyses and the retrofit plan identified CIP projects and programs to renew infrastructure, improve water quality and aquatic habitat, and improve fish passage. The following sections provide a brief summary of the study areas.

### 2.6.1 Lower Padden Creek Sub-watershed

The Lower Padden Creek sub-watershed is an area of approximately 1,289 acres within the larger Padden Creek watershed (an area of 4,125 acres). Lower Padden Creek is defined as the basin downstream of Lake Padden to the mouth at Bellingham Bay, as illustrated in Figure 2-11. Lower Padden Creek flows 2 stream miles from the outlet of Lake Padden to Bellingham Bay and includes the tributary area of Connelly Creek (ESA 2015). Lake Padden is 160 acres in size

and receives stream flow from upper Padden Creek and numerous wade-able, intermittently flowing small streams flowing directly to it. The Lake Padden outlet is controlled by a dam with an overflow weir (Figure 2-10). The weir is maintained by the City, but the dam is not. Seasonal lake levels prevent release of water from the lake to the stream between midsummer and late fall (ESA 2015). The dam, registered by Ecology, was last inspected in November 2018. Ecology gave the dam a “satisfactory” rating with no immediate safety concerns (Ecology 2018b). Land use in the Padden Creek sub-watershed is primarily residential (56 percent) with open space (16 percent) as the next highest land use category. The area-weighted impervious area of lower Padden Creek is 33 percent.



**Figure 2-10. Lake Padden outlet structure**

Historically, Padden Creek flowed through an almost half-mile-long conveyance pipe (known as the “Brick Tunnel”) beneath the Happy Valley neighborhood and Old Fairhaven Parkway. The stream then entered Fairhaven Park, just south of the Fairhaven commercial district, before finally flowing through substantial commercial and industrial development near the bay. In 2015, the Padden Creek Daylighting project removed the stream from the brick tunnel (ESA 2015). In 2014, the Washington State Department of Transportation (WSDOT) replaced the tunnel crossing east of 20th Street with a fish-passable bridge. The project improved stream and riparian conditions (ESA 2015).

Connelly Creek drains the tributary area north of Old Fairhaven Parkway east of 21st Street, including a portion of I-5 and Samish Way. The lower portion of Connelly Creek is a shrub/grass/deciduous tree-dominated riparian corridor surrounded by residential development. The upstream channel is located in a mature mixed forest vegetation setting. Historically, the Lower Padden Creek floodplain was prone to urban flooding upstream of the 22nd Street tunnel inlet (ESA 2015); however, after the 2015 daylighting project, risk of flooding has been reduced in the Happy Valley Neighborhood.

Padden Creek is listed on the 303(d) list for fecal coliform and dissolved oxygen (Ecology 2008); a total maximum daily load (TMDL) for temperature has been developed for Whatcom, Squalicum, and Padden Creeks collectively (ESA 2015). The 303(d) list, so called because the process is described in Section 303(d) of the Clean Water Act, lists waters in a “polluted water category,” as it is functioning below its intended use.



**LOWER PADDEN CREEK SUB-WATERSHED**  
 FIGURE 2-11  
 City of Bellingham  
 Surface and Stormwater Comprehensive Plan





A TMDL is the calculation of the maximum amount of a pollutant allowed to enter a water body so that the water body will meet and continue to meet water quality standards for that particular pollutant. A TMDL determines a pollutant reduction target and allocates load reductions necessary to the source(s) of the pollutant.

Lower Padden Creek has documented presence of host salmonids: a relatively small number of Chinook and steelhead salmon, chum salmon, coho salmon, kokanee, and cutthroat trout, and a relatively small number of Chinook (WDFW 2015a, 2015b). Cutthroat spawning habitat is provided by two unnamed tributaries to Lake Padden: a stream at the southeast end of the lake and a stream that flows from Our Lake through the Lake Padden Golf Course to Lake Padden (City 2007). Fish ladders beneath the Chuckanut Drive bridge and at the east end of Fairhaven Park allow anadromous fish to travel upstream.

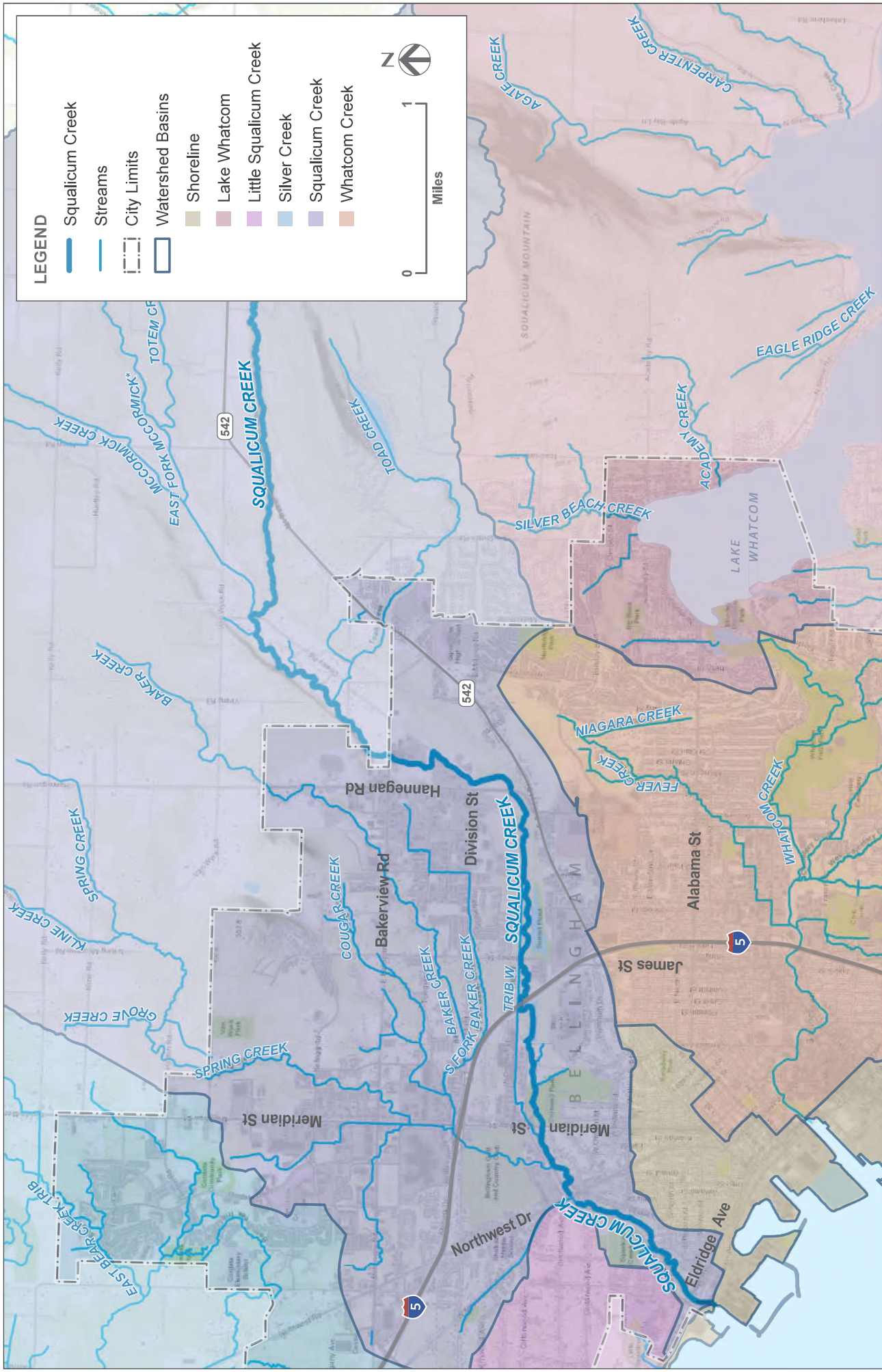
Lower Padden Creek also fosters a biodiverse corridor connecting the Chuckanut and Galbraith Mountains, eastward patches, several wetlands, the Padden Creek estuary, and wildlife including the bald eagle, great blue heron, Townsend's big-eared bat, and western toad (ESA 2015).

## 2.6.2 Lower Squalicum Sub-Watershed

The Lower Squalicum study area is approximately 3,121 acres, and includes approximately 10.8 stream miles and approximately 364 acres of wetland area (City 2020h). As shown in Figure 2-12, the Squalicum Creek watershed is located north of downtown Bellingham and drains to Bellingham Bay.

Most of the Squalicum watershed is located outside of the city limits and is forested or developed in low-density residential or agricultural land use. The city of Bellingham has high-density development west of I-5 and along Guide Meridian. Established residential neighborhoods are found in the downstream sub-basins near the bay and out to Irongate, an industrial site north of the stream. Some significant forests remain within Lower Squalicum along with a relatively contiguous riparian corridor along the main stem (ESA 2015). Within the Lower Squalicum sub-watershed the area-weighted impervious average is 28.4 percent according to 2020 land use analysis. Land use is predominantly residential with some commercial land use near the mouth of the creek.

The watershed is drained primarily by the main stem of Squalicum Creek and two major tributaries: Baker Creek and Spring Creek (ESA 2015). Most drainage features consist of streams and culverts, with pipes and ditches in the more heavily developed southwest/downstream sub-basins. Between Guide Meridian and Hannegan Street, Squalicum Creek lies in a relatively flat-bottomed valley. The creek flows through a single contained channel, but may also flow underground in some locations.



**LEGEND**

- Squalicum Creek
- Streams
- City Limits
- Watershed Basins
- Shoreline
- Lake Whatcom
- Little Squalicum Creek
- Silver Creek
- Squalicum Creek
- Whatcom Creek

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**LOWER SQUALICUM CREEK SUB-WATERSHED**  
 FIGURE 2-12  
 City of Bellingham  
 Surface and Stormwater Comprehensive Plan



Squalicum Creek is barrier-free to salmon passage for most of its distance within city limits. Salmonids, Chinook salmon, steelhead, bull trout, coho salmon, chum salmon, and cutthroat trout use the sub-watershed (WDFW 2015a, 2015b). Problem passage sites previously identified in the 1992 R.W. Beck study consisted of (1) a footpath in Cornwall Park upstream of Guide Meridian, (2) an underground channel upstream of Bug Lake, (3) entering the I-5 culverts, and (4) a heavily braided channel between I-5 and Bug Lake and upstream of Sunset Pond. These all have been addressed by the City. In 2015, the City constructed a portion of a project to reroute Squalicum Creek around two man-made ponds (Bug Lake and Sunset Pond) to reconstruct the stream in the floodplain and improve fish passage under I-5 (ESA 2015).

An industrial site north of the stream (Irongate industrial area) discharges untreated stormwater to the sub-watershed (ESA 2015). The riparian corridor consists of immature forest vegetation and some development encroachment.

The lower reaches of Squalicum Creek (as with many urban reaches) suffer from nonpoint source pollution due to the proximity of residential and commercial development and runoff from the I-5 corridor. Squalicum Creek is 303(d) listed for dissolved oxygen and fecal coliform and a single TMDL related to temperature has been developed for Whatcom, Squalicum, and Padden Creeks (ESA 2015). The creek has been identified as inadequate (for its intended use) relating to water quality (Hood 2006) and non-functional for instream flow conditions (lacking sustained flow) and runoff rates (Nahkeeta 2003; City 2009). Further, lower Squalicum Creek was identified for not functioning for instream flow conditions and runoff rates (Nahkeeta 2003; City 2009).

### 2.6.3 Lower Baker Creek Sub-Watershed

The 47-acre Lower Baker Creek (occasionally referred to as South Fork Baker Creek) is part of the Squalicum Creek watershed as shown in Figure 2-13. Lower Baker Creek includes approximately 5.4 stream miles, including the main stem Baker Creek and Irongate Creek, along with 47 acres of wetland (City 2020h).

Baker Creek includes relevant physical, chemical, and biological conditions that contributed to its Tier 1 classification (ESA 2015). Notably, along I-5, culvert crossings pose as fish passage barriers (WDFW 2015b). Where Baker Creek flows downstream of I-5 through the Bellingham Golf and Country Club golf course, there is little riparian cover with scattered deciduous trees (ESA 2015).

Further, a 100- to 500-foot-wide corridor of forested upland and riparian buffer is present from approximately Hannegan Road downstream to approximately 1,500 feet southwest of James Street (ESA 2015).

Baker Creek includes the Irongate industrial area that has water quality and peak flow issues typical of industrial areas. Much of the industrial subcatchment drains untreated and undetained stormwater to Baker Creek, making this a prime area for water quality retrofit projects. The City's stormwater regulations require new and redeveloping properties to implement flow control and water quality treatment BMPs if area thresholds trigger the regulations. Downstream of I-5, Baker Creek is 303(d) listed for fecal coliform bacteria (Ecology 2008).

The primary focus for this sub-watershed coming from the 2015 Habitat Restoration Assessment indicated a focus on riverine, wetland, and forest actions consisting of a combination of restorative and protective actions, such as the Baker Creek Wetland Restoration (LBC-WR1) and Riparian Buffer Restoration (LBC-RR2). In 2006 the City completed a major restoration along Baker Creek with a 0.75-acre parcel dedicated to salmon habitat restoration. In 2004 the City's Culvert Replacement Program removed a barrier culvert, restoring access for anadromous salmonids.

#### 2.6.4 Spring Creek Sub-Watershed

The 1,705-acre Lower Spring Creek sub-watershed is part of the larger Squalicum Creek watershed as illustrated in Figure 2-14. Lower Spring Creek includes approximately 5.2 stream miles, including the main stem, West Fork, and Middle Fork of Spring Creek, along with 158 acres of wetland (City 2020h).

While neither the main stem of Spring Creek nor associated tributaries are listed for 303(d) exceedance, the sub-watershed does support anadromous fish. The Lower Spring Creek sub-watershed has documented presence of chum salmon, cutthroat trout, and steelhead to West Kellogg Road with coho salmon presence in Lower Spring Creek (WDFW 2015a, 2015b). Further, several small and large forest patches are located in the southern portion of the basin (ESA 2015). Similar to Lower Baker Creek, this sub-watershed was recommended in the 2015 Habitat Restoration Assessment for riverine, wetland, and forest actions consisting of a combination of restorative and protective actions, in addition to stormwater restorative actions that address water quality and flow control.

#### 2.6.5 Baker Creek Tributary Sub-Watershed

Within the Squalicum Creek watershed, the South Fork Baker Creek study area is a major tributary (as depicted in Figure 2-13), consisting of approximately 395 acres with approximately 2.9 stream miles and 36 acres of wetland (City 2020h) draining the northern portion of the watershed. The Baker Creek basin is adjacent to and primarily north of I-5. The southern and western portions of the basin along I-5 and Guide Meridian are generally covered by commercial land uses, except for the drainage area immediately downstream of I-5 that is within the Bellingham Golf and Country Club property. The eastern and northern portions are primarily residential and the headwaters have minimal development (City 2020h).

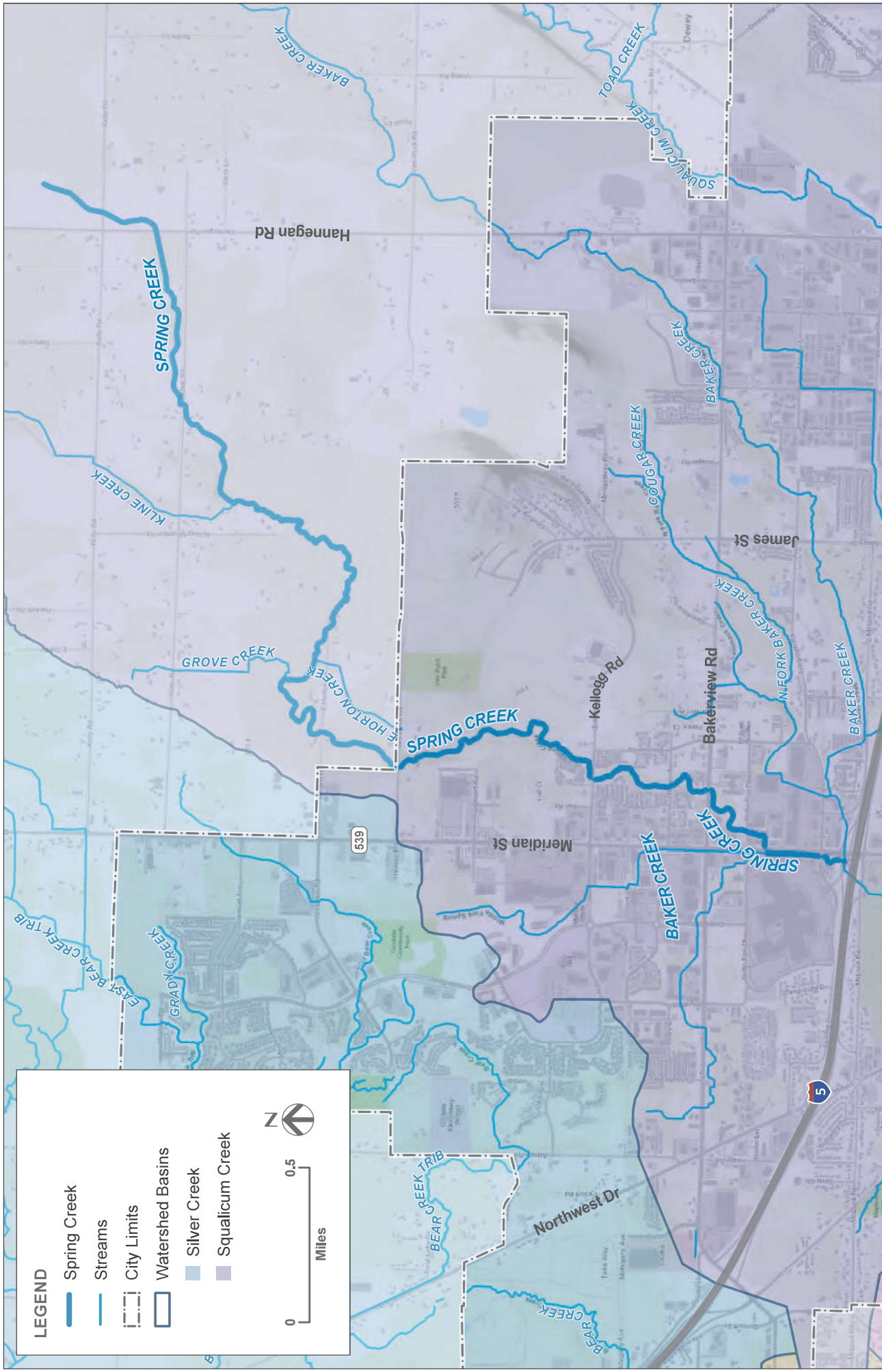




**SOUTH FORK BAKER CREEK**  
 FIGURE 2-13  
 City of Bellingham  
 Surface and Stormwater Comprehensive Plan







**SPRING CREEK**  
 FIGURE 2-14  
 City of Bellingham  
 Surface and Stormwater Comprehensive Plan



Sixteen wetlands in the Baker Creek tributary drainage have previously been identified (City 2020h). In general, these wetlands were situated in low, seasonally saturated bottomlands and were hydrologically connected to Baker Creek or its tributaries. Most of the wetlands were characterized by mixtures of forest and scrub-shrub vegetation. Other areas had wet meadow/pasture grass vegetation (City 2020h).

Baker Creek has a barrier to fish passage a short distance upstream of its confluence with Squalicum Creek (ESA 2015). The culvert under Birchwood Avenue blocks upstream salmon migration, has been addressed by the City. Also, coho salmon use the North Fork Baker Creek to East Bakerview Road with a series of downstream culverts through commercial areas (WDFW 2015b; ESA 2015).

The lower reaches of Baker Creek receive nonpoint source pollution due to the proximity of commercial development and highway runoff (ESA 2015). Automobile-related pollutants from roads and parking areas together with fertilizers and herbicides from lawns are the most likely nonpoint source pollutants entering lower Baker Creek. Upstream, manure runoff from agricultural operations is a significant source of nonpoint pollution entering Baker Creek and its tributaries. The sub-basin is not 303(d) listed; however, there are reported water quality issues related to stream temperature and low dissolved oxygen (Vandersypen 2006).

## 2.7 Previous Stormwater Planning

The City of Bellingham has historically been proactive in its stormwater planning efforts through watershed studies and comprehensive planning. To provide some context to the past and highlight where previous work is used for this SSWCP, the following sections discuss the 1995 Watershed Master Plan and the 2007 Stormwater Comprehensive Plan.

### 2.7.1 1995 Watershed Master Plan

The goal of the 1995 Watershed Master Plan (City 1995) was to analyze existing facilities and environmental resources, identify existing and future-projected drainage problems, analyze alternative solutions, make recommendations, and prepare a management plan to implement the recommendations.

The 1995 Watershed Master Plan analyzed all of the major drainage basins in the city by developing hydrologic runoff models for existing- and future-conditions land use (City 1995). An environmental assessment was based on field reconnaissance of inventoried wetlands and qualitative assessments for water quality and channel geometry of the major streams. Similarly, a fishery/aquatic habitat qualitative assessment was performed to identify barriers and degraded habitat locations.

Pollutant loading to receiving waters was estimated using published concentration values of constituents and simulated runoff results. Runoff and hydraulic modeling in the 1995 Watershed Master Plan were based on the methodology shown in Table 2-4.

The basins analyzed were Whatcom Creek and tributaries (Silver Creek, Lincoln Creek, Cemetery Creek, Hannah Creek), Lake Padden basin, Padden Creek, Chuckanut Creek, and Squalicum Creek and tributaries (Baker Creek and Spring Creek). The purpose of the analysis

was to analyze the existing conveyance network, identify capacity and velocity issues, identify impacts of future growth, and evaluate the effectiveness of alternative strategies.

**Table 2-4. Criteria for hydrologic/hydraulic analysis**

Aspect of analysis	Criterion	Value(s)
System capacity	Design storm	
	<ul style="list-style-type: none"> <li>Frequency</li> </ul>	2-, 25-, and 100-year/24-hour events
	<ul style="list-style-type: none"> <li>Total precipitation</li> </ul>	As provided by NOAA
Runoff	Hydraulic capacity	System inventory
	Land use	Current: established by aerial photography Ultimate: assumed as full build out development as currently zoned
	SCS curve numbers	
	<ul style="list-style-type: none"> <li>Pervious areas</li> </ul>	Variable
	<ul style="list-style-type: none"> <li>Impervious areas</li> </ul>	CN = 98

## 2.7.2 2007 Stormwater Comprehensive Plan

The goals and objectives of the 2007 Stormwater Comprehensive Plan were as follows:

- Provide an analysis of existing stormwater facilities and aquatic resources
- Identify existing stormwater problems
- Analyze alternative stormwater solutions
- Document the stormwater plan for implementation by City staff
- Provide City staff a tool to address stormwater and pollutant control

The 2007 Stormwater Comprehensive Plan had a primary focus on the development of citywide, basin-scale continuous-simulation models, developed by Clear Creek Solutions, to identify stormwater conveyance systems that were undersized or risked failure. The Western Washington Hydrology Model (WWHM) with Hydrological Simulation Program-Fortran (HSPF) hydrology and PCSWMM hydraulic inputs were used to determine stormwater facility needs and deficiencies. As part of the 2020 SSWCP update, an evaluation of the 2007 models was done as the City was interested in potentially updating the models for future use. Chapter 3, Hydrology, discusses the findings of that model evaluation.

Several capacity-constrained conveyance lines were identified in the 2007 Stormwater Comprehensive Plan. Those that have not been updated were brought forth into the 2020 CIP.