STEWARDSHIP PLAN

CHUCKANUT COMMUNITY FOREST
BELLINGHAM, WASHINGTON

Prepared for
Chuckanut Community Forest Park District

Prepared by
Herrera Environmental Consultants, Inc.

HERRERA

Note:
Some pages in this document have been purposely skipped or blank pages inserted so that this document will print correctly when duplexed.

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Prepared for
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P.O. Box 4283
Bellingham, Washington 98227

Prepared by
Herrera Environmental Consultants, Inc.
1329 North State Street, Suite 200
Bellingham, Washington 98225
Telephone: 360-598-5075

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CONTENTS

APPENDICES

TABLES

FIGURES

INTRODUCTION

BACKGROUND AND PURPOSE

This Stewardship Plan (Plan) has been developed to support the Chuckanut Community Forest Park District (CCFPD) mission to "ensure the entirety of the Chuckanut Community Forest (CCF), an 82-acre forested property, is protected in perpetuity in public ownership, with respect for its ecological, recreational, and educational functions." The property, located adjacent to and south of Fairhaven Park and west of the Interurban trail in southwest Bellingham, was purchased out of foreclosure in 2011 by the City of Bellingham (City) though the Greenways Endowment Fund. In 2013 the voter approved CCFPD was founded as a metropolitan park district to protect the property environmentally and to serve as a fiscal mechanism to repay the loan, via a tax levy. As repayment of the loan is almost fulfilled, the City has commenced a process to develop a Park Master Plan for City-owned properties. This Stewardship Plan has been prepared to provide a framework for the protection, conservation, and restoration of the CCF that is intended to contribute to the City's Park Master Planning process. On January 3, 2014, the City granted the CCFPD a conservation easement for the property and is currently in the process of updating it. This Stewardship Plan has also been prepared to support the development of this updated conservation easement, which will define the future use and management of the site.

The development of this Stewardship Plan built off the extensive scientific research and programmatic recommendations documented in the Chuckanut Community Forest Baseline Report prepared in 2017 by Ann Eissinger (Eissinger, 2017). The baseline report provides a thorough synthesis of the existing environmental documentation of the time. While it was extensively used as a technical resource in the development of this Stewardship Plan, this Plan does not include all the content in the Baseline Report. Readers seeking more information on the habitat in the CCF should consult the Baseline Report as well as the other sources listed in the reference section of this report.

Two public hearings/meetings were held by the CCFPD to receive public comments on the draft Stewardship Plan and the City of Bellingham's Draft Parks Master Use Plan. The recorded minutes and public comments received during these meetings, held on July 7 and July 27, 2022, are included in Appendix A of this report.

METHODS

Development of this Stewardship Plan included a review of past studies of the site; regulatory guidance and planning support documents from public agencies; scientific literature; field investigations by Herrera Environmental Consultants, Inc. (Herrera) biologists on January 25, 2022, and February 7 and 16, 2022; and Herrera's past work at sites like the CCF.

No formal wetland or drainage delineations were performed by Herrera for this project. Visual evidence of wetland connectivity, seasonal surface water inundation and/or saturation at trail crossings, wildlife observations, habitat features, native and nonnative vegetation communities, and other data were recorded as handwritten notes, photographs, and/or digitally recorded as GPS mapped locations.

EXISTING CONDITIONS

LANDSCAPE SETTING

The CCF is situated within the foothills of the Chuckanut mountains in the Cascade Range. The Chuckanut mountains, part of the Puget Lowland Forest Ecoregion, are considered unique as the place "where the Cascades meet the sea." The CCF is positioned between several fish-bearing streams: Padden Creek, Hoags Creek, and Chuckanut Creek; and multiple wetlands are on site (Figure 1). The nearby Chuckanut Pocket Estuary and Mud Bay, located approximately 2,000 linear feet (LF) to the southwest of the CCF, provides valuable marine nearshore habitat for many species. The CCF provides terrestrial connectivity for species dependent on forested habitats and large contiguous migratory corridors. The CCF's unique landscape setting and habitat characteristics to provide refuge and connectivity for many species within the greater community has been the impetus for advocating for its protection through public process (Ballot Measure 2013). Located amid a residential neighborhood in the southwest corner of Bellingham, the CCF is connected for recreational use via an existing extensive onsite and regional trail network to surrounding City parks, including Fairhaven Park, Lake Padden Park, Woodstock Farm, Teddy Bear Cove, Arroyo Park, and Happy Valley Park, as well as other adjacent open space properties. The CCF is served by direct connections to the Interurban trail, which provides linkage between trails at Galbraith Mountain, Larrabee State Park, and the Chuckanut Mountains

The CCF's landscape setting also provides historic and educational perspectives regarding land use practices, natural regeneration and or degradation of environmental ecosystems and other factors, which can be considered in regard to planning its future. In recognition of the site's pre-historic heritage, consultation with the Lummi and Nooksack Tribal Nations to designate a Coast Salish name for the site is encouraged.

WETLANDS

Previous wetland studies identified a total of 16 wetlands throughout the CCF (Figure 1). Although the most recent delineation was conducted in 2009, the wetland categorical ratings were updated according to Ecology's updated (2014) Washington State's Wetland Rating System for Wetlands in Western Washington in the Chuckanut Community Forest Baseline Report prepared in 2017 (Eissinger 2017). Washington State's rating system is designed to differentiate wetlands based on their sensitivity to disturbance, rarity, the habitat and water quality and hydrology functions they provide, and how replaceable they may be. Washington State classifies wetlands into the following four categories, as outlined in Table 1.

Table 1. Washington State Wetland Categories.	
Wetland Category[a]	**Description**
I	Wetlands that: ● Represent a unique or rare wetland type, such as old growth or forested wetlands; or ● Are more sensitive to disturbance than most wetlands; or ● Are relatively undisturbed and contain ecological attributes that are impossible to replace within a human lifetime; or ● Provide a high level of functions. The risk of any degradation to Category I wetlands is extremely high because of the irreplaceability of their functions and values.
II	Category II wetlands are difficult, though not impossible, to replace, and provide high levels of some functions. These wetlands occur more commonly than Category I wetlands, but still need a high level of protection.
III	Category III wetlands: ● Provide functions at moderate levels. ● Can often be adequately replaced with a well-planned mitigation project ● Include interdunal wetlands between 0.1 and 1 acre in size. Category III wetlands have generally been disturbed in some ways and are often less diverse or more isolated from other natural resources in the landscape than Category II wetlands.
IV	Category IV wetlands are often heavily disturbed and provide the lowest levels of functions overall, although they may provide some important functions and therefore also need to be protected. Category IV wetlands should be replaceable and potentially improved. However, Ecology recognizes that replacement cannot be guaranteed in any specific case.

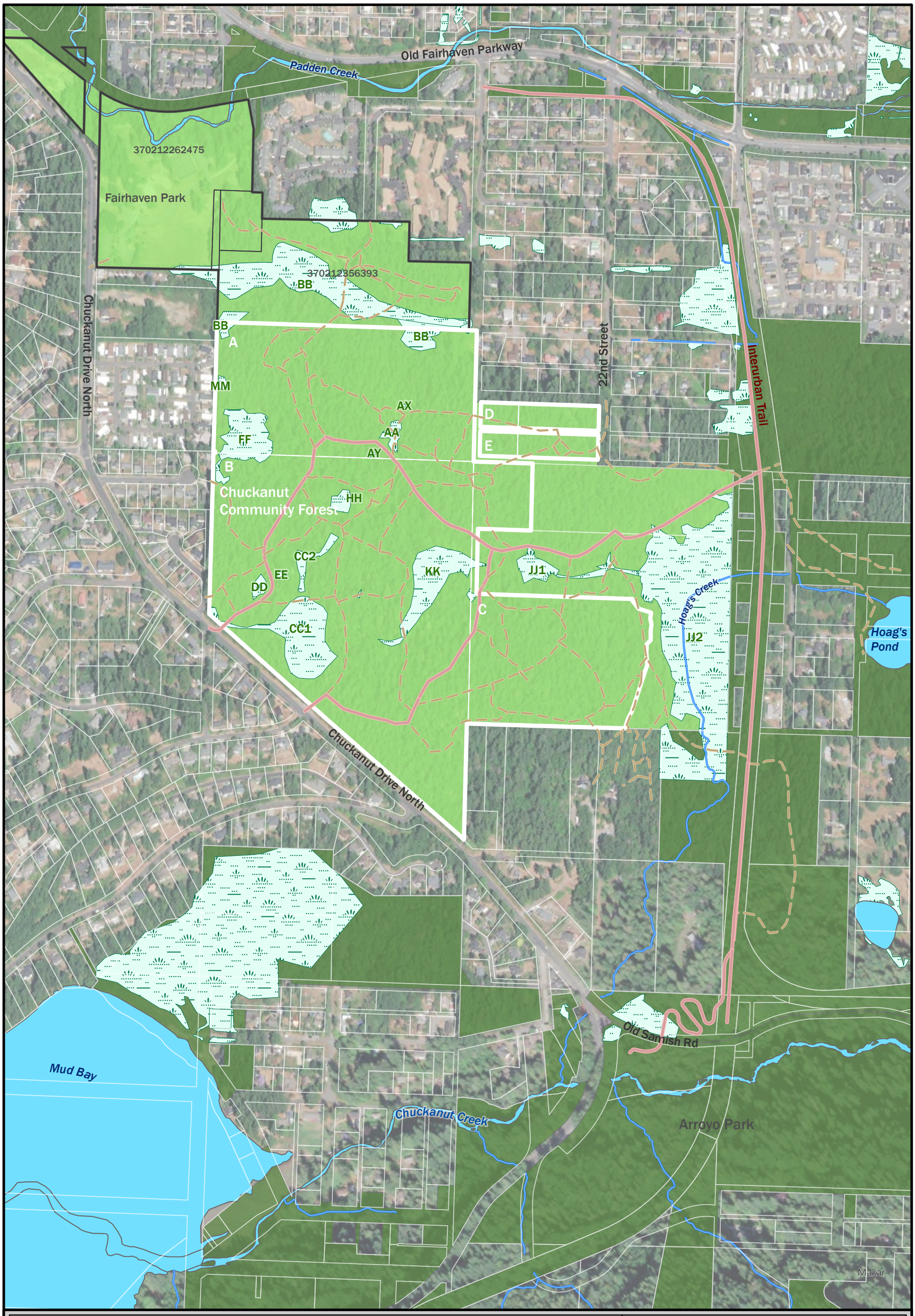
[a] Wetland Categories are defined by the Washington State Department of Ecology (Hruby 2014).

Of the 16 wetlands reported in the CCF's baseline report, 5 of the wetlands were evaluated to meet classification as Category I wetlands, 2 were rated as Category II wetlands, and 9 were classified as Category III wetlands (Eissinger 2017).

Reclassification of Wetlands CC1 and CC2

Wetlands CC1 and CC2 were originally delineated as one highly functioning Category I wetland in 1990 (Shapiro and Associates 1992) and then separated into two wetlands (Category I CC1 and Category II CC2) in 2009 (NES 2009). The rational for the separation was a lack of hydric soils and an only seasonally connected surface water between the two wetlands. It was postulated that this was exacerbated by compacted soils from the existing bisecting trail.

Wetlands JJ1 and JJ2, previously delineated as one wetland prior to 2009, were similarly separated (Cooke, 2010). Observations of surface water connection during Herrera's 2022 field visits indicate that this area should be similarly reassessed and considered for recombining into one Category II wetland.



Legend

- Whatcom County Tax Parcels (2021)
- Chuckanut Community Forest Boundaries (COB 2021)
- Park Jurisdiction (COB 2021)
- Open Space (Private, Public; COB 2021)
- Water Bodies (COB 2021)
- Streams (COB 2021)
- Delineated Wetlands (COB 2021)

Existing Trails (Open Street Map 2022)

- Minor
- Major

Figure 1. Chuckanut Community Forest - Land Ownership, Trails, and Wetlands

N

0 250 500 1,000 Feet

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At the time of site visits performed by Herrera biologists in January, February, and March of 2022, surface water was observed flowing over the trail bisecting the CC1 and CC2 wetland areas (see Photos 5 and 6 in the Area B: Wetlands CC1 and CC2 Hydrology Connection Trail Crossing subsection). Hydrophytic vegetation was observed growing next to both sides of the trail alignment, and a large contiguous area of saturated soils was also present to indicate wetland connectivity. Although these hydrology connections were observed during the wet season, ditching and the placement of rocks to serve as ad hoc measures for conveying surface water flows across and or adjacent to the trail indicate that saturated and or inundated conditions between the wetlands is frequent. For the purposes of designating protection and restoration priorities in this stewardship plan, it is recommended that the CC1 and CC2 wetland areas be recombined as one Category I mature forested wetland. Future restoration to minimize impacts along this section of the existing trail will require compliance with City critical areas protection and permitting regulations which will depend on further evaluation of problematic soils and hydrology indicators during the growing season (Environmental Laboratory 2010). Additional information regarding Herrera's review of hydrology connectivity within the CCF and adjacent area is included in the Hydrologic Connections – Priority 3 subsection of the Ecological Significance section of this report.

Gravel Pit Wetlands

Wetlands AA, AX, and AY located at the site of a former gravel pit were observed to be highly disturbed by historical site use and by the current trail system (see Photos 1 through 4 in the Area A: Improvement of Main Trail and Former Gravel Yard Restoration subsection). Nonnative and invasive vegetation including creeping buttercup (*Ranunculus repens*), English ivy (*Hedera helix*), and English holly (*Ilex aquifolium*) were prevalent in these wetlands. The disturbed nature of these wetlands resulted in their lower rating as Category III wetlands. During Herrera's January and February 2022 site visits, a surface water connection was observed to flow downgradient from the gravel pit wetlands over the cross-roadbed trail to a small, delineated wetland and another suspected wetland area that had not been mapped within the adjacent historical gravel pit site area to the south. Invasive Himalayan blackberry (*Rubus armeniacus*) dominates the vegetation within the southern gravel pit site area.

Category I Mature Forested Wetlands

According to the Washington State Wetland Rating System, forested wetlands over 1 acre in size and meeting the WDFW's priority habitat criteria for the old-growth or mature forests are categorically assigned a Category I rating (Hruby 2014). WDFW's criteria for "old growth" forest (west of the Cascade Crest) includes stands of at least two tree species forming a multi-layered canopy with occasional small openings; with at least 20 trees/hectare acre (ha) (8 trees/acre) that are more than 81 centimeters (cm) (32 inches) diameter-at-breast height (dbh) or more than 200 years of age; and more than 10 snags/ha (4 snags/acre) over 51 cm (20 inches) diameter and 4.6 meters (15 feet) tall; with numerous downed logs, including 10 logs/ha (4 logs/acre) that are more than 61 cm (24 inches) diameter and more than 15 meters (50 feet) long (WDFW

2021). "Mature forests" (west of the Cascade Crest) includes stands where the largest trees are 80 to 200 years old ***OR*** the species that make up the canopy have an average diameter (dbh) exceeding 21 inches (53 cm); crown cover may be less than 100 percent; decay, decadence, numbers of snags, and quantity of large, downed material is generally less than that found in old growth. Ecology has noted that WDFW's criterion for dbh is based on measurements for upland forests and that 80- to 200-year-old trees in wetlands will often have smaller dbh because their growth rates are often slower (Hruby 2014).

An in-depth analysis measuring the dbh of trees growing within Wetlands CC, FF, and KK and the onsite portion Wetland BB, which extends north of the CCF property on City-owned land associated with Fairhaven Park, was conducted by City Parks Arborist James Luce in January 2009 in association with the proposed Fairhaven Highlands development project (Luce – City of Bellingham, January 2009). The trees measured within Wetlands CC, FF and KK meet Ecology's criteria for these areas to be classified as Category I mature forest wetlands. At least five of the trees documented in each of these wetlands measured greater than 32 inches dbh, and thus were more representative of old growth habitat. The trees documented within the onsite portion of Wetland BB included three Douglas firs, one measuring 50 inches dbh and two each measuring 23 inches dbh. The trees are indicative of the extended forest conditions within the larger offsite portion of the wetland to the north of the CCF property, therefore meeting the Category I mature forested wetland criteria. Mature tree species documented within the wetlands included Douglas fir (*Pseudotsuga menziesii*), red cedar (*Thuja plicata*), grand fir (*Abies grandis*), red alder (*Alnus rubra*) and paper birch (*Betula papyrifera*).

Wetland HH and several other of the forested wetlands are likely to meet the tree size criteria representative of mature forest. However, based on each of these wetland's dimensions measuring less than 1 acre in size, Ecology's threshold for rating as a Category I wetland based on special characteristics as mature or old growth forest is not positively met. The smaller-sized forested wetlands, evaluated for rating based on their functions, were assigned ratings of Categories II and III.

Wetland Buffers

Since the most recent 2009 wetland study, the City's protective buffers to protect wetland areas, based on land use, wetland categorization ratings, and habitat have been updated. However, the City's updates do not incorporate Ecology's 2014 updated recommended Wetland Rating habitat score point values. In essence, the buffers indicated in the original reports no longer reflect regulatory updates and should be modified. Using Ecology's guidance in Table 2 (Ecology 2022), a crosswalk was performed to merge this information, converting the originally evaluated habitat scores in 2009 to the new habitat scoring criteria updated in the 2014 Wetland rating system and Ecology recommended point ranges.

Table 2. Crosswalk of Ecology-Recommended Functional Scores from 2004 to 2014 Rating System.		
Function Score	**2004 Rating System Previous Point Range as Recommended by Ecology**	**2014 Rating System Point Ranges as adopted by the City of Bellingham (BMC 16.55.340)[a]**
Habitat – Low	≤19	3 to 4
Habitat – Moderate	20 to 28	5 to 7
Habitat – High	29 to 36	8 to 9
Water Quality – High	24 to 32	8 to 9[b]

[a] Ecology has provided updated recommended point ranges as of July 2018, which is not reflected in BMC 16.55.340 (Ecology 2022).

[b] City of Bellingham does not use water quality function scores to determine buffer widths.

BMC = Bellingham Municipal Code

Table 3 and Figure 2 provide details regarding the site wetlands updated categorical ratings and City-designated standard protective wetland buffer widths.

Table 3. Wetlands and Buffer Widths in the CCF.				
Wetland	**Wetland Size (square feet)**	**Category**	**Habitat Score**	**Buffer (moderate intensity land use)**
AA	8,998	III	Medium	100
AX	130	III	Medium	100
AY	449	III	Medium	100
BB	21,516 (on site, wetland extends off site to the north of CCF property)	I	Medium	110
FF	57,543	I	Medium	110
MM	2,402	III	Low	60
CC1 + CC2	93,964 + 12,791	Combined I	High	190
DD	5,919	II	Medium	110
EE	919	III	Low	60
GG	329.3	III	Low	60
HH	8,764	II	Medium	110
KK	72,181	I	High	190
LL	1,631	III	Low	60
JJ1	28,842	III (previously COB category II)	Medium	100
JJ2	estimated to be >10 acres	I	Medium	110

Buffer functions are typically served at high, moderate, and low levels based on the existing vegetation. Forested buffers typically provide functions at high levels, while open, cleared vegetation areas serve functions at the lowest levels. Table 4 provides a summary of the levels of wetland buffer functions that can be provided by various vegetation communities.

Table 4. Levels of Buffer Functions Typically Served By Vegetation Class.			
	Existing Buffer Vegetation		
Buffer Function	**Forest**	**Scrub-Shrub**	**Open Meadow/Grass**
Water Quality: Stormwater run-off infiltration	High: Trees and woody stemmed plants provide year-round infiltration	Moderate	High – Low – Dense herbaceous vegetation can provide high levels of water quality treatment, seasonally, when grass is not dormant by drought
Shoreline/Soil Stability	High	Moderate	Low
Temperature Moderation (shade)	High	Moderate	Low
General Wildlife Habitat	High	Moderate	Low
Recruitment of Large Woody Debris in Aquatic Area	High	Moderate	Not Applicable

Although the CCF's upland forested buffers provide relatively high levels of buffer functions, the ability of the site to perform the highest levels of wildlife habitat connectivity, shelter, and refuge functions is reduced due to disturbances associated with the existing trail system that surrounds, and in some cases directly bisects, the site wetlands. For each of the site's wetlands, the City's standard buffer width designated to provide its protection is reduced by a bisecting trail, as illustrated on Figure 2.

The former gravel pit wetlands, AA, AX, and AY are bisected by multiple trails; only Wetland AX's City-regulated standard buffer width of 100 feet along its northern edge remains relatively undisturbed because it is not directly bisected by a trail.

The Wildlife Habitat section of this report provides details regarding disturbances to wildlife associated with trail uses within 100 meters (328 feet). Regardless of the wetland's categorical ratings, the CCF wetlands support diverse aquatic, emergent, shrub and forest vegetation plant communities that provide habitat for a variety of insect, amphibian, mammal, and bird wildlife species. Freshwater fairy shrimp (*Branchinecta sp.*) have been documented within the CCF's vernal pool wetlands and there are plenty of habitat opportunities for beavers.

The effectiveness of the wetland buffers can be reduced when bisected by trails. The existing trails in wetland buffers should be prioritized for removal in the City's Master Planning process. The buffers situated between the outer edge of the Category I mature forested wetland KK and the nearest trail range in widths from 0 feet where a trail bisects the wetland's southern end to approximately 40 feet near the wetland's western edge. These limited buffers are not adequate for protecting wildlife species from disturbances associated with trail use, as described the Wildlife Habitat section of this plan. The wetland's buffer width to the north is 84 feet, and the buffer along the wetland's eastern boundary is equal to or greater than the City's standard regulated buffer width of 190 feet, which provide more than double the distance of the smaller buffer width to allow refuge for wildlife.

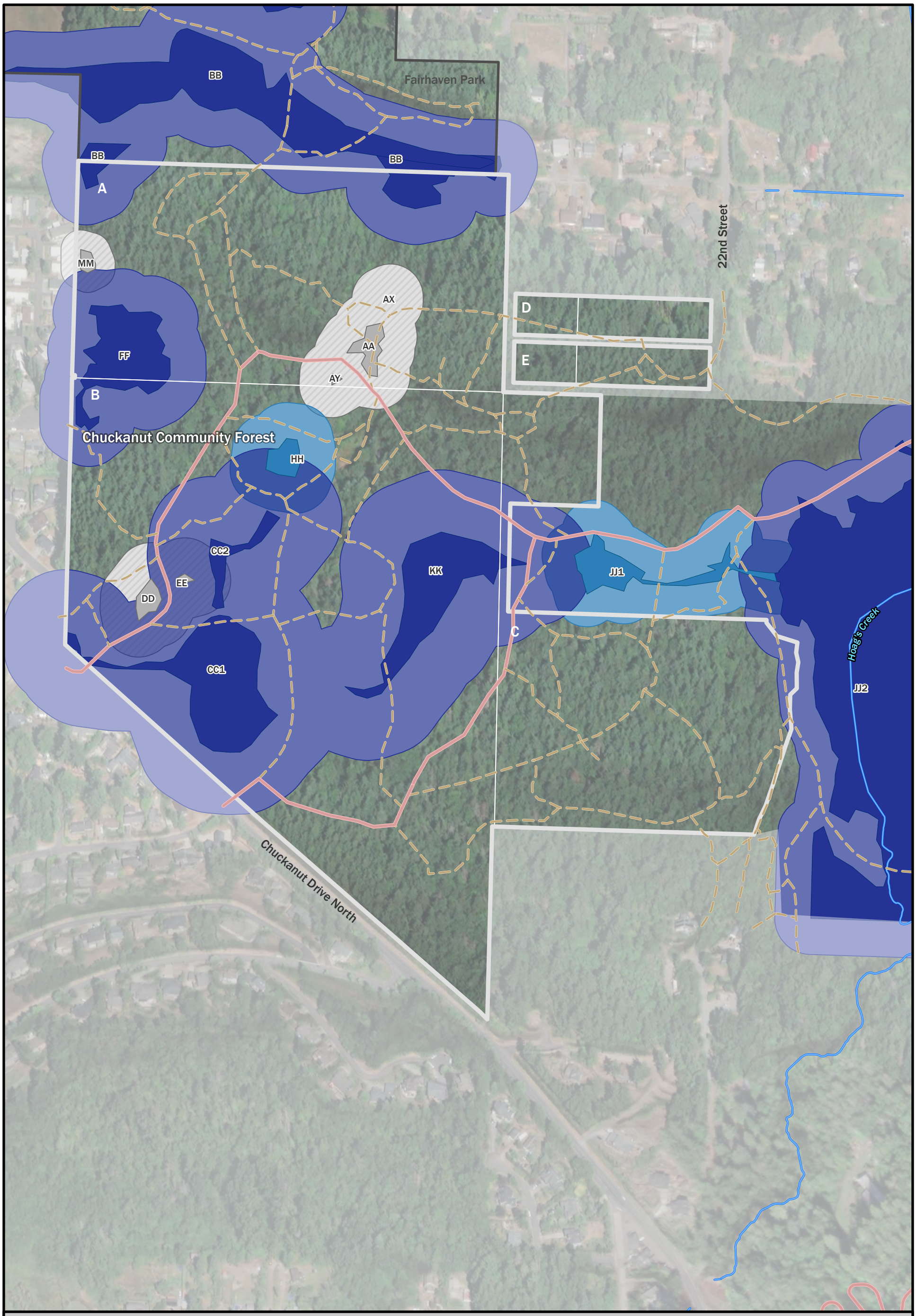


Figure 2. Chuckanut Community Forest - Updated Wetland Categories and City Regulated Buffer Widths

The existing buffers extending from the outer boundary of Wetland HH, a Category II forested wetland, to the nearest trail range in width from 42 feet to 84 feet. The undisturbed portion of Wetland HH's buffer situated between the wetland's other boundary to the nearest trails represents a buffer width reduction of 24 percent to 61 percent of the City's standard designated protective buffer width of 110 feet.

FOREST

Previous Studies

Previous reports identify coniferous, and mixed coniferous/deciduous within the CCF. Mature (stands more than 80 years old) forested wetlands were also identified. These studies have provided qualitative forest descriptions, and some quantitative measurements. Although delineation efforts have described many wetlands within the CCF as mature forested, the Baseline Report identified a further need to evaluate upland trees for forest maturity (Eissinger 2017).

Forest Structure and Maturity

The City of Bellingham Phase 1 Urban Forestry Management Plan (UFMP) – Canopy and Forest Structure Analysis Summary report classifies forest structure into the following five categories: Old Forest, Mature Forest, Young Forest Tall, Young Forest Short, and Pole Saplings and Shrub (Diamond Head 2021). The vegetation structure identified for the majority of the CCF in the UFMP is Tall Forest Young, which is characterized as trees aged between 50 and 80 years with heights ranging between 82 feet to less than 115 feet (Figure 3). Old and Mature Forest areas are identified to the south of Old Samish Road within areas adjacent to Arroyo Park and Whatcom County's Chuckanut Mountain Park. The Mature Forest vegetation structure is characterized by trees aged 80 to 240 years with heights between 115 feet to less than 148 feet. The locations of the ground truthing plots to support the UFMP Phase 1 analysis, which is primarily based on 2013 LIDAR interpretation, are not identified in the report; and therefore, any data specific to the CCF is not transparent.

The Washington Department of Fish and Wildlife (WDFW) describes mature forest west of the Cascade crest as forest stands of generally 80 to 200 years old. Old growth forest is described as more than 200 years old. Mature forest is defined by stands where average dbh is 21 inches or greater. Old growth requires stands at least 8 trees/acre with a dbh greater than 31 inches. Old growth also requires 4 snags/acre measuring 20 dbh and greater than 15 feet tall, and 4 logs/per acre averaging 24 inches in diameter and at least 50 feet in length. Generally, mature forests exhibit less decay and decadence and contain fewer snags and logs than old growth forests (WDFW 2021).

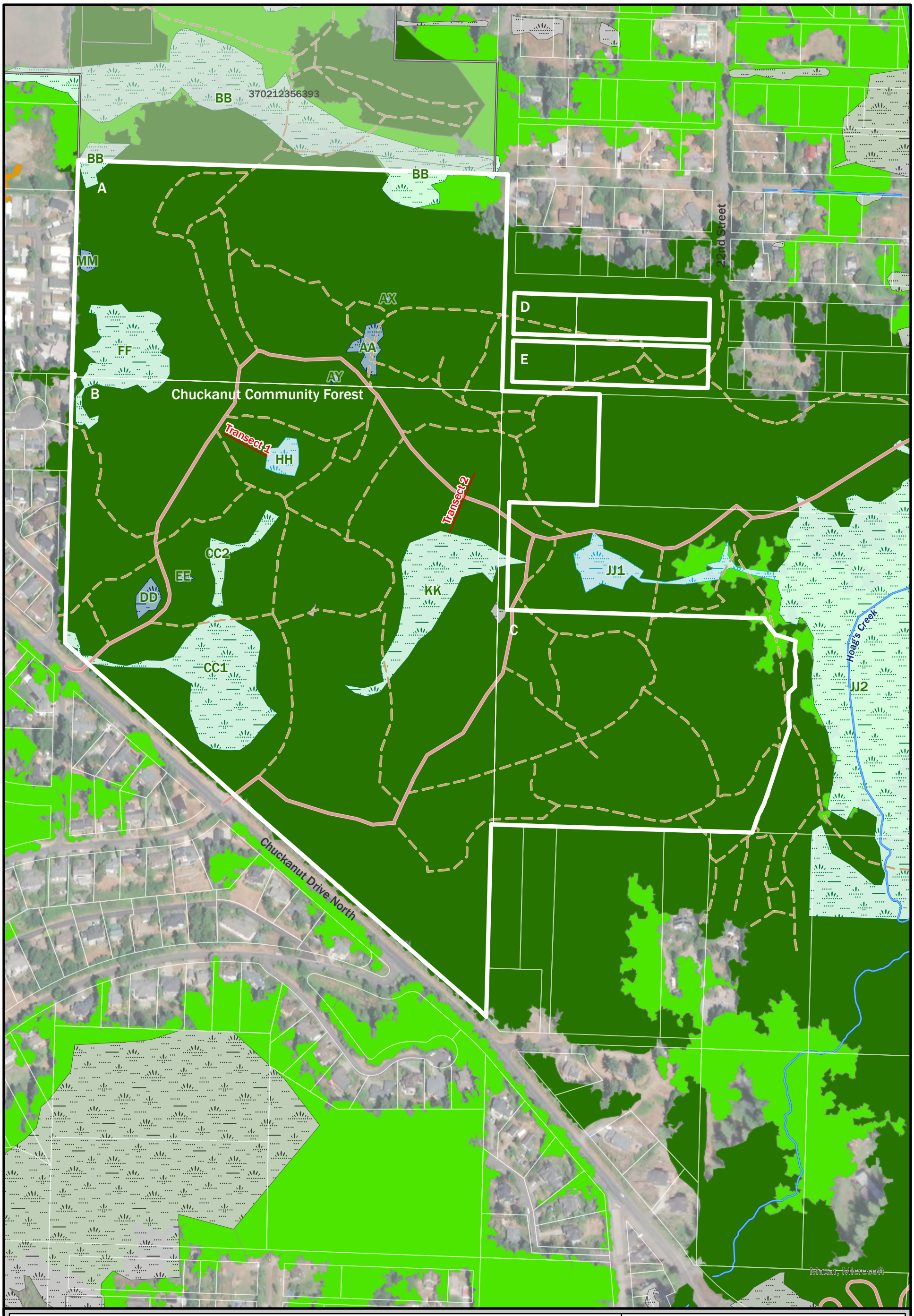
It should be noted that forest ratings based on average diameters, or averages of most other characteristics, may be misleading. Averages can introduce bias by under-rating forests due to

skew in tree size distributions: abundant small trees lead to averages that underestimate forest age. Characteristics used by the US Forest Service to define old growth/mature forest may provide better source material to develop criteria to assess forest maturity and is identified as a data gap in this report (Ruggiero et al. 1991).

As a preliminary means for examining forest maturity within the CCF, Herrera documented trees and large woody debris along two transects. on February 6, 2022 (Appendix B). Transect 1 encompassed an area of 2,700 square feet (18 feet wide by 150 feet long). Transect 2 was a total of 3,600 square feet (18 feet wide by 200 feet). Transects were located within the City's designated protective buffers associated with the forested wetlands HH and KK, respectively (Figure 3). Both transects were bisected by existing trails; Wetland KK's buffer was bisected by two paralleling trails.

Species and dbh were recorded for all live trees that were partially or fully rooted within the forest transects. Diameter and average length were recorded for all snags and logs occurring in the transects and evaluated according to WDFW's criteria for mature and old growth forest, as well as priority habitat features. Due to the level of decay of some of the downed logs and snags, species identification was not determined for all recorded habitat features, although some were at least simply identified as deciduous when applicable. WDFW describes snags and logs that exhibit sufficient decay to enable cavity excavation and use by wildlife as habitat features. Priority habitat snags are identified of having a dbh greater than or equal 20 inches and are at least 6.5 feet tall. Priority logs have an average diameter of 12 inches and are a minimum of 20 feet long (WDFW 2021). Upland forest transects indicate approximately 7 priority snags and 62 priority logs per acre.

The average dbh for trees present along both transects was approximately 15 inches. Transect 1 met WDFW's old growth criteria for snags only. Based on this information, it was determined that the evaluated upland forest buffer areas within the transact areas did not meet the WDFW criteria for old growth or mature forest. The existing snags and downed logs, however, meet the criteria described by WDFW as priority habitat features. Qualitative observations made throughout the CCF suggest priority snags and logs are present throughout the site. Further characterization and study are recommended since Herrera's evaluation, limited in size and scope, was not intended to be statistically significant. The long-term preservation of the CCF will allow the site's trees to continue to mature and provide habitat complexity typical of mature and old growth forests. Qualitative observations indicate that the CCF is dominated by a mature forest community and that future management decisions should be based on this assumption.



Legend

- Whatcom County Tax Parcels (2021)
- Chuckanut Community Forest Boundaries (COB 2021)
- Fairhaven Park
- Streams (COB 2021)
- Water Bodies (COB 2021)

Forest Structure (COB 2021)

- Young Forest Tall
- Young Forest Short
- Pole Sapling

Trails (Open Street Map 2022)

- Minor
- Major

Delineated Wetlands (COB 2021)

- Category I - Mature Forested
- Category II
- Category III
- Wetlands outside project area

Study Transect Lines

Figure 3. Chuckanut Community Forest – Forest Maturity, Trails, and Wetlands.

N

0 150 300 600 Feet

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Understory Conditions

Data collected from the upland forest transects were also used to evaluate understory vegetation conditions (Appendix B). Understory vegetation in the forest transects were representative of upland forest conditions found throughout the CCF. Dominant species include western sword fern (*Polystichum munitum*), dull Oregon grape (*Mahonia nervosa*), Pacific trailing blackberry (*Rubus ursinus*), and salal (*Gaultheria shallon*). Some invasive vegetation was identified in the transects and throughout the forest. Invasive vegetation identified includes English holly (*Ilex aquifolium*), English ivy, Himalayan blackberry, cherry laurel (*Prunus laurocerasus*), and periwinkle (*Vinca minor*). Community members have additionally identified European mountain ash (*Sorbus aucuparia*) , Scotch broom (*Cytisus scoparius*), English hawthorn (*Crataegus monogyna*), herb Robert (*Geranium robertianum*), sweet woodruff (*Galium odoratum*), bohemian knotweed (Fallopia × bohemica), lesser celandine (*Ficaria verna*), and giant hogweed (*Heracleum mantegazzianum*) (James, F., CCFPD, 2022). The Baseline Report describes areas within the CCF where invasive non-native plants are present and in need of restoration (Eissinger, 2017). The Whatcom County noxious weed list lists giant hogweed Class A which is required for control (Whatcom County 2022). Knotweed is listed as a Class B designated weed and control is required. Lesser celandine and Scotch broom are listed as Class B or targeted control, mapping and educational or biological efforts. Laurel Baldwin, Whatcom County Weed Coordinator for Noxious Weeds in Whatcom County, provided a presentation to the CCFPD on April 28, 2021 (Baldwin, 2021). The presentation, which includes a map of the locations of noxious weeds identified within the CCF and a questions and answer session regarding best management practices and priorities for controlling noxious weeds is provided as Appendix C of this report.

The shrub layer within the CCF appears to be underrepresented in comparison to conditions that are typical of upland forests of the region. As an example, native common snowberry (*Symphoricarpos albus*), a hardy shrub that is highly adaptive to many habitat conditions, is sparsely represented in portions of the CCF where it would be typically present, if not dominant, in similar forest conditions. The lack of a dense native shrub layer within portions of the CCF may be due to historical vegetation clearing and or soil compaction from other past land use disturbances.

Soils

Three main soil types are mapped by the Natural Resources Conservation Service within the CCF (Figure 4): Everett-Urban land complex, 5 to 20 percent slopes; Chuckanut gravelly ashy sandy loam, 15 to 30 percent slopes; and Squalicum-Urban land complex, 5 to 10 percent slopes.

These soil types are thoroughly described in the 2005 Wetland Delineation Report (NES) and the 2017 Baseline Report (Eissinger 2017). Many test pits and borings have examined existing wetland and upland soils throughout the site (NES 2005; GeoEngineers 2009).

The majority of the site's wetlands are situated within depressional areas of the Everett-Urban Land Complex. Although the non-hydric Everett-Urban Land Complex is characterized by excessively drained gravelly ashy sandy loams and very gravelly sand, undrained hydric Labounty silt loams are included as a minor (3 percent) soil component in landform depressions. Hoag's Pond located to the east of the CCF is associated with artificially drained Panghorn muck, hydric Soil Unit #116.

Several historical gravel or borrow pits are located on the CCF site. Throughout its post-colonial history, the site has also undergone logging operations and other resource extracting practices. Historical land uses, as well as recent trail development, have disrupted and likely compacted the native topsoil on much of the site, thus straining growing conditions and preventing the reestablishment of native forest understory while also aiding in the establishment of nonnative vegetation in some areas.

Wildlife Habitat

The presence and residence of wildlife species is highly dependent on the suitability, diversity, and quality of available habitat. Forested patches and large trees provide canopy cover, forage, and refuge habitat for many organisms. "Significant tree" is a regulatory term adopted by many local agencies that provides baseline measurements for determining their value on the landscape. The City of Bellingham defines significant trees as trees of any species that are 6 inches in diameter or greater as measured 4.5 feet from the base of the tree (BMC 16.60.040). A formal inclusive survey of the CCF has not been done to date; however, qualitative observations indicate that most trees with the CFF meet the City requirements of significant.

In general, forested wetlands support a large diversity of wildlife that are dependent on the intersection of terrestrial and aquatic habitats including beaver, muskrat, waterfowl, songbirds, and amphibians. Snags are dead trees that are left upright and decompose naturally. Although there are no regulatory minimums for snags, the City encourages preservation of snags and downed wood (BMC 16.550.080, 16.55.490.C.2) because they provide important forage, perching, and roosting habitat for wildlife. However, City code on removal hazardous trees (BMC 13.40.080) may undermine snag retention efforts in many instances. Appropriate management of CCF, including explicit protection of snags, would provide an opportunity to maintain this rare and important habitat component within the city.

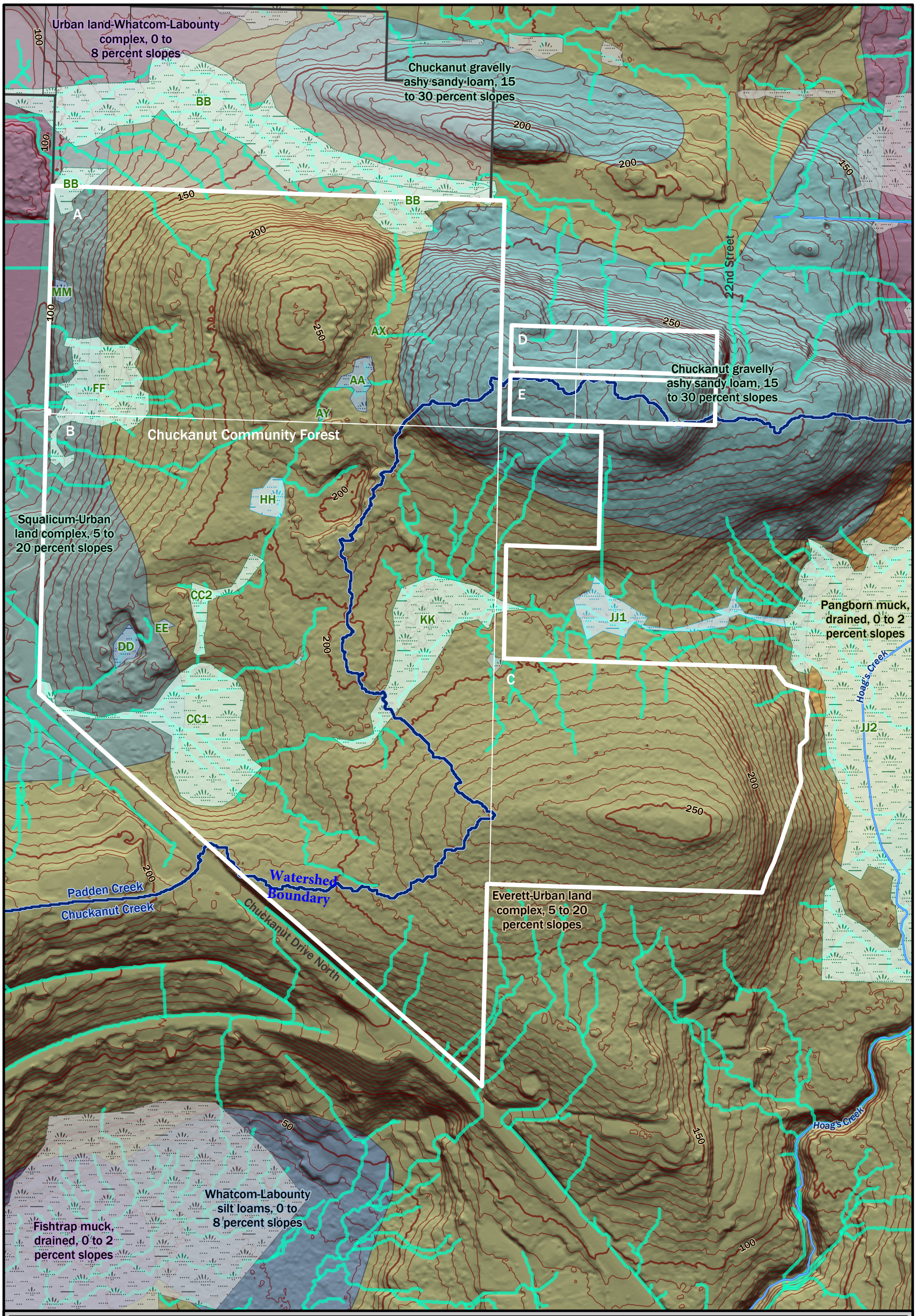
Use of the forest and wetland habitat in the CCF has been thoroughly documented in previous studies (Shapiro and Associates 1992; Aqua-Terr Systems 1994; Eissinger 2003; NES 2007). The Environmental Baseline Report identifies that these studies are outdated, and additional field survey is needed to collect data to identify and map specific priority habitats (Eissinger 2017).

Adjacent Habitats

Whatcom County identifies a large montane area south of the CCF including Chuckanut Mountain as the Chuckanut Wildlife Corridor (Whatcom County GIS). The Chuckanut Creek riparian area is also identified by WDFW as a terrestrial biodiversity area and corridor. Agency notes describe the area as containing a known bald eagle nest site, wood duck (*Aix sponsa*) breeding area, and hairstreak butterfly (subfamily Theclinae) and several bat species including Townsend's big-eared bat (*Corynorhinus townsendii*), Yuma myotis (*Myotis yumanensis*), and little brown bat (*M. lucifugus*).

A series of caves in Chuckanut Mountain County Park have been recorded as Townsend's big-eared bat hibernacula (Whatcom County Wildlife Advisory Committee 2021; Whatcom County 1994). In addition, a Whatcom County report from 1994 provides indicates Chuckanut Mountain area provides habitat for several WDFW priority species including Vaux's swift (*Chaetura vauxi*), band-tailed pigeon (*Patagioenas fasciata monilis*), and breeding habitat for black-tailed deer (*Odocoileus hemionus columbianus*). The estuarine habitat in Mud Bay is identified by WDFW as habitat for hard-shell clams, and shorebird concentrations including dunlins (*Calidris alpina*).

The City of Bellingham 2021 Wildlife Corridor Analysis used geospatial modeling to identify important habitat areas and connectivity linkages between habitat patches within the Bellingham city limits (COB 2021). The City identifies the CCF and the surrounding natural habitats as a part of a terrestrial wildlife habitat network (Figure 5). Several wildlife corridors were identified that connect habitat in the CCF to surrounding habitats including Chuckanut Mountain and the Chuckanut Bay. The City analysis indicates a wildlife corridor that crosses Chuckanut Drive North at the southernmost point of the CCF and connects to habitat at Chuckanut Bay. No formal wildlife crossing exists at this location. The road is likely a linear movement barrier for some terrestrial wildlife species. Additionally, Interstate 5 was identified as a Significant Movement Barrier between habitat in the region of Hoag's Pond (and the CCF) and habitat around Lake Padden. It should be noted that the Wildlife Corridor Analysis provides a high-level overview of habitat within the entire city. Information used to inform management decisions with the CCF should be site specific and informed by best available, peer-reviewed science, which has been accepted for use by regulatory agencies.



Legend

- Chuckanut Community Forest Boundaries (COB 2021)
- Fairhaven Park
- Delineated Wetlands (COB 2021)
  - Category I - Mature Forested
  - Category II
  - Category III
  - Wetlands outside project area
- Streams (COB 2021)
- 5 FT contours (from 2013 LiDAR)
- Soils (NRCS 2020)
  - Chuckanut gravelly ashy sandy loam, 15 to 30 percent slopes
  - Everett-Urban land complex, 5 to 20 percent slopes
  - Fishtrap muck, drained, 0 to 2 percent slopes
  - Pangborn muck, drained, 0 to 2 percent slopes
  - Squalicum-Urban land complex, 5 to 20 percent slopes
  - Urban land-Whatcom-Labounty complex, 0 to 8 percent slopes
  - Whatcom-Labounty silt loams, 0 to 8 percent slopes
- Modeled Hydrologic Connections (from 2013 LiDAR)
- Modeled Watershed Boundaries (Herrera 2022)

Figure 4. Chuckanut Community Forest - Soils and Topography.

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0 125 250 500 Feet

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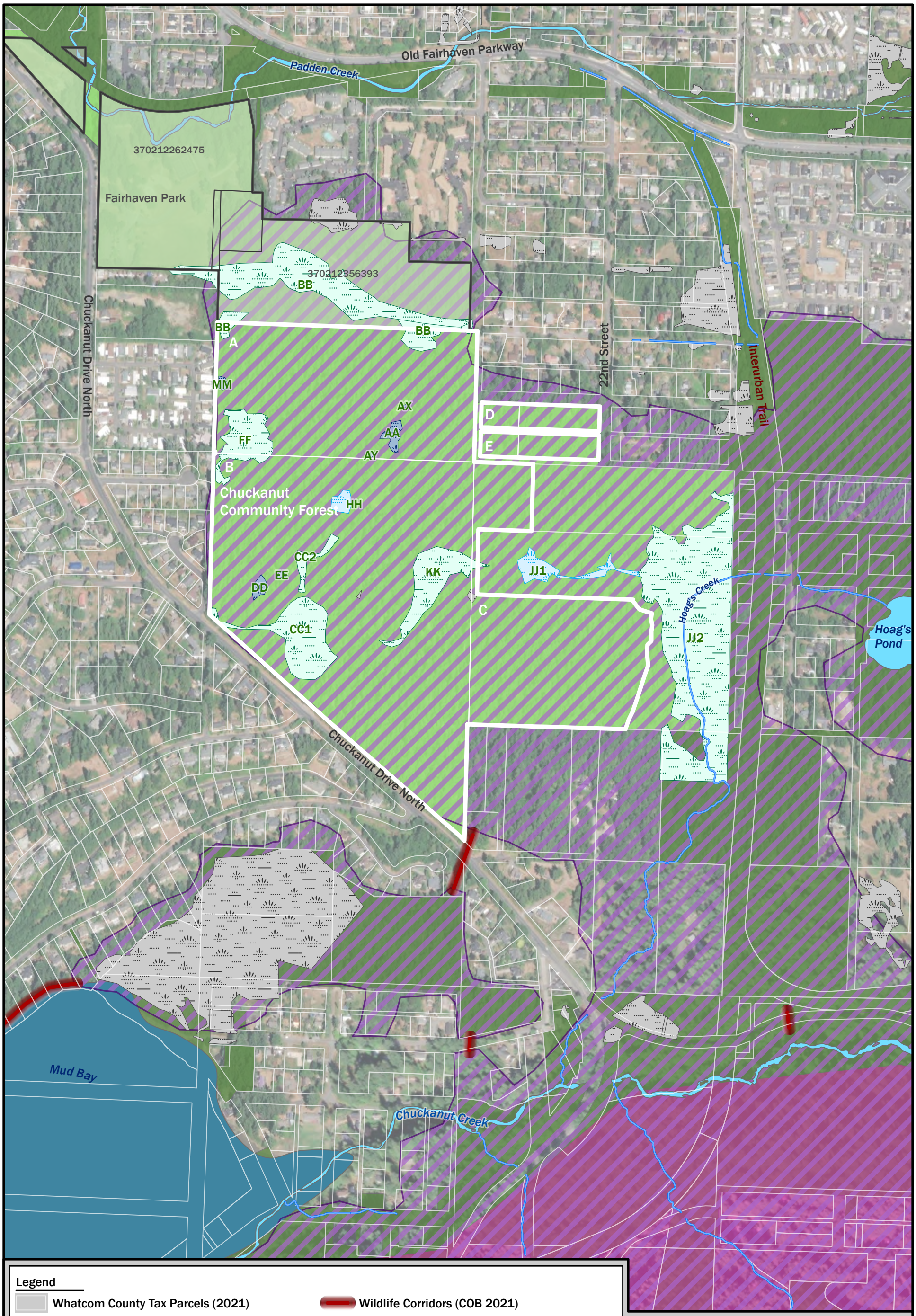


Figure 5. Chuckanut Community Forest - Natural Areas and Habitats.

ECOLOGICAL SIGNIFICANCE

PRIORITY AREAS

Based on the baseline existing conditions information and mapping as described in the above sections, areas within the CCF can be prioritized based on their presumed ecological value. Areas assigned a high numerical value should be prioritized for preservation, restoration and or enhancement activities as necessary (Figure 6). Table 5 and the following sections summarize these priorities into five areas with Priority 1 being the highest priority for preservation and restoration. It should be noted that the CCF functions as an integrated whole for many species and ecological functions. Aggregating spatial data into discrete units may diminish the interconnectedness of ecosystem functions. For example, forested wetlands would be affected by impacts to upland forest. This ranking system was intended only to provide a high-level overview so that managers may prioritize immediate management actions. Restoration, protection, and development activities should consider a holistic approach regarding the larger ecosystem in the CCF.

Table 5. Ecological Priority Areas for Preservation and Restoration.

Priority 1	Priority 2	Priority 3	Priority 4	Priority 5
Mature Forest Wetland	All Other Wetlands	Non-Wetland Drainages	Buffers	Upland Forest (non-buffers)

Mature Forested Wetlands – Priority 1

The site's mature forested Category I wetlands represent a rare ecosystem in Washington State. The functions provided by the mature forested wetlands may take longer than a century to develop the relatively undisturbed wetlands that provide high levels of functions and contain attributes deemed irreplaceable within a human lifetime.

Therefore, impacts to the site's mature forested wetlands have an associated temporal loss of function. In addition to the hydrologic and water quality functions provided by all wetlands in the CCF, the mature forest wetlands provide significant functions habitat functions including high biodiversity and habitat for unique and sensitive species.

Due to the rarity, sensitivity, and irreplaceably of this ecosystem, these areas are deserving of the highest level of protection in the CCF. Where human activities have already disturbed areas of these wetlands, targeted restoration and rehabilitation should occur.

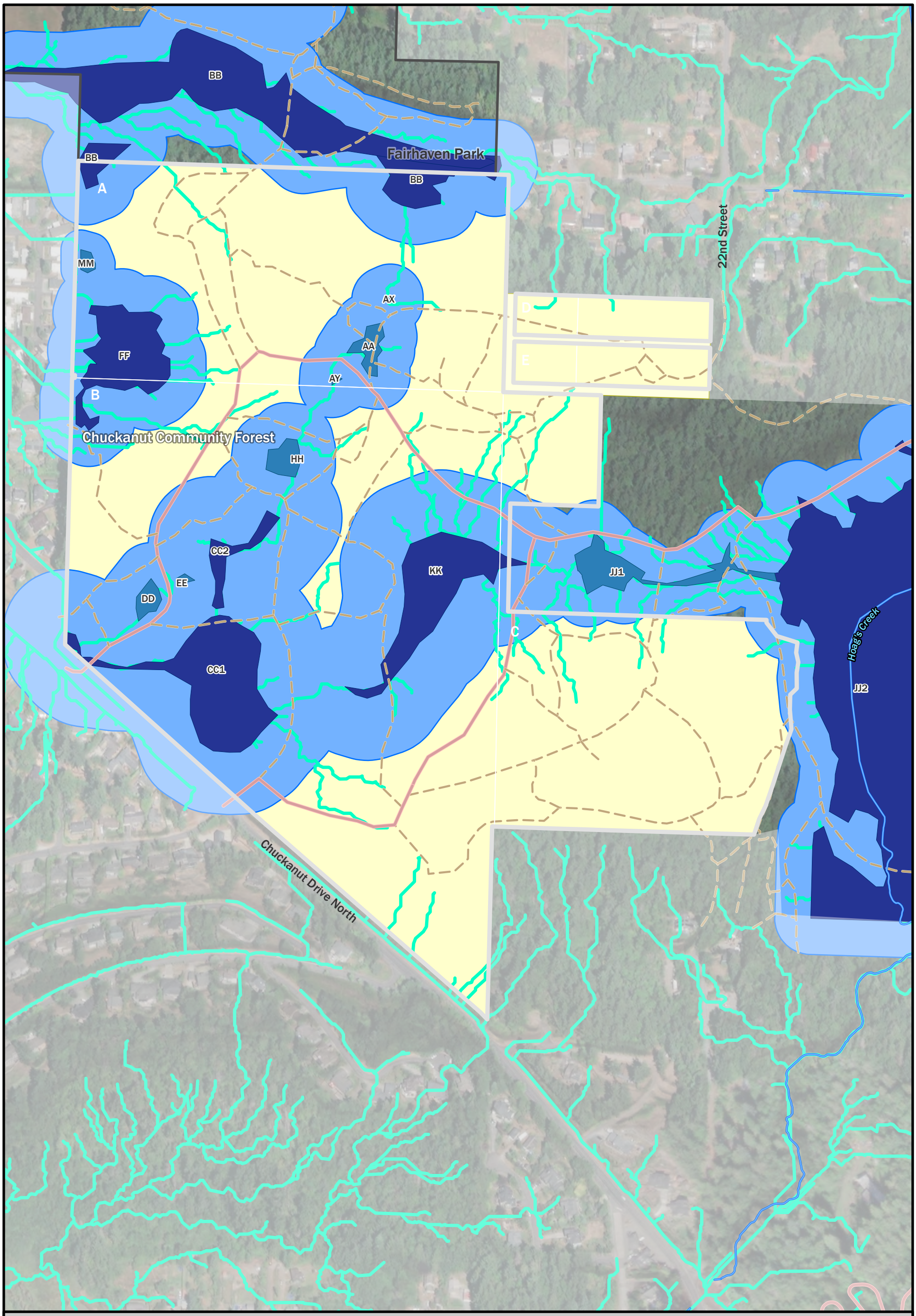
Other Wetlands – Priority 2

Non-mature forested wetlands in the CCF are providing significant ecosystem functions. These include connectivity between habitats (terrestrial forest, wetland, aquatic, vernal pool) hydrology and water storage functions, water quality filtration, and nutrient cycling. Protection of these wetlands is also a high priority; and impacted areas where trails can be reduced, forest canopy restored and or enhanced through nonnative species removal, and native plant species and structure diversity increased is recommended.

Hydrologic Connections – Priority 3

Areas providing seasonal connectivity between wetlands are important for many of the same reasons as wetlands. These areas provide seasonal habitat and connectivity between wetlands for water dependent species. Wetland connections help maintain hydrology in wetlands located downgradient. Subsurface flows through these areas provide water quality functions through filtration. For these reasons, hydrologic connections deserve protections and corrective actions where they are intersected by trail development or other disturbances.

The 2017 CCF Baseline report suggests that seasonal surface flows and seeps occur throughout the site and are related to seasonal precipitation and water movement downslope from seeps potentially exiting from wetland areas (Eissinger 2017). Seasonal hydrologic connectivity between the CCF site wetlands was estimated by Herrera based on a desktop topography/LiDAR analysis, on-the-ground hydrology observations, and examining previous reports. A formal wetland delineation was not performed for this study to determine if these areas are contiguous with the mapped wetlands. Analysis suggests that many of the wetlands occurring in the CCF, as well as wetlands off site, are hydrologically connected via wet season surface or shallow subsurface water (Figure 5). During the 2022 Herrera site visits, observations of ponded or flowing surface water, saturated soils, and or hydrophytic vegetation were made in topographic low points between wetland features. Where wet conditions existed between wetlands, a GPS point was recorded and documented with photographs. This data led to identifying those areas where bisecting trails should be improved to accommodate hydrology connections and/or to rehabilitate soils from compacted conditions, as described in the Needs and Opportunities section of this report. Although not formally documented as a stream, an offsite drainage that flows west through Wetland BB is present directly north of the CCF on the adjacent Fairhaven Park property. The existing boardwalk crossing of this drainage feature and associated wetland is typical of that recommended for some of the trail crossings of Priority 4 and 5 wetlands and Priority 3 non-wetland drainage areas in the Needs and Opportunities section (Photo 17).



Legend

- Chuckanut Community Forest Boundaries (COB 2021)
- Fairhaven Park
- Streams (COB 2021)
- Water Bodies (COB 2021)

Trails (Open Street Map 2022)

- Minor
- Major

Delineated Wetlands (COB 2021)

- Category I wetlands (Priority 1)
- Other wetlands (Priority 2)
- Modeled Hydrologic Connections (Priority 3)
- Wetland buffer (Priority 4)
- Upland forest non-buffer (Priority 5)

Figure 6. Chuckanut Community Forest - Priority Areas for Preservation and Restoration

0 150 300 600 Feet

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Buffers – Priority 4

Prioritizing the preservation/restoration and/or rehabilitation of the City's designated buffer areas is important for regulatory compliance, as well as for maintaining and or increasing the level of critical areas functions performed at the site. Trail removal and vegetation restoration within the site's wetland buffers is highly recommended to provide increased benefit to wildlife and long-term preservation of the site's wetlands and forest structure.

Upland Forest – Priority 5

The upland forest vegetation community is a priority for preservation within the CCF. However, the ranking of City-regulated buffers is higher in priority than those areas of upland forest where no critical areas regulations are applied. Maintaining the integrity of the upland forest is important for the wildlife habitat connectivity, species diversity, and defense against invasive species encroachment.

Wildlife Habitat

Significant, species-specific habitat areas and mapping have been identified as a data gap (Eissinger 2017). Recreational activities, even quiet forms, can have significant impacts to wildlife and biodiversity (Gaines et al. 2002; Tulalip Tribes 2021). Recreational activities such as horseback riding, hiking, jogging, ecotourism, and mountain biking can negatively impact wildlife as well as plant ecosystems. These activities can lead to soil compaction, erosion, spread of disease and introduction of exotic species. On and off leash dogs can also negatively affect the wildlife by trampling habitat and disturbing wildlife. Although there is a lack of site-specific data in this regard for the CCF a large body of literature indicates that recreation activities influence wildlife behavior, physiology, and reproduction.

A literature review by the US Forest Service (USFS) suggests that wildlife is impacted by recreational trails by altering habitat use through displacement and avoidance behaviors (Gaines et al. 2002). Fragmentation resulting from trail establishment has been shown to affect forest bird species that require large forest patches. The paper indicated that trails may break up forest patches and increase nest predation and parasitism rates. Hiking trails were noted to have a zone of influence of 100 meters for some bird species. The USFS study also indicates that while roads negatively affected cavity dependent species such as pileated woodpeckers, recreational activity is unlikely to have the same effect as their nests are more secure from nest predation than any other group of forest birds (Gaines et al. 2002).

The following table provides an overview of recreational impacts and their significance in wilderness, as summarized by Leung and Marion in 2000 for the USFS (The full report is included in Appendix D of this report).

Recreation Impacts and Management in Wilderness: A State-of-Knowledge Review (Leung, Y, and J. Marion. 2000)

Table 1—Common forms of recreation impacts in wilderness.

	Ecological component			
	Soil	**Vegetation**	**Wildlife**	**Water**
Direct effects	Soil compaction Loss of organic litter Loss of mineral soil	Reduced height and vigor Loss of ground vegetation cover Loss of fragile species Loss of trees and shrubs Tree trunk damage Introduction of exotic species	Habitat alteration Loss of habitats Introduction of exotic species Wildlife harassment Modification of wildlife behavior Displacement from food, water and shelter	Introduction of exotic species Increased turbidity Increased nutrient inputs Increased levels of pathogenic bacteria Altered water quality
Indirect/ derivative effects	Reduced soil moisture Reduced soil pore space Accelerated soil erosion Altered soil microbial activities	Composition change Altered microclimate Accelerated soil erosion	Reduced health and fitness Reduced reproduction rates Increased mortality Composition change	Reduced health of aquatic ecosystems Composition change Excessive algal growth

A 2021 literature review by the Tulalip Tribes indicates that recreational activities can have significant impacts to wildlife and biodiversity and that recreational pressures on the environment may be increasing. Repeated disturbance may trigger spatial or temporal avoidance behaviors in wildlife. Spatial avoidance may displace wildlife to less desirable, less ecologically significant habitat (Tulalip Tribes 2021). Some research suggests that disturbance may vary slightly by activity. Direct approaches caused greater disturbance than tangential approaches, rapid movement by joggers was more disturbing than slower hikers, children and photographers were especially disturbing to birds (Jordan 2000). Ecotourists created lower nesting rates and lower reproductive success in Least Tern colonies than other types of human disturbance (Koshak 2005). Studies have indicated that hiking and biking activities may have a similar level of impact on ungulates (Taylor and Knight 2003). A summary of scientific studies that compare mountain biking to other forms of trail travel.in 2003 provided little evidence to suggest that bikers cause more wear to trails, damage to vegetation, or negative behavioral responses in wildlife than other forms of trail recreation although further studies may provide different results (Sprung 2003). However, regardless of user group, trails need to be planned and constructed properly to be stable and durable to provide the desired user experience without

adversely affecting the environment. Poorly designed and constructed trails can lead to interruptions to site hydrology and erosion, which will negatively impact the health and function of aquatic habitat (and degrade the user experience).

Studies show that wildlife is more negatively impacted by trails that allow dogs (Lenth and Knight 2008; Miller et al. 2001). A 2001 study found that upon approach of hikers with leashed dogs, deer became alert at 280 feet and flushed at 160 feet, compared to 150 feet and 112 feet from hikers without a dog (Miller et al. 2001). Apart from behavioral responses, wildlife may experience physiological stress, which has not been well studied or documented. Dog presence triggers an avoidance behavior in most species which temporarily reduces the amount of functionally available habitat. It is important to understand that people with dogs substantially increase the amount of wildlife habitat affected and are more detrimental to wildlife than people without dogs. The scent of dogs or urine may last several days, and repeated disturbances lead to chronic stress and may reduce wildlife health, reproduction, growth, impair the immune system and increase vulnerability to parasites and diseases. Off-leash dogs not under control may chase and kill wildlife species (Hennings 2016).

The following summarizes Lori Hennings' (Metro Parks, City of Portland, Oregon) compiled literature review of the impacts of dogs on wildlife and water quality (Hennings 2021). The full report provided in full in Appendix E of this report.

> "The evidence that dogs negatively impact wildlife is overwhelming. It is clear that people with dogs – on leash or off – are much more detrimental to wildlife than people without dogs. Dogs *(Canis lupus familiaris*) are considered to be a subspecies of wolves (*Canis lupus*), and wildlife perceive dogs as predators. Impacts include:
>
> 1. Physical and temporal displacement – The presence of dogs causes wildlife to move away, temporarily or permanently reducing the amount of available habitat in which to feed, breed and rest. Animals become less active during the day to avoid dog interactions. Furthermore, the scent of dogs repels wildlife, and the effects remain after the dogs are gone.
>
> 2. Disturbance and stress response – Animals are alarmed and cease their routine activities. This increases the amount of energy they use, while simultaneously reducing their opportunities to feed. Repeated stress causes long-term impacts on wildlife including reduced reproduction and growth, suppressed immune system and increased vulnerability to disease and parasites.
>
> 3. Indirect and direct mortality – Dogs transmit diseases (such as canine distemper and rabies) to and from wildlife. Loose dogs kill wildlife.
>
> 4. Human disease and water quality impacts - Dog waste pollutes water and transmits harmful parasites and diseases to people." (Hennings 2016).

Key factors that influence the overall magnitude of impact of recreational activities include:

- The spatial distribution of trails (i.e., high density trail networks have greater impacts on wildlife and habitat).
- Less predictable forms of recreation (off-trail use, off-leash dogs) have a stronger negative impact on wildlife.
- Recreation type and seasonality influence the degree of wildlife disturbance.
- Disturbance to wildlife is directly related to the volume of trail users.

Various recreational activities can be mitigated through effective management strategies to reduce negative impacts and increase ecosystem health. Because various ecological components are interrelated, recreation impact on a single ecological element can eventually result in effects on multiple components (Leung 2000). In addition, trails and their visitors have the potential to generate undesirable impacts on wildlife from population to ecosystem levels, with significant implications for biodiversity conservation. A principal goal for managing wilderness visitation is to avoid impacts that are avoidable and to minimize those that are not. To achieve this goal, wilderness managers must effectively educate and regulate visitors and manage wilderness resources (Leung 2000). This can be accomplished by reducing the width of trails (creating less foot traffic), reducing the number of trails in species sensitive areas, excluding dog access to sensitive areas, and using signs to educate and deter visitors from these high impact areas.

NEEDS AND OPPORTUNITIES

There are multiple opportunities for preserving, restoring, and rehabilitating portions of the CCF to allow for the long-term protection of ecological habitat, including priority wetlands, associated upland forest buffers, and the overall connectivity of the site's hydrology and wildlife corridors.

PRESERVATION

The existing Chuckanut Community Forest Conservation Easement, recorded on January 6, 2014 (AF# 2140100259), is the primary legal instrument currently ensuring the protection of the CCF. The purpose of the easement is to ensure that the natural features, functions, and values of the CCF are protected in perpetuity including the existing wetlands, forest, wildlife habitat, wildlife habitat corridors, and other features of ecological significance, while also allowing for nature-oriented, non-motorized public recreational, scientific, and educational uses, and the construction of appropriate facilities to enhance these uses may be allowed provided that they are sited, designed, maintained, and operated so as to minimize the impact to the natural attributes of the site.

The existing easement's provision for public use is not limited to passive recreation. Additional allowances pertaining to maintenance and site improvements, including associated authorized motorized vehicles access and limited tree clearing for public safety, are also permitted provided that any potential adverse impacts to critical areas is mitigated as required by the City's Critical Areas Ordinance, BMC Chapter 16.55. Incompatible activities and developments have not occurred in the time since CCF establishment however, ecological conditions have degraded. This degradation increases the importance of restoration, and it reinforces the need to restrict allowed activities and development in the Conservation Easement. Recognizing the CCFPD's unique mission towards the long-term preservation of the CCF's natural habitat and ecological condition, the conservation easement's prescribed uses for the site could be designated according to more restrictive prescriptions of a forest or ecological preserve rather than those uses typical of the City's managed Parks.

The 2017 Baseline report states that several of the identified allowed uses stated in the conservation easement would permanently alter, impact, or change the CCF's current conditions and that monitoring of the Conservation Easement will require close consideration of the original easement purpose and values, which is the standard reference for compliance (Eissinger 2017). As the CCFPD is currently negotiating a new conservation easement with the City, it is anticipated more restrictive uses and allowances will be defined for the further protection of the site.

The Stewardship Plan has identified that each of the site's wetlands and their City-regulated buffers are of highest priority for preservation. Their hydrologic connections to adjacent site wetlands, including Wetland JJ1 to the east of the CCF are also prioritized. Where existing trails or previous development activities have intersected a priority area, restoration/rehabilitation or other corrective actions are needed.

This Stewardship Plan is intended to be a resource to both the City's Master Planning process and the process to update the Conservation Easement so the CCF can be managed to limit and focus recreational uses and other development to preserve and enhance existing wildlife habitat. The Conservation Easement is expected to establish legally binding minimum criteria for the care and use of the site, the Master Plan is intended to provide an aspirational vision for the ultimate plan for the care and use of the site, and this Stewardship Plan is intended to support both with technically sound analysis.

Restoration/Rehabilitation

The CCFPD's restoration priorities adopted by Resolution No. 16 include the following:

- Remove, realign, and narrow trails, and add boardwalks.
- Remove invasive species and restore vegetation.

Implementation of the CCFPD's restoration priorities will:

1. Improve natural conditions by adding three-dimensional volume through added vegetation.
2. Increase vegetation, which filters noise and improves soundscape.
3. Improve wildlife habitat by adding vegetation for cover, forage material, and structure for animals
4. Restore soil porosity.
5. Increase sense of solitude by filling in open spaces between different trails.
6. Deter re-use or establishment of removed trails.
7. Protect wetlands areas by adding boardwalks (preventing people from walking around wet spaces and compacting soils), which also aids hydrologic connection.

Further descriptions of actions recommended to support the CCFPD's restoration goals and intended benefits are described in the following sections of this report.

Trail Removal and Improvement Priorities and Techniques

As a part of its Park Master Plan process, the City is proposing that the existing main trail on the existing roadbed be rebuilt to a shared use path standard and used as the major route to connect users to Fairhaven Park to the north and the Interurban Trail network to the east (Figure 7). Utilizing the existing roadbed as the main trail connector route will reduce direct site impacts that would be required for a new main trail alignment; however, to meet City standards for a multi-use hard-surface trail and to support the City's maintenance operations, improvements are planned for its surfacing and width to support more pedestrian traffic and permit City-only authorized vehicle access for maintenance and public safety. Standard trail improvements would include the City's standard specifications for a crushed limestone surface course over a gravel base course, however trail improvement methods discussed in the below section, *Method for Reducing the Ecological Impacts of Trails,* should be considered where feasible. On-going monitoring and adaptive management should be implemented in conjunction with any trail improvements to ensure compatibility with the Master Plan.

This existing roadbed appears to have been informally built many years ago, potentially as part of historical logging or gravel mining operations. In some locations the roadbed crosses water courses and other wet areas without adequate drainage practices. These impacts can be addressed to support the restoration of the interruptions to the site hydrology and support aquatic habitat using culverts, bridges, and replacing the subgrade with permeable ballast rock wrapped in geotextile fabric. These techniques are discussed further below.

In some cases, retrofitting trails with drainage connections is insufficient to protect or restore habitat, and the trails need to be removed altogether when they are located within critical habitat areas or their buffers. In evaluating trails for removal, the existing trail network was overlaid onto the mapping of the priority areas identified in this Plan for preservation and restoration. The current trail use from Strava data was also considered; and the trails identified by the City that appear to be redundant, paralleling major trails, or that are sited in challenging topographically steep areas, were also prioritized for removal. Based on this analysis, 7,863 linear feet (LF) of existing trails, as indicated on Figure 7, are recommended for removal to support the health and function of wetlands, their buffers, and the wildlife that rely on these areas for habitat. Although a reduced network of trail connections would result from the recommended trail removal, 37,027 LF of existing trails would be retained. Some sections of these will need improvements to reduce impacts. Seven locations where existing trails are causing major environmental impacts are identified and labeled on Figure 7 as sites A through G. Recommendations for restoration actions to be implemented at each of these areas are described below.

Figure 8 illustrates the proposed site conditions after recommendations for trail removal and improvements are implemented. Existing buffer areas, currently impacted by trails, will be restored, as feasible, to comply with the City's standard regulated buffer widths ranging between 60 feet and 190 feet.

Area A: Improvement of Main Trail and Former Gravel Yard Restoration

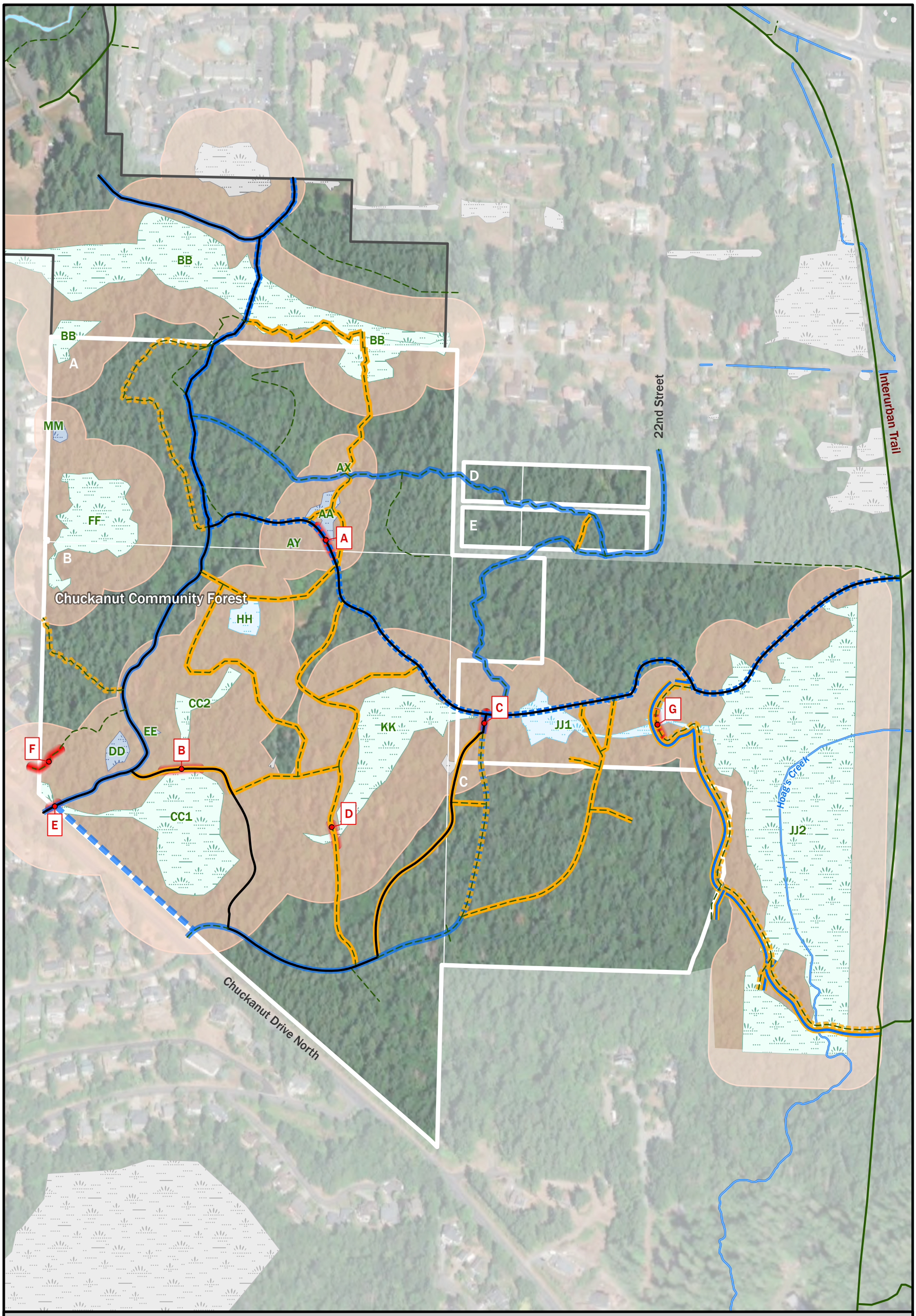
The City's proposal to utilize the existing roadbed, which constitutes a historical site disturbance near a former gravel yard, as a major cross-property trail connector between Fairhaven Park to the north and the Interurban Trail to the east is also recommended in the CCF's Baseline Report (Eissinger 2017) (Figure 7). However, one section of this roadbed trail was observed to intersect seasonal surface water flows from Wetland AY downslope to a small wetland on the south side of the trail (Photos 1 through 4). In order for the City to continue utilizing and improving this trail for major use, the installation of a culvert, bridge, or boardwalk structure or other low-impact development measures (such as a ballast rock base or "burrito") is recommended in order to preserve the seasonal surface water hydrologic connections while also minimizing impacts.

Photo 1.

Photo 2.

Photo 3.

Photo 4.



Legend

- Chuckanut Community Forest Boundaries (COB 2021)
- Fairhaven Park
- Water Bodies (COB 2021)
- Streams (COB 2021)

Existing Trails (COB 2021)

- Main Loop Trail
- Primary Trail (6-12')
- Minor Trail (1-4')

Maintain Trails

- Main Loop Trail (Herrera 2022)
- Improve Trail (COB '21)

Add Trails

- New Connector Trail/Main Loop Trail (Herrera 2022)

Remove Trails

- Remove Trail (Herrera 2022)
- Remove Trail (COB '21)
- Remove or Rehabilitate (Herrera 2022)

- Trail Modification Areas

Delineated Wetlands (COB 2021)

- Category I - Mature Forested
- Category II
- Category III
- Wetlands outside project area
- Wetland regulatory buffer

Figure 7. Chuckanut Community Forest - Trail Recommendations - DRAFT

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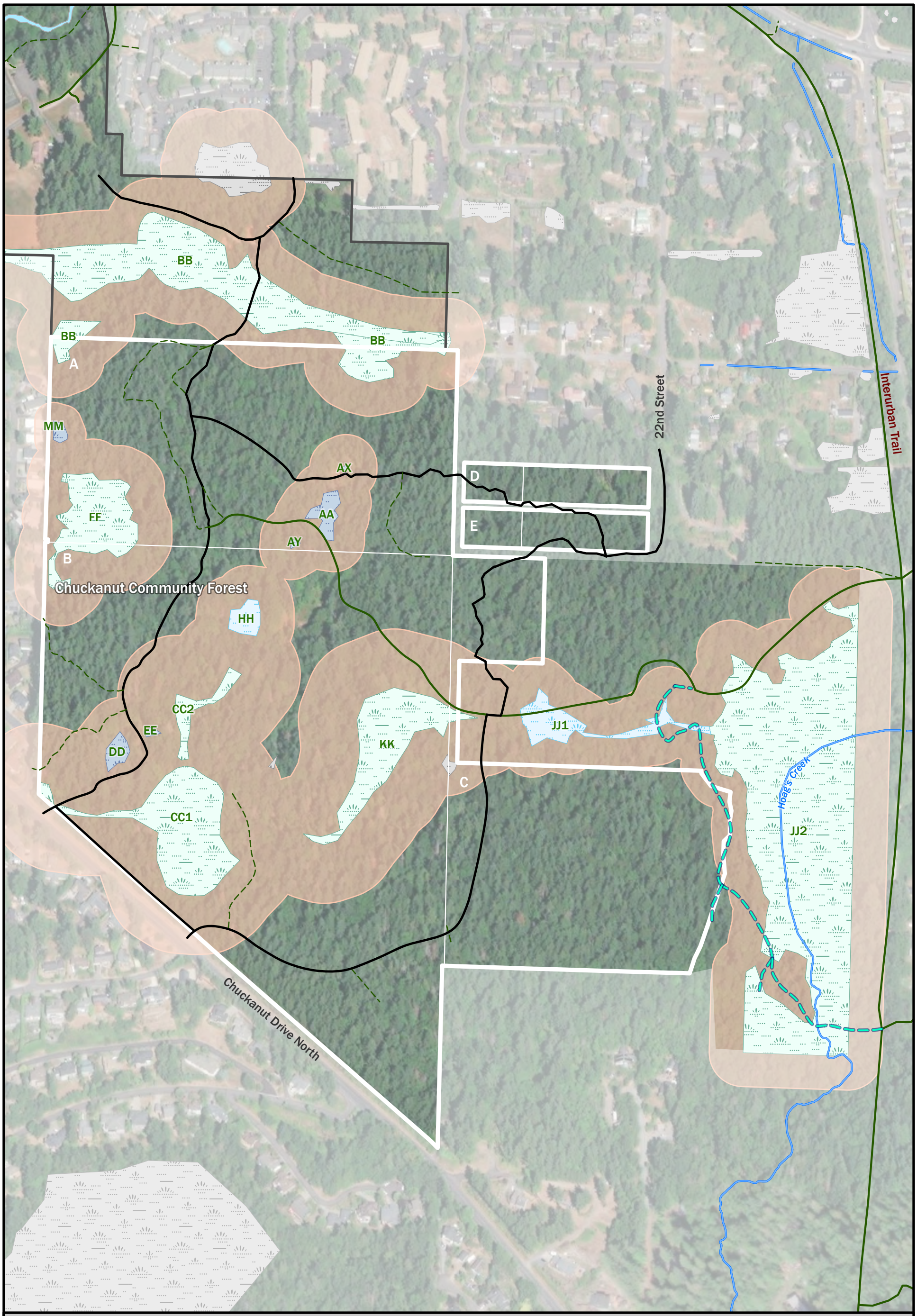

Legend

- Chuckanut Community Forest Boundaries (COB 2021)
- Fairhaven Park
- Water Bodies (COB 2021)
- Streams (COB 2021)

Stewardship Plan Recommended Trails (Herrera 2022)

- Main Loop Trail
- Primary Trail (6-12')
- Minor Trail (1-4')
- Remove or Rehabilitate
- City Proposed Potential Loop Connector

Delineated Wetlands (COB 2021)

- Category I - Mature Forested
- Category II
- Category III
- Wetlands outside project area
- Wetland regulatory buffer

Figure 8. Chuckanut Community Forest - Stewardship Plan Trail Configuration - DRAFT

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0 150 300 600 Feet

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The existing trails adjacent to and crossing through Wetlands AA, AY, and AZ are also directly impacting wetland hydrology, habitat, and buffer functions; and their removal is imperative for the site's recovery. Existing vegetation in this area is low functioning; and invasive nonnative species establishing within the exposed area should be removed and replaced with native tree, shrub, and herbaceous plant installations. A fence that does not impede wildlife migration, but that discourages pedestrian access from the trail into natural habitat areas, such as a two-rail fence (see the Wildlife Habitat Protection section below for more information) should be installed. This area, due to its historical land use and proposed process for its restoration, also presents an excellent educational opportunity. Accessible overlooks from the trail crossing toward the historical gravel pit areas to the north and south are possible locations for interpretative signage additions.

Nonnative and invasive Himalayan blackberry (*Rubus armeniacus*) dominates the vegetation in the adjacent depressional area to the south of the trail, also a remnant from former land use gravel extraction. Its removal and replacement with native plant installations is recommended; however, this work is not as critical as the recommended trail improvement and restoration of the wetlands to the north of the trail crossing.

Area B: Wetlands CC1 and CC2 Hydrology Connection Trail Crossing

Current review of the CC1 and CC2 wetlands indicates that these areas should be combined as a single Category I mature forested wetland under City Environmental Critical Areas regulations with a standard designated protective buffer width of 190 feet. The existing trail, accessed from Chuckanut Drive North, which bisects the wetland, is impacting the system's natural hydrologic surface water connectivity (Photos 5 and 6). The highest level of preservation recommended for this area would be to remove the trail, as alternative trails connecting the View Crest trail access with the existing main roadbed trail to the northern portion of the site are already present.

Photo 5.

Photo 6.

Trail abandonment may be readily implemented through the installation of large logs, stumps with root wads, two-rail fencing, and dense native vegetation plantings. Herrera biologists, when in the eastern interurban trail network, noticed that a minor trail had apparently been abandoned as a natural circumstance of a fallen tree that had impeded easy pedestrian access. Signage alerting users to the sensitivity of the CC1/CC2 wetland complex and its associated wildlife habitat and therefore a need to restrict its access could also be installed in this location.

City Parks staff, in reviewing the potential for a more direct north/south loop trail connector trail on this portion of the forest, identified a route that could minimize potential direct buffer impacts by utilizing portions of existing trails while also extending new trail segments within the unregulated forest areas between the CC and KK wetland complexes, as illustrated on Figure 8. As a component of the City's permitting and critical areas compliance review for any new trails or proposed improvements to existing trails, a previously mapped small wetland within the vicinity of this proposed route will need to field investigated and its critical areas regulatory status updated according to current municipal code for impacts analysis. The proposed route would result in maintaining the Wetland CC and Wetland KK complexes as two eco-regions bisected by trails, rather than consolidating these complexes into one larger relatively undisturbed protected habitat corridor with no bisecting trails, as recommended by Herrera.

Area C: East Cross Road Trail Improvement – Wetlands KK and JJ

Seasonal surface water connectivity between the mature forested Category I Wetlands KK and JJ is at a crossroad on this portion of a well-used but oversized trail located within and adjacent to the CCF's eastern boundary (Figure 7; Photos 7 and 8). The installation of a culvert, bridge, or boardwalk structure, or other low-impact development measure (such as a ballast rock base or "burrito") is recommended, as well as reducing the overall width of the trail to 6 feet or less. Exposed soil areas outside of the 6-foot width should be revegetated with densely planted native shrubs and ground cover plants.

Photo 7

Photo 8

Area D: Category 1 Wetland KK Southern Trail Crossing – Recommended for Elimination

The existing ad hoc trail crossing at the southern end of Wetland KK, a Category I mature forested wetland, is recommended for removal. The proposed main trail loop does not include this portion of the site, and therefore trail-related impacts to Wetland KK and its associated buffers can be avoided. By eliminating this trail crossing, the total extent of the City's standard 190-foot-wide buffer designated to protect the wetland at this location can be restored and protected. To remove the trail and restore the area to a natural state, the procedure outlined in Method for Trail Removal below should be followed. Photo 9 shows the existing trail at the southern end of Wetland KK that is recommended for removal.

Photo 9

Area E: 16th Street and Chuckanut Drive Entrance Access

The existing access to the CCF from Chuckanut Drive and across from 16th Street crosses a piped segment of a ditch that discharges seasonal surface water flows from the Category I mature forested Wetland CC1 to a storm water drainage system within the Padden Creek subbasin (Figure 7; Photos 10 and 11). Although not formally delineated, a degraded reed canarygrass dominated Palustrine Emergent (PEM) wetland that parallels the ditch extends north to the road corner. This area needs restoration to improve the diversity of native vegetation and appropriate sizing of the existing conveyance pipe should be evaluated to ensure that site hydrology is managed. A new trail corridor that would provide connectivity along Chuckanut Drive between View Crest Road and 16th Street is recommended for consideration to support the removal of existing trails that surround and directly impact Wetland CC1 at the site. Improvements along the new roadside trail corridor to provide additional parking are also recommended.

Photo 10

Photo 11

Area F – 16th Street Entrance

The existing pedestrian access into the CCF from the residential community at the east end of 16th Street is encumbered by an open roadside ditch that conveys seasonal surface water flows west from the corner of Chuckanut Drive (Figure 7; Photos 12 and 13). Crossing of the ditch, which is currently spanned by a single wood plank to provide ad hoc trail access, should be improved through the installation of a properly sized culvert pipe (12-inch diameter, minimum).

Photo 12

Photo 13

Area G: Wetland JJ Drainage Improvement

Although not located directly within the CCF, Herrera biologists identified a sizable drainage along the Wetland JJ open space corridor that is creating the potential for continued site degradation and soil erosion downslope (Figure 7). Management of the hydrology of this drainage with a properly sized culvert pipe (12-inch diameter, minimum) is recommended.

Method for Trail Removal

The following steps for trail removal are to be implemented in the dry season (June 1 through September 30). Planting should occur early in the wet season to maximize survivability:

1. Secure permits for all work within wetlands or their buffers.
2. Remove plank crossings and other debris.
3. The entire width and length of the trail should be ripped to a minimum depth of 18 inches with a machine-mounted soil ripper.
4. A topsoil layer with a minimum organic matter content of 10 percent dry weight should be established in the ripped area by placing 3 inches of coarse compost meeting the requirements of Section 9-14.5(8) of the Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge, and Municipal Construction over the entire ripped area.
5. After placing the compost, rototill it into 5 inches of native soil (a total amended depth of about 9.5 inches, for a settled depth of 8 inches).
6. Densely plant the area with native plants and shrubs.
7. Install 30 to 50 LF of two-rail fence where the trail to be removed connects to other trails as per City of Bellingham Drawing 2840.06.
8. Install one "Stay on Trail" sign in the center of the new fence section per City of Bellingham Drawing 10430.10.

Method for Reducing the Ecological Impacts of Trails

The following methods can be implemented to reduce the ecological impact of the trails to remain.

Establishing Trail Standards

A set of trail standards should be established for the site and each trail segment to remain should be assigned a surface and a width as part of the master planning process. The City of Bellingham Parks Department has published standards for gravel surface trail sections but does not have standards for narrow foot paths with native soil surfacing. The May 2021 Bellingham Trail Guide lists a width of 6 to 12 feet for "Primary Trails" and 1 to 3 feet for "Minor Trails." Table 4 from the *Seattle Parks and Recreation Soft Surface Trails Management Plan* (Figure 9) shows the Seattle Parks Department's "Recreation Trail Classification and Maintenance Goals."

Table 4. Seattle Parks and Recreation Trail Classification and Maintenance Goals.

Soft-Surface Trails	Surface	Width	Level of Service Goals
Secondary Trail: No vehicle access.	Crushed rock	2' – 4'	• Inspection: 1x/year • Routine Maintenance: 1x/1–4 years • Major Maintenance: rare • Wood Replacement: 1x/10–15 years
Primitive Trail: Pedestrian only. Allows some obstacles, such as a log that can be stepped over.	Mineral soil	1' min.	• Inspection: 1x/2–3 years • Routine Maintenance: rare (as needed) • Major Maintenance: rare (as needed) • Wood Replacement: 1x/10–15 years

Source: *Seattle Parks and Recreation Soft Surface Trails Management Plan*

Figure 9. Table 4 from Seattle Parks and Recreation Soft Surface Trails Management Plan.

In addition to the gravel and mineral/native soil surfacing, trails can also be built on structures (i.e., bridges over streams and elevated boardwalks through wetlands) and can be paved with hard surfacing such as concrete or asphalt, which can be designed to be pervious. The following trail standards are presented by surfacing type from the most to least formal. For each segment of the onsite trail network to remain, a trail/surface type and width should be assigned and then maintained.

Herrera developed the planning level costs shown in Table 6 for developing new 6-foot to 8-foot-wide crushed limestone primary trails per City of Bellingham Standards through undeveloped areas. These costs are fully burdened and reflect a full project cost inclusive of project management, planning, design, permitting, mitigation, and trail construction including all amenities (i.e., bollards, benches, signage, sidewalks and ramps, etc.). These costs are based on bid tab analysis from built projects in Bellingham over the past few years.

Table 6. Planning Level Trail Construction Costs.

Trail Type (6 feet wide)	Trail Cost ($ per LF)
Pervious Concrete Trail in Uplands	$300
Crushed Limestone Trail in Uplands	$160
Crushed Limestone Trail in Wetlands Buffer	$410
Crushed Limestone Trail on old roadbed in Wetlands Buffer	$210
Wetland Boardwalk	$1,000

Paved Hard Surface Trail

Trails in the highest traffic locations can be paved with a hard and durable surface such as asphalt (such as the segments of the Whatcom Creek trail from Railroad Avenue to Ellis), or concrete (such as a typical sidewalk). In some cases where the soil and site conditions are appropriate, a hard-surface trail can be made pervious (such as the trail from Westridge Place to Magrath Road near Northridge Park; see Photo 14).

Hard-surface trails are not appropriate for use in the Chuckanut Community Forest and are presented only for completeness.

Photo 14. Pervious Concrete Trail, Westridge Place, Bellingham, Washington.

Gravel Soft Surface Trail

The majority of the developed trails in the City of Bellingham's park system are considered "Primary Trail" and are surfaced with 1/2-inch minus crushed limestone in varying widths (most commonly 6 to 8 feet); the trails are designed in compliance with Chapter 1515 of the WSDOT Design Manual for "Shared-Use Paths," available here: <https://wsdot.wa.gov/publications/manuals/fulltext/M22-01/1515.pdf>. As per WSDOT, shared-use paths are designed for both transportation and recreation purposes and are used by pedestrians, bicyclists, skaters, equestrians, and other users. The existing roadbed in the Chuckanut Community Forest is proposed by the City to be this type.

The City's standard plan (Drawing 2505.1) for limestone shared-use paths can be found here: <https://cob.org/wp-content/uploads/02505.01-typical-trail-section.pdf>. An example of this type of trail is shown below in Photo 15. Managers should weigh the needs for city maintenance, ADA accessibility, and recreational users against the importance of preserving ecosystem functions within the CCF before installing this type of high impact trail.

These trails frequently have 8-foot-wide hard surfaces and therefore can accommodate occasional use by park maintenance vehicles

Photo 15. Typical Crushed Limestone Trail from Herrera's Design at Julianna Park, Bellingham, Washington.

Trails on-Structure

The preferred method to cross wetlands or streams with a trail is with a bridge or boardwalk structure. Several vendors (such as Contech or Big R) provide pre-fabricated pedestrian bridges that meet the City of Bellingham's standards for crossing streams. Using a pre-fabricated bridge is typically the most cost-effective approach to providing stream crossings when compared to a custom-designed and site-fabricated bridge; see Photo 16.

Boardwalks with open grating can be built on pin piles or other low-impact pier foundations within wetlands and largely avoid impacts requiring mitigation; see Photo 17.

Photo 16. Example Pre-Fabricated Pedestrian Bridge from Herrera's Design at Pressentin Park, Marblemount, Washington.

Photo 17. Example Wetland Boardwalk Design from Herrera's Work at Fairhaven Park Adjacent to the Site, Bellingham, Washington.

Narrow Foot Path

Narrow foot paths 1 to 3 feet wide are surfaced with native soil and represent the secondary trail network. Most of the existing trails on site are this type; however, many of them are wider than the 1 to 3 feet necessary, and minimizing their footprint is encouraged.

Installing logs along the outer edges of a redefined narrower trail width is a low-cost measure that will restrain but not impede current trail uses. Native shrub and ground cover plant installations along the outer edges of the formerly wider trail can aid in restoring the impacted areas within a short time frame of only a couple of years. Mulch can also be applied along the trail's formerly wider edges to discourage nonnative plant encroachments and retain soil moisture for regenerating plants.

In addition to the City of Seattle reference above, the USFS Trail Class Matrix (<https://www.fs.fed.us/recreation/programs/trail-management/documents/trailfundamentals/National_Trail_Class_Matrix_10_16_2008.pdf>) can be useful in classifying less formal tails. The existing narrow footpaths on the site are a combination of Trail Class 2 and 3, as shown in Figures 10 and 11.

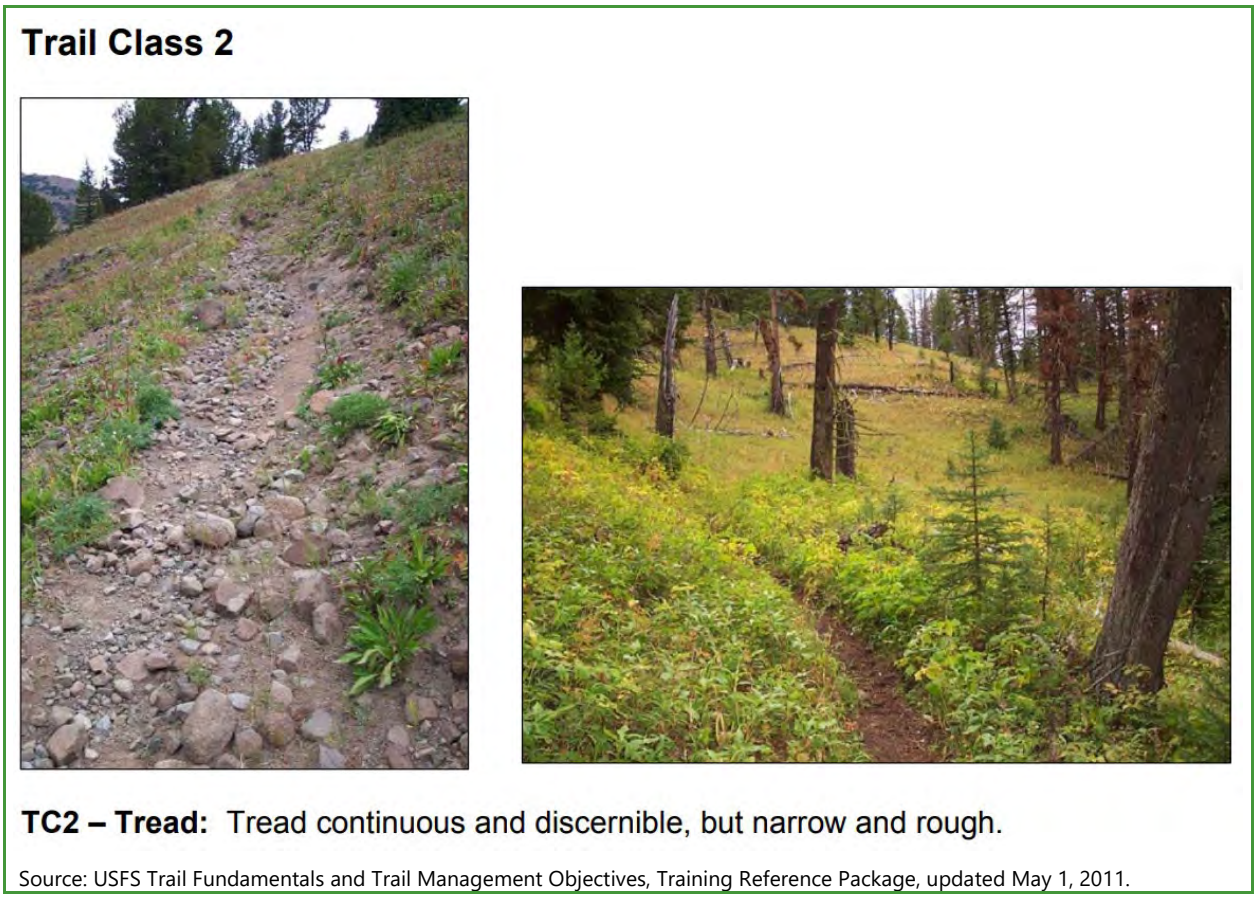
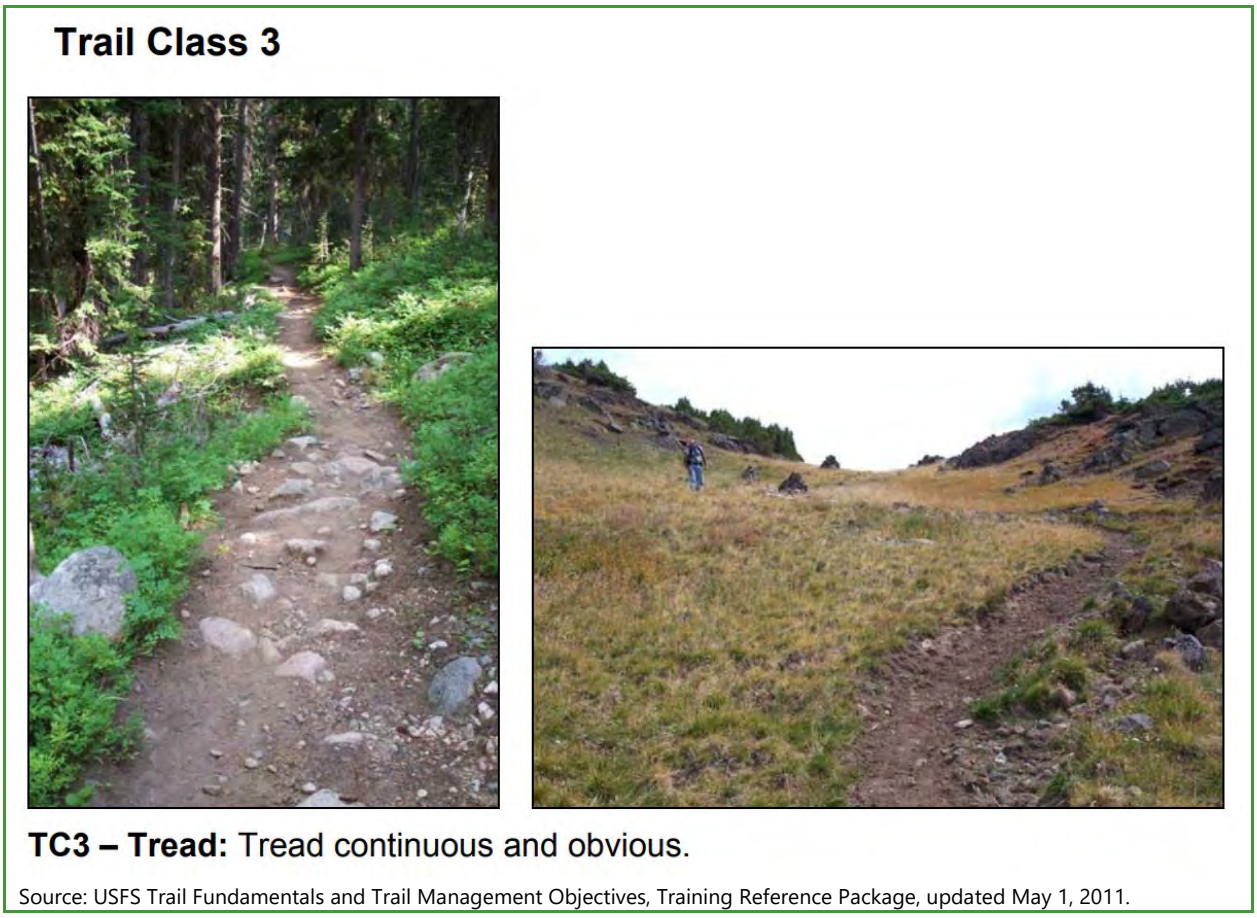


Figure 10. Trail Class 2 Example Photographs, USFS.



Source: USFS Trail Fundamentals and Trail Management Objectives, Training Reference Package, updated May 1, 2011.

Figure 11. Trail Class 3 Example Photographs, USFS.

The images below show examples of Trail Class 3 narrow foot paths in the Chuckanut mountains.

Photo 18. Trail Class 3 Chuckanut Mountains Example Photograph, Whatcom County Parks & Recreation.

Photo 19. Trail Class 3 Stimpson Nature Reserve Example Photograph, Whatcom County Parks & Recreation.

Maintain Site and Wetlands Hydrology

In many locations on site, trails and the existing roadbed were built by compacted soils that interrupt the flow of both the sheet flows on the surface and the shallow groundwater flows, also called interflow. In some locations stormwater flows are on the surface and concentrated in a watercourse that does not rise to the level of being classified as a "stream."

To convey shallow concentrated flows, a simple culvert can be used (see Photo 20 for an example).

Photo 20. Example Culvert Installation Under a Trail.

Sheet flow and interflow interrupted by the compacted soils below the trail can be restored by replacing the subgrade with permeable ballast rock wrapped in geotextile fabric (informally referred to as "burritos"), as shown in City of Bellingham Drawing 2505.04 for "TRAIL W/RAILROAD BALLAST," which can be found here: <https://cob.org/gov/rules/standards/park-design-standards>.

Wildlife Habitat Protection

The USFS recognizes adaptive management and monitoring as important management tools to conserve ecosystem processes and functions while providing recreation opportunities (Gaines et al. 2002). To minimize habitat fragmentation and disturbances to wildlife from trail users, trail density should be minimized or reduced from its current state. Trails that intersect high-priority areas should be assigned a higher priority for removal or restoration.

Several studies emphasize that the "area of influence" around trails is of importance (Tulalip Tribes 2021; Taylor and Knight 2003). Implementing buffers can help managers calculate the amount of area potentially unsuitable for specific species due to trails. Trail buffers can also help managers address spatial zonation in conjunction with temporal restrictions and the creation of suitable habitats away from highly used trails (Tulalip Tribes 2021).

To change recreation behavior or timing, increasing the knowledge of trail users may be an effective tool for detouring off-trail activity and improving the acceptance of management strategies (Tulalip Tribes 2021).

Specific actions that should be considered for incorporation into CCF management include:

- Minimize displacement/avoidance interactions for species of interest by creating a spatial separation of humans and dogs and in key habitats (i.e., Priority Areas).
- Establish or restore natural corridors free from trails that connect significant habitats located adjacent to the CCF (Padden Creek, Hoag's Pond, Chuckanut Creek, Mud Bay).
- Incorporate temporal separation of humans and species of interest at critical periods such as breeding and nesting periods which may include seasonal closures of trails.
- Provide information and education to recreational users to minimize human behaviors that may impact wildlife. Ideas include increasing educational signage, implementing a docent stewardship program, or engaging the public in a citizen science monitoring approach.
- Create recreational and restoration designs that incorporate wildlife habitat values and special features during all phases of project design.
- Create wildlife crossings at major roads by creating underpasses or overpasses.

Two techniques for separating people from wildlife and protecting habitat include fencing and dense native vegetation installations, such as are shown below in Photos 21 and 22. The fencing shown in the images is two-rail fence, as per City of Bellingham Drawing 2840.06. Along with this fencing, a "Stay on Trail" sign per City of Bellingham Drawing 10430.10 should also be installed. Both of these can be found here: <https://cob.org/gov/rules/standards/park-design-standards>.

Photo 21. Wildlife Separation and Habitat Protection with Dense Vegetation.

Photo 22. Wildlife Separation and Habitat Protection with Two-Rail Fence.

Additional Habitat Opportunities

Abundant snags and large woody debris within the CCF provide excellent foraging, shelter, and refuge opportunities for a variety of insect, amphibian, bird, and small mammal species that

utilize wetland and forest habitats. Retaining large trees and snags are essential roosting and foraging habitat for many species. Roosting habitat, while best provided by natural forest processes, may be supplemented by adding special habitat features, such as bat boxes, to encourage bat roosts and nesting boxes for birds which can increase opportunities for various wildlife in the near term, presumably while recruitment of these structures is developing naturally under proper forest management. Underplanting with native species should be targeted to areas where understory vegetation was sparse. Plants that provide high value for wildlife forage, such as beaked hazelnut (*Corylus cornuta*) can be used to increase forage opportunities throughout the CCF.

Photo 23.

Photo 24.

Bat Houses Provide Refuge for Area Bats.

Monitoring and Additional Studies

Ongoing Monitoring and Maintenance

Monitoring and maintenance will be essential to the success of the Master Plan over both short and long-time scales. Because CCF differs from other COB Parks in many ways, it will require a unique monitoring program. Monitoring will be essential to adaptive management and any other programs or decisions to address changing conditions.

Monitoring to ensure no new trails are constructed or illegal camping occurs should be a regular Parks operational management measure. Ongoing invasive plant monitoring and removal as prescribed by the Parks operational guidelines is recommended. However, the use of pesticides and herbicides is discouraged. Manual pulling of invasive plants and disposal off site is preferred. The Washington State and Whatcom County Noxious Weed Programs should be consulted for additional information on the proper removal methods, safe handing, and disposal of noxious weeds (Washington State NWCB 2022, Whatcom County NWCB 2022).

The City coordinates educational and volunteer stewardship programs related to ecology restoration and trail maintenance activities based on an annual plan and schedule for implementing effective invasive plant removal and native plant installation according to growth habits.

Monitoring the success of restoration efforts, where native vegetation and habitat features are installed and soil decompaction measures and hydrology connections are implemented, shall be conducted according to site specific performance standards and time periods. Typically, environmental regulatory agencies authorizing restoration of forested upland and wetland areas require the proponent's submittal of monitoring compliance reports in Years 1, 2, 3, 5, 7 and 10 after installation. When monitoring indicates that the prescribed restoration measures are not meeting the site's performance standards, contingency measures or plans to re-evaluate the restoration actions are to be developed. Representative performance standards for monitoring plans may include, but may not be limited to, installed native plant survival, native plant species diversity, percentages of canopy and non-native and invasive plant vegetation cover, hydro-period durations and use of habitat features by wildlife.

Table 1 in the 2017 Baseline report provides a framework for tracking the CCF's ecological health, functions and value over time, such as its ability to both capture/store water and carbon and produce oxygen, which will be extremely important as the climate changes (Eissinger, 2017). Adding additional quantified data to track the CCF's existing conditions, including conducting additional studies, as recommended below, will ensure that future changes in the CCF are measurable for adaptive planning.

Additional Studies

The detailed plant and animal lists presented in the 2017 Baseline Study for the CCF can serve to initiate monitoring for species use and habitat conditions. Within the Bellingham city limits, wetland delineations and ratings are valid for a period of 5 years (BMC 16.55.280E; BMC 16.55.290C). Before any project actions are conducted, applicable wetlands will need to be re-evaluated to determine if any changes in wetland conditions have occurred and to assess whether updates to the 2014 Rating System or the City of Bellingham code alter buffer widths. Based on observations of connectivity between the site wetland hydrology and buffer areas, re-evaluation of the CCF as one connected habitat complex could be considered to justify categorical wetland ratings and or higher buffer protection. The City's director has the authority to increase the standard buffer width on a case-by-case basis when a larger buffer is required by an approved habitat assessment as outlined in BMC 16.55.480©.

Several additional research needs were identified during the development of this report. These include:

- Long-term effects on forest health due to changing climate conditions were not investigated for this report. Future areas of study should include this analysis to help inform forest fire and drought planning.

- An assessment of forest maturity using peer-reviewed, science-based sources is needed to accurately depict forest community at the CCF.

- Habitat connectivity should be informed by site specific analysis using best available science.

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APPENDIX A

Chuckanut Community Forest Park Board July 7 and 27, 2022, Public Hearing/ Meeting Minutes

Public Hearing Minutes
CHUCKANUT COMMUNITY FOREST PARK DISTRICT
Wednesday, July 6, 2022
Online Meeting Through Zoom
Mailing Address: PO Box 4283, Bellingham, WA 98227

Official email addresses for Commissioners, where public may send comments (subject to public disclosure):
Frank James fjames.ccfpd@gmail.com John Hymas jhymas1331@gmail.com
John McLaughlin johnm.ccfpd@gmail.com Hue Beattie hue.ccfpd@gmail.com
John G. Brown jbrown.ccfpd@gmail.com

Our Mission: The mission of the Chuckanut Community Forest Park District is to ensure the entirety of the property is protected in perpetuity in public ownership, with respect for its ecological, recreational, and educational functions and to serve as a fiscal mechanism through which the district, via a tax levy, will repay the City of Bellingham for the Greenways Endowment Fund loan.
This meeting will be recorded. A visual and audio recording of this meeting will be posted on the CCFPD website. If your camera is on during the meeting, your voice, likeness, and surroundings, will be publicly available and viewable on the CCFPD website. If you choose to speak with your camera off, or by calling on a telephone, only your voice will be recorded.

Call to order: Welcome Commissioners and Citizens. Per Chapter 42.30 RCW (Open Public Meetings Act), CCFPD board meetings are open to the public. Due to the Covid-19 outbreak and the Governor's "Stay At Home" Order, this meeting of the Chuckanut Community Forest Park District will be conducted online on Zoom.

Roll Call: Frank James (President), John Hymas (Clerk), John McLaughlin, and Hue Beattie present. John Brown excused.

Motion: by John McLaughlin to approve the Agenda for today's meeting. Second by Hue Beattie. Approved 4/0.

Introductions: Those who wish to be acknowledged including legal counsel, Catherine Moore, secretary Robyn Albro, Chris Webb and Tina Mirabile from Herrera Environmental.

Open Public Hearing on Stewardship Plan and Master Plan
Frank James: Tonight's event is a public hearing. This is the first of two hearings. This hearing is a presentation of information about both the Stewardship Plan, which is recently completed, and also a presentation of the information in the Draft Master Plan that the City Parks Department did to try to present all the information that citizens would need to meaningfully participate in the further development and clarification, and perhaps correction of some of the plans that have been made in these two efforts to preserve the 100 Acre Wood and make it a place where the public will be welcome and where the public can interact with nature in a very meaningful and unique way that isn't available elsewhere.

We'd like to welcome all of you. The first part of the meeting is going to be a presentation by Tina Mirabile and Chris Webb, who work with Herrera Environmental. They're both long term members of our community. They have been very involved in volunteering for the preservation and appropriate development of this parcel. We were delighted that they were able to bring their scientific expertise to join us. The second presentation is going to be by John McLaughlin who has a PhD in Ecology from Stanford University and who teaches at Western Washington University. He'll be doing the presentation about the Parks Draft Master Plan.

Next, people can ask questions first after the presenters present and then we'll have a period of time when anybody who wants to can make a comment. The documents are posted on our website. There are beautiful graphics and lots of information in both documents. I encourage everybody to read them and then on July 27th, at our next scheduled board meeting, we will have a second public hearing, hopefully where people can come better informed with productive comments where we can go back and make recommendations about modifying these documents.

Presentation on Stewardship Plan by Chris Webb and Tina Mirabile of Herrera Environment Consultants
My name is Chris Webb and I'm a civil engineer with Herrera Environmental Consultants here in Bellingham. I've been a practicing civil engineer in Bellingham since 1995 and my practice is focused on reducing the environmental impact of our infrastructure and focusing on stormwater management and leading projects in sensitive ecological areas. There are about 10 of us here in Bellingham and we have our headquarters in Seattle. We were retained by the Chuckanut Community Forest Park District to prepare this Stewardship Plan and the lead author of the plan is Tina Mirabile, who's an ecologist in our office and I'll let her introduce herself as well as take us through the nine slides that summarize the high-level scope and scale of the Stewardship Plan. The complete plan is 75 pages long and it's on the District website for more detailed review.

Tina Mirabile: Thanks everyone for your interest in this. I just want you to know technically I feel a little bit at odds because I'm actually calling from my cell phone. I wanted to recognize Danielle Rapoza who is also on this call. She is the co-author with me and actually a lot of the beautiful photos and graphics in this presentation she also pulled together for us today because I was in the field today. I'm a senior ecologist and professional land scientist and I've been in Bellingham since 1995 in a regulatory capacity at Whatcom County and the City of Bellingham, so kind of in a different role.

First slide: The purpose of this document is to support the Chuckanut Community Forest Park District's mission: To ensure that the entirety of the Chuckanut Community Forest, which is 82 acres of forested property, is protected in perpetuity in public ownership with respect for its recreation and educational functions and the plan is intended to contribute towards the City's Park Master Plan, which John will be presenting an overview on after our presentation. We're trying to provide a framework for the protection, conservation and restoration of the Community Forest and it's also been prepared to support the joint Community Forest Park District in developing an updated conservation easement that will define the future use and management of the site. So, we used a couple of methods to approach the project. One was we reviewed and built upon past studies, of which there have been many, but I'm highlighting a few of those that some of you may already be familiar with, which was the Baseline Documentation report that was prepared by Ann Eissinger in 2017. There's a lot of scientific knowledge that is presented in that report that was very helpful for us to get our hands around the existing conditions on this site. Then we also were able to tap into a wetland tree survey that James Lucia at the City of Bellingham did. He was an arborist for Park Operations in 2009. Then we also used lots of available maps and GIS data, mostly from the City and Washington Department of Fish and Wildlife and other sources. We also conducted a field investigation. The purpose of that was to use best available science to inform the long-term restoration and stewardship of the Chuckanut Community Forest. We concentrated on developing restoration needs and strategies and prioritizing areas for presentation. We did ground truthing in trying to get at the forest structure as part of our field investigation.

The very next slide shows one of the several figures, but this one summarizes the locations of the wetlands. There were 16 identified by prior delineations at the site, but a lot of that information was from 2009. So, in order to be current with code and methodologies from the City as well as Ecology, we updated those ratings. The wetland ratings and the buffer widths are wider now than what they would have been in 2009. We also use hydraulic modeling to estimate the surface water connections on how all of these wetlands in the forest work and share together important habitat. In doing that we came up with five categories to prioritize protection areas with the highest being category one mature, forested wetlands, which is a relatively rare habitat in the state. Then other wetlands were also prioritized, they came in second as important. The hydraulic modeling showed the non-wetland drainages that we wanted to highlight to make sure that as the Forest gets utilized that we're not impacting those hydrology connections and trying to preserve the surface water flows and groundwater flows throughout the property. Then the City's regulated buffers were the fourth priority for protection. Then the non-critical area regulated upland forest and even though it might not be regulated as a critical area, it's still a very important habitat. This is why we love the Community Forest, it's an intact forest within our residential urban community, so it still is important to recognize that those upland forest areas are something we want to protect.

On the next slide we overlaid the trail network as it exists over the priority habitat areas to try and identify areas that need to be prioritized for restoration actions. There are seven prioritized areas labeled A through G on the map. The main actions within these areas are restoring degraded habitat. There's an area called the gravel yard wetlands where we have trails going through, not necessarily forested, there's a lot of opportunity to remove invasive plants and put in more native vegetation. Some of them are about removing trails where they're cutting through wetlands or buffer areas or improving drainage connections, which might be putting in a boardwalk or a culvert. These are areas we identified as, if we can do these things, that will really help improve the forest condition.

The next slide shows ways for soil and hydraulic preservation related to trails. I mentioned boardwalks, but there's also a sense of narrowing some of the trails that have gotten wide to allow a more connectedness with the forest. When you're on a smaller trail, it feels more nature oriented. Also, Herrera is very experienced in doing low impact development methods and we have this thing called the burrito which was done up north. Chris actually led that action, but it's a way of wrapping soils trying to not have them get compacted, but still allow access as a trail through an area that might be sensitive.

Chris Webb: The burrito is a ballast rock wrapped in geotextile fabric. It is actually now a City of Bellingham Parks standard for maintaining shallow groundwater flow, particularly in wetland and conductivity scenarios.

Tina Mirabile: Thanks Chris. The next slide is recognizing the wildlife habitat and what kinds of impacts, how they can occur. There's direct disturbances, which is loving the forest too much, with all the trail users and what time of year we might be in there. If it's wet, then some impacts will be more apparent into soil conditions, hydrology, and activities such as dogs off leash. We did quite a bit of literature review to look at wildlife habitat and how the forest gets used in ways that we can minimize impacts. Also, habitat degradation is another way of impacting the

opportunities for wildlife by disturbing the vegetation that they might be relying on for shelter and refuge. There's also potential for invasive species to be dispersed within the native habitats or even overtake native forest habitats. Just recognizing that we don't want to disturb sensitive areas or cause more habitat fragmentation. With the number and spatial distribution of trails we can separate habitat and lose that connectivity. For instance, some of the trails do go through wetland areas and we want to try to recreate or reroute trails to avoid those impacts.

The final slide is of different methods, as I mentioned, for opportunities for improvement for wildlife habitat in the forest which is removing the trails from the priority areas, preserving, and restoring habitat and hydrology, planting native plants, getting rid of invasive plants, and discouraging off trail use, especially in priority areas, which could be fences or hedges. Signs can be used to educate and formulate behaviors within the forest as people are using it. We need opportunities for ongoing maintenance and monitoring through the years so that we can determine if our restoration actions are actually working and recognize areas that might need to be addressed as things occur, like encampments within the Park space.

Chris Webb: I wanted to add for the users and attendees, that all of the graphics and a lot more are available in the report at a higher resolution, so I'm aware that on the screen in the PowerPoint, it may be hard to see some of the specifics, but all of the figures in the report are high resolution PDF's and so you can zoom in and get much more detail than we were able to share in this overview.

Frank James: Thanks Tina. We appreciate the high-level summary. I think Chris' point that the level of detail in the extensive report is going to be really helpful for review. This is an idea of what's in the report, but really you need to dig into the details and look at the references and begin to review the science to begin to make those difficult decisions about what needs to be prioritized and what we need to do to preserve this parcel of land and this wetlands forest that is unique and our responsibility to protect going forward.

Questions:

Michael Chiavario: I went over the Parks Master Plan final draft pretty thoroughly and for my understanding because I haven't been deeply involved with this process. The plan we just had an overview of is much more environmentally aggressive in terms of protection of the environment than the Draft Master Plan. So, my question is the Draft Master Plan is different and produced by the City with public input from this environmental review that we just saw the presentation of. Can you explain the difference between those two things Frank?

Frank James: I'm happy to. I'll ask Chris to add what he thinks, but basically it was our opinion that the science needed to be looked at in more detail than was done in the Master Planning process. I was on the Steering Committee as were a number of other people. I felt and I think the Commission felt that more science needed to be reviewed to understand some of the really difficult problems. It wasn't a popularity contest of who wants to use the Park for what and how to treat it like any other part. The unique features of this parcel actually really mandate that we do the three things that we mentioned to restore and to protect and to really make this a place that will be there for our children and grandchildren in a relatively pristine state so that means not only protecting what's there but restoring some of the things that were lost. That's really what this contract and this effort was made to do was to augment the work the city did and to make it bring in more science and to bring in a broader array of issues that our science reviewed, then indicate what was important to look at.

Chris Webb: Our effort and the City's Master Planning effort was done in parallel. I think ideally it could have been done a little more in series, but the intent of our plan was to gather up the information, previous studies, update it with current information, and tee up the relevant science to inform the decisions that are made in the Master Plan and provide this report as a resource for that process.

Frank James: There was a discussion in the Steering Committee for the Master Plan development that went to the fact that there was a great hurry to get it done and there was a sense of urgency to get it done so that it could be approved by the Fall. I would have hoped it could have been more a process in series, as Chris says, that this could have informed that process in a better way. We did have one overlapping meeting where we made our consultants available to the City to talk about issues of the science of it. It was a couple hours long and I think it was productive and useful, but I think there's a lot more issues that need to be discussed. I think the upshot, from my point of view, is that these discussions and these studies informing the master planning process is now going to have to take place during the public review period at the upcoming Parks Advisory Board meeting, at the upcoming Greenways meeting, and then in conjunction between our elected Commissioners from the Park District and the City Council, that's really where the opportunity will be to bring this scientific information to bear on the ultimate master planning documents to be developed.

Gerry Wilbour: One comment about the burrito drains at the boardwalk going out of Fairhaven Park. That's a burrito drain approaching the boardwalk, so that's just an example of a functioning one that doesn't look like much from the surface, it's what underneath it that counts. It looked like you had proposed a trail system, on page 40, as kind of your final proposal for a trail system and it looks to me that the most northerly trail you have on that goes north of

wetland A and that trail, I think goes over some very challenging terrain, does it not? There's some really steep area on that ridge top there and just strikes me as a really inappropriate place for a primary trail. Is that accurate?

Chris Webb: The scope of our study was to focus on the stewardship of the property from an ecological point of view, and we did not have as our primary focus the trail master plan from a utility or an experienced recreation experiential point of view. That was the purview of the City's plan. So while we considered some fundamental basic logic of connectivity in our work, we were not attempting to create the trail master plan, we are trying to create a plan that is using that lens so the trail network, and I think its page 45 Gerry that you're referring to, where we show the ultimate endorsed trail plan when we delete the segments that have the highest impact. It was really a division of labor and a focus we had because the city is very clearly doing the trail master plan from a trail's user experienced centered point of view.

Gerry Wilbour: I did read your whole report, but I skimmed it. I may have missed that in the narrative. If that's not clear in the narrative, you might be wise to add something to that effect because I took it quite literally and went oh my god, this doesn't work, from a physical standpoint. I just wanted that clarification and thank you for that.

Chris Webb: We could probably illustrate that a little more clearly that really, we were trying to stay in our lane of property protection and not into the City's realm of more of the experiential planning effort.

Jacob Stewart: Thank you for giving the public an opportunity to ask questions. I had an opportunity to read the 75-page report over the weekend and I found that pretty interesting. The question I had was that it seemed to me that the material recommendations that Herrera was making sort of solely related to trail deletions. I was wondering if you would agree with that characterization, and if not, if you could let us know if you have any other sort of material recommendations.

Chris Webb: It was trail deletions for the reasons of fragmentation of habitat and all of the reasons are described, but also hydraulic connection improvements to improve the site hydrology and to restore interrupted hydrology which will support aquatic habitat. The lion share of the recommendations were around restoring habitat integrity as well as the aquatic habitat hydraulic connections.

Frank James: Written question from Jessica: Could you please go into more detail on how the City's Master Plan scientific methods weren't sufficient. Who determined this? A number of us were involved at the Steering Committee level with the work that City Parks did, and actually Laine Potter and Nicole Oliver are with us tonight in the audience. I think that the issue was that much of the decision-making process involved public comment, and so they had a very effective and good system for getting public input. My feeling was that was more a popularity contest about who wants to do what. If you ask people, do you want to ride your bike here? Lots of people are going to say yes. If you ask people, do you want to walk your dog here, a lot of people are going to say yes. What we wanted was not what's popular or what people like to do, we really want to get to the science behind having dogs there or if having bicycles in the Park makes an impact on the long-term survivability of the ecological environment, so that's the question we sought to answer with the work that was done. Same thing about trails. The Stewardship Plan was not an effort to do or redo or have a substitute for the master planning process. The master planning process is the master planning process. What we wanted to do is provide additional information as Chris just said about the tradeoffs and the impacts of putting a trail one place and not another. We also want to have some idea about the cost of those various projects so that we can realistically plan for what can and can't be done. It might be great to have a good idea, but if you can't afford it, then it's not a real idea, so that's the gist of it. Jessica, I hope that answers your question.

Hue Beattie: I'd like to say something Frank. There are footnotes at the end of the report and one of them I found was quite good. I looked into it a little deeper and I'd suggest that people take a look at it. It's called the impact of dogs on wildlife and water quality. It was a literature review done in April of 2016 by the Metro Parks and Nature by a woman named Lori Hennings. It's available at oregonmetro.gov and it talks about a lot of impacts that people maybe never thought about. I've been thinking, well, here we've got these wetlands that are fairly shallow, and we have all these extra dogs in there pooping and peeing into that water and it heats up in the summer and it's probably quite difficult for a lot of animals to reproduce the frogs and the amphibians and such. So, it's kind of a critical area, these shallow wetlands are quite sensitive I would think. That's something to think about folks.

Frank James: That's a good example of science being brought to bear on it. They went out, found that review they included in this study, so that as we move forward, we can look at what science says about the wisdom of some of the choices, like having dogs in and what the impacts are. It's not a popularity contest, it's actually based. We have to look at the science that informs the decision in order to preserve this parcel in perpetuity to make it as stable and a long-term resource as possible.

Frank James: I'd like to go ahead and move forward then. John McLaughlin, who's a scientist of some repute and one of our colleagues on one of the Commissioners on the Park District has taken a detailed look at the master

planning process and we'll review it at this point and provide additional insights into what's there and how that might be improved going forward. How can we build on what's been done to make it a more robust product?

Presentation on Draft Master Plan by Parks Department

John McLaughlin: Thank you Frank. I hope also to try to keep it brief and what I'll have to say will actually provide a deeper answer to some of the questions people have been asking. In particular, the relationship between the Master Plan and the Stewardship Plan really are quite complementary. The Master Plan needs the Stewardship Plan and I would disagree a little bit with what Frank was saying about popularity contests. I think what we're really talking about is the City exercising its responsibility to decide about what happens to this place. But then they need information on how to achieve their goals. Right now, that information is lacking from the Master Plan and a lot of it is provided in the Stewardship Plan. We really have an opportunity to collaborate and work together.

This is a brief outline. I'll start with our mission statement, how we usually start our public meeting, a statement of what this Park District is all about. A little bit of context for both the hearing and the process for where we go forward regarding this place in our community, a bit of the time frame of how we got here, and where we're going. Then a review of what's in the Master Plan. Tina and Chris reviewed what's in the Stewardship Plan so I'll skip over that and then have a brief list of topics that people might want to consider. I'm sure people have their own topics, but some things to consider as you're reviewing the plans in addition to what I've been thinking. Then I'll yield the floor for public comment.

Our mission is to ensure the entirety of the property is protected in perpetuity. That gets to beyond the grandchildren of our children. In public ownership with respect to its ecological, recreational, and educational functions and to serve as a fiscal mechanism through which the district via tax levy will repay the City of Bellingham for the Greenways endowment fund loan. That latter function has been achieved. The former is ongoing and lasts in perpetuity and much of what I'll have to say is how do you achieve the three main interests of ecological function, recreational use, and educational benefit.

Let me start with a little bit of context to keep in mind as we work with each other, as we consider what the plans are, what our preferences are and all that. First, we are very fortunate to be where we are. We may have principled disagreements about the plan, its policies, about implementation, but I want to remind everyone as of only a decade ago, the plan was to clear cut the forest, to fill most of the wetlands, and to replace the area with buildings, roads, and parking lots. We have this meeting this Master Plan because the Community cared and had input, and we put up money. So, we are fortunate to have the opportunity to decide what's going to happen to this place given that we avoided a very different outcome. Our disagreements are healthy. We may disagree vehemently about policies about what happens, what people are allowed to do, what people are not allowed to do, and so on. But that means people care about this place, that we can actually talk about it, instead of it being a private development.

My second comment is to have respect and empathy for everyone involved. The Parks Department is responsible for a very large portfolio throughout the City. Their responsibilities exceed, really, their resources, staff, funding, and the tools and information they have. The place we're talking about tonight is really important, but it's a small part of their jobs, and so as we talk about this place and about the plans, have our principal disagreements, please remember that the Park Staff has a lot to do and they're doing the best they can with what they have and we should think of ourselves as partners in that process rather than the Commission, the Chuckanut Community Forest Park District Commission. We're all volunteers. You've devoted time, thought, effort without compensation. And so, this is people who care a lot about a place and are doing our best to fulfill our mission to achieve, to serve the community. Everyone has a stake in this place. We all have opinions and so I urge us to listen and to respect everyone. Respect and empathy are vital to the community.

The third part is the Parks Department actually decides policy and management. The Chuckanut Community Forest Park District and its Commission do not. We, as a Commission, cannot outlaw bicycle riding. We can't require you to leash your dog. The hearing tonight is an opportunity to share your ideas about policy and management to support a more robust public process, but the Commission does not get to make or implement any of those policies. We can facilitate public process, public input, public participation in what this place is and that's why. The public hearing process that we're doing and have done over the years is actually quite different than the way the City has done it. The City has had a survey and an open house. The Park District has had years of open public meetings and we've had three hearings in which people get to say what they want, what they think, unscripted, unfiltered, limited in time so that everyone gets to speak, but it is a very different process than what the City has done. So, I hope they're complementary and together yield a better result.

The future of this place and the master plan goals to some degree are in conflict. Goal One in the Master Plan is to restore and protect ecological functions. Goal two is to provide recreational opportunities. These two goals are often intentional and in fact, that's a tension that has played out with every public land management agency across the country and across the world. Recreational use, particularly when it gets intensive often degrades ecological

function. So, the challenge for planning, for implementation, and for management is how to provide for that recreational use, while also doing our best to protect and to restore. Because we are working in the area of classic tension, we should expect to find it here. We should expect to have disagreements. People place different emphasis on Goal One versus Goal Two, so let's keep that in mind too. We are dealing in areas that have tension by nature and that's perhaps a good thing. It means everyone cares. People can find the two documents about the Master Plan and Stewardship Plan at the two websites. Here, the Chuckanut Community Forest Park District website has links to both. The City has a link to the Master Plan. If you want to get to the Stewardship Plan, you have to go to the Park District site.

This basically makes the same point that our intentional recreational use of outdoor places has increased exponentially during the pandemic. It's expected to continue. We have seen the effects of growing use of this place on the ecological function, and so that tension has shifted towards recreation and to the degradation of many of the ecological conditions and ecological functions in the place. Much of the Stewardship Plan is designed to restore this place to support recreational use, but also to restore the ecological functions and conditions that we all value. This [map] is just basically showing the location within a network, a pivotal hub of biodiversity of recreational access and a variety of other things. I'll skip on that and go to the timeline.

So, we are in the middle of a fairly long process. The acquisition of these places started several decades ago, ultimately leading to the last large purchase of the 82 acres that we're calling the Chuckanut Community Forest 11 years ago. The Park District was established a couple years after that, then led to a Conservation Easement with the City in the next year. Over the prior three years we held three public meetings in addition to our monthly public meetings in which people had an opportunity to speak. Three public meetings that considered and took input on what people cared about for various elements of what is now becoming the Master Plan. What do you think about trails, use policy, what do you think about this place? Then the City started its process last year with online surveys, Engage Bellingham, a bunch of volunteers conducted in person surveys at the Chuckanut Community Forest Park. Then last year the Steering Committee met. Frank spoke a bit about what was involved there this past spring. The City held its virtual open house anticipating what the Master Plan would involve, following up with another survey. In April, Herrera released its Draft Stewardship Plan to the Commission, and we've been reviewing it ever since. Last month the City released the Draft Master Plan and then just a few days ago released its "Final Draft Master Plan" and then just a few days ago we the Commission made its final Stewardship Plan available on its web. The plan from here is later this month the City Council will review and vote on the Master Plan. If you read the Master Plan, it envisions two implementation phases with unspecified time frames.

Now I'd like to get into the Master Plan, in particular in the context of this fairly expedited timeline. What does it involve? The main components of the Master Plan are basically outlined by the chapters history of how we got to this place. What's there now? What was the planning process leading to development of the Master Plan and then looking at what are the goals, the strategies, and the milestones for achievement? In the Master Plan implementation strategy, which I will argue, actually the implementation strategy is what is in Herrera's report. It's really not that much detail of implementation in the Master Plan. Then a set of decommissioning criteria to decide which trails to keep and which trails to remove, and then it provides a number of schematics and photographs of what an outdoor classroom might look like.

This is a map of the implementation plan, and so there you can see there are few critical elements. Got a main primary trail that connects the Interurban Trail to Fairhaven Park and then over to Chuckanut Drive. There are a number of secondary trails in here. Some trails are removed, some trails to be retained, and some trails to be realigned. There is in the upper corner, an outdoor classroom, and a variety of other things. That's basically a summary of the implementation plan, details are in the report. Actually, if you want to know what it would take to achieve this map, a lot of the actual work is described in the Stewardship Plan, but it's not really in the Master Plan.

I'd like to give you a glimpse of what is envisioned for this main trail. There's an image in the Stewardship Plan of what that might look like. It's a 6- to 12-foot-wide crushed limestone road or trail, depending on what you want to call it. It conforms to the City's Trail standards. The actual trail in Chuckanut Community Forests would be in forested areas, unlike this rather open area, and it probably wouldn't have rocks along the side, but the trail surface would be very much like this. That's something to consider. Is that what people want for the main trail, again connecting the three major trailheads between Interurban Trail, Fairhaven Park, and Chuckanut Drive and we'd be talking about something that you could drive on.

Another thing I'd like to point out gets into the issue of science in the Master Plan, which includes work from the City's Urban Forestry Management Plan. That plan determined that the forest in the Chuckanut Community Forest or the 100 Acre Wood is what they call young forest tall, and they classify the forest using three categories. The first is the age of the forest, the second is the height, actually the height of the maximum height of trees in the forest, and the third is the structure of the understory. They concluded that the Community Forest is young forest tall, it's in a transition between a young forest and a mature forest. But if you actually look at those three characteristics, the

Master Plan itself notes that the Forest Age is between 90 and 100 years, which puts it well within the range for a mature forest and older than a young forest tall. If you look at the heights, I've got a graph here showing what the maximum tree heights in there are and the average of those heights is at the upper end for a mature forest. By height criteria, the Chuckanut Community Forest is clearly a mature forest and much taller than a young forest tall. Then if you consider the understory structure, in Ann Eissinger's baseline report, she notes 10 species of understory trees in the forest. There actually is a fairly well-developed understory in the Chuckanut Forest, not as well developed as you get in an old growth forest, but it's really commensurate with what we would call a mature forest. The only reason I mentioned this is some of the limited science in the Master Plan and it's incorrect. This forest is by every criteria very clearly a mature forest. The Master Plan, if it does nothing else, ought to get its facts correct. Tina and Chris already talked about this. I echo some of what I said before, the Master Plan has a bunch of goals and there's some very appropriate goals when you review the Master Plan. That's some of the critical things you ought to be looking at. What are the goals for this place? How you achieve many of those goals is in the Stewardship Plan.

In one of the public hearings, this is a summary of the comments people got. They wanted to keep trails. They wanted a primary loop trail. They want to be able to start and finish in the same area but walk through or travel through a considerable portion of the forest. They wanted secondary trails so they could feel like they're alone in the place, which means both you have secondary trails, and you have substantial vegetation at least up to the shrub layer to give them a sense of solitude where they can't look over and see people on an adjacent trail. Boardwalks are ok and you can see the rest of it. There were conflicting comments on both bikes and dogs, or very strong opinions in both directions for both of these interests.

So as people consider the plan, I would suggest these following topics in addition to the ones you may have. I put in large font both bicycle policy and access and dog policies, because those are the issues we've received the most comments on by far. Again, the Commission does not get to decide these policies, this is what the Parks Department does. Please share with us your interests on access or policies regarding both bicycles and dogs, but again, keep in mind that we don't get to decide that.

In addition, the report starts out in both the first and second chapters and mentions indigenous people, but I think does so in a rather disrespectful way as if they no long have an interest in this place, as if they're not here. I think that is a breach that really needs to be repaired City wide, but particularly with this place. There are some elements in the trail plan that are consistent with what we've heard with public input and contradict some of what people heard, in particular, this notion of a wide crushed limestone path or road. Many people have said they actually do not want that in this place. There may be reasons other people do, but that would be something to weigh in on. Many talked about bikes and dogs. The Master Plan Stewardship Plan relationship, the Master Plan, as it's written, does not mention the Stewardship Plan. It needs to because the Stewardship Plan actually provides really valuable information for how you would achieve many of the goals in the Master Plan. I think these are very complementary hand in glove sort of relationship. The Stewardship Plan ought to be part of the map.

Climate resiliency. I think we have a lot further to go on climate resiliency. Components in the Master Plan really underrepresent what is possible here. We, as a commission, have talked about how the place can support climate resiliency, a whole lot better than what's in the Master Plan and we'd be happy to share that fact. We even have designs and reports for how to do that. Finally, what's missing from the Master Plan, in addition to what all the actual work that's described in the Stewardship Plan is a schedule for how Phase One and Phase Two would be implemented. It does break tasks into Phase One and Phase Two but doesn't say when any of those things would happen. A budget for how that's going to happen, again, as Frank mentioned, if you don't have money to do something, then it's unrealistic to expect you're actually going to do it. Then monitoring, we need to know whether what we're doing is working, to determine if our investments are paying off, or if we need to do things differently.

There's a lot more to talk about with the Master Plan. I encourage everyone to read both it and the Stewardship Plan in detail and weigh in because this is your place. This is your city and we're all part of the same community.

Questions

Jacob Stewart: I watched the recording of the last meeting and the Commissioner stated that Park staff will be invited to give a presentation on their plan. Now it's mentioned that Nicole and Laine are here, so it's a two-part question. The first part is why did Park staff not present their Master Plan and then the second part is, why did Mr. McLaughlin spend most of the time presenting information that was tangential to the Master Plan? Or disputing minutiae in it instead of presenting it? Really weird to me.

Frank James: The idea was to present not just the details, you can read that, but to present the context and the relationship. I think that's what John was focusing on, the context of the Master Plan, how it functions and then how it relates to the Stewardship Plan. Both Nicole and Laine are here, and we'd be more than happy to have them comment anytime that they like. Again, this is the introduction of the first meeting and we're going to have another meeting and people can have lots of time to read both these things and become involved. There's going to be a

whole series of other meetings. The Parks Dept is going to be doing a presentation. We haven't been invited to be co-presenters there, but they're going to do both the Greenways Committee and the Parks Advisory Board. We hope to be there and hope to be allowed to present some of the information in this document.

John McLaughlin: Could I add that I did not want to go into all the detail of the Master Plan again, because people can read it, and because I wanted to provide more time for people to weigh in on what they care about this place.

Michael Chiavario: Is it appropriate to comment on a few specifics that are in the Parks Master Plan final draft? I have five things. I will be brief. On page 13 the map shows inaccurate wetland boundaries. There is the area between wetland KK and wetland JJ. One shows those wetlands as having quite a few feet in between them. In reality they run into each other and there is this big intersection there and I've seen previous wetland maps that show those literally touching each other. That's the basis for my opinion that that's inaccurate. I know that the Master Plan calls for repair and restoration of wetlands. I just hope that area will be seen as a wetland in its entirety. The fact that it's kind of a main trail road there is because it was filled in to be a vehicle road by owners decades past and that's why it's dry during some parts of the year and wet on other parts of the year. I'll put these in writing to the City.

On page 26, it talks about the gravel roadbed being improved there. You know there is no gravel roadbed existing within the Park or the 100 Acre Wood? There might used to be, but it's all dirt trail now and before page 26 the survey was cited that said that 86% of people said they did not want a wide gravel road connecting Fairhaven Park and the Interurban Trail, unless that was an inaccuracy earlier in the report. That's a real contradiction there. I, for one, am not in favor of a wide gravel roadbed running through the Park anywhere.

On Page 28, there's talk about removing a trail that's in the middle of wetland JJ. That's great, but it should be noted that wetland JJ isn't really much of a wetland now and hasn't been for some time. There are some wetland plant species there, but the reason it's not really a healthy wetland right now is because it was ditched a long time ago to help drain the area where they put the road through between wetland KK and JJ and that ditch needs to be filled in as part of the restoration. It's not specifically mentioned, and maybe that's already planned, but I'm glad that trail is going to be taken out, but that ditch needs to be filled in that the trail goes across.

There are lists of mammals, non-native plants, and other things in the Master Plan. One of the mammals that is not listed that are definitely present in the woods are cougars. Just wanted to make that point. They're not on the list, but they're definitely in the woods. They're frequently seen. Also, amongst the non-native plants there are non-native filberts particularly along the more well used trails. These filberts are all infested with blight and that spreads to other filberts in the area. Other mammals that were not listed but have definitely lived in the Park were beavers. They were present a couple of years ago in the Hoag's Pond section that is covered in the Master Plan. There was one beaver present. It's since gone. There used to be a family of beavers in wetland JJ that really made that a much healthier wetland because they maintained a dam at the outlet creek from wetland JJ too. So, I think beaver should be added to the mammal list. They should be returned, and they should be strongly considered as part of restoring the wetland JJ because it will keep it wet for all or most of the year if that dam is maintained by those animals. I will put these things in writing of course to the City, but just wanted to mention them. Thank you.

Vince Biciunas: I had three points that came to mind during the presentations, and one is to bring to your attention and to remind you, as you probably know. But remember when we had the floods, the epic floods last November 2021, I remember going through the Forest and noticing that it functioned hydrologically perfectly. There was no flood damage with the Community Forest after that heavy heavy rain, whereas along the Interurban Trail on Padden Creek there was one area right under the 12th St. Bridge that needed repair. I'm just bringing to your attention that hydrologically, it is a sponge and it work like a sponge, and it probably saved our community from some flooding just because of its existence, so climate resiliency, yes.

The second point is that the Interurban Trail exists around the perimeter of the actual 82 acres. So, bicyclists, if they're looking for a commuter route, it's already there so we don't absolutely need to have bicyclists for commuting purposes going through the forest and especially I'm concerned about the section from the gravel pit down to 18th St. and down to Fairhaven Park. That's a pretty steep section, and so if we want to have a loop trail that includes that loop, it's going to be difficult to make it bicycle friendly, so maybe we don't really need that in the end, and then I also wanted to bring to everyone's attention that this Master Plan covers more than just the 82 acres and that the Chuckanut Community Forest is an 82 acre section that has a Conservation Easement to protect its integrity. We need to remember that when we're talking about what are the recreational uses allowed there and the recreational use allowed in the bulk of the Master Plan is one thing, but that within those 82 acres, we need to think about that Conservation Easement. That's my three points. Thank you.

Frank James: Chris, you and Tina reclassified one of the wetlands or you believe they should be reclassified formally and could you briefly speak to that issue.

Chris Webb: I'd prefer that Tina address it directly because she did do the re-rating based on the hydraulic conductivity issue that was raised. That is addressed in the report under the wetland section. Tina did go out and observe the hydraulic conductivity. That resulted in a re-rating of the wetland which resulted in larger buffers because of that. The fact that that is really functioning as one large system rather than two separate ones.

Tina Mirabile: Chris pretty much answered that. That information was documented in more than one of the background documents that we read, and when we did our field investigation, although we didn't delineate the wetlands, we definitely saw surface water connection that made it very apparent that those two wetlands are or should be functioning as one and so we re-rated the wetlands as one unit, which gave it a higher category for functions than it would be as two separate. Then we also recognized JJ1 and JJ2 is another area for wetland consolidation in one system, as was previously mentioned by Michael Chiavario. I also just wanted to say that when the City or Parks Department does start to do any restoration actions, in order to meet the City's permitting requirements, wetland delineations are going to need to be actually performed and updated with the current code and then there's mitigation sequencing for how your project either avoids, minimizes and or mitigates for any impacts. So, there is a process for any actions that occur in regard to trails rerouting or hydrology connections that would need to happen as a part of this, the City's normal process for authorizing those type of restoration actions.

Chris Webb: And not just restoration actions right Tina, any actions if we were to do development activities such as trail improvements and the like. Right? Tina Mirabile: Yes.

Frank James: Andy has written in and says past meetings have referenced the ecological impact of bicycles justification to limit this user group. In developing the Stewardship Plan, did Herrera find any research regarding whether bicycles have a disproportionate impact compared to other user groups, such as walkers.

Tina Mirabile: It was kind of contrary to what you would think with the research that we were able to review that basically the disturbance from mountain biking to wildlife is pretty much similar to that of even someone just walking through the trails, but that doesn't necessarily mean erosion impacts and other things that happen with a bicycle going through an area, especially if its saturated, which many of the trails where we don't have good hydrological draining or connection are going to be definitely impacted differently by bicycles. As far as disturbance to the wetland, it wasn't that significantly different than just actively walking through trails oddly enough.

Chris Webb: But the other thing to keep in mind too is the presence of the trail at all, right? I think that's really the finding in terms of the impact to habitat in terms of fragmenting the intactness, the size of the habitat units and so forth by having the trail there at all I think is the real bulk of the impact.

Frank James: Bicycles about the same or similar to other users of trails, but the trails having an impact themselves and that's for wetlands and animals, but there is erosion widening of trails and other issues that are related to bicycles that do make a significant difference and I think that we get evidence about that. Chris Webb: Yes.

Frank James: I'd love to have either Laine or Nicole speak up if you'd like.

Nicole Oliver: I'm Nicole Oliver, the Park Director of the City. My staff and I have reviewed the Stewardship Plan. We will be reviewing it in more detail. It has a lot of technical citations to two other studies and found that it is largely consistent with the Master Plan, and it even identifies the same seven key problems areas where trails are impacting wetlands and their buffers. I think it's going to be a great resource as we move into Phase One, it's really helpful and it's what we hope for as far as more information on restoration approaches and priorities and then there's a couple areas of concern.

The references to changes the Conservation Easement to further restrict uses and allowances presents potential contradictions with the initiative that the voters elected to pay for the land. That would have to be approached with great care, so I urge caution in that area, but we really appreciate the effort made on behalf of the Park District in pulling this together with Herrera's help, I think it's going to be a great resource as we work together on implementing the plan. I also wanted to let you know that Park planning processes are public planning processes. This is public property, and we are utilizing information from our existing resources, of which there are many and the Stewardship Plan relied on very similar resources that we did as well. It is an iterative process of implementing a project and a plan for an area this large, that's over 100 acres and by prioritizing Phase One, I want to also point out that the photo that's in the Stewardship Plan of an improved gravel trail is not in any way identified as what type of trail would be improved. The improvements to that main line that was formerly a gravel road can be done focused on hydrology and drainage and it's going to require several boardwalks. I have $600,000 that I have put into the next biennium for that project in anticipation of getting this plan through the process so we can start actually doing some work. The longer we take, and that's part of my urgency in getting a plan done, the more degradation is occurring, and our inability to start the restoration that needs to happen. I am very encouraged by the content in this Stewardship Plan, and I'm looking forward to having it be a resource. Thank you.

Frank James: Thank Nicole, appreciate your comments. Laine, you've been involved in the process as well from the City, and did you want to say anything?

Laine Potter: I don't think I have anything in addition to what Nicole just said. She covered it all.

Frank James: Thank you Laine and thank you Nicole. I also notice that John Blethen has been a member of the Steering Committee for the Master Planning Process has joined us and John did you have any additional comments or thoughts?

John Blethen: I'm glad to see that you guys are continuing this process and I'm happy that you've added additional material to this process, but beyond that I have little to say.

Frank James: Thanks John, Nicole. While you're here, could I ask when are the upcoming meetings? Our next public hearing is going to be on the 27th to revisit this. Once everybody has a chance to digest the whole process and I was wondering when will the Greenways Committee and the Parks Advisory Board meetings will be?

Nicole Oliver: The Greenways Committee reviewed the Master Plan for the second time on last Thursday, the 30th of June, and recommended approval. They don't typically review Master Plans for approval, but because this is such an extraordinary Greenways funded asset, I felt it was important for the group to weigh in. The Park Board will be taking a second look at the Plan on July 13th. Then we hope to bring it to the City Council in late August.

Gerry Wilbour: Now that we're commenting out that the last one was just question answered so I held on my broad comments and I just wanted to say thanks for the opportunity to do this and I think it's really important for a broad based public participation to have a public hearing format on this stuff and I really appreciate all the effort that everybody put in, especially the citizens and the professionals who have been involved in the process. This is long overdue, but I could go on on that one for a while. There's been a lot of procrastination on getting this thing going, but the people that were involved in the City that were kind of pushing that to the back burner are no longer around, so I really like the fact that we're moving forward in the interim. We've seen a lot of damage to the natural elements of the woods by kind of the bootleg use that has gone on there for decades. I just wanted to make a statement on the climate issue. The primary tree species that is in the 100 Acre Wood is a Douglas Fir and they grow for centuries, and they are the world champ in terms of carbon capture and storage, and especially at the age that they are in those woods. In other words, they filter a lot more carbon dioxide out of the atmosphere and turn it into stored carbon at a greater pace than pretty much all trees. Both plans see the greatest source of impact of recreational use is on the wetlands and specifically the wetland crossings and I very much agree with that. I think fixing those areas with maybe boardwalks and burrito drains or other facilities. In some instances, we need to do some decommissioning, and some re-routes as we did with the trail going out of Fairhaven Park. Some of those trails are just in the wrong place and that's why they have a lot of impact.

I strongly disagree with the Master Plan's priority of building the main trail through the woods first. My heartburn with it is that it will bring in lots of new users and there's lots of damage going on to the woods generally from the level of use that's there. I think the priority should be on fixing the high use areas that are causing a lot of problems rather than building the trunk trail through the woods from Fairhaven Park to the Interurban. Both plans also refer to the City Parks standards for trails and those standards need to be modified so that they're narrower. Specifically, you need to lose the wide shoulder for trails in the woods. That's a way to minimize the footprint and still have an adequately wide trail, essentially by their standards when you're building an eight-foot-wide trail, it ends up being 10 or 12 feet of impact. That's just inappropriate in an environment like this and I don't know any other land manager that manages trails in a wildland or natural areas that they would have that kind of detail. It wouldn't compromise the physical function of the trail and would considerably reduce the impacts. For the smaller trails, the narrower trails, I would recommend referring to the four service standard specifications of trails, because basically everybody uses them, or some derivative of them, and they're commonly available so you don't have to reinvent the wheel.

I think both plans miss the second greatest negative environmental impact of the trails on the woods and that is the existing bootleg trails that go down the slope at way too steep an angle and these are going to become a maintenance and management nightmare if they're not realigned or removed. In some cases, realignment is because they're functioning as a secondary trail. If people like to use that secondary trail, and want to continue to use, realigning them or re-routing them would be the preferred choice. In a few areas there are really steep trails that can simply go away because they're not needed for the function of the recreation experience. When I write this up, I'll designate where I think those removals and whatnot can happen as I did earlier on my comments. They cause a lot of problems both environmentally and management wise when in any other kind of trail design guide would say don't do that and for a lot of good reasons. So those need to be addressed. But again, they're not nearly as important as the wetland crossings and whatnot.

Neither plan addresses accessibility for those with mobility impairments, and there are many opportunities to have this potential, and it would be very attractive. The Access Board has adopted required standards that are very appropriate and sufficiently flexible for natural areas. I'm not talking about something that would access a building

downtown or even a house, but they have been created for creating trail facilities in natural areas and I think it's really important that we be inclusive of everybody. And quite frankly, if somebody in the neighborhood that would otherwise use these trails can make the claim they were excluded because it was not considered, they'd have standing in perpetuity to go after the City for it. So, it's not only good public policy, but it's a legal requirement.

Neither plan gives us an inventory of the positive or attractive waypoint for natural features and viewpoints and whatnot that should be incorporated into this system. From my perspective, that's kind of an unaddressed gap and I assume in a later stage that can be brought into play, but it speaks to creating systems that kind of self-manage themselves. In other words, people go where you want them to go without management intervention or education. Essentially, they're just cheaper to manage and they're more attractive to the using public. Speaking very generally, I'd find that the Master Plan is too light on minimizing, mitigating or limiting negative impacts of the currently informally developed system.

Thanks for doing this Stewardship Plan. I think it was greatly needed. I need to review the Stewardship Plan more. I'm having a hard time swallowing some of the recommendations out of it. I think they're pie in the sky quite frankly, but I need to look at it in a little bit more detail. Chris' earlier comments were greatly clarifying in that regard. Good planning, design, and management of trails and sensitive, natural areas can be effectively done only on the ground and on a case-by-case basis. You really have to look at what the needs and opportunities are there and in much the art of creating sustainable systems in natural areas is social psychology as much as anything. It requires anticipating what users want, where they will go, where they won't, and instead of the fence along the trail that's a physical feature, essentially you create a draw that draws people in where you want them to go and what that does is it reduces the impacts that people will have on the natural systems and it creates a better recreational experience. I think that kind of approach is very necessary going forward as this plan gets implemented. Thanks for the opportunity to comment.

Frank James: Thanks Gerry. There was another comment that disappeared.

Robyn Albro: I answered it. They asked if all written comments will be included in the record for this meeting and I said yes, they will.

Hue Beattie: I'd like to ask a question of Chris or Tina. I noticed that the County now has a Wildlife Advisory Committee where they list species of local importance and they've asked the other governments within the County to become aware of this and such and they list things like the Oregon spotted frog, the western pond turtle and the western toad. Have any of these things been observed in the 100 Acre Wood?

Tina Mirabile: Anything we might have mentioned would have been in the baseline report that Ann Eissinger did where she actually lists whole orders of species. And what's there that's been observed and then Whatcom County has a wildlife corridor in the Chuckanut Mountain area that is based on I think the cascade toad. So, with the connectivity being very close to the Chuckanuts for us, even though there is a road that splits those habitats, it just seemed like it was worth mentioning that proximity. But not that we necessarily were able to observe all those species during our two field visits, but we did see appropriate habitats for certain species, but definitely refer to the baseline report because that has a lot of details and lot of studies were done for that.

Hue Beattie: This Oregon spotted frog is on the endangered species list now and I just wondered if it was around in our area. Tina Mirabile: It's not around in the Chuckanut Forest as far as I know, it's not necessarily the best habitat they would prefer, but it definitely has been documented in Whatcom County, but a little further to the east and to the north and it's generally associated with canary grass dominated wetlands that are grazed, but they also need to have forest connectivity for them when they migrate out of there or once they hatch from their aquatic habitat. I would say probably not exactly in the forest, but then studies could show things differently, but there's definitely room to do more investigation studies, even since Ann did her report in 2017.

Hue Beattie: One thing I can say to the general public who is watching this is when all this started when this area was up zoned back in 1980. It was done by somebody on the Council back in 1980 and since that time the population has grown from 30,000 to 93,000 and so we've got a lot more impact on the woods than we ever did. Keep that in mind. There's probably a lot less wildlife now than there was.

Frank James: Thanks everyone for participating. I think it's been a very productive meeting. I really appreciate Chris and Tina coming and taking this time with us and answering our questions and John McLaughlin you did a superb job. I wanted to thank you for your measured and thoughtful comments and the broad perspective you brought to it. I appreciate that.

John McLaughlin: I wanted to respond to Hue. Years ago, I served on the Wildlife Advisory. They were always talking about coming up with a list of important species. I'm glad to see they've come up with it. I haven't looked at that list myself, but of the species you mentioned, the Oregon spotted frog is not known from the Chuckanut Community Forest. Vicki Jackson, who is the longtime member of that committee, runs the Whatcom Amphibian

Monitoring Committee, so I'm fairly confident she hasn't reported it there. The western toad was formally detected there back by a retired biology faculty professor at Western, but there haven't been surveys done for them since. That would be a species that is particularly impacted by all the trail proliferation and the loss of cover as the bootleg trails that Gerry mentioned have expanded. We've moved a lot of the vegetative cover that those toads will be using and that of course applies to many of the other species. One of our hopes is that we can restore a lot of the vegetative cover and habitat throughout the property. That's going to improve both recreational experience and improve wildlife habitat. That's an example where those two goals of Goal One and Goal Two from the Master Plan are not in conflict at all. But that's going to take a lot of work and a lot of restoration, which is really important work, and it gets back to Gerry's point that there has been a lot of overuses of the place, and it has degraded both recreational and wildlife plant habitat. That's where the Stewardship Plan really comes if we implement a lot of the components there.

Frank James: I'd like to just comment that one of the people that's been most dedicated to this parcel of land for a long time is Ann Eissinger and I did get an email from her just during the meeting saying "Thank you Frank for sending this information to me. I will look at the documents and send comments if I have time. As I've said in the past, the key to protection of this site is the Conservation Easement and the language needs to provide a foundation for the management plan. All my best." I just couldn't go without adding her comments since she provided them and great appreciation for all the extensive work that she's done for this parcel and many other parcels in our community. I think we've had a good discussion. I appreciate all the comments of the visitors and panelists. Thank you for coming and the Commissioners, Robyn.

Frank James: We are towards the end of our time, but more than happy to have anybody else that hasn't had a chance to speak or to write a comment. Just know that this is the beginning, not the end of a process. This is an introduction of the documents. We hope to have a much larger meeting that will really be a hearing that focused not on presentations but on discussion of ideas and I've really appreciated the openness of the Commissioners to have not three-minute talks, but an actual conversation that leads someplace and allows people to have a complete whole thought presented.

Frank James: I will close the public hearing now. We do have a little more business to do. You're welcome to stay. All of our meetings are public and open. Chris and Tina, you're welcome to stay too, but I appreciate your presence here tonight and I know you're busy. Laine, I know Nicole has already left, but you're welcome to stay as well.

Close Public Hearing

Written Comments Attached

Wendy Scherrer
Bryce Fegley
Jacob Stewart
Jessica Orr
Sonja Max
Neil Schaner – Comments on Master Plan (excerpted from full Plan)

7.3.2022

To: Robyn Albro, Secretary, CCFPD ralbro.ccfpd@gmail.com
From: Wendy Scherrer [redacted]
RE: Comments on Stewardship Plan for the Chuckanut Community Forest

Thank you for the excellent work on the *Stewardship Plan for the Chuckanut Community Forest.*

The mission statement states, cited on page 9, is:
"ensure the entirety of the Chuckanut Community Forest (CCF), an 82-acre forested property, is protected in perpetuity in public ownership, with respect for its ecological, recreational, and ***educational functions****."*
Comment;

- ***Amplify the emphasis on the importance of the important function of using the site for education functions. I am interested in moving the plan, as soon as possible, to implementation.***
- ***Include funding to engage for a professional environmental educator/interpreter, to develop education materials to reveal knowledge and relations about natural, cultural, historical and recreational resources.***

p. 11 The CCF's landscape setting also provides historic and educational perspectives regarding land use practices, natural regeneration and or degradation of environmental ecosystems and other factors, which can be considered in regard to planning its future.
Comment:

- ***Signage, brochures and websites relating to the site should include photos, information and perspectives on past land use practices, and current strategies in process to promote natural regeneration and restoration processes.***

In recognition of the site's prehistoric heritage, consultation with the Lummi and Nooksack Tribal Nations to designate a Coast Salish name for the site is encouraged.
Comment:

- ***Events to dedicate the site should include invitation all local tribes (Lummi, Nooksack, Samish).***
- ***Signage, brochures and websites relating to the site should include invitation for local tribal participation and review.***
- ***Educational efforts should include the place name for this site, what the name means, any traditional use of the site, and any significance.***

p.25 The Baseline Report describes areas within the CCF where invasive non-native plants are present and in need of restoration (Eissinger, 2017). The Whatcom County noxious weed list lists giant hogweed Class A which is required for control (Whatcom County 2022). Knotweed is listed as a Class B designated weed and control is required. Lesser celandine and Scotch broom are listed as Class B or targeted control, mapping and educational or biological efforts.

Comment:

- ***Signage, brochures, photos identifying invasive species specific to the site should be developed, including ongoing eradication and restoration strategies. This information should be based on best available scientific methods, and posted on a website dedicated to this site, as well as in printed form, signs at the site and brochures.***

p. 47 A fence that does not impede wildlife migration, but that discourages pedestrian access from the trail into natural habitat areas, such as a two-rail fence (see the Wildlife Habitat Protection section below for more information) should be installed. This area, due to its historical land use and proposed process for its restoration, also presents an excellent educational opportunity. Accessible overlooks from the trail crossing toward the historical gravel pit areas to the north and south are possible locations for interpretative signage additions.

Comment:

- ***Use the fence sites as potential interpretive sign locations***

p.60 Provide information and education to recreational users to minimize human behaviors that may impact wildlife. Ideas include increasing educational signage, implementing a docent stewardship program, or engaging the public in a citizen science monitoring approach.

Comment:

- ***Develop formal partnership agreement with nonprofit organization, neighborhood associations or colleges (WWU, WCC or NWIC) to establish citizen science monitoring of site before plan is implemented.***

p. 63 The City coordinates educational and volunteer stewardship programs related to ecology restoration and trail maintenance activities based on an annual plan and schedule for implementing effective invasive plant removal and native plant installation according to growth habits.

Comment:

- ***Develop Restoration Plan or Management Plan, with protocols transparent to all involved in future invasive plant removal and native plant installation.***
- ***Educate all stakeholders involved in on-the-ground restoration work, on Restoration Plan or Management Plan***

Gmail

Robyn Albro <ralbro.ccfpd@gmail.com>

100ac Woods Easement Proposal

Bryce F <[redacted]>
To: ralbro.ccfpd@gmail.com

Wed, Jun 29, 2022 at 2:56 PM

Dear Commissioners,

My comment, as a resident of South Hill since 2014, is to preserve the use of the 100 Acre Woods in much the same way as it is currently being utilized. My understanding is this utilization explicitly encompasses bicycle and dog use.

These woods have provided my family with an accessible venue for multi-modal exploration and are where both of my children learned to venture off-road on their mountain bikes.

Proposals to restrict these uses would appear to contradict the 2014 easement.

Sincerely,
Bryce Fegley
443 14th St
Bellingham, WA 98225

Gmail

Robyn Albro <ralbro.ccfpd@gmail.com>

written comments on 100acre wood master plan

Jacob Stewart [redacted] Mon, Jun 27, 2022 at 4:36 PM
Reply-To: [redacted]
To: ralbro.ccfpd@gmail.com

Hi, I would like to submit written comments to the Park Commissioners for the upcoming hearing after reviewing the draft master plan and watching recordings of the previous two meetings.

Thanks!

-Jacob Stewart

Name of Park
The park commissioners appear to view the 100 Acre Wood as a nature preserve. It is not currently a nature preserve; nor does it appear to have ever been one. This is clearly and intentionally reflected in the language found in the 2014 easement, which enshrines "nature-oriented non-motorized public recreational" use. The 100 Acre Wood is properly understood as a park, and is quite literally a metropolitan park district, however much the Commissioners wish to the contrary.

Bicycle Access
Section IV.1.C of the 2014 easement clearly and intentionally contemplates use by mountain bikes

Leashed Dogs
Section IV.1.N of the 2014 easement clearly and intentionally contemplates off-leash dog use

Results of Parks Survey
The Commissioners do not like the results of public outreach conducted by Parks staff regarding park usage. The outreach process is in fact working exactly as it was designed, and it is illogical and inappropriate to appeal to *hypothetical silent constituencies* who did not respond to the outreach. Citizens who *did* choose to participate should expect to have their concerns addressed – not ignored.

User Conflict
The Commissioners appear concerned about hypothetical conflict between various park users. I do not believe this is a good faith objection, as Bellingham residents (eg., dog-walkers, cyclists, birders, whatever) currently happily share trail networks all over the city without conflict.

Gmail

Robyn Albro <ralbro.ccfpd@gmail.com>

comment to 7/6 CCFPD special meeting

Jessica Orr [redacted]
To: ralbro.ccfpd@gmail.com
Cc: parks@cob.org

Tue, Jul 5, 2022 at 8:05 PM

Hello -

I would like to express my support for the Bellingham Parks Department's Master Plan Draft, as written, as well as for the disbandment of the CCFPD.

I also support continued access for bikes to the 100 Acre Wood. As noted on pg 36 of the CCFPD-commissioned Herrera "Stewardship Plan," no evidence exists that bikes have any different environmental impact compared to hikers/walkers. I believe that any effort to limit the use of bikes in the 100 Acre Wood is based on one user group's preference and emotions rather than any scientific or other evidence.

Thank you,
Jessica Orr
Resident of South Bellingham Neighborhood
697 Chuckanut Dr N, Bellingham, WA 98229
352-262-9493

Gmail

Robyn Albro <ralbro.ccfpd@gmail.com>

Public Comment for CCFPD July 6 hearing

sonja max [redacted] Tue, Jul 5, 2022 at 1:09 PM
To: Robyn Albro <ralbro.ccfpd@gmail.com>
Cc: noliver@cob.org

Hello, I would like to submit the following written comment to the Chuckanut Community Forest Park Commissioners for the July 6 hearing:

Dear Commissioners,

As a resident within the Metropolitan Park District, I voted in favor of the taxing district's formation in 2013. I could not be more grateful that the Hundred Acre Wood was saved from development and that we are approaching the property's conversion to a City Park. I appreciate current and past commissioners' efforts in this success.

After watching recordings of past meetings, re-reading the ballot measure that helped inform my vote, the 2014 conservation easement that directs appropriate conservation of the land, and the recent stewardship plan that was commissioned and paid for with taxpayer money, I would like to express the following concerns that lead me to believe the CCFPD commissioners are over-reaching their power and straying from their duty to serve the community at large.

• Petition Language
The community signed a petition to get the taxing district on the ballot that, among other things, stated, "Whereas, the Chuckanut Community Forest and surrounding area supports a diversity of rich ecological habitat and *active recreational open space* with important educational and community value..."

This implies the continued use of recreation that had been enjoyed by neighbors within the park. There is no mention of restricting types of recreation or creating a restrictive nature preserve.

• Ballot language for taxing district:
When I voted in favor of the creating the taxing district, the same sentiment carried through the ballot language.
The Statement For includes the following sentences:
"Assuring its preservation as a park, forever. The alternative is that an unknown portion of the land may be sold."
"As a park, the forest offers easy access to healthy outdoor recreation to five nearby Southside neighborhoods."
Use of the word "Park," not "nature preserve." This again implies that this park's purpose is to maintain the level of recreation that neighbors have come to enjoy in this area, instead of the property being developed into private dwellings and multi-family housing units. There are numerous children who live in these five nearby Southside neighborhoods who, doing what kids do, need places like this to ride bicycles and play outdoors. It so happens that this park is the only one within a short riding distance from many of these families' homes, where their kids can venture on their own. To restrict this activity and force these families to drive their children to another park is contrary to whole intent of this park providing recreation within the vicinity of these neighborhoods.

"The commissioners will assure its preservation,... leaving management to Bellingham Parks."
It seems to me that the commissioners have assured the preservation of the property, preventing it from being sold to a private developer. Now is the time to let Bellingham Parks continue with the park's management.

• 2014 conservation easement:
- Section IV.1.C specifically includes the use of mountain bikes
- Section IV.1.N specifically includes off-leash dogs
I gather from statements made in meetings that the CCFPD is no longer happy with the original conservation easement and would be willing to spend a lot of taxpayer money to write a new one. In my opinion, there is no need for this. The original easement was clear and appropriate.

• City's draft master plan
- It was clear from comments during public meetings that the CCFPD did not like the City's public engagement process. Whether the commissioners like it or not, that is the best tool the City has available to us currently. It is used

for all city-wide projects. People who take the time to respond on Engage Bellingham expect their responses to inform the final plans. *It is not appropriate to anticipate the desires of people who did not respond to the survey* and change the outcome based on that silent constituency. That ends up reflecting the personal wishes of a few members of a committee, not the several hundred community members who took the time to voice their opinions.

- It is also clear that commissioners have personal biases against certain forms of recreation that do not reflect the community at large harmoniously sharing trails between various user groups. I have used those trails for years and never had a negative encounter with another trail user.

-Also, what better way to raise a generation of respectful park-goers, than to teach them in neighborhood parks how to share trails and give right of way appropriately? If we ban children from community parks and force them to ride in bike parks or pump tracks, they will never know how to act when they do come upon other users in a shared trail in the future. This is part of the "educational value" component that was mentioned in the petition.

• **Stewardship plan:**
Finally, the stewardship plan that the CCFPD commissioned with taxpayer money has serious flaws. It states *within the document* "...there is a lack of site-specific data in this regard for the CCF."

It also states, "there is little evidence to suggest that bikers cause more wear to trails, damage to vegetation, or negative behavioral responses in wildlife than other forms of trail recreation (Sprung 2003)."

Many of the references used for the plan are not local.

One of the references is "collated emails" from a commission member to Herrera staff. Commissioners should not be feeding the consultant cherry-picked emails to influence the outcome of the report.

The report says children and photographers are disturbing to birds. This is strange.

The report recommends eliminating over a mile of trails in the park, again without very much site-specific data. The City of Bellingham would be best equipped to develop a trail plan. The City has its own wetland requirements and mitigation strategies, and I trust the City to develop and maintain a perfectly adequate trail plan. If there is an endangered species or special wetland, don't put a trail there.

To conclude, it appears that the commissioners are attempting to strong-arm the City into excessive restrictions on the Hundred Acre Wood to create a nature preserve instead of the **metropolitan park** that was voted for. This is deceptive to voters.

Please move this planning process along by supporting the City's Draft Master Plan so we can stop wasting taxpayer dollars with CCFPD legal fees and consultants. The commission has done its job of preventing private development, and management of the property should now be handed over to the City of Bellingham Parks and Recreation Department.

Sincerely,

Sonja Max

extraction operations. Today, the old road is used as a trail and the pits from gravel extraction have been partially naturalized.

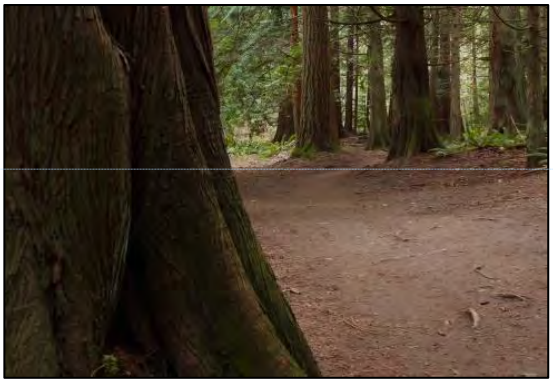
Development Proposals and Public Protection

Between the 1980s and 2011, several proposals were made to develop the Hundred Acre Wood area. These proposals were met by considerable opposition from concerned community members. Ultimately, each development proposal failed to obtain an approval or permitting following an extensive environmental review. Following the failure of multiple development proposals, project financer Horizon Bank forced foreclosure and sold the parcel to Washington Federal Savings Bank (Washington Federal).

Acquisition History and Development of the Conservation Easements

The Hundred Acre Wood Park consists of multiple parcels that were acquired by the City over the course of several decades. Key milestones in the development of the Park include:

- The City acquired the Interurban Greenway parcels between 1991 and 2003 (see Figure 2).
- In 2001, the City and Whatcom Land Trust established a conservation easement to ensure future protection of the 16.5-acre Interurban Wetland Conservation Easement, located in the southeast corner of the current Park (Auditor File No. 2011203959).
- In 2011, the City purchased the Chuckanut Community Forest property (82-acres) from Washington Federal for $8.23 million using a combination of Greenway Levy funds, City Park Impact Fees, and a loan from the Greenway Maintenance Endowment Fund.
- In 2013, voters approved the formation of the Chuckanut Community Forest Park District (Park District) to protect the 82-acre forest property from future development and manage the repayment of the Greenway Maintenance Endowment Fund loan.
- In 2014, the City and the Park District established a conservation easement to permanently protect the Chuckanut Community Forest property (Auditor File No. 2140100259). The conservation easement protects the property in perpetuity and ensures that any future projects that enhance recreational and educational elements of the Park do not negatively impact environmental functions or features.
- In 2014, an interlocal agreement was established between the City and the Park District. (COB Contract # 2013-0624).
- In 2014, the City rezoned 111 acres, including the Community Forest parcel, the Whatcom Land Trust parcel, and the surrounding acreage, from Residential Multi, Planned to Public, Open Space.



Commented [SP4]: Laine: Double check this is the correct title.

How is this defined? Typical environmental review and permitting often leaves environmental resources degraded or at risk.

Commented [SP5]: Laine: Is this correct? Rezoned after the interlocal agreement was established?

CHAPTER 3: EXISTING PARK CONDITIONS

This chapter describes the existing conditions within the Park at the time the Plan was written. It includes notable features within the Park, current uses, and adjacent land uses.

Site Description

The Hundred Acre Wood consists of approximately 111-acres of forest and open space, including the 82-acre Chuckanut Community Forest Easement, the 16.5-acre Interurban Wetland Conservation Easement, and all contiguous forest and open space parcels acquired as part of the Interurban Greenway. Six public access points provide entry to the forest (see Figures 3 and 4), including access from the Interurban Trail, Fairhaven Park upper shelter, Chuckanut Drive at 16th Street, Chuckanut Drive at Viewcrest Road, the end of 18th Street, and the end of 22nd Street.

Natural Features

A native coniferous and mixed forest covers the property. The forest is categorized as "young forest tall" in the UFMP canopy and forest structure inventory (See figure 5). The forest lacks a mature understory and is transitioning toward a mature forest. Numerous wetlands and one natural pond are situated across the planning area on an uneven landscape with various grades. These forest and wetland environments are crucial natural ecosystems in this area and provide habitat for native plant and wildlife species. They also serve as an essential habitat corridor for wildlife that relies on the area for migration through an urban setting.

The native species of plants, animals, fungi and other biota within the forest and wetlands rely heavily on the habitat provided by the Hundred Acre Wood. A list of native and non-native wildlife species that have been observed or are expected to exist in the park is available in the Chuckanut Community Forest Baseline Documentation Report (Baseline Report) (Eissinger, 2017). The Report provides a baseline record of the relevant conditions and conservation values of the property subject to the Chuckanut Community Forest Conservation Easement and forms

Commented [PLR6]: Add figure - UFMP canopy and forest structure inventory

Commented [SP7]: Laine: Is this true for the entire park (or just CCF easement section)?

Commented [PLR8]: Verify this

Commented [PLR9]: Add Hoag's Creek; watershed; drainage - Add the two watersheds to plan.

Commented [PLR10]: Add reference to Tier 1 assessment from HRTA and summary of importance from 2021 wildlife corridor analysis

I regret I don't have time to read the Eissinger report and it was not provided. I would be interested to know the metrics to be used to monitor the property to fulfill the requirements of the easement. It is impossible to know if this plan will achieve the easement requirements without knowing the metrics. Further, what changes is the City willing to make to park management if the easement requirements are not fulfilled? This might be an opportunity for an adaptive management plan, one that may align with the District's stewardship plan.

Section 6.2 of the Baseline Report describes the topography, geology, soils, hydrology, and wetlands within the Hundred Acre Wood (Eissinger, 2017). The City's Urban Forestry Management Plan includes information about the canopy cover, riparian areas, and forest structure and composition (City of Bellingham, TBD; Diamond Head, 2021).

Human-made Features

The Park has been mostly undisturbed following the last logging and gravel extraction activities. Remnants of old roads, borrow pits, several groundwater monitoring wells, old fencing, and scattered signage are some of the only human-made features that remain on the property from historical land uses.

Will some of these existing features be removed? Fencing removal would be great.

Commented [PLR11]: Add Hoag's Pond - any manmade features?

Remnants of an old road used for logging and gravel extraction on the property have been repurposed as trails. Wildlife and human use have created a web of additional informal trails, as depicted in Figure 6. Limited parking exists in two locations along Chuckanut Drive. Recreation Northwest, a Bellingham-based non-profit organization, established a northwest native plant garden, boardwalk, and outdoor classroom close to the Park's boundary with Fairhaven Park.

Current Uses

The current use of the Hundred Acre Wood is as a public park and open space. Visitors use the

Figure 4. Hundred Acre Wood access from Chuckanut Drive and Viewcrest Road.

Park's trail network, and the connections to other nearby parks and neighborhoods, for various passive, non-motorized recreational activities, and multi-modal transportation purposes. A

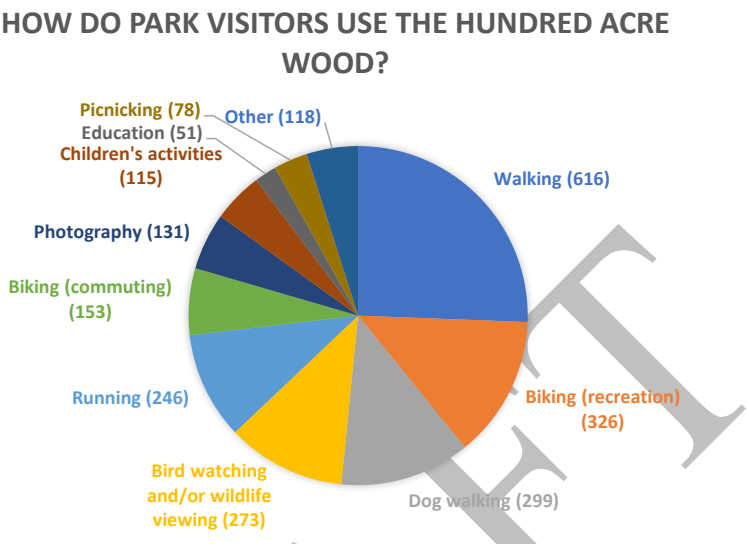


Figure 7. The chart indicates the number of public survey (Fall 2021) respondents (#) who use the Hundred Acre Wood for various activities.

A total of 716 respondents completed the survey. Ninety-nine percent (99%) of respondents visit the planning area, and 64% visit the planning area at least once a week. Respondents reported primarily using the area for walking, dog walking, recreational biking, bird watching, and/or wildlife viewing, and running (see Figure 7).

The majority of respondents agreed:

- With the proposed master plan boundaries (88%)
- That the planning area should be named Hundred Acre Wood (63%)
- That dogs should continue to be only on-leash in the planning area (67%)

Respondents wanted to see the following improvements in the planning area:

- Directional signs (71%)
- Boardwalks and bridges (69%)
- Native plant garden (62%)

Open House and Follow-Up Survey

Staff members from the Parks Department hosted a live, virtual public Open House on March 16, 2022. The event included a presentation by Parks Department staff followed by a public question and answer session. Verbal comments, comments in the chat, and questions were collected as input for the final Plan. The event was recorded, and the recording was posted on Engage Bellingham for the public to review.

Key themes from the input collected during the Open House include:

I don't have a sense to as to the effectiveness of the City's/Parks' general outreach procedures. Are there discussions prior about use populations not likely to respond to computer-based and meeting-based surveys and outreach? There could be a significant missing cohort of park users that don't get notice for Engage Bellingham, don't have access, or cannot attend an open house.

There is also known activity by specific groups to skew (gently or not) public survey results. WMBC members asked other members to ride by and through the park once they became aware that Parks was conducting on-site surveys/ counts.

- Attendees shared both support for and considerable opposition to limiting bike usage in the Park.
- Several participants noted that various types of trail users seem to get along in the Park.
- Attendees voiced both support for and concerns about the on-leash requirement proposal.
- Participants shared specific feedback on the trail plan.
- Several participants urged the City to move quickly in wetland protection.
- Participants also advocated for wildlife conservation and noted the carbon storage value of the forest within the Park.

A follow-up survey was open to the public from March 18-April 1, 2022. The follow-up survey provided an additional opportunity for the public to respond to the proposed plan elements covered in the Open House.

A total of 670 respondents completed the Open House Follow-Up Survey. Highlights from the survey include:

- Ninety-five percent (95%) of respondents agreed with the name Hundred Acre Wood.
- Approximately 78% of respondents agreed with the dog on-leash requirement and the installation of dog waste stations and signage to remind people of on-leash requirements. Several respondents advocated for locating waste stations at Park access points, but not within the Park. Several respondents commented that they would like an area of the Park to be designated as an off-leash area for dogs.
- Approximately 86% of respondents disagreed with improving the existing trail from Fairhaven Park to the Interurban Trail with limestone and limiting bikes to this trail (with park users walking their bikes on other trails). Several respondents commented that families use this area for biking with their children. Others noted that there are not many reports of trail user conflicts in this Park.

As you are aware, dog leashing for the protection of other users and the environment comes down to enforcement.

Relevant Documents

The following documents helped shape the Plan. These documents should be reviewed in the development of specific projects, as applicable.

- Whatcom Land Trust Conservation Easement
- Chuckanut Community Forest Conservation Easement
- Chuckanut Community Forest Baseline Documentation Report, May 8, 2017
- Urban Forestry Management Plan (in process as of 2022)

Strategy 1.3: Restore hydrologic connections

Identify barriers to historic hydrologic flows and reestablish hydrologic connections. Aerate compacted soils in these areas and with culverts, bridges, or boardwalks.

Strategy 1.4: Invasive Plant Removal

Replace invasive plants with suitable native species.

Strategy 1.5: Restore Vegetation

Restore soil structure and native vegetation. Utilize established Park restoration best practices and prioritize climate resiliency.

What does "prioritize climate resiliency" mean? Choice of plant species, planning for future hydrology, planning for future migration of species?

Goal 2: User safety and experience

Strategy 2.1: Install wayfinding and signage

Signage and wayfinding are important to help park users navigate the trails safely. Signage welcomes the public, directs and manages impacts, and educates and informs Park visitors. The following wayfinding and signage improvements aim to improve user safety and experience:

- ◊ Add signage to mark public access points.
- ◊ Install area trail map at primary entrances and key trail intersections.
- ◊ Add park rules and dog on-leash requirement signage.

Figure 7. A map indicating "You are here."

Figure 8. A wayfinding post with trail names and directional arrows.

Don't forget to add the Greenways plaque.

Strategy 2.2: Manage pet and other waste.

Install garbage cans and pet waste stations at main access points.

Strategy 2.3: Improve vehicle and bicycle parking

Improve existing vehicle parking along Chuckanut Drive, provided there are no significant negative impacts on conservation values.

Speed and existing sight distance might make adding parking complex.

Strategy 2.4: Benches

Install benches in key locations along the main loop trail.

Goal 3: Education and Interpretation

Strategy 3.1: Create an outdoor learning space

Create an outdoor learning space such as an outdoor classroom. Figures 9 and 10 include initial concepts for learning spaces considering existing conditions within the Park.

Commented [PLR13]: Figure ____ shows the location of the outdoor classroom.

Strategy 3.2: Native plant interpretation

Install native plant identification signage at approved locations within the Park. Figure 10 includes initial concepts for native plant signage.

Goal 4. Climate Resiliency

Strategy 4.1: Promote climate resiliency consistent with the City's PRO Plan.

Consistent with Goal 4 of the City's PRO Plan, take action to reduce the impacts of climate change and enhance the natural carbon sequestration function of the Park.

How specifically?

Strategy 4.2: Install fire warning signage.

Add fire warning signage at primary access points during periods of heightened fire risk.

Strategy 4.3: Consider climate change when making decisions

Consider climate change when making decisions about improvements, conservation, and restoration efforts. For example, use climate-tolerant plants in restoration efforts.

Strategy 4.3: Promote City-wide climate resiliency and mitigation efforts.

Implement City-wide efforts to build climate resiliency, reduce greenhouse gas emissions, and educate the public about climate change.

Public Hearing Minutes
CHUCKANUT COMMUNITY FOREST PARK DISTRICT
Wednesday, July 27, 2022
Online Meeting Through Zoom
Mailing Address: PO Box 4283, Bellingham, WA 98227

Official email addresses for Commissioners, where public may send comments (subject to public disclosure):
Frank James fjames.ccfpd@gmail.com John Hymas jhymas1331@gmail.com
John McLaughlin johnm.ccfpd@gmail.com Hue Beattie hue.ccfpd@gmail.com
John G. Brown jbrown.ccfpd@gmail.com

Our Mission: The mission of the Chuckanut Community Forest Park District is to ensure the entirety of the property is protected in perpetuity in public ownership, with respect for its ecological, recreational, and educational functions and to serve as a fiscal mechanism through which the district, via a tax levy, will repay the City of Bellingham for the Greenways Endowment Fund loan. Due to the Covid-19 outbreak and the Governor's "Stay At Home" Order, this meeting of the Chuckanut Community Forest Park Dist. has been conducted online on Zoom. A visual and audio recording of this meeting will be posted on the CCFPD website. If your camera is on during the meeting, your voice, likeness, and surroundings, will be publicly available and viewable on the CCFPD website. If you choose to speak with your camera off, or by calling on a telephone, only your voice will be recorded.

Call to order: Frank James. Welcome Commissioners and Citizens. Per Chapter 42.30 RCW (Open Public Meetings Act), CCFPD Board meetings are open to the public.

Roll Call: Frank James, John Brown, and Hue Beattie present. John McLaughlin excused. John Hymas arrived later.

Open Public Hearing on Stewardship Plan and Master Plan

Public Comments:

Barbara Zylstra: First, I want to thank all of you Commissioners and also Nicole and all the City staff who've been working to try and get in place the documents that will protect this precious property. To that end, I've written my thoughts down so that I won't ramble.

For many decades, many of us have looked to protect this unique precious property and now that we have them protected from draining and development, I fear we may harm them by committing human uses that further degrade these important forests and wetlands. I appreciate the recent changes to the Draft Master Plan incorporating some of the scientific Herrera report. We must realize this property as a preserve not a park. It's intended purpose is first ecological protection, and only after that is achieved should we address recreation.

I understand that many cyclists want to continue to ride in the 100 Acre Woods. I have observed incredible damage that off trail users have created in Fairhaven. This damage has occurred and continues to occur despite Park employees' efforts to make the newly created trails usable. I will share just a few photos of how Fairhaven Park woods have been harmed in the past decade. [technical difficulties sharing photos, they will be emailed to Commissioners to be included in the record]. The photos show long trails on steep inclines, and I was going to count how many because the massive numbers of them is really pretty incredible, but I didn't count them all. My guess is there are more than 15 rogue trails in the Park. I understand that not all cyclists will ride up off trail, but the risk that some may continue as they have in Fairhaven Park, is too great a chance to take.

We need to protect these woods and wetlands from uses that will damage them even when log barriers have been anchored in place in Fairhaven Park. The cyclists continue off road and treat them like moguls, so they just go around them. I've placed logs and branches across these destructive trails only to return a day or two later and find them moved aside so that a rider could ride where he wanted with no concern for the forest.

Allowing dogs in a wild area is counter intuitive. Dogs are predators and wild animals know to avoid them. Even a whiff of them or their urine is enough to stress the wild animal and cause it to flee or hide and that's taken from Herrera's report, pg. 34, Miller et. al. 2001. For this reason, no dogs are allowed in the Stimpson Reserve, a similar forested wetland property in Whatcom County. We should follow their lead.

Already trails have been created in the 100 Acre Woods that are intruding in the wetlands and their buffers and that's really apparent in the Stewardship Plan. The Master Plan echoes the Stewardship Plan recommending removing such trails, amending the compacted soils, replants to help the forest heal. I would like to see more trails

removed from the Draft Master Plan following the Stewardship Plan, Figure 8. The decommissioning trail section of the Master Plan should be reprioritized. The two most critical criteria are: Does the trail impact the protected wetland, critical habitat and species, or impact hydrologic connectivity? Does the trail support the City's conservation and restoration goals, does not negatively impact ecological or hydrological function? Instead, the first priority listed in the Master Plan considers "fulfilling recommendation by the public." Trails need to be decommissioned and created according to best science and the Stewardship Plan gives us ample direction. I do think it is important to hear what people want and have to say, but we must remember that not all wants can be accommodated if we are to save these forested wetlands.

If we did not have Fairhaven Park, the Interurban Trail, and Arroyo Park surrounding these wetlands, I would be more moved to consider the desires of humans wanting more freedom to use the forest as they wish, but adjacent to the 100 Acre Woods, these are ample trails and parks in which to ride a bicycle and walk a dog. As Dr. Seuss wrote, "I speak for the trees, for the trees have no tongues." Those of us familiar with these woods know that the trees do in fact communicate, if we would just listen. All wildlife, animals, and plants need our respect and our protection. We may not be able to ride a bicycle or walk a dog in these woods, but that is something we willingly give up to allow the trees, the wetlands, the animals to survive, and with time, to thrive.

We may not be able to ride a bicycle or walk a dog in these woods, but that is something we willingly give up to allow the trees, the wetlands, the animals to survive, and with time to thrive. No one needs to ride a bicycle in these woods. No one needs to walk a dog in these woods. Maybe we want to do these things, but we do not need to do them to survive. Can we be big enough humans to give up something we want so that the wild ones can survive? I think we can, and this is our challenge.

John Brown: Passionate, I'm moved. I'm on her side. I don't think we are going to get all that, but that's very impressive. Thank you from my corner. Frank James: Thank you very much.

Christopher Grannis: Hi, Thanks for all the good work you folks are doing. I think that the priority should be to restore where the wetlands have been damaged and put in boardwalks and burritos or whatever's the best, most appropriate way of crossing wetlands. That, for me, should be the priority. Thank you.

John Brown: Thank you Christopher. Frank James: Yes, and I think most people involved in this are very much in agreement with you. Safely traveling through both the wetlands and the surrounding area that feeds water into the wetlands is very important to very carefully negotiate those with human traffic of any kind. Thanks Christopher.

Peter Gill: Thank you to the group for having this hearing and continuing your discussion on the 100 Acre Wood. I work for the Parks Department as the Planning and Development Coordinator. I've had a hand in helping to bring this plan along. I am mostly here just to hear what you all have to say and what the public has to say and answer questions, if necessary. But I would also encourage Barbara and others that are on the line to participate in the public hearing at the City Council on August 29th. So, just here, listening in and thank you again for all your comments and for continuing to keep this discussion alive.

John Brown: Thank you for the reminder about the August 29th meeting Peter, that's very helpful.

Frank James: We also want to thank you for all the work that you've done. I know Laine is here too. Of course, many other people in Parks Department, some of whom we never see or hear from, have done a great deal of work to get the Master Plan to where it's at today. We appreciate that very much and look forward to working with you as we move through some of the issues. Thanks Peter and thank you for joining us.

Edward Wolf: Thank you to all of you on the Park District Board and to all of the members of public who've been part of the process of helping to guide the 100 Acre Wood towards this master planning phase. I wanted to comment tonight. I looked at the Draft Master Plan this afternoon and was particularly pleased to see that one of the four themes of the Master Plan is climate resiliency. I'm sorry that John McLaughlin isn't here tonight, because he might have a little bit more to say about my comment, but basically I want to observe that the mature forest in the 100 Acre Wood, because of the prior history of logging, are trees that are just entering their phase of life of maximum carbon uptake and storage and so not only is it good that the 100 Acre Wood has lots of mature cedars, Douglas firs, and hemlock trees, but it's doubly good that the 100 Acre Wood has trees that are in the roughly 80 to 120 year age class. The significance of those trees continuing to grow in their mature decades and centuries is that they are absolutely the champions of carbon capture. In forests they are absolutely the best at capturing carbon in large volumes and holding onto it for the decades to centuries that we need. And before this country, if everything

were to go right, reaches net zero, the best natural climate solution that we have available is trees in that mature age class that are not yet at the peak of their lifecycle. They're still approaching the peak. This is so significant, it's much more significant than is widely understood. It's much more significant than the tree planting efforts that we can undertake in the next few decades when it comes to meeting our nation's climate goals and the 100 Acre Wood will absolutely be the cap keystone of City of Bellingham's natural assets in combating climate change through capturing carbon and storing it in a biological form. I'll leave it at that and thank you so much for inviting my comment.

Frank James: Thank you for showing up and speaking your mind. I think the issue you raised is an important one for the ecological future of our society. If we can't do this, I'm worried. I'm really glad we're doing this as a community and that the community stepped up all along the way to put additional resources into these kinds of things.

John Brown: Mr. Wolf, that's news to me. It's something that I should know, probably something that I've read. Can you fill us in on your education in that issue?

Edward Wolf: Yes, thank you for asking that John. I have a background in forest ecosystem analysis from the University of Washington. I have a little bit of academic experience, lifelong involvement as a forest-oriented environmentalist and have recently worked with a former professor and colleague who's one of the IPCC, Intergovernmental Panel for Climate Change lead authors over many years. He is now retired from that work and has shifted his focus almost exclusively to value of mature and maturing forests from the carbon capture standpoint. His name is William Moomaw, and he has promoted a concept that he calls proforestation, which is letting mature trees continue to grow because of their capacity to capture and store carbon. His point is the forest industry has focused on a very early stage of the tree life cycle. In most parts of the country, including ours, where Douglas firs and western hemlock are often harvested on industrial forestland at a rotation of about 40 to 50 years. That's about a 20th of the average Douglas fir lifecycle. Much of the value of the maturing major timber trees of our region is lost from a carbon storage standpoint when trees are harvested early. Most of our landscape has been logged. Old growth in the multi century range is rare and so we've got a lot of trees about which we can make decisions and the decisions are, is it ever right to replace these trees or it is best to leave them growing. I think from a climate standpoint and particularly with the urgency of the IPCC Special Report goal of what's necessary to meet a 1.5-degree temperature increase, the best thing most of our mature trees can do for us is to keep growing so we have to shift policies in that direction. The Department of Natural Resources in Washington made a little turn in that direction by creating a carbon reserve and taking up to 10,000 acres of mature trees that would be eligible for timber harvest out of its harvest schedule. I have a feeling there's going to be more of that and from that standpoint again, the 100 Acre Wood is ahead of the curve. I can send you some information about proforestation if it's valuable to you.

Frank James: It would be valuable to us Edward and thank you very much and it's amazing how technically proficient the people in our community can be and how expert they are. Thank you very much. John Brown: Wonderful information.

Gerry Wilbour: I talked a fair amount at our last session, so I just want to thank everybody for their work and their comments on this. It's a great process. I'm really happy to see it and glad to see the broad public presentation. It's something I asked for and I like the addition of the climate issue to this process. The previous speaker outlined that as well. I haven't look at the new version of the plan, but that says a lot about it. As I said last time, the Douglas fir of this age that are growing in the 100 Acre Wood are considered to be world champs in terms of carbon capture and storage. They're the best in terms of their ability to grab carbon out of the atmosphere and put it into the tree in the ground, and they last for centuries, especially if they're not logged. Great opportunity for a contribution in that respect.

I had some additional comments. Barbara brought up the Simpson Reserve as a possible model. One thing I wanted to mention about that is that was intentionally built to be a sustainable system before people got there. That makes it a lot easier to figure out how to manage it and direct people where you want them to go and get them to the high points in the site in a way that is not damaging to the landscape. We have a very different situation in the 100 Acre Wood, and I'm actually pretty pissed off that we haven't gotten on this before. We've had this property for 10 years. We've known that there was a lot of recreation damage and we've let it just happen. I put most of the blame on the City recognizing that the Mayor's office and the staff has turned over and so we got a new lease

there. I'm delighted to see that they're not only working on this, but they have a significant amount of money budgeted to take on the issues.

I would agree with the prior comments that the thing we needed to tackle first are the environmental impacts that the recreation is having to the woods, particularly the wetland crossings. It's very challenging to revise recreation behavior once it's established. I think we have to give the managers some slack on timing and sequencing of how they do that. Most people who use the woods, say like 99% of the people that will use those woods in the next 10 years have never heard of this process, nor are they involved. So, creating a system that revises that behavior and keeps people going in directions that aren't going to harm the landscape is not an easy undertaking. Mostly one thing I wanted to mention, because I know there's a lot of anti-bike sentiment, most of the trampling in the 100 Acre Wood is from foot traffic and it's happened over many decades. I started using these woods probably in the late 70's, certainly in the early 80's. There was an old horse farm that was right off Chuckanut Dr that established a trail system for their tenants to use and there's some large areas that involve pretty massive impacts to category one wetlands that at that time were two full wide trails that had really robust wetland plants growing on either side. Certainly, in the last 10 years there's been a substantial uptick in recreational traffic. That has done additional damage and the reason I say that the foot traffic is doing most of the damage is bikes don't tend to move around mud puddles and foot traffic always does, so that's where the widening comes from. It's not that anybody is innocent, its that we all cause problems when there's a bootleg system that has not been thoroughly thought through before it became established and so that's the battle that we're fighting. It's a very different battle than they had establishing the trail system at Simpson reserve.

Frank James: Most of us here know you and know your experience and background, but just for the record, maybe you could share with us the basis for your making these comments, your experience and training.

Gerry Wilbour: I've been a trail maintenance and construction contractor for over 40 years. I've written a number of master plans and participated in a number of planning studies and read a lot of the research around recreation ecology and whatnot and interacted with people who do that kind of research. Our work always has to comply with the recommendations that are made at that level. I didn't want to be involved on any other level on this plan because I'm a neighbor of the properties and I wanted to speak freely. When you're a professional or you have any position, you have to be a lot more neutral. I'm not neutral on this one, so I want to be able to express myself. None of the plans are addressing some of the fundamental problems with the unsustainable trail network. By that I mean there's a lot of environmental impacts that aren't being addressed and one of the ones that's pretty graphic is right at the end of JJ 2 wetland right where the main trail comes off the Interurban up to the right as you're entering the trail, there's a trail that traverses up a steep ridge there. Had about a 35 to 40% gradient, that thing is going to be running a lot of silt into that category one wetland. It's just a very poor location for a trail. It's not that you can't have a thread going up that ridge, in fact, I think trying to prevent any trail from going up that ridge would be kind of foolhardy. If you simply block what was there, if you were successful in blocking it, you'd get braided trails which is worse. So, since people want to go that direction, you have to provide an alternative that doesn't have the negative impacts that one has.

One thing I wanted to mention was that there was a webinar that American Trails sponsored, americantrails.org, a couple weeks ago by a fellow named Dr. Jeff Marion. He's with the United States Geological Survey and also a professor at Virginia Tech. He's probably the most prolific writer on recreational ecology and trails. The webinar itself is kind of a Cliff Notes summary of all his research, but he provides a number of links to back that up. [https://www.americantrails.org/training/the-science-of-sustainable-trail-design-and-management]

The last thing I'd mentioned on the bike issue is I think the biggest issue there is bike speed. I understand that the City has now established a speed limit on trails for bikes, and I think that's totally appropriate, especially in the 100 Acre Wood. I don't think the place is suitable for aggressive adult riders. There're just too many people walking, too much potential for user conflict from that standpoint. What I don't want to see is it closed to young people, especially kids who are learning how to ride. My main passion for the woods, if I had a number one thing that was most important to me, is engagement of youth in an urban natural area, my number one priority. There's a number of measures we can take to enhance that. One of them is allowing the generation of youth who live in the area to be able to learn to ride in the woods and at modest speeds and respectfully. Limiting speed I think may help that issue a lot. The other thing it does is it means that people stay on the trail. In other words, when you develop a lot of speed, you do miss the trail at times and the trail gets widened because of that. I think the city bike speed is 12 miles an hour on trails. That honestly strikes me as a little bit high for the trails in these woods and they probably

should consider lowering that. The other thing is it should be signed. It's difficult to enforce, but nothing like a bunch of peer pressure to help enforce it, especially if it's a sign.

The other thing that the Parks Department may consider is, and it's been used successfully in other areas, is to allow bike use only every other day, whether it be odd days or even days. Then people know that there's going to be three or four days a week that are bike free every week, for those who want that experience. Thanks for doing all this, especially for the people on the committee and good luck going forward.

Steve Wilson: Thank you to the committee for putting this together, the Stewardship program. I have not been as thorough in reading as I should be, so my comments are going to be limited to the perimeter of the area. I remember the View Crest entrance seems problematic as far as access. That was one thing I was going to suggest that maybe we try and eliminate if possible and prioritize other entry points for cars. I've agreed with all the comments so far. My concern seems to be, it would be nice to be able to move forward all together so that we're all moving in the same direction and supporting each other. If there's any way that the South Neighborhood Association can be supportive of moving forward in a cooperative way, I would be willing to help facilitate that on the neighborhood level.

Frank James: Thank you Steve. To highlight what you're referring to, is I think the park currently near View Crest right at the crest of the hill where there's impaired visibility. There is a danger in that for sure. I think that's something that needs to be considered. I think your recommendation to minimize there and maximize parking someplace else is a great idea.

Hue Beattie: I think a little signage further South along Chuckanut as you're coming up to this Park area, for the tourists would be helpful so that they don't run into somebody backing out of somewhere there.

Frank James: John Blethen, I had heard, and I wanted to confirm and maybe either Peter or Laine could clarify this too, but I heard there was going to be another hearing at the Parks Advisory Board meeting this August. I didn't want to miss out on that schedule.

John Blethen: There's another hearing this month and I've kind of chosen to stay quiet because I'm going to be voting and I'm enjoying listening to the good comments, but I also have to be part of the Park Board team.

Frank James: I didn't mean to call you out about that. John Blethen: It's ok, I can be called out. Frank James: If you know the date for that meeting I think that would be helpful for everybody.

Peter Gill: The next Park Board meeting is August 10th at 7:30 AM.

Frank James: Peter, Do you know what time that meeting on the 29th, the City Council meeting is?

Peter Gill: I do not. I'm not sure when that would be.

Frank James: We'll find out and we'll get it posted on our website.

Peter Gill: Check the website.

John Blethen: I would recommend that as many of you come to that Park Board meeting as possible. There is a chance for you to speak to address the issue and we missed that last month, and we didn't get that at the Greenways meeting. So, if somebody has the time to attend that meeting, there is a public comment period and I'm sure that your thoughts would be entertained. It's a zoom meeting.

Frank James: Thank you John. I appreciate your comments and the information. Robyn, could you find out where and when those meetings are, time, date, location and make sure we post those prominently on the website, so everybody who has asked us knows? Robyn Albro: Yes.

Frank James: Laine, you're the only one who hasn't said anything, if you'd like to, we'd be happy to hear from you. If you just want to listen, that's okay too.

Laine Potter: I don't have too much to add. I'm happy to hear everyone's comments. It sounds great that everyone wants to prioritize restoring wetlands and I think we're all really close to being on the same page. I was curious if this group will be putting together public comments and providing those to the City or just keeping those for your own record.

Frank James: No, we'll be putting them together as comments and we'll continue to evolve the Stewardship Plan as well. A couple things that we were looking at right now. There was a very brief mention and I think none in the

Master Plan and only briefly in the Stewardship Plan about invasive species. We had quite a good hearing, actually a guest speaker about those issues and we have a map and a pretty extensive list of what those issues are. We plan on adding that as an appendix to our current plan. There are some other issues we're going to add to that as well and we can certainly append the summary of the comments of the two hearings we had. We'll have to decide, when everybody has had a chance to speak, if we want to have another meeting or not. Thanks Laine.

John Blethen: I believe you could probably send your comments to Parks and ask that they be included in the packet that's sent out to the Parks Board so that people can see those comments in advance, maybe you could tweak the plan a bit, worth sending on. I think there's probably still time to get it in the packet.

Frank James: Right, we're trying to get on the same page as Parks with respect to the timeline, and that's been a challenge for years actually, but we'll try to do that for sure. We definitely want the information for the City Council, and we'd like to have it for the Parks Advisory Board as well. We'll do our best to do that. Thank you for the suggestion John.

Laine Potter: There's certainly still time to do that. We'll be sending out the packet to Parks Board by Friday of next week, the 5th, so we could certainly include that in our packet. That would be great.

Tina Mirabile: I wanted to mention that I was grateful to the City when we were looking into the invasive plant removal that they actually provided a calendar that shows the best times for treating certain species and that was helpful. We did receive your information Frank and we were referring to Ann Eissinger's Baseline Study regarding invasive plants, but we're more than willing to add additional information. The one thing Laine that I didn't get that I'm still kind of wondering, is if the City has an operational manual on how they actually remove invasive plants, such as pulling roots manually or using herbicide. I don't know if that was possible to get, but the other thing the City provided was the kind of educational and volunteer programming, to which removing invasive plants is a great opportunity for the Community to come out. I know it has been happening anyway and a lot of the neighbors definitely organized to help remove invasive plants in the forest, but it's a great opportunity for people to learn more. You can see how invasive plants, even within a forested condition, can encroach and create a distribution of plants that is not providing the highest level of habitats. Being involved with invasive plant removal and education is a good opportunity for people to learn more about the natural condition of the forest too.

Frank James: Of course, there's been efforts at doing that already and the City wonderfully provided leadership, tools, and other things in the past. I expect that's going to be an ongoing sort of activity and invasives don't go away in a decade. To get rid of them all is going to be a big job. The City has real expertise and real leadership and organizational skills in doing those things. We look forward to working with them on that. Thank you, Tina.

Christopher Grannis: Every time, I come out of the woods with as many stinky Bob plants as I can hold in my hand. I was thinking if everyone who walked through the woods did that, then that particular invasive could be wiped out pretty quick. I don't know if this is something that can be communicated to people so that learn how to do it. It's really easy. Find where they come out of the ground and they're easy to pull.

Frank James: I think the issue when we heard from the invasive plants person from the County was that they actually have a very detailed map with coordinates of all these things which they do not make public. Because people have gone in and for example, people that work with stinky Bob know the difference between that and bleeding heart. A lot of people that don't know that might eradicate a whole bunch of bleeding heart instead. I think there are reasons that it is done under the leadership of a city program with a person on site that's an expert. Like you do, I hate stinky Bob and pull it up wherever I go. It is along the trails where these disturbed soils are really promotes distribution and it gets on fur and feet and pant legs and all that and we become the distributive mechanism for it in some cases. I think that's a good point, but I would just caution that I think we need to really work with our County and City leadership to do that, so it doesn't cause harm.

Christopher Grannis: I agree entirely, and I don't pull out a stinky Bob until I see those really pretty little pinkish flowers and I do agree they do look an awful lot like bleeding heart. One other thing I wanted to comment about as a result of this process, I was looking at the trail maps and I realized there was one I hadn't been on. That's the trail that goes from Hoag's Pond, north, northeast up the hill and I followed that. There's a lot of stinky Bob on that trail, but anyway I found myself in the backyard of a couple of condos. I think I must have lost the trail somewhere and I went back and found another trail that went up a very steep slope, too steep for me to go up. So, I'm wondering if there are any plans in the works about that trail. Would be nice if it could connect to Cody or something, but I don't know, maybe the topography is such that it should be closed. Do you know anything about that particular trail?

Frank James: Our purview is the 100 Acre Wood, the Chuckanut Community Forest, and so it's well away from that. I think the city has information and has thought about it.

John Blethen: I push for that 28th Street Trail all the time and it'll be great to have a connector between the Interurban and the 28th St Trail, which would allow you to get all the way over to Sehome Hill into the Sehome Neighborhood. It's an important connector. It needs to happen and the City is aware of it. It will happen, I'm sure, hopefully soon. Frank James: It looks like there's just a little bit of private property in between, right? Is that the issue?

John Blethen: The trail is actually east of that development up that steep hill, but I'm sure we can come up with a work around. The steep hill is the right of way, unfortunately.

Laine Potter: So that trail corridor that John mentioned is in process. We just acquired a property in June that's going to help us make that connection and we're working with a couple landowners in that area because that right of way is so steep, it will likely need a bit of private property and easements to get through there, but we are working on it.

Frank James: Thank you Laine.

Christopher Grannis: I just wanted to say Thanks John and Laine. I'm very happy to hear somebody working on that and I'm just delighted with how many people are pulling in the same direction on this whole woods.

Frank James: I want to thank all of our participants so much for coming and thank you so much for your significant ideas and you're taking the time to comment and bringing this forward. And of course, to Laine and Peter for coming, and being able, knowledgeable, and assisting us in answering questions. I appreciate that very much.

Hue Beattie: There are signs that will go up if there's a high forest fire danger. I guess that was in there a little bit, but it's like we need a little more. We need the fire department to make a plan for a forest fire and an outline where all the hydrants are on the edge of the property. Maybe we could put up hose connections and things like that so if there is a fire, people can put it out quickly.

Frank James: That's a great idea. I was involved in putting out a fire over on the property being developed above Mud Bay. It got put out by the fire department, but they're building guys, they don't do wildland fires. It burst back into flame a few hours later and I think some additional thought about how we manage forests specifically with fire and not just rely on our fire department. They do great with homes, but I think it only got put out when the City pulled up and wildland people finally came. It takes a while to get them there and this is a fire that could have taken out all of Edgemoor. I think that is a concern and we should definitely add that in. If you would mind sending a note to remind me that and we'll include it in the document that we're responsible for. Hue Beattie: Ok.

John Brown: Laine Potter asked if comments at this meeting could be sent to the Park Advisory Board for the meeting on August 10th and I imagine that Robyn will have the minutes of this particular meeting in her thorough way and can collate the comments that everyone has made and send them perhaps to Laine.

Frank James: What I'd like to do John, my suggestion is that we append the hearing to the document itself and include it as part of the Stewardship Plan because the comments are actually directly to that and of course to the Master Plan. But I think if we could do that summary as you suggested and then actually append them to the Plan.

John Brown: That's a good idea Frank. I'm wondering if it will be available for the meeting on the 10th.

Frank James: I think it will be. We don't have any choice. I think it has to be, so we just need to pull out the stops and get it done.

Robyn Albro: I just wanted to say that usually things that are part of the minutes we don't release until after the minutes have been approved. We don't actually have a quorum here of people who have been at those meetings recently. I don't know if it's possible to just release the public comment part of the minutes and send those to the Park Board and Laine.

Bob Carmichael: Our minutes can be release in draft form without adoption. It's very rare there's anything that's confidential in them. The fact that they're in draft form does not prevent them from being released, so I think the simplest thing is just to release them.

John Brown: Then we can release the comments right now to Laine's office or to the Park Advisory Board before August 10th. That's one alternative. If I understand you Frank, you are saying that the comments now made would

become part of the Stewardship Plan and appended to the Stewardship Plan. But you are suggesting that all can be done by August 10th. I think we are going to try to get it in I mean.

Frank James: The City Council is going to make definitive decisions about this on the 29th and I think we need to do everything we can to do that well before that. If I understood Laine correctly, it's actually a week from Friday that we have to have this done when they send it out. So, we will need to do it by then.

Robyn Albro: I can send the minutes from the last meeting that we've already done that have comments both written and oral. Then I can do these other minutes and try and get them done by Wednesday of next week and then send those to Laine, so she'll have them both before they send the packets out on the 5th. I could, if you want me to, pull the comments out and separate them so they can be appended to the thing, or do we want to append the whole minutes?

Frank James: I think it's better to have hearing comments as an entity, because that's what these hearings are for is to discuss and make recommendation with regard to the Stewardship Plan. So, if you could get that by Wednesday, then we could just append them. I'm going to be working with Chris and Tina to get any final revisions to the Stewardship Plan done by then. So, I think that should be doable.

Frank James: Well, I think from a civics point of view, we probably need to, if there isn't further discussion about these two documents, to close the hearing. We've had good participation. I want to thank everyone that came to comment. Then I'd like to go ahead and close this public hearing at 7:06 PM. I really appreciate everybody coming and having the time to really talk and discuss it. It was a very civilized and appropriate conversation to improve the process and I really approve.

John Brown: Excellent, just wonderful comments.

Frank James: Thank you everybody and thanks Laine and Peter as well.

Public Hearing Closed.

Attached: Written Comments from Edward Wolf and Barbara Zielstra

Gmail

Robyn Albro <ralbro.ccfpd@gmail.com>

Comment on the Hundred Acre Wood Master Plan: Climate Resiliency Goal

2 messages

Edward Wolf [redacted] Thu, Jul 28, 2022 at 4:49 PM
To: Robyn Albro <ralbro.ccfpd@gmail.com>

Hello CCFPD —

Thank you for the opportunity to comment on the latest draft of the Hundred Acre Wood Master Plan. I am writing to reiterate a comment I made verbally at last night's Public Hearing, and to add a couple of informational links that may be helpful.

I spoke up to applaud the Master Plan's focus on the goal of Climate Resiliency, and to emphasize the special climate importance of mature trees in the age classes predominant in the Hundred Acre Wood. These Douglas firs, western red cedars, and western hemlocks in the 80-100 year age class (approximate time since logging) are still "young" but have reached the point in their lifecycle where they are now, and will continue to be during this century, absolute champions of carbon capture and storage. Mature trees absorb and store carbon at very high rates, storing far more per tree and per acre than seedlings, saplings, or young trees can. They are at peak carbon capture performance, and will continue to be so for decades to centuries to come.

This capacity is important because it is available NOW, during the decades when high rates of carbon capture are most necessary to help efforts to reach and pass Net Zero carbon emissions by 2050. We cannot build comparable capacity in the next 28 years by planting new trees, as important as those efforts are. We have to maintain and protect mature forests already capable of the most substantial carbon capture. Hundred Acre Wood, along with the nearby 175-acre Sehome Hill Arboretum, is a high carbon landscape with maturing trees in the most important age classes, probably the City of Bellingham's best natural assets for carbon capture at scale. This capacity must be recognized, prioritized, interpreted, and celebrated!

This "let old trees grow" strategy has been called "proforestation" by Intergovernmental Panel on Climate Change Lead Author William Moomaw. Here are two references that provide more detail about why forests like the one that will be protected in Hundred Acre Wood possess disproportionate importance as natural climate solutions:

"Intact Forests in the United States: Proforestation Mitigates Climate Change and Serves the Greatest Good," by William Moomaw, Susan Masino, and Edward Faison (2019)

"Why Keeping Mature Forests Intact is Key to the Climate Fight" (interview with William Moomaw), by Fen Montaigne, Yale e360, October 2019.

Thank you for the opportunity to share this information with CCFPD and with the City of Bellingham.

Edward Wolf
926 16th Street
Bellingham, WA 98225
(503) 853-9085 cell/text

Robyn Albro <ralbro.ccfpd@gmail.com> Thu, Jul 28, 2022 at 5:24 PM
To: Frank James <fjames.ccfpd@gmail.com>, John Brown <jbrown.ccfpd@gmail.com>, Hue Beattie <hue.ccfpd@gmail.com>, John Hymas <jhymas1331@gmail.com>, John McLaughlin <johnm.ccfpd@gmail.com>
Cc: Bob Carmichael <Bob@carmichaelclark.com>, Catherine Moore <Cmoore@carmichaelclark.com>, Taryn Maloy <TMaloy@carmichaelclark.com>

Barbara Burk Zielstra
316 Willow Ct. N.
Bellingham, WA 98225
July 27, 2022

CCFPD Commissioners
Frank James
John Hymas
John McLaughlin
Hue Beattie
John G. Brown

Nicole Oliver, City Parks Director
Laine Potter, Design and Development
Peter Gill, Park Planning and Development
Karleena Burdick, Intern

For decades many of us have worked to protect this unique, precious property. And now that we have them protected from draining and development, I fear we may harm them by permitting human uses that will further degrade these important forests and wetlands.

I appreciate the recent changes to the draft Master Plan, incorporating some of the scientific Herrera report, July, 2022. We must realize this property as a Preserve, not a park. Its intended purpose is first, ecological protection, and only after that is achieved, should we address recreation.

I understand that many cyclists want to continue to cycle in the 100 Acre Woods. I have observed incredible damage that off trail uses have created in Fairhaven Park. This damage has occurred and continues to occur, despite Park employees' efforts to make the newly created trails unusable. I will share just a few photos of how the Fairhaven Park woods have been harmed in the past decade.

I understand that not all cyclists will ride off-trail but the risk that some may continue the as they have in Fairhaven Park is too great.to take the chance. We need to protect these woods and wetlands from uses that will damage them. Even when log barriers have been anchored in place, the cyclists just continue off-road and treat them like moguls. I have placed logs and branches across these destructive trails only to return a day later and find them moved aside so a rider could ride where he wanted with no concern for the forest.

Allowing dogs in a wild area is counter intuitive. Dogs are predators and wild animals know to avoid them, even a whiff of them or their urine is enough to stress the wild animal and cause it to flee or hide, (Miller, et al, 2001 referenced in Herrera report, page 34). For this reason, no dogs are allowed in Stimpson Reserve, a similar forested wetland property. We should follow their lead.

Already trails have been created in the 100 Acre Woods that are intruding on the wetlands and their buffers. The Master Plan, echoing the Stewardship Plan, recommends removing such

trails, amending the compacted soils and replanting to help the forest heal. I would like to see more trails removed from the draft Master Plan, following the Stewardship Plan, Figure 8. The Decommissioning Trails section of the Master Plan should be reprioritized. The 2 most critical criteria are:
Does the trail impact a protected wetland, critical habitat and species, or impact hydrologic connectivity?
And
Does the trail support the City's conservation and restoration goals (does not negatively impact ecological or hydrologic function)?

Instead, the first priority listed in the Master Plan considers "fulfilling recommendations by the public"?
Trails need to be decommissioned and created according to best science and the Stewardship Plan gives us ample direction.

I do think it is important to hear what people want and have to say, but we must remember that not all wants can be accommodated if we are to save these forested wetlands. If we did not have Fairhaven Park, the Interurban trail and Arroyo Park surrounding these wetlands, I would be more moved to consider the desires of humans wanting more freedom to use the forest as they wish. But adjacent to the 100 Acre Woods are ample trails and parks in which to ride a bicycle and walk a dog.

As Dr. Seuss wrote, "I speak for the trees, for the trees have no tongues."
Those of us familiar with these woods, know that the trees do, in fact, communicate, if we would just listen. All wildlife – animals and plants – need our respect and our protection. We may not be able to ride a bicycle or walk a dog in these woods, but that is something we willingly give up to allow the trees, the wetlands, the animals to survive and with time, to thrive. No one needs to ride a bicycle in these woods, no one needs to walk a dog in these woods. We may want to do these things, but we do not need to do them to survive. Can we be big enough humans to give up something we want so that the wild ones can survive? I think we can and this is our challenge.

Hopefully,

Barbara Zielstra

APPENDIX B

Upland Forest Structure Transect Results

Summarized Data (February 6, 2022) Forest Structure based on Washington Department of Fish and Wildlife Criteria

		Transect ID and Area	
		Transect 1	Transect 2
		150' long x 18' wide	200' l x 18' w
		2700 square feet	3600 square feet
		0.062 Acre	0.0826 Acre
Vegetation Structure	WDFW criteria	# of Features Recorded	
Mature forest	Mature trees (>21 diameter at breast height [dbh])	4	7
	Small trees (<21 dbh)	12	16
	Average tree dbh	14.8	15.5
Old growth snags	Large snags (>20" diameter, 15' tall)	1	0
	Small snags (<20"diameter or <15' tall)	4	6
	Snags/acre	16.1	0
Old growth logs	Large logs (>24" diameter)	0	0
	Small logs (<24"diameter)	12	10
	Logs/acre	0	0
Priority Snags and Logs	Priority snags (>20"dbh, 6.5' tall)	1	0
	Priority logs (>12"diameter, 20' long)	3	6

Transect 1

Transect 1 Size: 150' long by 18' wide

Date: February 6, 2022

Location: Upland Forest Buffer of Category II Wetland HH, 1 trail bisects buffer

Feature Number	Feature type	Species		Circumference	Diameter at Breast Height (DBH) / diameter (inches)	Length (Feet)
		Scientific Name	Common Name			
1	Tree	*Thuja plicata*	Western Red Cedar	4'6"	17.2	
2	Snag	*Pseudotsuga menziesii*	Douglas fir	6'6"	24.8	>40
3	Tree	*Betula papyrifera*	Paper birch	5'5"	20.7	
4	Log	*Betula papyrifera*	Paper birch	3'	11.5	>20
5	Tree	*Thuja plicata*	Western Red Cedar	4'6"	17.2	
6	Log	Unknown		2'6"	9.6	>20
7	Tree	*Thuja plicata*	Western Red Cedar	4'	15.3	
8	Tree	*Thuja plicata*	Western Red Cedar	7'11"	30.3	
9	Log	*Thuja plicata*	Western Red Cedar	2'	7.6	>20
10	Tree	*Thuja plicata*	Western Red Cedar	7'10"	29.9	
11	Log	Unknown		2'6"	9.6	
12	Tree	*Thuja plicata*	Western Red Cedar	7'	26.8	
13	Snag	Deciduous		4'2"	15.9	>10
14	Tree	*Pseudotsuga menziesii*	Douglas fir	2'6"	9.6	
15	Log	Unknown		2'3"	8.6	
16	Tree	*Pseudotsuga menziesii*	Douglas fir	3'10"	14.6	
17	Log	Deciduous		2'	7.6	>20
18	Snag	*Betula papyrifera*	Paper birch	3'9"	14.3	>40
19	Snag	*Betula papyrifera*	Paper birch	3'6"	13.4	>20
20	Snag	*Betula papyrifera*	Paper birch	3'2"	12.1	>40
21	Tree	*Thuja plicata*	Western Red Cedar	1'4"	5.1	
22	Log	*Betula papyrifera*	Paper birch	3'5"	13.1	>20
23	Log	*Betula papyrifera*	Paper birch	3'	11.5	>20
24	Log	*Betula papyrifera*	Paper birch	1'6"	5.7	>20
25	Log	Deciduous		2'6"	9.6	>20
26	Tree	*Thuja plicata*	Western Red Cedar	1'	3.8	
27	Tree	*Thuja plicata*	Western Red Cedar	2'6"	9.6	
28	Log	*Thuja plicata*	Western Red Cedar	1'10"	7	>20
29	Log	Unknown	Unknown	1'9"	6.7	>20
30	Tree	*Thuja plicata*	Western Red Cedar	3'	11.5	
31	Tree	*Thuja plicata*	Western Red Cedar	2'7"	9.9	
32	Tree	Deciduous		2'6"	9.6	
33	Tree	*Pseudotsuga menziesii*	Douglas fir	1'9"	6.4	

Transect 2

Size: 200' long by 18' wide

Date: February 6, 2022

Location: Upland Forest Buffer of Category I Mature Forested Wetland KK, 2 trails bisect buffer

Feature Number	Feature type	Species		Circumference	Diameter at Breast Height (DBH) / diameter (inches)	Length (Feet)
		Scientific Name	Common Name			
1	Tree	*Thuja plicata*	Western red cedar	8'9"	33.4	
2	Log	*Thuja plicata*	Western red cedar	3'9"	14.3	>20
3	Log	*Thuja plicata*	Western red cedar	4'4"	16.6	>20
4	Tree	*Thuja plicata*	Western red cedar	1'10"	7	
5	Log	Deciduous		2'	7.6	>20
6	Tree	*Thuja plicata*	Western red cedar	1'4"	5.1	
7	Tree	*Pseudotsuga menziesii*	Douglas fir	7'3"	27.7	
8	Tree	*Thuja plicata*	Western red cedar	1'7"	6.1	
9	Tree	*Pseudotsuga menziesii*	Douglas fir	4'	15.3	
10	Snag	Deciduous		3'3"	12.4	>40
11	Tree	*Pseudotsuga menziesii*	Douglas fir	5'4"	20.4	
12	Tree	*Pseudotsuga menziesii*	Douglas fir	7'5"	28.3	
13	Log	Unknown		4'	15.3	>20
14	Log	*Tsuga heterophylla*	Western hemlock	1'6"	5.7	>20
15	Tree	*Thuja plicata*	Western red cedar	2'6"	9.6	
16	Snag	Deciduous		2'10"	10.8	>20
17	Log	*Betula papyrifera*	Paper birch	2'10"	10.8	>20
18	Tree	*Thuja plicata*	Western red cedar	3'6"	13.4	
19	Snag	*Betula papyrifera*	Paper birch	2'5"	9.2	>40
20	Tree	*Thuja plicata*	Western red cedar	2'4"	8.9	
21	Snag	Abies grandis	Grand fir	1'6"	6.7	>40
22	Log	*Pseudotsuga menziesii*	Douglas fir	6'	22.9	>20
23	Log	*Pseudotsuga menziesii*	Douglas fir	4'8"	18.2	>20
24	Tree	*Thuja plicata*	Western red cedar	3'3"	12.4	
25	Tree	*Thuja plicata*	Western red cedar	9'4"	35.7	
26	Tree	*Thuja plicata*	Western red cedar	3'	11.5	
27	Snag	*Betula papyrifera*	Paper birch	2'2"	8.3	>20
28	Tree	*Thuja plicata*	Western red cedar	7'4"	28	
29	Snag	*Thuja plicata*	Western red cedar	2'9"	10.5	>20
30	Tree	*Prunus emerginata*	Bitter cherry	3'	11.5	
31	Tree	*Prunus emerginata*	Bitter cherry	3'	11.5	
32	Tree	*Acer macrophyllum*	Big-leaf maple	3'4"	12.7	
33	Log	Deciduous		2'7"	9.9	>20
34	Log	*Betula papyrifera*	Paper birch	3'3"	12.4	>20
35	Tree	*Acer macrophyllum*	Big-leaf maple	2'2"	8.3	
36	Tree	*Thuja plicata*	Western red cedar	2'2"	8.3	
37	Tree	*Thuja plicata*	Western red cedar	1'3"	4.8	
38	Tree	*Thuja plicata*	Western red cedar	4'3"	16.2	
39	Tree	*Thuja plicata*	Western red cedar	5'2"	19.8	

Chuckanut Community Forest Stewardship Plan - Understory Vegetation Recorded along Transects
February 6, 2022

	Species		
	Scientific Name	Common Name	Origin
Transect 1	*Ilex aquifolium*	English holly	Non-Native
	Hedera Helix	English Ivy	Non-Native
	Polystichum muniturm	Western sword fern	Native
	Rubus urisinus	Dewberrry	Native
	Mahonia nervosa	dull Oregon grape	Native
Transect 2	*Prunus laurocerasus*	Cherry laurel	Non-native
	Ilex aquifolium	English holly	Non-Native
	Thuja plicata	Western red cedar sa	native
	Polystichum muniturm	Western sword fern	Native
	Rubus urisinus	Dewberry	Native
	Gaultheria shallon	Salal	Native
	Mahonia nerevosa	dull Oregon Grape	Native

Chuckanut Community Forest Stewardship Plan - Wildlife Observations During Herrara Site Visits (January 25, Feburary 6 and 16, 2022)

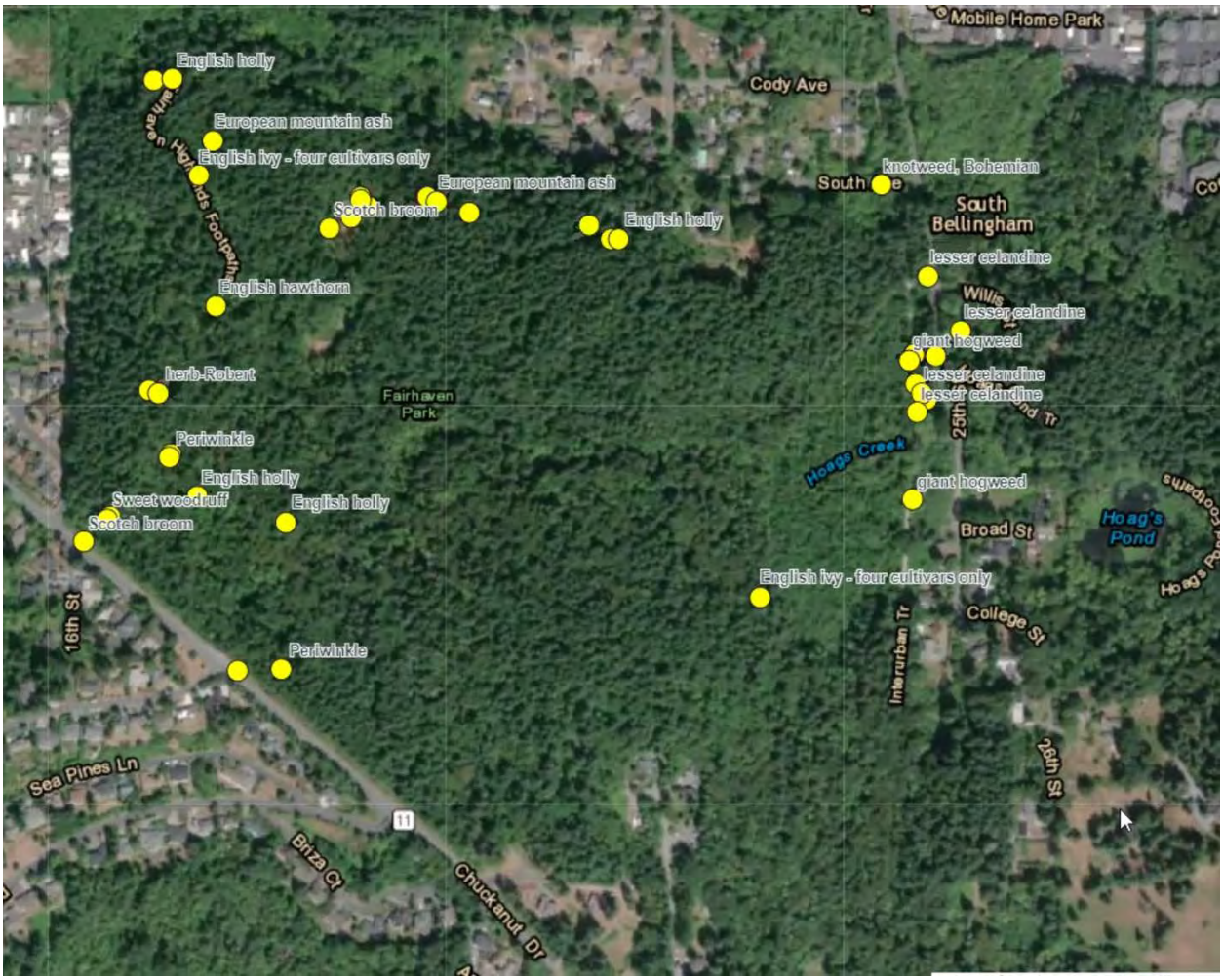
Species			species abbrieviation on dataform
Common Name	Scientific name	observation type	
Dark-eyed junco	*Junco hyemalis*	audio, visual	DEJU
Black cap chickadee	*Parus atricapillus*	audio, visual	BCCH
Anna's humingbird	*Calypte costae*	audio, visual	ANHU
Stellar jay	*Cyanocitta stellleri*	audio, visual	STJA
american robin	*Turdus migratorius*	audio, visual	AMRO
Red breasted nut hatch	*Sitta canadensis*	audio	RBNU
Varied thrush	*Ixoreus naevius*	audio	VATH
Common raven	*Corvus cryptoleucus*	audio, visual	CORA
Northern flicker	*Colaptes auratus*	audio, visual	NOFL
Pileated Woodpecker	*Drypocopus pileatus*	evidence	PIWO
Red breasted sap sucker	*Sphyrapicus ruber*	evidence	RBSA
Spotted towee	*Pipilo fuscus*	audio	SPTO
Great blue heron	*Ardea herodias*		GBH
Bald eagle	*Heliaeetus leucocephalus*	audio, visual	HALI
Unidentified to species			
owl, juvenile		visual	
weasel		visual	

APPENDIX C

Noxious and Invasive Weeds in the Chuckanut Community Forest – A presentation provided by Laura Baldwin (Whatcom County Weeds Control Board Coordination) to the CCFPD Meeting on April 28, 2021

Noxious Weeds and Invasive Species in Chuckanut Community Forest. 28 April 2021
Presentation by Laurel Baldwin, Weed Control Coordinator for Noxious Weeds in Whatcom County.

We did a survey in the Forest last Thursday and did some mapping. We hiked three or four miles all around in the Forest on all the trails we could get to. We got a pretty good feel for the impacts on the Forest. I was surprised to not find a few things. Fairhaven has quite a population of Spurge Laurel (an evergreen plant) and we didn't really see it in the Forest. There was an oddity of a bamboo planting in the middle of the Forest in an open area. It is a short growing species; don't know which bamboo cultivar it is. We have a mapping program I can share with you [comes up at 6:05 in the video of the meeting]. Yellow dots are the points and labels of the weeds that we found. We tended to stay more on the periphery, the outside borders, but we certainly can do a more comprehensive survey at some other time. The reason I wanted to stay on the outer edges is that is where a lot of the weeds come in, from the trail heads, people track them in, or they drift in to open spots. Saw a fair amount of Bush Holly. I came in from the Fairhaven Trailhead. There is a fair amount of English Hawthorne (listed on the noxious weed list) in the northwest area. The Noxious Weed List is revised every year and those are the weeds that get our attention. They are noxious, non-native plants. We also have priorities of weeds.



Most of the weeds we found in the Chuckanut Community Forest are C class or B class, they are more widespread and more commonly found in Whatcom County and Western Washington. We didn't find any unusual/rare or Class A noxious weeds, which if we did, we would try to see about helping eradicate those. The other ones are for management and we are not requiring control at this point. Had some English Holly and European Mountain Ash in the north of the Forest. Mountain Ash is a monitor species, not a regulatory one at this time. I was happily surprised to see that there weren't huge swaths of Herb Robert, which is a very common and invasive understory problem for forests here in Whatcom County. I was pleased to see that this forest, this ecosystem, is at a point where it is starting to see some impacts moving in from invasive species but by and large it is a well-established native plant community. It is still feasible, at this point, to move in and remove some of those things by hand, with volunteers in the community involved, stick to a mechanical removal. It is not pristine, but it is a really nice forest to be in.

There is some Periwinkle off Chuckanut Dr and some Scotch Broom also, and that could be WSDOT right of way rather than the Forest. Sweet Woodruff is another ornamental I found. It looks like perhaps in the community to the southeast of Chuckanut Dr. that the trailhead was used as a yard waste dump. When people dump their yard waste, they end up with ornamentals spreading in forested areas. There was more English Holly and more Periwinkle (Vinca) off the trailhead further south off Chuckanut Dr. English Ivy comes and goes. There are some places where it is not up in the trees, it is only on the ground. Pretty easy to solve up in the trees, you can cut them along the base of the trunk and let the above ground plants die off. The understory is more of a concern because it can crowd out native plants. There aren't vast swaths of English Ivy in this forest.

We did have a Class A, Giant Hogweed, over on the Interurban Trail, but not in the Forest. Two plants showed up a couple of years ago, they have since been controlled and removed. There is another little plant called Lesser Celandine, a Class B Noxious Weed. There are small patches that we have been digging up along the trail as well, also outside of the Forest. It travels well on shoes and boots and it is a cute little plant, so people have traded it. Now it is illegal to buy, sell or transport in the state. There is also a patch of knotweed on the eastern edge to the north but didn't see any in the Forest. In the north there is more English Holly and Mountain Ash. The short bamboo is in the north in with some Scotch Broom, which is the only batch of Scotch Broom I found within the Forest. They are young Scotch Broom that drifted in because this is an opening or were tracked in and grew there because there is sunlight. They are young plants, and they could be weed wrenched out pretty easily.

If you click on the dot on the map, it shows the latitude/longitude, date we were out there and number of plants. There are photos attached as well. There is a specialized tool that is just for Scotch Broom to wrench it out that we loan out for free. The tool also works on young invasive trees, European Mountain Ash and English Hawthorne.

Question:: Is it true that if you cut Scotch Broom to the ground while it is blooming, you get a decent kill rate?

Laurel Baldwin: Yes, it is. There are a couple of different options. Weed wrench is one of the options; you can also cut it down to the ground. On older plants we've gone in and cut the plants in the fall, about 6 to 8 inches above ground, then girdle the bark off the stump. When you do that, you save the soil disturbance from happening. Anytime you pull up a weed, especially the scotch broom, you are disturbing the soil and any seeds that are dropped off the scotch broom are exposed to sunlight, water, and air and they germinate, so you can get a flush of seedlings.

There is a weird little bamboo planting in here in the northeast, about 600 sq. ft. Not very noticeable because it is a very short bamboo in a forest opening.

Could be mistaken for weed canary grass.

Question: Are there methods to control it that are relatively easy?
Laurel Baldwin: Excavators. When you get into a situation like this, you are looking at excavation or chemical treatment. There is also Ivy hanging in the same space.

Question: Can you cover it?
Laurel Baldwin: You can experiment with black plastic or even maybe with solarizing where you use clear plastic in the heat of the summer to bake the weeds. Someone would have to check and make sure the tarp or cover was staying down and it would have to be there long-term, for a few years. Have to keep checking the edges of the tarp to make sure things are not poking out the edges. Bamboo is sharp when it first comes up and it can poke right through plastic. Plastic would have to be loose so when the tip comes up it just bends.

Question: Is this map publicly available?
Laurel Baldwin: No, this is a mapping program given to us through Washington State Dept. of Agriculture. They haven't made it available to the public on a really useful

scale. There is a large-scale map, but when you scroll in, the points disappear, and that is because of private property issues. I can send the link for that map for whatever use it would be. I wanted to impress upon all of you that I think the Forest is in good shape and a good place to be protected. It is getting a little bit of invasion, but it is not terrible.

Question: If you were to prioritize that list in terms of what should be addressed first?
Laurel Baldwin: I think I would go after English Ivy first, just because it is so limited, and it can take off so badly.

Question: There has been some community effort on that up in the northeast corner and possibly another place too.
Laurel Baldwin: Because Scotch Broom is so easy and it is in a central part, it would be easy to work on that too and get that out of there.

Question: There is soil disturbance in the south on an adjacent piece of property where machinery is being used to make trails. It seems like soil disturbance is a major source of new invasive weeds.
Laurel Baldwin: Absolutely.

Question: Is there something we can do to help prevent the spread from places of disturbance.
Laurel Baldwin: Clean equipment is important, such as hosing down equipment before it comes in and ensure it is cleaned up and doesn't track things in from other sites. Also establishing cover on whatever exposed soil you have. That is really important to get something in there that you want, even if it is temporary, otherwise mother nature is going to pick out something opportunistic like a weed. Covers for a spot depends on the conditions but stick to native plants that will work in that spot, or an annual grass to cover it for now. Wood chips work, but it depends on your end intent for that site.

Question: There are bike trails that people are developing, and I think the person would be quite cooperative with us if we had practical ideas, such as cleaning equipment and using wood chips.
Laurel Baldwin: Ivy can sometimes come in with wood chips. Eventually you might want to plant the area, but the wood chips do cover the soil and keep the weed seeds from settling in.

Frank James: That is an immensely helpful presentation and eye-opening to all of us. We were all worried and the presentation was reassuring to me. Frank James described the planning phase we are in right now with the city and the long-term planning document that will guide the city and us, and whoever holds the conservation easement.

Laurel Baldwin: Discussed the use of goats to eat the bamboo, similar to a weed eater, deals with the parts above ground, but not the roots. Also talked about Japanese Knotweed being a concern, even though it is outside the boundary of the forest. Another noxious weed, Spurge Laurel is an evergreen shrub that is all over Fairhaven, it has been an ornamental, no longer sold in nurseries, very invasive, birds eat the berries and

spread it. Looks like a little rhododendron, little green flowers, and black berries. Have a taproot that goes forever, and they are hard to control. Pulled up some Herb Robert and Mountain Ash seedlings that we could pull up with our bare hands.

Question: Could we make educational material or interpretive materials available in a sign, what to look for, though there is some danger in that as people might pull out the wrong thing?
Laurel Baldwin: There could be some interpretive signing, the city did that in the Padden Creek daylight project for noxious weeds. At Lookout Mountain, Stimpson, Hertz Trail and other county parks, we have boot brush stations. There is a boot brush at the bottom of a sign and the top of the sign says stop invasive species in their tracks, wipe off your shoes before you go in the forest. Those get a lot of use and brings about the awareness that people should be cleaning their shoes. I think a lot of people use it to clean off their shoes before they get in their car. That is another form of outreach that we have found to be successful. In terms of having people pull up weeds, it is helpful if they are trained in identification. People can think they are pulling up something that is invasive, for instance, native bleeding heart looks a lot like Herb Robert, and it is easy for people to mistake the two. It is good to have volunteers and have them monitored, but I wouldn't encourage the public to pull weeds out there. There has already been a volunteer who has offered to help with that, that is a steward at Arroyo Park for noxious weeds.

John Blethen suggested working with the Parks volunteer coordinator, Amy Brown, to put a work party together.
Frank James mentioned there were previous work parties with Amy to pull out English Ivy. Laurel Baldwin could make sure that Amy and City Parks get access to the map.
Discussed taking out the Scotch Broom out by Chuckanut Dr., but Laurel wasn't too worried about it.
Steve Wilson with South Neighborhood said they would work to get volunteers out for a work party.

Laurel Baldwin would be happy to work with the City Parks Department on noxious weeds in the forest.

Frank James expressed gratitude for the informative presentation and looks forward to working together to make our community noxious weed free.

Conclusion: "I wanted to impress upon all of you that I think the Forest is in good shape and a good place to be protected." Laurel Baldwin

APPENDIX D

Recreational Impacts and Management in Wilderness: A State-of-Knowledge Review (Leung, Y., and J. Marion. 2000. USDA Forest Service Proceedings Publication #15 Vol 5. October.)

Recreation Impacts and Management in Wilderness: A State-of-Knowledge Review

Yu-Fai Leung
Jeffrey L. Marion

Abstract—This paper reviews the body of literature on recreation resource impacts and their management in the United States, with a primary focus on research within designated wildernesses during the past 15 years since the previous review (Cole 1987b). Recreation impacts have become a salient issue among wilderness scientists, managers and advocates alike. Studies of recreation impacts, referred to as *recreation ecology*, have expanded and diversified. Research has shifted its focus more towards questions driven by wilderness and park planning frameworks such the Limits of Acceptable Change and the Visitor Experience and Resource Protection. This paper begins by providing an overview of recreation impacts and their significance in wilderness, followed by a review of research approaches and methods. Major findings from recent studies are summarized. The contribution of this knowledge base to management decisionmaking and practices is examined. The paper concludes with a discussion of major knowledge gaps and suggested areas for future research.

The passage of the Wilderness Act in 1964 and the creation of the National Wilderness Preservation System (NWPS) marked a milestone in nature conservation in the United States. The system has expanded from 54 units and 9 million acres at its inception to 624 wilderness areas and 104 million acres by 1998 (Landres and Meyer 1998).

The Wilderness Act recognizes the value of wilderness recreation and specifies that unconfined and undeveloped recreational opportunities are to be provided in wilderness areas as a legitimate type of use. Results from recent recreation trends studies show that wilderness visitation has experienced impressive growth during the past three decades (Cole 1996). Hiking, overnight camping, wildlife viewing, horseback riding and nature study remain popular activities, and participation in more specialized activities, such as caving and rock climbing, is increasing. In-depth discussion of wilderness recreational use and user trends is provided in another state-of-knowledge review (Watson, this volume).

Continued growth in recreational use in wilderness has tremendous environmental, economic and social implications. This paper focuses on the environmental challenges wilderness managers face in addressing a large and expanding number of recreationists and their associated impacts. Sustaining current use and accommodating future growth in wilderness visitation while achieving an appropriate balance with resource protection presents a considerable challenge.

Scope and Definitions

Several definitions and limitations are provided here to clarify this discussion. The term *impact* is used to denote any undesirable visitor-related biophysical change of the wilderness resource. Social impacts are excluded from this review. The scope of this paper is generally limited to studies conducted in wildernesses designated by Congress. However, research studies from similar backcountry areas outside the NWPS are occasionally included for comparison. Active research in recreation impacts exists in other countries such as Australia, Britain, Canada and New Zealand, but this body of international literature deserves a separate review. Finally, this paper limits its scope to recreation impacts generated from within wilderness boundaries, although recreational use and development outside wilderness boundaries can pose an external threat to the integrity of wilderness resources (Cole and Landres 1996).

The Field of Recreation Ecology

Negative impacts on wilderness are an inevitable consequence of recreation. Even the most thoughtful visitors would leave footprints and unintentionally disturb wildlife. As recreation is a legitimate use in wilderness areas, the issue for managers is at what level do resource impacts become unacceptable based on wilderness management goals and mandates.

Recreation activities can cause impact to all resource elements in a wilderness ecosystem. Soil, vegetation, wildlife and water are four primary components that are affected (Table 1). Because various ecological components are interrelated, recreation impact on a single ecological element can eventually result in effects on multiple components (Hammitt and Cole 1998). The scientific study of recreation impacts, also referred to as *recreation ecology*, is a research response to the knowledge gaps and information needs about ever-growing visitor impacts in wilderness as well as other protected areas.

Recreation ecology can be defined as the field of study that examines, assesses and monitors visitor impacts, typically to protected natural areas, and their relationships to influential factors (Hammitt and Cole 1998; Liddle 1997; Marion 1998). Such knowledge can help managers identify and evaluate resource impacts, facilitating understanding of causes and

In: Cole, David N.; McCool, Stephen F.; Borrie, William T.; O'Loughlin, Jennifer, comps. 2000. Wilderness science in a time of change conference—Volume 5: Wilderness ecosystems, threats, and management; 1999 May 23–27; Missoula, MT. Proceedings RMRS-P-15-VOL-5. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Yu-Fai Leung is Assistant Professor, Department of Parks, Recreation and Tourism Management, North Carolina State University, Raleigh, NC 27695-8004 U.S.A., e-mail: yu-fai_leung@ncsu.edu. Jeffrey Marion is Unit Leader and Scientist, USGS Patuxent Wildlife Research Center, Virginia Tech Cooperative Park Studies Unit, Blacksburg, VA 24061-0324 U.S.A., e-mail: cpsu@vt.edu

Table 1—Common forms of recreation impacts in wilderness.

	Ecological component			
	Soil	**Vegetation**	**Wildlife**	**Water**
Direct effects	Soil compaction	Reduced height and vigor	Habitat alteration	Introduction of exotic species
	Loss of organic litter	Loss of ground vegetation cover	Loss of habitats	Increased turbidity
	Loss of mineral soil	Loss of fragile species	Introduction of exotic species	Increased nutrient inputs
		Loss of trees and shrubs	Wildlife harassment	Increased levels of pathogenic bacteria
		Tree trunk damage	Modification of wildlife behavior	Altered water quality
		Introduction of exotic species	Displacement from food, water and shelter	
Indirect/ derivative effects	Reduced soil moisture	Composition change	Reduced health and fitness	Reduced health of aquatic ecosystems
	Reduced soil pore space	Altered microclimate	Reduced reproduction rates	Composition change
	Accelerated soil erosion	Accelerated soil erosion	Increased mortality	Excessive algal growth
	Altered soil microbial activities		Composition change	

effects and improving insights regarding the prevention, mitigation and management of problems. In a broader sense, recreation ecology may be conceived as the study of ecological interrelationships between humans and the environment in recreation/tourism contexts (Leung and Marion 1996; Wagar 1964). Under this broader definition, recreation ecologists are also interested in how environmental attributes influence the availability and quality of recreation opportunities.

Recreation ecology began in the 1920s and '30s (Bates 1935; Meinecke 1928), although earlier observations of visitor impacts are available (Liddle 1997). However, substantial scientific work in this field did not occur until the late 1960s, when backcountry and wilderness visitor use in the United States increased sharply, along with associated resource impacts. A modest body of literature accumulated during the ensuing two decades and several conferences devoted specifically to recreation impacts were held (Bayfield and Barrow 1985; Ittner and others 1979; IUCN 1967). Since the mid-1980s, the study of recreation ecology has been expanding, diversifying and shifting its focus (Table 2).

Results of recreation ecology research in wilderness are disseminated in various forms, including scientific journals, conference proceedings and management reports. Some of the common journal outlets include *Biological Conservation*, *Environmental Conservation*, *Environmental Management*, *International Journal of Wilderness*, *Journal of Applied Ecology*, *Journal of Environmental Management* and *Journal of Soil and Water Conservation*. As findings and knowledge accumulated from these studies, monographs that synthesized the research literature and management applications of recreation ecology began to appear (Edington and Edington 1986; Hammitt and Cole 1998; Knight and Gutzwiller 1995; Kuss and others 1990; Liddle 1997). Knowledge generated from research has also been applied to the management of wilderness resources and visitors, although many of these applications have not been documented in the published literature.

Cole (1987b) provided a succinct account of the historical development of recreation ecology, noting that there was only a small group of scientists who consistently conducted studies in this field. Fifteen years have passed since this

Table 2—The development and major events of recreation ecology research.[a]

Approximate time period	Development/event(s)
1990s	Refinement of methods; new topics and perspectives
1980s	Integration with management frameworks
1970s	Period of active research
1960s	Period of rapidly increasing use and impact
1940-50s	First scientific studies in the United States
1930s	First experimental trampling studies in the United Kingdom
1920s	Early observations and descriptions of the problem

[a]Partly based on Cole (1987b).

review, and Cole's statement remains valid. The size of the research community in this field is still not commensurate with the extent of the problems. Currently, the study of recreation impacts and their management attracts a growing yet still small number of scientists or students, even though wilderness and other resource managers increasingly require visitor impact assessment and management assistance.

Recreation Ecology Research in Wilderness

Generally, recreation ecology studies in wilderness have enjoyed better support from the USDA Forest Service, primarily at the interagency Aldo Leopold Wilderness Research Institute (formerly Wilderness Research Unit of the Intermountain Research Station). As a result, the majority of recreation ecology studies have been conducted in wilderness areas managed by the Forest Service. Less research has been conducted in USDI National Park Service-managed wilderness areas, with some notable exceptions, such as Shenandoah and Yosemite National Parks. Very little research has been conducted in wildernesses managed by USDI Bureau of Land Management and USDI Fish and Wildlife Service.

David Cole, Forest Service, has produced a substantial number of publications and has been influential in the building of a recreation ecology knowledge base. Jeffrey Marion, Virginia Tech Cooperative Park Studies Unit (USGS Patuxent Wildlife Research Center), has conducted numerous recreation ecology studies in national parks, with a primary focus on refining impact assessment, monitoring and management techniques. A smaller institutional research effort is supported by the National Outdoor Leadership School (NOLS), led by Christopher Monz. Recreation ecology studies are also conducted by faculty members and graduate students at several academic institutions such as Clemson University, Colorado State University, North Carolina State University, University of Idaho, University of Montana and Virginia Tech.

The Significance of Recreation Impacts

Why should we care about recreation impacts? Recreation impacts are significant because they reflect success in meeting two primary legal mandates: resource protection and recreation provision. Derived from the Wilderness Act, these mandates state that wilderness areas "shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas [and] the preservation of their wilderness character..." (Public Law 88-577, 1964). The Wilderness Act thus identifies two concerns relative to recreation impacts: (1) protection of the integrity of wilderness environments, and (2) protection of the quality of recreational experiences. A minimal system of trails and campsites is generally viewed as essential to support recreational use of wilderness. Wilderness managers must therefore be willing to accept some degree of resource degradation associated with the creation, maintenance, and use of these recreation facilities. However, excessive resource degradation of facilities and the proliferation of user-created trails or unnecessary campsites are viewed as unacceptable.

The managerial significance of recreation impacts is also reflected in the substantial costs incurred by managing agencies to construct, maintain and rehabilitate trails and campsites, and to operate visitor management programs. While some of these costs reflect provisions for recreational use, many are directed at avoiding or minimizing recreation impacts. For example, a trail both facilitates wilderness travel and concentrates recreation traffic and impact along a single narrow tread designed and maintained to minimize resource impacts.

Resource Protection

How and to what extent recreation impacts affect the integrity of wilderness environments and natural processes have not been thoroughly examined. We do know that many wilderness areas have extensive networks of trails and campsites which are frequently in poor condition (Marion and others 1993; Washburne and Cole 1983). Cole (1990a) suggests that impacts which seriously disrupt ecosystem function and that either occur over very large areas or affect rare ecosystems are most significant. In particular, long-term or irreversible changes are problematic.

Several studies show that recreation impacts relatively small proportions of wilderness areas. For example, campsite monitoring at the heavily visited Great Smoky Mountains National Park (83% of which is recommended for and managed as wilderness) located and assessed 327 backcountry campsites and shelters with an aggregate disturbed area of 550,824 ft^2 (Marion and Leung 1997). The Park's 930 miles of trails contribute an additional 9,820,800 ft^2 of recreation-related disturbance, assuming a conservative average trail width of two feet. While these values may seem large, they represent only .05 percent of the Park's total acreage. Campsite monitoring surveys of six less visited wilderness areas in Virginia's Jefferson National Forest revealed camping had disturbed only .0007 to .015 percent of the wilderness (Leung and Marion 1995). Vegetation disturbance resulting from use of areas adjacent to campsites and trails would likely only double or triple these areal estimates.

While recreation impacts directly affect small percentages of wilderness areas, the effects are usually distributed unevenly due in part to visitor use patterns (Lucas 1990b), with intensive disturbance in some places and less intensive disturbance in surrounding areas. However, even localized impact can harm rare or endangered species, damage sensitive resources or diminish ecosystem health. For example, the collection and burning of firewood in desert ecosystems and at high elevations, where wood production is low, can disrupt nutrient cycling critical to plants that depend upon organic matter and nutrients contained in woody debris (Fenn and others 1976). Furthermore, certain forms of impact (such as soil loss) and certain environments (such as alpine meadows) have extremely low resource recovery rates, requiring long periods to recover from even limited degradation (Liddle 1997).

Visitor impacts may also extend far beyond localized use areas (Cole 1990a). Hunting and fishing directly alter the abundance, distribution and demographics of wildlife and can lead to changes in the relative abundance and composition of nongame fauna and flora (Knight and Cole 1991). The introduction and stocking of fish, particularly introduced species, alter aquatic food webs and have been cited as a contributing cause to the decline of native species (Liddle 1997). Similarly, the introduction of exotic plant species in wilderness is widespread, and some naturalized species are able to alter plant dynamics over large areas (Marion and others 1986). Other examples include stream sedimentation from trail and campsite erosion, which reduces the quality of aquatic habitats for insect and fish populations.

The mere presence of visitors may harm wildlife by displacing them from essential habitats or disrupting their raising of young (Knight and Cole 1995; Liddle 1997). Trail networks and campsites may cause a landscape fragmentation effect similar to that of roads, possibly interfering with movement of some animal species (Noss and Cooperrider 1994).

Impacts to Visitors

Recent studies suggest that perceived impacts can degrade the quality of visitor experiences (Roggenbuck and others 1993; Vaske and others 1982). Perceptions are based on how visitors believe impacts affect the overall attributes of the setting like scenic appeal or solitude, and whether or not the impacts are considered to be undesirable (Lucas 1979; Whittaker and Shelby 1988). Visitors appear to be more sensitive to impacts caused by inappropriate behavior, such as litter and tree damage, and to particularly obtrusive examples of physical impacts, such as badly exposed tree roots.

Surveys of wilderness visitors reveal considerable variability in visitor responses to recreation impacts. While several earlier studies found that visitor satisfaction was not diminished by trail and campsite impacts (Knudson and Curry 1981; Lucas 1979), Roggenbuck and others (1993) reported that littering and human damage to campsite trees were among the most highly rated indicators affecting the quality of wilderness experiences. Similarly, wilderness visitors rated ground vegetation loss and bare ground on campsites as two important determinants of their satisfaction (Hollenhorst and Gardner 1994).

The mere presence of trails and campsites, particularly those in degraded condition, also remind visitors of those that preceded them. The proliferation and high densities of trails and campsites in popular locations give wilderness a "soiled" or "used" appearance, in contrast to the ideal of a pristine wilderness. Particularly in remote areas, the discovery of even a single trail or campsite can diminish opportunities for solitude.

Impacts associated with a specific type of use may intensify perceived crowding and conflict between different visitors or groups (Vaske and others 1982). For example, horse manure or excessive muddiness on trails or trash at hunting camps might provoke negative impressions about horseback riders among other wilderness users. Such negative reactions could polarize user groups and lead to tensions with land managers.

Finally, recreation impacts such as trail rutting and excessive muddiness can provoke visitor dissatisfaction by increasing the difficulty of hiking and making it an unpleasant experience. Such impacts may also jeopardize visitor or packstock safety and increase agency liability.

Research Methods

Since the previous review (Cole 1987b), there has been a steady increase in the diversity and sophistication of research methods employed to investigate recreation resource impacts in wilderness. Research methods range from simple qualitative descriptions of impact conditions to controlled laboratory experiments with elaborate experimental designs. Some studies involved intensive and sophisticated measurements but included only a limited number of sample sites. Other studies encompassed a large number of sample sites distributed over a large landscape but often involved rapid field observations and measurements. Studies of various approaches and designs generally complement each other in developing a thorough understanding of recreation impacts. These studies, if well designed and executed, can yield useful data for wilderness managers. The choice of methods is essentially based on the research questions asked, types of data needed, character of study area, the training of investigators and logistical constraints.

Major Research Questions and Themes

1. What types of recreation impact exist?

Previous studies have documented the obvious and direct forms of recreation impact, including the area of disturbance, tree damage, soil exposure, soil erosion, vegetation loss, trash, human waste and wildlife disturbance. Among these, soil and vegetation attributes are most frequently measured (Hammitt and Cole 1998). Less attention has been paid to less visible environmental qualities, such as bacteriological water quality, soil microbial communities and wildlife physiology. However, the number of studies on these ecological components has been increasing in recent years (Knight and Gutzwiller 1995; Zabinski and Gannon 1997).

Indirect or secondary effects of recreational use, such as increased predation rates on wildlife displaced by recreation visitation, have seldom been examined. In addition, the types of recreation impacts examined have been restricted in spatial, temporal and ecological scales (Cole and Landres 1996). Few studies have investigated ecosystem or landscape-level effects. As the popularity of non-conventional types of recreational activity and equipment increases, new forms of recreation impact are likely, which will require further research, assessment and monitoring. Caving, rock climbing, llamas as pack animals, and use of hiking poles are some more common examples.

2. What is the magnitude and significance of recreation impacts?

Knowledge of the magnitude of impacts is needed to evaluate their ecological and social significance and acceptability, and to prioritize management and maintenance needs. The magnitude of recreation impacts is often judged by two components: the intensity of impact and the spatial qualities

of impact (Clark and Stankey 1979; Cole 1994). The assessment of impact intensity has received more attention than the spatial component (Cole 1989c). Examples of spatial qualities include spatial extent, distribution and association of impacts. Spatial extent is perhaps the most examined spatial quality, although recent studies have begun to investigate the distribution of impacts in space (Cole 1993a; Leung and Marion 1998; McEwen and others 1996).

As mentioned earlier, a number of studies have examined the social significance of recreation impacts (Knudson and Curry 1981; Marion and Lime 1986; Roggenbuck and others 1993; Shelby and Shindler 1992; Shelby and others 1988). Two important issues—perception and acceptability of impacts to visitors and managers—are beyond the scope of this paper.

3. What is the relationship between amount of use and intensity of impact?

Research addressing this question was highlighted by the concept of carrying capacity and its application to recreation and park management. One objective of this large body of research has been to determine a threshold level of use beyond which recreation impacts will intensify. Unfortunately, these studies often concluded that the use-impact relationship is both complex and situational, depending on a diverse array of environmental and social factors. Recognizing limitations of the traditional carrying capacity model, recent work has been redirected at determining appropriate indicators and standards that reflect explicit levels of acceptable impacts. A detailed discussion on recreation carrying capacity is provided in another state-of-knowledge review (Manning and Lime, this volume).

4. What factors contribute to the problem?

Although amount of use is the most studied factor influencing recreation impacts, other use-related and environmental factors interact to determine the intensity and extent of impacts (Hammitt and Cole 1998; Leung and Marion 1996). Visitor and site management actions can moderate many of these factors and thus influence the quality of impacts (Marion 1995).

5. Have conditions worsened or improved over time?

Recent studies have examined trends of recreation impacts over time. The increasing availability of long-term monitoring data sets permits such analyses. Examples include trail monitoring (Cole 1991), campsite monitoring (Cole 1993a; Cole and Hall 1992) and a 30-year trampling/trail study in Glacier National Park (Hartley 1999).

6. How effective are visitor and site management actions?

As wilderness managers implement various visitor and site management actions to reduce or contain resource impacts, they need to know which actions have the greatest chance of success (Hammitt and Cole 1998). An example is the national Leave No Trace (LNT) outdoor skills and ethics program. Little research has been conducted to evaluate the effectiveness of recommended LNT practices in reducing the intensity and extent of impact.

7. How can research and impact assessment methods be improved?

Methodological improvements address the accuracy and precision of different methods, as well as the need to make procedures more efficient. The possibility of reducing the number of indicators for campsite assessment and monitoring has been addressed (Gettinger and others 1998; Leung and Marion 1999b), as has the choice of sampling interval for trail assessment and monitoring (Leung and Marion 1999c).

Research Approaches and Designs

A substantial number of recreation ecology studies during the past three decades were associated with the carrying capacity framework (Sumner 1942; Wagar 1964). Research approaches and methods were developed for evaluating the relationship between amount of use and intensity of impact. Another group of studies has evaluated relationships between environmental attributes and the quality of recreation impacts. For instance, a significant portion of trail research was devoted to environmental influence on trail degradation, including soil compaction, trail widening and soil erosion (Leung and Marion 1996). Experimental studies on trampling effects have also been conducted to evaluate the relative resistance and resilience of various vegetation types (Cole 1988; Cole 1993b; Cole 1995b; Cole 1995c; Marion and Cole 1996). Most recently, with the increasing adoption and implementation of the *Limits of Acceptable Change* (LAC) framework (Stankey and others 1985), the *Visitor Impact Management* framework (Graefe and others 1990) and the *Visitor Experience and Resource Protection* (VERP) framework (National Park Service 1997a; National Park Service 1997b), recreation ecology studies have begun to focus on the selection of indicators, standards and monitoring protocols to support these management planning processes (Belnap 1998).

Cole (1987b) discussed the following four major study designs in recreation ecology studies (Table 3). The ability of these designs to isolate cause and effect varies.

1. Descriptive surveys of recreation sites.
2. Comparisons of used and unused sites.
3. Before-and-after natural experiments.
4. Before-and-after simulated experiments.

Trampling and wildlife impact studies tend to adopt before-and-after experimental designs with controls, while trail and campsite condition assessments often adopt the first two designs with few exceptions (Cole 1995a). A large number of recent studies were still conducted within a short time-frame, although more long-term assessment and monitoring studies on recreation impacts have emerged.

In addition to these four types of research design, a few conceptual and simulation studies have been published (Cole 1992; Leung and Marion 1999c). Such studies are likely to increase with continued advancements and expanding application of geographic information systems (GIS) and statistical software programs.

Research Methods and Techniques

Research methods for four specific topics are discussed in this subsection. These topics, which include trampling studies, trail impacts, campsite impacts, and indicators and indices, are highlighted because they constitute a large portion of the recreation ecology literature.

Trampling Research—Trampling studies are often regarded as basic research in recreation ecology (Liddle 1997).

Table 3—Four common study designs employed in recreation ecology research with recent examples.[a]

Study design	Description	Recent example(s)
Descriptive surveys	Estimates or measurements are taken on recreation sites to assess current resource conditions	*Trails and Campsites*: Cole and others (1997); Rochefort and others (this volume)
Comparison of used and unused sites	Measurements are taken on recreation sites and nearby undisturbed sites (control) and compared to infer amount of impact	*Trails*: Hall and Kuss (1989) *Campsites*: Marion and Leung (1997); Monz (1998); Zabinski and Gannon (1997)
Before-and-after natural experiments	Measurements are taken before and after (1) commencing or ceasing use of sites, or (2) applying management action(s) to sites to infer amount of impact due to the change	*Trails*: Doucette and Kimball (1990) *Campsites*: Marion (1995); Spildie and others (this volume)
Before-and-after simulated experiments	Measurements are taken before and after treatments (including known type, frequency and intensity of use) are applied, often with random assignment, to infer amount of impact due to the treatment	*Trampling*: Cole (1993b, 1995d); Cole and Spildie (1998); Hartley (1999) *Trails*: DeLuca and others (1998) *Campsites*: Cole (1995a)

[a]Partly based on Cole (1987b).

As such, experimental designs usually employ varying trampling intensities, randomly assigned to replicated experiment plots or lanes. Known intensities or frequencies of trampling are applied by artificial or human tramplers.

Most trampling studies have been directed at the relationship between amount of use and intensity of impact and the different susceptibilities of plant species or vegetation types. A few studies have assessed the effects of different types of tramplers, such as human and horses. Recent trampling studies have included new use-related variables such as shoe type and trampling weights (Cole 1995d) and emerging types of use such as llamas (Cole and Spildie 1998).

The designs of these trampling studies varied significantly across different studies, limiting valid comparisons (Bayfield and Aitken 1992; Kuss 1986a). In response to the need for standardized procedures, trampling experiment protocols and guidelines have been proposed (Cole and Bayfield 1993).

Methods for Studying Trail Impacts—Early research on trail impacts focused on impact severity and environmental factors affecting trail degradation (Leung and Marion 1996). Very few data sets exist on temporal change of trail conditions, with an exception of a 11-year trail assessment conducted in the Selway-Bitterroot Wilderness of Montana (Cole 1991). A variety of trail assessment and monitoring techniques have been developed (Cole 1983), which can be classified into three approaches (Table 4). These techniques, many of which have been applied to wilderness, include condition class assessments (Cole and others 1997), evaluation of aerial photos (Coleman 1977; Price 1983) and quantitative measurements and experiments (Bratton and others 1979; DeLuca and others 1998; Hall and Kuss 1989). Improving some of these methods has been the subject of several recent studies. In the Eastern U.S., a problem-assessment method was developed and applied to Great Smoky Mountains National Park (Leung and Marion 1999a; Marion 1994a). The sampling issue of trail assessment methods has also been examined (Leung and Marion 1999c).

In Montana, the influence of use type on trail erosion was examined using trampling and rainfall simulation experiments (DeLuca and others 1998). Intrusion experiments were also conducted in several studies by Gutzwiller and his colleagues to examine disturbance of birds by walkers on existing trails or trailless experiment sites (Gutzwiller and Anderson 1999; Gutzwiller and others 1998; Gutzwiller and others 1994; Riffell and others 1996).

Methods for Studying Camping Impacts—Due to activity concentration and duration of stay, campsites receive the highest level of visitor impacts, particularly those related to inappropriate behavior. Campsite impact assessment approaches range from condition class (Frissell 1978) and photographic approaches (Magill 1989) to more intensive quantitative measurements (Table 5). These procedures provide managers with objective data on campsite conditions, both at a general level (reconnaissance approach) and for individual resource indicators (multiple-indicator approach). Replicating procedures allow monitoring of changes in campsite conditions, which can be used to document trends in site conditions and to evaluate the effectiveness of management actions.

Interrelationships between campsite impacts and use-related or environmental factors often require the application of more complex research designs. An interrelated set of recreation ecology studies within backcountry zones of three Eastern national parks provides an example (Cole and Marion 1988; Marion and Cole 1989; Marion and Cole 1996).

Table 4—A summary of different trail impact assessment and monitoring approaches and designs.

Item	Reconnaissance approach		Sampling-based approach		Census-based approach	
	Condition class	Photo appraisal	Point sampling	Point-quadrat sampling	Sectional evaluation	Problem assessment
Implementation	Descriptive classes are defined and assigned to trails/segments	Trails are identified and evaluated from aerial photos	Measurements are performed at a series of points along a trail that is determined by a sampling scheme	Measurements are performed within quadrats at a series of points that is determined by a sampling scheme	Trail is divided into sections; evaluation is made for each section	Impact problems are defined, followed by complete census of these problems
Unit of observation	Segment/trail	Trail/regional	Site (point)	Site (quadrat)	Segment	Dimension of impact problem
Typical data type(s)	Nominal/ordinal	Interval/ratio	Interval/ratio	Interval/ratio	Ordinal/ percentage	Interval/ratio
Major utility	Prompt assessment of trail conditions	Detect proliferation of trail networks; detect new trails	Quantitative data for statistical analysis; adaptable to management frameworks	Quantitative data for statistical analysis; adaptable to management frameworks	Prompt assessment of trail conditions and their spatial variations	Data on the frequency, extent, and distribution of impacts; adaptable to management frameworks
Limiting factor(s)	Singular qualitative measure; conflicting criteria within a condition class	Availability; resolution of aerial photos; photo interpretation skills	Relocation of sampling points; measurement error; field time	Relocation of sampling points; measurement error; field time	Definition of section; scale dependence of results	Quantitative definition of impact problems; interrater variability
Examples	Cole and others (1997)	Coleman (1977); Price (1983)	Cole (1991)	Hall and Kuss (1989)	Bratton and others (1979)	Marion (1994a); Leung and Marion (1999a)

Multiple-indicator measurements taken on campsites and paired control sites over five years were recorded and analyzed to evaluate the effect of: (1) different amounts and types of use, (2) different environmental settings, (3) temporal variation in vegetation and soil conditions, (4) initial degradation following campsite creation, and (5) initial recovery following campsite closure.

In the past 15 years, refinement of campsite impact assessment procedures for monitoring has received more emphasis. This work has been driven by management needs for longitudinal data to support management planning frameworks and decisionmaking. Refinement has occurred through numerous applications of these procedures in the Western (Cole 1993a; Gettinger and others 1998), Central (McEwen and others 1996; Williams and Marion 1997; Farrell and Marion 1997) and Eastern U.S. (Cole and Marion 1988; Leung and Marion 1995; Marion 1991; Marion 1994b; Marion and Leung 1997; Marion and Snow 1990; Williams and Marion 1995). Attempts have been made to standardize campsite assessment procedures (Marion 1991). There have also been refinements of assessment and analytical procedures and adaptation of assessment procedures to different environment types (Gettinger and others 1998; Leung and Marion 1999b; Monz 1998).

Impact Indicators and Indices—To a large extent the increased emphasis on indicators and indices over the past 15 years was a direct result of the adoption and implementation of standards-based management frameworks such as LAC and VERP. Judicious selection and periodic monitoring of indicators are critical components in these management frameworks.

An indicator may be broadly defined as an important quality that indicates resource change due to recreational use. Watson and Cole (1992) and Merigliano (1990) provided reviews and examples of indicators adopted or proposed in the wilderness management literature. Examples include amount of bare ground on a campsite, number of cut trees, incision depth of a trail and flush distance of an avian species.

In contrast, an index is generally referred to as a mathematical combination of two or more indicators (Westman 1985). They are constructed to simplify and facilitate the communication and evaluation of results. These impact indices may be classified into four groups. First, indices of impact intensity are constructed to represent the severity of environmental damage. Two examples are floristic dissimilarity and cover alteration (Cole 1978; Cole 1993b). Shannon-Wiener species diversity index (H) and community similarity index,

Table 5—A summary of different campsite impact assessment and monitoring approaches and designs.

Item	Reconnaissance approach		Multiple-indicator approach	
	Condition class	Photo appraisal	Ratings	Quantitative measurement
Implementation	Descriptive classes are defined and assigned to each campsite	Site photo is taken and evaluated for each campsite	Assessment at ordinal scale is made on each selected indicator on a campsite	Measurement is taken for each selected indicator on a campsite
Typical data type(s)	Nominal/ordinal	Interval/ratio	Ordinal	Interval/ratio
Major utility	Prompt characterization of campsite conditions	Visualize campsite conditions; relocation	Efficient field work; minimal training required	Accurate and precise; permit quantitative analysis; allow aggregate measures; adaptable to management frameworks
Limiting factor(s)	Singular measure; conflicting criteria within a condition class	Scale and quality of aerial photos; photo interpretation skills	Composite ratings may not be mathematically appropriate	Field time; staff training; accuracy and precision
Examples	Frissell (1978); Marion (1995)	Magill (1989)	McEwen and others (1996)	Marion (1991); Marion and Cole (1996)

two indices commonly used in the ecological literature have also been employed (Hall 1989). Indices of spatial qualities may also be constructed to represent the spatial extent and distribution of impacts. Examples include the index of trail area (Cole and others 1997), the campsite expansion index (Gettinger and others 1998), Gini coefficients and linear nearest neighbor index (Leung and Marion 1998). The third group of indices provides a summary of resource condition of a site (Marion 1991). Area of vegetation loss (Cole 1989a), summary impact index (Cole and Hall 1992; McEwen and others 1996) and the impact index (Stohlgren and Parsons 1992) are some examples of summary indices. The final group of indices are designed to represent environmental sensitivity to impacts. Examples include the resistance and resilience indices (Cole 1995b; Cole 1995c) and the durability index (Cole 1993b).

Research Results

Since the last review more than a decade ago (Cole 1987b), there has been substantial progress in knowledge and understanding of recreation impacts and in practices of impact management. Study locations have expanded, and research topics and methods have been diversified. Many studies have focused on vegetation and soil parameters, and most have investigated impacts on campsites and trails. However, there has been more work on wildlife impacts, impact assessment and monitoring techniques and the effectiveness of management actions.

Much of this section is organized by two primary locations where recreation impacts occur—trails and campsites, with emphasis placed on studies conducted between 1986 and 1999. Earlier studies are reviewed by Cole (1987b). More extensive reviews are presented in Hammitt and Cole (1998), Kuss and others (1990) and Liddle (1997). A comprehensive bibliographic database of the recreation ecology literature is being developed as an update of the previous compilation (Cole and Schreiner 1981). This searchable database will be accessible online through the Aldo Leopold Wilderness Research Institute web site (http://www.wilderness.net/Leopold/default.htm).

Trail-Related Impacts

Soil and Vegetation Impacts—Trail construction and use can have substantial impacts to soil and vegetation, including soil compaction, erosion, muddiness, loss of vegetative groundcover and changes in species composition. Most recent research on soil and vegetation related trail impacts has been conducted outside wilderness and in other countries (Figure 1). This body of literature is beyond the scope of this paper but has been reviewed by Hammitt and Cole (1998), Kuss and others (1990) and Liddle (1997). A few studies were conducted in wilderness or similar backcountry areas. For example, Hall and Kuss (1989) investigated vegetation change along backcountry trails in Shenandoah National Park, Virginia. They found that groundcover and species diversity increased closer to trails, a finding they

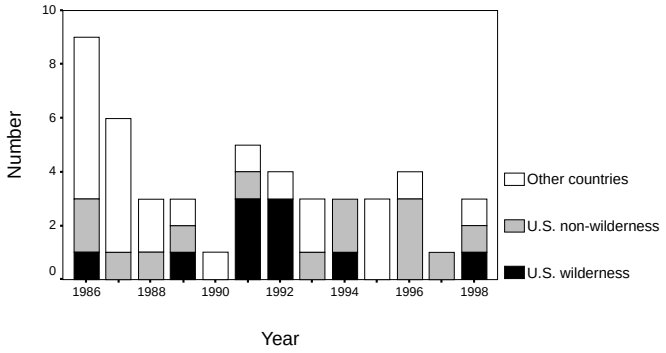


Figure 1—The numbers of publications on trail impacts between 1986 and 1998 (based on the literature that was available to the authors when this paper was prepared).

attributed to environmental alterations along trail corridors (Hall and Kuss 1989).

Trail impacts are influenced by a diverse array of use-related and environmental factors. Many studies identified environmental factors to be more important in determining the levels and rates of trail incision and associated soil erosion than use-related factors (Leung and Marion 1996). Environmental information may not be useful to predict trail impact problems in some cases, however (Burde and Renfro 1986). For example, trail widening is often associated with amount of use than site attributes (Cole 1991).

Trail impact assessments in Great Smoky Mountains National Park found that heavily used trails had significantly more soil erosion and tree root exposure, while trails receiving a high proportion of horse use were significantly wider, muddier and had more multiple treads (Leung and Marion 1999a; Marion 1994a). Trails located on ridgetops and upper slopes exhibited the greatest erosion, probably due to higher precipitation rates, more open forest canopies and reduced root mass from woody vegetation. Ridgeline trails also often directly ascend slopes, hindering the removal of water from treads of embedded trails. Problems with tread muddiness were most common in valley bottom positions, where treads commonly become embedded in moist organic soils. The number of tread drainage features (for example, water bars or drainage dips) was not correlated with these impacts, suggesting that increased trail maintenance is not a substitute for good trail positioning and layout. A recommended solution to both problems was trail relocation to valley walls with side-hill construction methods.

Introduction of Exotic Species—Cole (1987b) noted the paucity of research on recreation as a means of introducing exotic plant species into wilderness. Several studies have recently investigated this issue in greater detail. In Glacier National Park, Tyser and Worley (1992) found that trail corridors were an effective conduit for introducing exotic species such as Canadian bluegrass (*Poa compressa*), Kentucky bluegrass (*Poa pratensis*) and common selfheal (*Prunella vulgaris*) to fescue (*Festuca*) grasslands. Exotic species richness remained at high levels 330 ft from the sampled backcountry trails (Tyser and Worley 1992). In Rocky Mountain National Park, exotic species richness was found to be negatively correlated with distance from the trailhead (Benninger-Truax and others 1992). In contrast, Marcus and others (1998) reported a less serious problem with exotic species in the Selway-Bitterroot Wilderness, Montana. They found that spotted knapweed was present only along limited portions of 5 sampled trails and on 6 of 30 surveyed campsites. Over 95% of spotted knapweed along the trails occurred within 0.31 mile of the trailhead and within 15 ft of the trail. (Marcus and others 1998).

Trail Effects on Wildlife—A number of recent empirical studies examined wildlife disturbance caused by recreational use of trails. The first group of studies investigated community composition and wildlife behavior in relation to trails. The existence of a trail network can act as a barrier or attraction to different wildlife species. In northwestern Montana, grizzly bears were found to avoid roads and trails (Kasworm and Monley 1990). In a Colorado recreational area, Miller and others (1998) found that generalist bird species were more abundant near trails, while specialist species were less common. Higher nest predation rates were also recorded near trails (Miller and others 1998). Visitors hiking on trails may disturb wildlife, displacing them from trail corridors during times of heavy use (temporal displacement) or permanently (spatial displacement). Knight and Cole (1995) reviewed research that documented highly variable wildlife responses to the presence of visitors, depending on the visitors' behaviors, the context of the disturbance and the wildlife's learned responses.

The second group of studies utilized an experimental approach to examine human disturbance related to trail use. In the Medicine Bow National Forest, Wyoming, Gutzwiller and others (1998) identified variations in avian response to an experimental walker. Intrusion tolerance was found to be lower when birds were in smaller groups, for more conspicuous species, and for species that are active closer to the ground (Gutzwiller and others 1998).

Results from these two groups of trail-wildlife studies suggest that trails and their visitors have the potential to generate undesirable impacts on wildlife from population to ecosystem levels, with significant implications for biodiversity conservation (Cole and Knight 1990).

Trail Impact Assessment and Monitoring—Trail impact assessment studies have been conducted in both Eastern and Western environments over the past decade. In Great Smoky Mountains National Park, a census-based problem assessment method identified the locations, extent, and frequency of selected trail impact problems (Leung and Marion 1999a; Marion 1994a). Subsequent work at this Park and an ongoing study in Shenandoah National Park compare the problem-oriented survey approach to the more traditional point sampling approach (Leung and others 1997). The point sampling method provides a lineal sequence of values typically assessed at a fixed interval along the trail, summarized with descriptive statistics (such as range, mean, median). The problem assessment method characterizes trail conditions by providing statistics such as number and location of occurrences, feet/mile, percent of trail length and aggregate distance for predefined trail impact problems. Preliminary observations suggest that the higher utility of this type of data for managers may be offset by reduced precision, a result of inherent subjectivity in defining and assessing where impact problems begin and end along a trail.

Cole replicated his earlier trail assessment (Cole 1983) in the Selway-Bitterroot Wilderness. Over an 11-year period, the monitored trail systems remained relatively stable, with cross-sectional area measurements revealing virtually no net erosion or deposition on tread surfaces. Individual sections did change markedly, primarily influenced by trail location and design. Tread width increased an average of 9.8 inches over a nine-year period, but bare width did not change significantly. In Rocky Mountain National Park, Summer reported that the degree of soil erosion and deposition was primarily a function of active geomorphological processes interacting with climatic factors (Summer 1986). Steep, upper-slope trail positions were most erodible. Intermediate positions experienced both erosion and deposition; and level terrain was most stable, though trail widening was problematic. Intensive runoff from natural events was cited as a more significant cause of erosion than visitor use.

Camping-Related Impacts

Campsites are primary destinations for many wilderness visitors and receive high levels of use. In contrast to trail studies, most campsite studies were conducted in the U.S., and many were conducted in designated wildernesses (Figure 2). Earlier studies on campsite impacts have been reviewed by Cole (1987b). Recent research has focused on: (1) understanding previously ignored topics of impacts (Zabinski and Gannon 1997), (2) examining the effectiveness of site restoration techniques (Spildie and others, this volume), (3) improving assessment and monitoring procedures (Cole 1989d; Leung and Marion 1999b; Marion 1991), and (4) adapting procedures to new environments and recreation settings (Monz 1998).

Soil and Vegetation Impacts—Camping activities can generate substantial and usually localized soil and vegetation changes (McEwen and Cole 1997). Most studies have found high levels of groundcover loss and soil exposure even with modest use (Cole 1986). For example, in Prince William Sound of Alaska, low-use campsites lost 93% of their vegetation cover on gravel sites and 81% on organic soil sites (Monz 1998). An experimental camping study conducted by Cole (1995a) found that one night of camping activity caused significant groundcover loss in all four vegetation types examined. In more heavily used wilderness areas, such as Shining Rock Wilderness in North Carolina, frequent camping use often results in extensive land disturbance and vegetation damage (Saunders 1986).

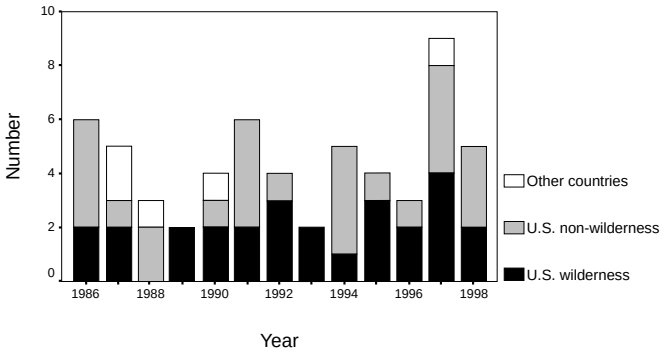


Figure 2—The numbers of publications on campsite impacts between 1986 and 1998 (based on the literature that was available to the authors when this paper was prepared).

Little research has been conducted on recreation impacts to soil microbial communities and underground processes (Cole and Landres 1996). Zabinski and Gannon (1997) examined this issue and reported less microbial activity in the upper layer (0-2.4 in) of soil on campsites than on their undisturbed controls, although there was no significant difference in the lower soil layer (2.4-6.8 in). The percentage of total carbon sources utilized by soil microbes was also significantly less in disturbed camping areas than in undisturbed control sites (Zabinski and Gannon 1997).

While camping impacts are usually spatially concentrated, some forms are more extensive. Taylor investigated 30 campsites in Yellowstone National Park and found that tree sapling density on campsites was only one-eighth that on control sites, which were located 160 ft from camp (Taylor 1997). Such decreases in tree saplings due to recreational use have a significant implication on tree regeneration and future forest structure.

Using a modeling approach, Cole (1992) examined the relative influence of use-related and environmental factors in determining the total amount of campsite impact. He demonstrated that degree of activity concentration is the most important factor. Several studies have documented the effectiveness of site locations and management actions that increase spatial concentration of use. In Great Smoky Mountains National Park, campsites at mid-slope topographic positions tend to be smaller than those on valley bottom or ridgetop positions, attributable to the site expansion resistance offered by sloping terrain (Leung and Marion 1999b). In the Chisos Mountains of Big Bend National Park, Texas, placement of campsite posts and logs to mark indistinct campsite borders have helped concentrate visitor activities within core use areas (Williams and Marion 1997). Median campsite size for these designated sites was only 650 ft^2. Similarly, the placement of many Isle Royale National Park campsites in sloping terrain, coupled with design and construction practices that create small flat camping benches, reduced median campsite size to 550 ft^2 (Farrell and Marion 1997). Camping shelters were even more effective in concentrating camping activities, with a median area of disturbance of 377 ft^2.

Other environmental factors, including elevation, aspect and plant community type, have also been investigated. Analyses of the influence of elevation on campsite conditions in Shenandoah and Great Smoky Mountains National Parks found no significant relationships with campsite size, vegetation loss or exposed soil (Williams and Marion 1995; Marion and Leung 1997). Campsites in Shenandoah National Park with a northerly aspect had more onsite vegetation cover and less than one-third the areal loss of vegetation cover than those with other aspects; no patterns were found in similar analyses at Great Smoky Mountains National Park. Analyses of forest cover type at Shenandoah National Park found that the chestnut oak and northern red oak forest types generally had the smallest and least altered campsites (Williams and Marion 1995). Campsites in the hemlock type were largest and had the least onsite vegetation cover at Great Smoky Mountains National Park (Marion

and Leung 1997). Hemlocks have particularly dense canopies that support limited ground vegetation, so expansion potential is often high while trampling resistance is low. Evaluations of forest canopy densities consistently reveal a positive relationship between decreasing canopy density and increasing onsite vegetation groundcover (Marion 1994b; Marion and Leung 1997; Williams and Marion 1995). This finding is attributed to the higher trampling resistance and resilience of shade-intolerant grasses and herbs.

Very little recent work has examined use-related factors. An experimental camping study by Cole (1995a) found that one night of camping reduced relative vegetation height by 60% or more. Relative vegetation cover was reduced to as low as 66% following only one night of camping in four vegetation types. The impact associated with three additional nights of camping was less substantial, further reducing relative cover to only 50%. Results from this study generally corroborate those of earlier studies (Cole 1987b) that describe a curvilinear use-impact relationship.

McEwen and others (1996) investigated differences in impact from two types of use on campsites in four south-central U.S. wildernesses. Sites used by horse groups and hikers were more highly impacted than sites used only by hikers. Specifically, horse-hiker sites were larger and had more exposed soil and more tree damage than hiker-only sites.

Camping-Related Wildlife Impacts—Visitors spend considerable time on campsites, and their activities can disrupt normal wildlife activities, attract animals or alter wildlife habitat through vegetation and soil impacts. Wildlife that avoid areas with campsites can be displaced from vital riparian vegetation and water sources, a particularly critical impact in desert environments (Hammitt and Cole 1998). Intentional or unintentional wildlife feeding is also common at campsites, leading to attraction behavior and unhealthy food dependencies. Species that frequent campsites in search of food include birds, mice, rats, ground and red squirrels, skunks, racoons, foxes and bears. Consistent human feeding can lead to increases in small animal populations, which then crash suddenly at the end of the use season. Bears that obtain food pose a serious safety threat to visitors, and many must be relocated or killed (Merrill 1978).

Campsite Impact Assessment and Monitoring—Campsite impact assessment and monitoring programs are generally more common than trail assessments, and a large number have been conducted in the past decade. The campsite monitoring program in Kings Canyon and Sequoia National Parks of California is one of the earliest and best documented of its kind (Parsons 1986; Parsons and Stohlgren 1987; Stohlgren and Parsons 1986; Stohlgren and Parsons 1992; van Wagtendonk and Parsons 1996). Over 8,000 sites had been assessed as of 1990 (Fodor 1990). Published accounts of assessment programs are also available for wildernesses and national parks in Arizona (Cole and Hall 1992), Montana (Cole 1993a; Cole and Hall 1992), Oregon (Cole and Hall 1992; Cole and others 1997), Washington (Cole and others 1997; Gettinger and others 1998; Rochefort and Swinney, this volume; Scott 1998), Michigan (Farrell and Marion 1997), North Carolina/Tennessee (Leung and Marion 1999b; Marion and Leung 1997; Marion and Leung 1998), Virginia (Williams and Marion 1995), Texas (Williams and Marion 1997), and Illinois/Missouri/Arkansas (McEwen and others 1996).

Studies of trends in campsites (Cole and Hall 1992) monitored for 5 to 11 years in three Western backcountry areas found that campsites both improved and degraded over time. Campsite size, mineral soil exposure and tree damage were some of the impacts that increased (Cole and Hall 1992). In three Western wildernesses, Cole (1993a) found that the number of campsites increased 53% to 123% over 12 to 16 years. Campsite proliferation contributed more to net increase in the total amount of impact than change in the condition of existing campsites (Cole 1993a).

Trampling Research

Trampling, either by humans or recreational stock, is the fundamental impact force applied to trails and campsites, directly affecting vegetation and soil within trampled zones. Although often localized, trampling may have widespread effects. The extirpation of Scarbrous black sedge (*Carex atratiformis*), northern singlespike sedge (*Carex scirpoidea*) and other alpine plant species in the New England region (Zika 1991) and the decline of endangered desert fish populations in Zion National Park of Utah (Shakarjian and Stanford 1999) have been attributed to human trampling. Research on trampling and traffic effects on soil and vegetation have recently been compiled and reviewed (Yorks and others 1997).

Several trampling experiments were conducted in wilderness and backcountry areas in the past decade. Cole continued his earlier work (as reviewed by Cole 1987b) on six forest and grassland vegetation types in the Bob Marshall Wilderness complex (Cole 1987a; Cole 1988). He expanded his studies to 16 vegetation types in four Western and Eastern states (Cole 1993b; Cole 1995b; Cole 1995c). Using standardized experimental procedures, he compared vegetation types by their differential responses to foot trampling. The relationship between trampling intensity and vegetation damage was curvilinear in most cases, corroborating previous research (Figure 3). Resistant vegetation types, such as sedges (*Carex* spp.), were found to be able to absorb 25 to 30 times as much trampling as the least resistant type, ferns (*Dryopteris* spp.) (Cole 1993b). Morphological characteristics were the primary factor influencing plant resistance to trampling. Grasses and sedges have flexible stems growing in mats or tufts. More fragile were woody plants and taller herbs.

The resilience of plants, their ability to recover following trampling disturbance, varied substantially by habitat, with higher recovery in the most productive environments—those with higher soil fertility and moisture. For example, recovery rates are high in riparian areas in the Eastern states (Cole and Marion 1988; Marion and Cole 1996). In contrast, trampling impacts in less resilient environments, such as alpine and subalpine environments, require a long time to recover (Hartley 1999; Stohlgren and Parsons 1986). Plant characteristics, notably the position of the plants' perennating bud and physiological characteristics such as reproductive capacity and growth rates, also influence resilience (Cole 1988; Kuss 1986b).

In the wind River Range of Wyoming, trampling response of five native plant species was examined (Monz and others 1994). Increased trampling intensities were associated with substantial increases in soil compaction and decreases in species richness at forest understory sites. Little effect was

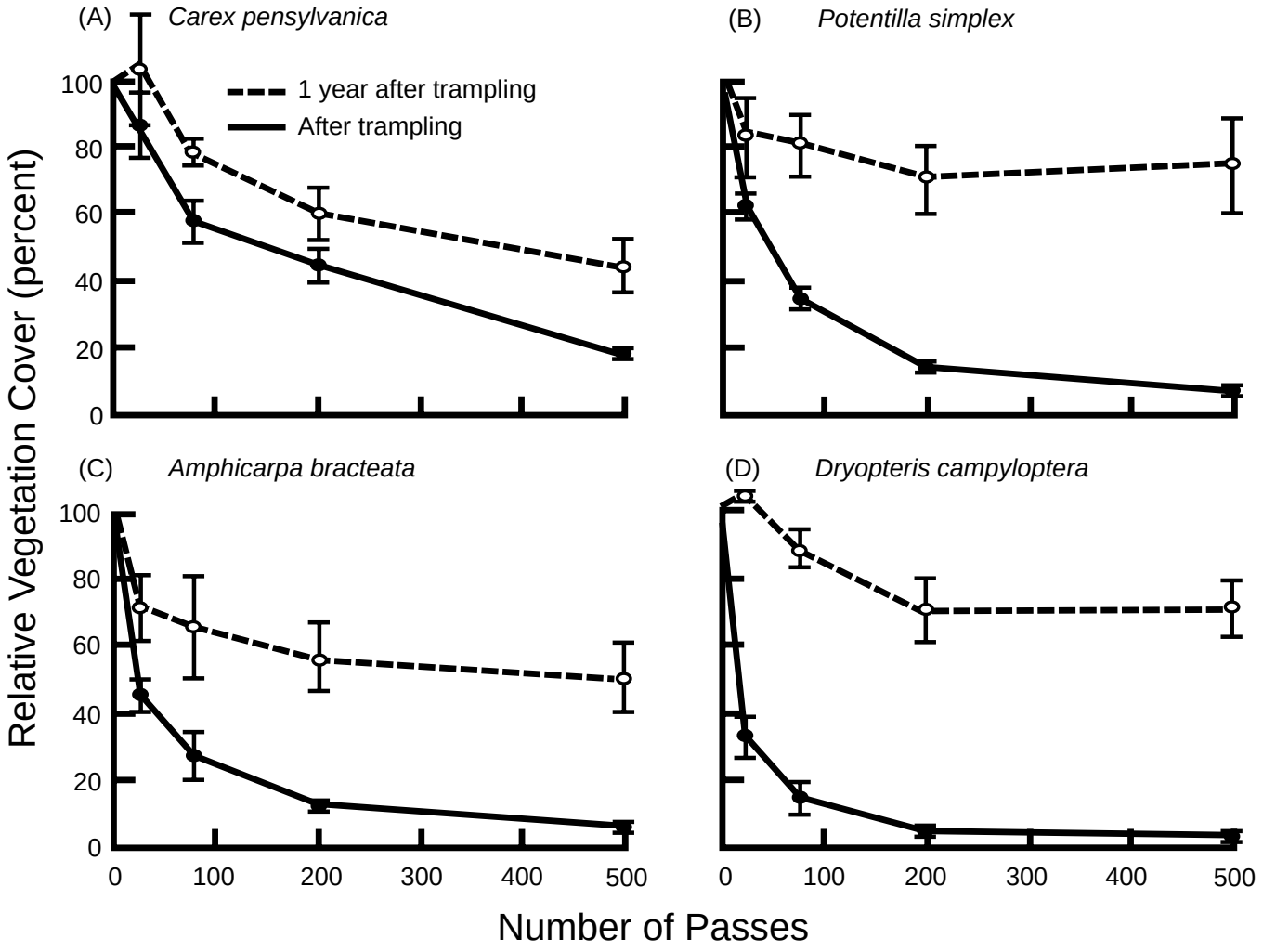


Figure 3—Relationships between trampling intensity and relative groundcover in four vegetation types in the Great Smoky Mountains, North Carolina. Bars denote one standard error (Source: Cole 1993b).

found on subalpine meadows. More recently, Monz and others (1996) examined trampling and increased temperature on moist and dry arctic tundra. Moist tundra was found to be highly susceptible to trampling disturbance, though warmer temperatures resulted in decreased leaf nitrogen, increased percent cover and increased number of leaves in mountain-aven (*Dryas octopetala*) (Monz and others 1996).

Hartley conducted a long-term study of trampling effects and recovery in the subalpine meadows of Glacier National Park, Montana (Hartley 1999). Thirty years after trampling was first applied in 1967, he reported significantly shorter inflorescence heights of fleabane (*Erigeron*) and significantly lower densities of both yellow avalanche-lily (*Erythronium* spp.) and fleabane (*Erigeron* spp.) within trampled plots than in control plots. As has been reported elsewhere (Kuss and Hall 1991; Weaver and Dale 1990), recovery of trampling impacts can be exceptionally slow in less resilient environments.

Cole investigated trampling effects on cryptogamic soil crusts in Grand Canyon National Park (Cole 1990b). He found that cryptogamic soil crusts, which are ecologically important features in arid ecosystems, are fragile and extremely susceptible to trampling impact. Crust structure damage was caused by only 15 trampling passes. Complete loss of crust cover occurred after 250 passes (Cole 1990b). de Gouvenain (1996) examined indirect effects of soil trampling on plant growth in the northern Cascade Mountains, Washington. He reported significantly higher soil water content and temperature on trampled sites, which may have influenced long-term plant succession in the study area (de Gouvenain 1996).

Cole conducted trampling experiments to evaluate two recommended LNT practices: removing boots and the use of a geotextile ground cloth in camp. His results showed that these two practices have small short-term benefits but no long-term benefits (Cole 1997).

Recent increases in popularity of llamas and other nontraditional pack stock have generated research interest in their relative trampling effects (McClaran and Cole 1993). DeLuca and others (1998) compared the effects of llamas with horses and hikers on soil erosion and found that horse traffic produced significantly higher sediment yield from established forest trails in Montana than either llama or hiker traffic, which did not significantly differ from each other.

Cole and Spildie (1998) also found greater trampling impact on vegetation by horses than by llamas or humans.

Other Types of Recreation Impact Research

Effectiveness of Management Actions—There have been few but increasing numbers of trail and campsite studies that investigate the effectiveness of impact management strategies and actions. The placement of scree walls along trail boundaries, for instance, was reported to be effective in containing hikers and associated trampling impacts within trail treads (Doucette and Kimball 1990). Marion (1995) provides a detailed case study of management success in Delaware Water Gap National Recreation Area in Pennsylvania. Two major management actions were the designation of campsites and the provision of anchored fire grates. Together with supporting actions, these management efforts effectively reduced aggregate camping-induced land disturbance by more than 50 percent between 1986 and 1991, even with modest increases in visitation (Marion 1995).

A management program recently adopted in Idaho's Selway-Bitterroot Wilderness also demonstrates the effectiveness of a spatial containment strategy (Spildie and others, this volume). A coordinated set of management actions, including: (1) designation of stock containment areas, (2) closure of some sites to stock use or all use, and (3) intensive site restoration. In five years, the areal extent of recreation disturbance was reduced by 37 percent, and bare soil was reduced more than 40 percent. Designated camping policies and site restoration actions were also found to be effective in the Boundary Waters Canoe Areas Wilderness, Minnesota (Marion and Sober 1987).

Attempts to restore impacted sites have been less effective, however. In Yosemite National Park of California, efforts to restore bare core areas on degraded high-elevation campsites by transplanting vegetation met with only modest success. Three years after program initiation, species richness and percent plant cover increased only slightly and the survival rate of transplants was low (Moritsch and Muir 1993). A 1998 study of these same campsites found that plant re-establishment was substantial on campsites with higher soil moisture, while recovery on dry sites was low (Eagan and Newman 1999). Some success with soil amendments and planting techniques as a means of speeding recovery rates was recently reported from the Eagle Cap Wilderness (Cole, this volume).

Impact Indicators for Management Frameworks—As input to management planning frameworks such as LAC and VERP, a diverse array of resource and impact indicators and their utility have been reviewed (Merigliano 1990; Watson and Cole 1992). Belnap (1998) investigated steps for selecting resource indicators in Arches National Park, Utah, as part of the Park's VERP planning and implementation process. Based on a list of selection criteria and a ranking system, she selected eight resource and impact indicators to define the health of this arid ecosystem. Indicators were assigned to two categories, one requiring measurements every year, and another requiring measurements every five years (Belnap 1998).

Setting standards for recreation impacts is another emerging issue with little research and management attention. A recent survey of trail managers found that condition standards for backcountry trails were either lacking or poorly defined in the parks studied (Burde and others 1998). With increasing adoption of management frameworks in wilderness and backcountry areas, research in this area is much needed.

Packstock Grazing Impact—The impact of packstock grazing and recovery processes were the subject of two pack horse grazing studies in subalpine meadows within the Lee Metcalf Wilderness of Montana (Olson-Rutz and others 1996a; Olson-Rutz and others 1996b). The grazing behavior of horses was quantified and related to the intensity and extent of impact. Results indicated that increased grazing duration was associated with reduced plant heights, and that grass heights appeared to be reduced more than forb heights (Olson-Rutz and others 1996a). One year after the pack horse grazing, more bare ground and less litter and vegetative cover were recorded, attributed to reduced stem numbers (Olson-Rutz and others 1996b). Research on packstock grazing impact on meadows is currently being conducted in Yosemite National Park (van Wagtendonk and others, this volume).

Climbing—Rock climbing is rapidly growing in popularity. Potential climbing-related impacts, including trail creation and use in steep approach areas, cleaning of vegetation and lichens from cliff faces, and use of protective hardware such as expansion bolts, have received little research attention until recently (Attarian and Pyke 2000). Earlier studies focused primarily on the proliferation of social trails and trampling of climbers in the access zone at the base of cliffs (Genetti and Zenone 1987). More recent studies have turned their attention to the cliff plant and wildlife communities on the vertical climbing zone. In Joshua Tree National Park of California, cliffs used intensively for climbing were found to have the lowest richness of cliff plant communities, and the number of individual plants and plant cover decreased with increased level of use (Camp and Knight 1998). Other studies in nonwilderness areas also found significant impact on vegetation and microflora (Nuzzo 1995; Nuzzo 1996).

Human Waste—The problem of improper human waste disposal is a perennial concern among wilderness managers (Cilimburg and others 2000). In Mount Rainier National Park of Washington, up to 10,000 climbers visit the summit of Mount Rainier each year, raising the possibility of fecal contamination in high-elevation areas such as the Muir Snowfield. An initial investigation was conducted recently to determine if surface water runoff from the snowfield was contaminated by fecal microorganisms such as fecal coliforms, fecal streptococci, fecal enterococci and E. coli (Ells 1997). Results indicated no significant evidence of contamination. Cilimburg and others (2000) provide a comprehensive review of the human waste disposal problem and management options.

Management Responses and Related Research

The identification and selection of effective management techniques requires knowledge of the impacts that are

occurring, their underlying causes and the role of various influential factors. The research described in the preceding section should be integrated with current monitoring data and management expertise in a careful problem analysis prior to the identification and selection of management strategies and actions.

Management Needs and Constraints

Faced with a limited wilderness resource base and increasing recreational demands, managers must decide how much and what kinds of recreation use are acceptable, recognizing that any visitation generates some degree of resource impairment. They must explicitly define when visitation-related environmental change becomes an unacceptable impact, requiring management intervention. Research and monitoring can inform such decisions, but managers must make them, preferably in consultation with the public.

The Wilderness Act (P.L. 88-577) defines wilderness as "undeveloped" lands "without permanent improvements" which "has outstanding opportunities for solitude or a primitive and unconfined type of recreation," and where "the imprint of man's work is substantially unnoticeable." Furthermore, it states that "except as necessary to meet minimum requirements for the administration of the area...there shall be no...motorized equipment...and no structure or installation within any such area." In light of this mandate, managing agencies have generally adopted what has become known as the *minimum tool rule* to guide their wilderness management actions (Hendee and others 1990). This rule directs managers to apply only the minimum tools, equipment, device, force, regulations or practice that will accomplish the desired result.

This guidance is frequently interpreted as a need to first select and attempt indirect management actions, such as Leave No Trace educational practices or improved trail and site design and maintenance before more direct controls such as regulations. However, if indirect methods fail to resolve resource protection problems, managers must be prepared to apply more restrictive measures. It has been argued that managers must not hesitate to employ direct controls, even as initial actions, when long-term or irreversible resource degradation is occurring (Dustin and McAvoy 1982).

Decisions about the use of site hardening and facility development actions in wilderness are particularly difficult. A constructed and maintained trail is a permanent wilderness facility designed both to facilitate wilderness travel and protect resources. Such facilities can involve vegetation disturbance, soil excavation and deposition, and the potential disruption of surface water movement. However, a properly managed trail system limits the areal extent and severity of recreation impacts by concentrating traffic on resistant tread surfaces. The absence of formal trails in popular locations would lead to a proliferation of poorly located and heavily impacted visitor-created trails. Similarly, although less common in wilderness, designated campsites can be located, constructed and maintained to substantially reduce the areal extent and severity of camping impacts. The Wilderness Act clearly permits managers to employ such facilities, although their use must be justified as the minimum means for managing sustainable visitation.

Management Strategies and Tactics

Recreation impact problems may be addressed through an array of management strategies and tactics (Anderson and others 1998; Brown and others 1987; Cole and others 1987; Hammitt and Cole 1998; Hendee and others 1990; Leung and Marion 1999d). The following discussion follows the strategies and tactics described by Cole and others (1987) (Table 6).

Management interventions seek to avoid or minimize recreation impacts by manipulating either use-related or environmental factors. Use-related factors, particularly the redistribution or limitation of visitor use, have received more research and management attention. However, research has increasingly demonstrated the importance of environmental factors, such as focusing use in environmentally resistant locations or increasing resource resistance through the use of facilities like trails and campsites (Cole 1990a). The modification of visitor behavior through educational and regulatory actions is another frequently applied strategy.

Modification of Use-Related Factors—Managers can control or influence amount of use, density of use, type of use, and user behavior. The type of visitor action contributing to the management problem is often an important consideration (Cole 1990a). For example, impacts from visitors knowingly engaging in illegal actions require a law enforcement response. Careless, unskilled or uninformed actions are often most appropriately addressed through visitor contacts and educational responses (Lucas 1982). Unavoidable impacts are commonly reduced by relocating visitation to resistant surfaces or by limiting use.

1. Amount of Use: Amount of use is perhaps the most studied use-related factor in recreation ecology. Earlier studies have consistently found a nonlinear asymptotic relationship between amount of use and amount of impact (Cole 1987b). Most forms of camping impact occur rapidly with initial and low levels of use (up to 10 nights/year), then begin to level off as near-maximum impact levels are reached at moderate to high use levels. This use-impact relationship has been corroborated by recent trampling studies for most impact parameters with a few exceptions (such as exposure of mineral soil) (Cole 1987a; Cole 1988; Cole 1990b; Cole 1993b; Cole 1995b; Cole 1995c; Cole and Trull 1992; Kuss and Hall 1991).

The curvilinear use-impact relationship reduces the potential effectiveness of use limitation for reducing recreation impacts (Strategies I & II, Table 6). Substantial use reductions would be necessary to achieve even modest improvements in resource condition on heavily impacted trails and campsites. However, use reductions can lead to pronounced improvements at lower use levels, where use and impact are more strongly related (although slow recovery rates prevent rapid improvements) (Cole 1995a). Also, limitations on the number of groups, particularly during times of peak use (Strategy IV), can reduce the total area of camping disturbance by shrinking the number of campsites needed. For example, a popular travel zone may receive over twice the

Table 6—Strategies and tactics for managing recreation impacts to resources or visitor experiences.

I.	Reduce use of the entire area
	• Limit number of visitors in the entire area
	• Limit length of stay in the entire area
	• Encourage use of other areas
	• Require certain skills and/or equipment
	• Charge a flat visitor fee
	• Make access more difficult throughout the entire area
II.	Reduce use of problem areas
	• Inform potential visitors of the disadvantages of problem areas and/or advantages of alternative areas
	• Discourage or prohibit use of problem areas
	• Limit number of visitors in problem areas
	• Encourage or require a length-of-stay limit in problem areas
	• Make access to problem areas more difficult and/or improve access to alternative areas
	• Eliminate facilities or attractions in problem areas and/or improve facilities or attractions in alternative areas
	• Encourage off-trail travel
	• Establish differential skill and/or equipment requirements
	• Charge differential visitor fees
III.	Modify the location of use within problem areas
	• Discourage or prohibit camping and/or stock use on certain campsites and/or locations
	• Encourage or permit camping and/or stock use only on certain campsites and/or locations
	• Locate facilities on durable sites
	• Concentrate use on sites through facility design and/or information
	• Discourage or prohibit off-trail travel
	• Segregate different types of visitors
IV.	Modify the timing of use
	• Encourage use outside of peak use periods
	• Discourage or prohibit use when impact potential is high
	• Charge fees during periods of high use and/or high-impact potential
V.	Modify type of use and visitor behavior
	• Discourage or prohibit particularly damaging practices and/or equipment
	• Encourage or require certain behavior, skills and/or equipment
	• Teach a wilderness ethic
	Encourage or require a party size and/or stock limit
	• Discourage or prohibit stock
	• Discourage or prohibit pets
	• Discourage or prohibit overnight use
VI.	Modify visitor expectations
	• Inform visitors about appropriate uses
	• Inform visitors about conditions they may encounter
VII.	Increase the resistance of the resource
	• Shield the site from impact
	• Strengthen the site
VIII.	Maintain or rehabilitate the resource
	• Remove problems
	• Maintain or rehabilitate impacted locations

Source: Cole and others (1987).

visitation on peak use weekends than it does during more typical high use periods. Use can also be limited during times when resources are more vulnerable to impact, by restricting horse traffic when trails are particularly wet, for example. Tactics for rationing use are reviewed in Anderson and others (1998), and Cole and others (1987).

2. Density of Use: How much visitation is concentrated spatially affects both the areal extent and severity of resource impacts (Marion and Cole 1996). Educational programs and regulations may be used to shape visitation density, generally through one of two strategies: visitor dispersal, which spreads use sufficiently to avoid or minimize long-term impacts, and visitor containment, which concentrates use to limit the areal extent of impact (Cole 1981; Cole 1992; Leung and Marion 1999d). Containment, as evidenced by the development and maintenance of formal trail systems, has a long tradition of use in wilderness. Its application to camping management is less common, but a variety of options are now in use (Marion, Roggenbuck and Manning 1993). In contrast, dispersal is rarely applied to reduce hiking impacts except for remote low-use areas. Its application to camping management is more common, although many factors thwart the success of this strategy.

When camping is unregulated, visitors are free to choose any existing campsite or create new ones. This policy can result in many poorly located campsites (Cole 1993a; Leung and Marion, this volume; McEwen and others 1996). For example, wilderness campsites in the Jefferson National Forest of Virginia were frequently located on trampling-susceptible herbaceous groundcover in areas that readily permit site expansion and proliferation (Leung and Marion, this volume). Campsites were also located close to trails and other campsites, enhancing the potential for visitor conflicts and reducing solitude for both campers and hikers.

A successful application of dispersal and containment strategies can reduce camping impacts. Consider three campsites that receive intermediate amounts of use (10-20 nights/year) under an unregulated camping policy (Figure 4). Aggregate resource impact for these sites would be three times the "a" amount of impact. Under the purest form of dispersed camping, these sites would be closed and their use distributed across 45 pristine sites, each receiving only one night of use/year. Most vegetation types can sustain such light camping with no permanent impact visible the following year. More resistant surfaces, like grassy groundcover, sand, gravel and rock, can accommodate many more nights of use without permanent impact. The

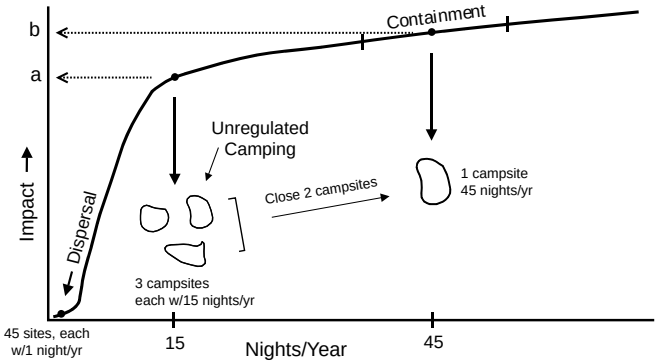


Figure 4—A generalized use-impact curve illustrating the intended locations of typical or average campsites under dispersal and containment strategies.

low camping densities under a dispersal strategy also resolve problems with crowding and conflicts.

In contrast, a containment strategy could be implemented by closing two of the three original sites and distributing their use to the third. Due to the curvilinear use-impact relationship, impact on this third site would increase only marginally, from "a" to "b" (Figure 4). Aggregate impact would decline substantially, from three sites with an "a" level of impact to one site with a "b" level of impact. Application of this strategy was largely responsible for a 50 percent reduction in the total area of disturbance from river camping at Delaware Water Gap National Recreation Area (Marion 1995). Furthermore, in addition to favoring resistant sites, site selection criteria emphasized the closure of sites within dense clusters, addressing crowding and conflict problems by maximizing intersite distances.

While these strategies may seem straightforward, additional issues often complicate their implementation. Achieving the level of camping dispersal necessary to prevent impacts has proven exceptionally difficult. In most vegetation types more than a few nights of camping will quickly create lasting impacts—that is, permanent campsites (Cole 1995a). Mountainous topography, dense vegetation, and availability of water frequently limit the number of potential camping locations, and few of these contain resistant surfaces (Williams and Marion 1995). Furthermore, most visitors prefer camping on established sites close to trails, water and popular features (Lucas 1990a). Generally, a dispersed camping strategy will be effective only in areas that receive low levels of use, have numerous potential camping locations that are resistant and/or resilient, and where visitors are willing to learn and apply Leave No Trace camping practices (Cole 1981; Leung and Marion 1999d). Managers at Denali National Park and Preserve of Alaska have developed one of the most successful dispersed camping programs, although visitor use numbers are also highly restricted.

A successful containment strategy requires concentrating camping activities on the smallest number of sites needed to accommodate the intended level of use (Leung and Marion 1999d). Reserved, designated site camping permits the smallest number of campsites and aggregate impact. However, fixed itineraries are difficult to follow in wilderness and entail a substantial loss of visitor freedom (Stewart 1989). Designated site camping without a reservation system allows greater flexibility. Visitor use surveys can provide information for matching campsite numbers and locations to visitor use patterns, or entry point quotas can restrict use based on available campsite numbers (Lime and Buchman 1974). To avoid excessively large inventories of campsites, use surveys should be conducted during average high use periods rather than peak use periods. In comparison to areas with site reservation systems, somewhat larger numbers of campsites are necessary to avoid the "musical chairs" dilemma of too many visitor groups and too few campsites. An educational approach, asking visitors to camp only on well-established campsites, may also be used (Cole and Benedict 1983).

Some wilderness and backcountry areas have adopted multi-strategy camping policies (Leung and Marion 1999d). New backcountry camping management policies at Shenandoah National Park provide an example (National Park Service 1998). A few areas containing sensitive cultural and natural resources or that accommodate high day use will be closed to camping. In high-use areas, visitors will be required to camp on a limited number of designated campsites on a first-come, first-served basis. In remaining areas, visitors will be asked to camp on well-established campsites, a limited number of which will be selected by managers for resistance and ability to promote solitude. Dispersed camping on pristine sites will be permitted when all available campsites are used. While more complex, such combined strategies offer substantial flexibility in balancing wilderness resource protection and recreation provision objectives.

3. Type of Use: Types of uses that result in greater or disproportionate impacts are often subject to special regulations or educational programs (Strategy V). For example, visitors with horses have been restricted to a subset of more resistant trails and campsites specifically selected and maintained to sustain such use. While large groups create larger campsites than small groups, splitting them up may require more campsites and an equivalent amount of aggregate impact (Cole 1987b; Cole and Marion 1988). Matching group size with site size is therefore a significant management challenge. Further research on the relationship between party size and resource impact is needed.

4. User Behavior: Many impacts are avoidable, often caused by uninformed or careless behavior (Lucas 1982). Managers can educate and regulate visitors to avoid or reduce visitor behavior that contributes to avoidable impacts (Strategy V). The most common avoidable resource impacts include littering, cutting switchbacks, creating new trails and campsites, trail widening and campsite expansion, moving or building new fire sites, improper disposal of human and food waste, wildlife and cultural resource disturbance and cutting trees or tree limbs. Management efforts can also target many unavoidable impacts, such as vegetation disturbance and soil compaction caused by foot traffic. A variety of low-impact hiking and camping practices have been described to address these impacts (Cole 1989b; Hampton and Cole 1995), along with alternative education techniques for conveying such practices to visitors (Doucette and Cole 1993).

The four federal wilderness management agencies in partnership with the National Outdoor Leadership School have founded and actively promote a national *Leave No Trace* program that teaches outdoor ethics and low impact hiking and camping practices (Hammitt and Cole 1998; Marion and Brame 1996). *Leave No Trace* training courses, publications and a comprehensive web site (http://www.LNT.org) are now reaching millions of potential wilderness visitors. Agency wilderness-specific educational contacts, signs and materials reinforce this effort and target specific problems.

Although more restrictive to visitor freedom and experiences, regulations offer another option for altering visitor behavior to reduce impacts (Lucas 1982). For example, regulations requiring proper food storage or fines for visitors who feed wildlife can help return wildlife to natural diets. Generally, regulations should only be used when indirect options are likely to be ineffective (Lucas 1990b). Interventions may employ both educational and regulatory responses. For example, excessive tree damage may be addressed by instructing campers to use stoves or to build small fires using dead down wood that can be broken by hand. A

regulation prohibiting axes, hatchets and saws removes the unnecessary tools most commonly used to damage trees.

Modification of Environmental Factors—Managers can also influence or control the location of visitor use in wilderness (Strategy III) and manage the trails and campsites that sustain that use (Strategies VII and VIII). For example, trails may be designed to avoid areas prone to muddiness, fragile vegetation types and steep slopes or erodible soils. Camping may be encouraged in durable vegetation types. Trail and campsite impacts can be reduced through careful site selection, design, construction and maintenance.

1. Environmental Resistance: Previous research has demonstrated considerable variability in the trampling resistance of different vegetative growth forms and plant communities (Cole 1987b; Kuss 1986b; Liddle 1991). Resistant plant communities and environments may be targeted for camping, while fragile communities may be avoided or identified for closures to camping. Examples of resistant plant communities include dry open forests and meadows with substantial grass or sedge cover, dense forests with little or no vegetation cover and sand, gravel and bedrock substrates.

Soils also vary in their resistance to compaction and erosion. Moist soils with little organic matter and a wide range of particle sizes (such as loams) are the most prone to compaction, while soils with a narrow range of particle sizes, particularly those high in silt and fine sands, are most prone to erosion (Hammitt and Cole 1998; Kuss and others 1990). Both soil compaction and erosion are accelerated by the absence of vegetation and organic litter, and slope is a critical determinant of erosion potential.

Wilderness managers can do little to modify environmental resistance. However, the construction and use of trails and campsites frequently opens forest canopies, allowing greater sunlight penetration and enhancing the survival and spread of shade-intolerant, trampling-resistant grasses, sedges and herbs. Seeding and transplanting resistant vegetation, using locally obtained sources of native plant materials, have been done in some wildernesses, and there is guidance for site restoration methods (Hanbey 1992). Although most commonly applied to closed campsites, many of these techniques have been employed by managers of the Boundary Waters Canoe Area Wilderness to reduce the size of open campsites (Marion and Sober 1987).

2. Environmental Resilience: Knowledge of the relative resiliency (ability to recover) of different vegetation and soil types may also be used to direct camping to areas that will recover quickly after trampling disturbance. However, impact rates are far greater than recovery rates, so off-season resource recovery is generally minimal and rest-rotation schemes to minimize impact are not warranted (Cole and Ranz 1983; Marion and Cole 1996). Environmental resilience can be an important consideration in low-use areas where dispersed hiking and camping are promoted (Cole 1995c). In more popular areas, the concentration of visitor activities is often sufficient to permanently remove most of the vegetation cover on trails and campsites. However, highly resilient vegetation still helps to restrict the size and further expansion of disturbance in these areas.

3. Site Management: Wilderness trails and campsites have rarely been planned and developed after careful evaluation of their expected ability to sustain use with minimal impact. Most wilderness managers simply inherit an inventory of trails dating back to earlier uses as Indian and settler travel ways, fire fighting roads and trails, logging roads and informal visitor-created trails. Similarly, most campsites, even those formally designated, were originally visitor-created. Examples abound of poorly located trails and campsites that are severely degraded. However, knowledge is now available to direct visitors to trails and campsites able to sustain heavy recreational traffic with far less resource impact than many existing recreation facilities. When necessary, site development that includes primitive facilities and sound maintenance can also contribute substantially to the avoidance and minimization of recreation impacts in wilderness.

Site Selection and Development—Knowledge of the environmental resistance and resilience of vegetation and soil types can be applied to select new and relocated trails and campsites (Hammitt and Cole 1998). Management options include educating visitors to improve site selection, marking resistant sites to encourage their use and designating resistant sites (Leung and Marion 1999b). Topography and other environmental attributes such as rockiness and vegetation density can also be considered to select locations that minimize impact severity and area of disturbance. In the Chisos Mountains of Big Bend National Park, managers have carefully selected and designated campsites to resist site expansion and promote solitude. The mean site size for these campsites is only 686 ft^2 (Williams and Marion 1997).

Managers at Isle Royale National Park have constructed campsites in sloping terrain, using standard cut-and-fill practices to create small benches for tenting and cooking areas (Farrell and Marion 1997). Camping posts and embedded logs or rocks are used in flat terrain to identify intended use areas and discourage site expansion. Managers can spatially arrange the sites to promote solitude and to minimize trail development to water sources and shared facilities like bear bag hanging devices and toilets (Hammitt and Cole 1998; Leung and Marion 1999d).

Site Maintenance—Trail maintenance programs exist in most wilderness areas, and many excellent manuals have been developed to guide this work (Birchard and Proudman 2000; Demrow and Salisbury 1998; Hesselbarth and Vachowski 1996). Active trail maintenance reduces impacts by providing a durable tread able to accommodate the intended traffic while minimizing problems with tread muddiness, erosion, widening and multiple tread development.

Much of the expertise gained in maintaining trails can be extended to maintaining campsites, although the appropriateness of such work in wilderness has been questioned (Cole 1990a). Maintenance work can reduce campsite sizes to the minimum necessary, prevent erosion and reduce campfire-related impacts (Hammitt and Cole 1998; Marion and Sober 1987). For example, excessive site size may be addressed by subtly improving tenting locations in core use areas (creating smooth, gently sloped areas) and ruining tenting locations in peripheral use areas. Site ruination work commonly includes “ice-berging” large rocks (burial except for sharp protruding tips), creating an irregular

tenting surface by digging shallow scrapes and mounding soil and renaturalizing areas with large logs, organic debris and vegetative transplants. Such work should use native materials and be carefully blended to match natural conditions (Marion and Sober 1987). However, more artificial work may be justified in high-use areas or on particularly troublesome sites. Such work includes embedding rocks or logs to visually identify intended campsite boundaries or placing a camping post to attract and spatially concentrate visitor activities.

Site Facilities—Site facilities are not always visitor conveniences, and many serve important safety and resource protection functions (Cole 1990a). Bridges along trails are often built to safely transport trail users across deep or dangerous currents. Bridges also protect sensitive riparian areas from vegetation damage and soil erosion on steep slopes. Placement of small, firmly anchored steel fire rings can be used to identify preferred or legal campsites, spatially concentrate visitor activities to reduce site size and limit resource impacts by focusing fire-related activities at only one spot (Marion 1995). Pit toilets can resolve problems with improperly disposed human waste, particularly on high-use campsites where the volume of waste poses a threat to human health. Impacts from recreational stock can be concentrated by placement of stock restraint facilities.

Site Closures—Camping closures represent a final resource protection strategy, generally most appropriate for protecting sensitive environments, rare flora and fauna or fragile historic sites (Cole 1990a; Hammitt and Cole 1998). Camping closures around popular features such as waterfalls, cliffs, ponds and lakes may be appropriate to separate overnight campers from intensive day use. Closures of popular highly impacted campsites are often ineffective and inappropriate. Little recovery will occur unless all use is removed, and new campsites with greater aggregate impact are frequently created in nearby areas (Cole and Ranz 1983). Generally, such closures are warranted only when use is shifted from impact-susceptible locations to impact-resistant locations, although social considerations may also provide justification (Cole and Ranz 1983; Trafimow and Borrie 1999).

Impact Management Decisionmaking

Management of recreation impacts directly affects the quality of recreation resources and visitor experiences. For example, restricting camping to designated campsites may reduce campsite numbers and aggregate impact, but it also imposes a direct management "presence" and control on visitor freedom to travel and select campsites. Achieving an appropriate balance between the dual management objectives of resource protection and recreation provision frequently requires decisions that trade off recreation experience quality with natural resource quality. Such decisions are difficult and often controversial and must be defensible in both the court of public opinion and law.

A decision framework is simply a standard process that provides structure to decisionmaking for planning or management purposes (Hendee and Koch 1990). Historically, managers have relied on informal decisionmaking when addressing visitor impact issues. Common problems with this approach include a failure to explicitly describe intended resource or social conditions, evaluate the acceptability of existing conditions, conduct a thorough problem analysis or consider a comprehensive array of management alternatives (McCool and Cole 1997). Subsequent decisions may be indefensible and ineffective at restoring desired resource conditions.

The expanding popularity of wilderness recreation, greater public scrutiny of management decisionmaking and widening demands for participatory public land management are placing greater demands on land managers to further develop and communicate the processes by which decisions are made (Krumpe and McCool 1997). Formal decisionmaking frameworks have been developed and applied to guide both planning and operational decisions. These frameworks offer a defensible process for defining desired future resource conditions for visitor impact management, identifying impact indicators and assessing impact acceptability, conducting problem analyses, and evaluating and selecting preferred management actions.

Types of Frameworks

Formal frameworks may be simple or complex, as long as they identify and describe the steps by which decisions are made. Management constraints, such as limitations in funding, staffing and time, must be considered carefully in selecting the most appropriate framework. Recently, the most widely applied frameworks include *Limits of Acceptable Change* (LAC) (Stankey and others 1985) and *Visitor Experience and Resource Protection* (VERP) (National Park Service 1997a; National Park Service 1997b). These frameworks transform wilderness mandates into prescriptive objectives that can be implemented and evaluated with standards defining the limits of acceptable conditions for selected resource and social indicators (Figure 5). Monitoring permits periodic comparisons of conditions to standards. If standards are exceeded, a problem analysis evaluates causal factors to aid in selecting appropriate and effective management intervention(s). These models provide dynamic decision processes; future monitoring evaluates the success of implemented actions, so managers can select and implement additional actions if unacceptable conditions persist. Comprehensive reviews of these frameworks and their application to wilderness are provided in two state-of-knowledge reviews (Krumpe, this volume; Manning and Lime, this volume).

Decision frameworks require objective monitoring to characterize resource conditions for comparison to management objectives and/or indicator standards and to evaluate the success of implemented actions. Monitoring may be informal, such as staff observations or simple inventories, or formal, involving the application of standardized qualitative or quantitative procedures (Cole 1983; Cole 1989d; Marion 1991). Formal visitor impact monitoring programs employing quantitative ratings or measures are required for frameworks that use indicators and standards. Quantitative monitoring data can also be used to document trends in resource conditions, providing a permanent record of conditions that transcend changes in wilderness staff. Monitoring data may reveal subtle trends, alerting managers and allowing time

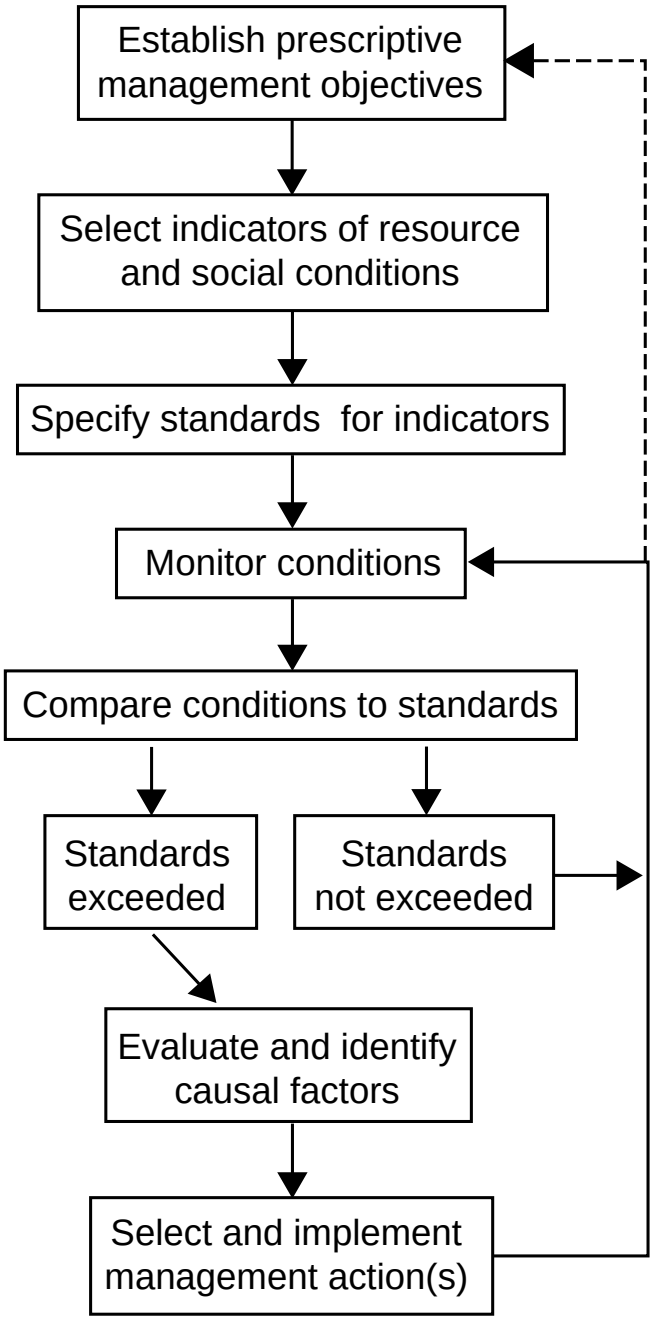


Figure 5—Diagram illustrating contemporary management planning frameworks such as LAC, VIM and VERP.

for the implementation of corrective actions that will avoid severe or irreversible impacts.

Monitoring data may also help gauge the effectiveness of management interventions implemented to correct deteriorating or unacceptable resource conditions. For example, analysis of campsite monitoring data at Delaware Water Gap National Recreation Area revealed the success of several site and visitor management actions implemented following the initial monitoring survey (Marion 1995).

Monitoring data may assist in identifying the underlying causes of impacts and help managers select effective management strategies and actions. For example, campsite monitoring data at Shenandoah National Park were used to develop campsite selection criteria based on vegetation type, topography and aspect (Williams and Marion 1995). Park staff are applying these criteria to rank existing campsites and potential campsite locations to shift camping to more durable locations.

Other uses of monitoring information include the formulation and justification of budget requests and resource or visitor management actions (Marion 1995). For example, monitoring data documenting a decline in trail conditions over time might suggest the need for increased trail maintenance funding. Similarly, data showing an increasing trend in tree damage following educational efforts might justify a ban on axes and saws. Finally, monitoring data may be used to assign limited agency funding or staffing within different wildernesses or regions of a single wilderness.

Knowledge Gaps and Future Directions

Recreation ecology is essential to the professional management of wilderness resources and recreational experiences. Managers frequently turn to scientific knowledge for the information needed to make informed decisions. The inadequate knowledge base of recreation resource impacts has meant that managers must act in the absence of scientific information, taking actions that are increasingly being challenged by the public.

Basic Processes and Factors

Cole and Landres (1996) reviewed various threats to wilderness ecosystems, including criteria for evaluating their significance. They highlighted gaps in knowledge about the pollution of water bodies and alteration of their biota due to the introduction of fish, disruption of natural conditions due to fishing, hunting and the introduction and translocation of game animals, belowground processes, including biotic-biotic interactions, and of nonconsumptive visitor impacts to wildlife. Many of these impacts, particularly at larger spatial and temporal scales, are so poorly understood that effective impact indicators cannot be identified, and monitoring programs cannot be initiated (Cole and Landres 1996).

Long-Term Consequences and Significance of Impact

More longitudinal research and monitoring studies are needed to document and evaluate the long-term consequences of wilderness visitation (Cole and Landres 1996; Hartley 1999). Managers are increasingly adopting containment strategies for limiting visitor impacts, concentrating and reducing the areal extent of traffic. A primary question is whether such locations will be able to sustain such intensive visitation and what ecological consequences this policy will produce. A more thorough examination of the managerial, ecological and social significance of recreation resource impacts is also needed.

Design, Accuracy, and Precision Issues in Impact Assessment and Monitoring

Increasing application of management decision frameworks that employ indicators and standards requires more objective resource monitoring protocols and programs. Few investigations of the accuracy and precision of existing impact assessment and monitoring methodologies have been conducted. Results suggest considerable subjectivity in assessment procedures for some indicators. Additional investigations are needed to characterize and find new ways to reduce measurement error so that monitoring data reflect real changes in resource conditions. Further work on employing the results of precision investigations to define confidence intervals for management decisionmaking is also needed (see Williams and Marion 1995). Working at odds with this issue is the need for efficient and flexible monitoring protocols; otherwise managing agencies cannot adopt or sustain them over time.

Management Effectiveness

Most recreation ecology investigations have focused directly on relationships between use-related and environmental factors and fail to consider management interventions that seek to manipulate these factors. The effectiveness of management actions in avoiding or minimizing visitor impacts represents a significant and largely untapped research topic of considerable importance to managers. Examples include evaluations of improved campsite or trail design and construction, containment and dispersal impact management strategies, visitor management practices such as group size limits and Leave No Trace educational efforts, use of facilities such as fire grates, and campsite and trail maintenance efforts. Very little is known about the relative effectiveness of these and other management strategies and tactics, or the role of supporting actions.

New Locations, Activities, and Technologies

Early investigations of recreation impacts often focused on large and remote wilderness areas in the western U.S. Recently research has expanded to Midwestern and Eastern states, as well as high-use wilderness destinations (Cole and others 1997). More research is needed in high-use areas to assess the magnitude of impacts and evaluate the effectiveness of management actions in more intensively visited locations.

Impacts from off-trail hiking or dispersed activities around campsites have seldom been documented. One example is the potential ecological effects of off-site trampling and wood removal related to campfire wood collection.

As new recreation pursuits and new types of recreation equipment are gaining popularity in wilderness, there will be needs for corresponding research. One example is the use of hiking poles, which have become a common hiking and backpacking aid. Initial observations seem to suggest that poles with long sharp tips could loosen soil aggregates, possibly leading to increased muddiness and erosion by water or wind. However, no research that we are aware of has been conducted to determine potential impacts induced by hiking poles. More empirical research is also needed for examining the impacts caused by expanding or new activities such as climbing, caving and the use of llamas.

The rapid advancement of computer and other technologies offers great potential for recreation ecology investigations, but few benefits have been realized. Promising technologies include global positioning system (GPS), geographic information systems (GIS), image capture technology and the Internet. With a greater accuracy and direct transferability of data to computer systems, GPS has been used for mapping the location of wilderness campsites and trails (Leung and Marion 1995; Monz 1998) and recently experimented on backcountry trails. The use of GIS is expanding, with a growing number of applications from spatial mapping and display of visitor distribution patterns (Wing and Shelby 1999) to spatial planning to predict potential human-wildlife conflict zones (Harris and others 1995). Image capture technology has been applied to simulate different scenarios of campsite impacts (Nassauer 1990). The Internet and World Wide Web offer an unprecedented opportunity to disseminate research results of recreation ecology studies and low-impact recreation practices. Although the applications are currently limited, use of these technologies will soon be common in all aspects of wilderness recreation research, including recreation ecology studies.

Staffing and Funding

Little progress has been made in the previous 15 years to develop and expand permanent recreation ecology research programs. The Aldo Leopold Wilderness Research Institute, established in 1993 by the USDA Forest Service, is the only national research group dedicated to developing the knowledge needed to improve the management of wilderness and other natural areas. Only one scientist at the Institute conducts research on recreation impacts in wilderness. Similarly, only one scientist in the U.S. Department of the Interior focuses on recreation impacts, in spite of that agency's considerable land and recreation management responsibilities - including National Park Service units, U.S. Fish and Wildlife Refuges and Bureau of Land Management areas. Academia and a nonprofit organization, the National Outdoor Leadership School, also each employ one scientist in the recreation ecology field of study, contributing to a national total of four scientists.

Funding is also extremely limited, with the Leopold Institute the only organization having a permanent base of annual research funding. This funding may be used to address system-wide or regional information needs of a basic or applied nature. However, even this support is generally insufficient for studies other than those of the Institute's recreation ecologist. Other funding is derived primarily from national forests and parks and is tied to specific management information needs. The most common needs over the past 15 years have been the development and initial application of visitor impact assessment and monitoring protocols.

Enhanced support for permanent federal land management sponsored centers of recreation ecology research are needed. Increased funding, particularly for basic research focused on the improvement of fundamental recreation

ecology knowledge and methodological development, is required to move this field of study to an advanced level of understanding. An increased number of scientists, representing a greater array of disciplines, are also essential to build the critical mass of researchers necessary to substantially advance knowledge. For example, there has never been a recreation ecologist with a career-level focus on visitor impacts to wildlife.

Concluding Remarks

Wilderness managers continue to be confronted by significant visitor impact problems throughout the 624-unit, 104-million-acre National Wilderness Preservation System. Visitor impacts threaten to compromise wilderness management mandates for preserving and sustaining high quality natural environments and recreational experiences. A principal goal for managing wilderness visitation is to avoid impacts that are avoidable and to minimize those that are not. To achieve this goal, wilderness managers must effectively educate and regulate visitors and manage wilderness resources.

While the areal extent of visitor impacts remains small, there is growing recognition and appreciation of their ecological, social and managerial significance. Recreation ecology has begun to document many of the impacts occurring to vegetation, soils, wildlife and water resources. Studies are also beginning to describe the extent and rates of change of these impacts, where they are occurring and their relationships to causal and noncausal factors. However, considerable gaps in our knowledge continue, and existing research staffing and funding severely limit the attainment of further knowledge.

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APPENDIX E

Literature Review: The Impacts of Dogs on Wildlife and Water Quality (Hennings, Portland Metro Parks, 2016)

The impacts of dogs on wildlife and water quality: A literature review

Compiled by Lori Hennings, Metro Parks and Nature, April 2016

SUMMARY

Metro periodically reviews the science literature behind its natural resource policies to ensure policies are based on the most current science. Recently staff reviewed the scientific literature regarding the impacts of dogs on wildlife to inform Metro Regulatory Code Title 10.01, which excludes pets from most Metro properties. The only exceptions are service dogs, leashed dogs on some regional trails, Broughton Beach, boat ramps and properties managed by others through intergovernmental agreements that are integrated into larger parks where leashed dogs are allowed (e.g., Forest Park).

Any human related activity can disturb wildlife. In order to meet Metro's dual goals of protecting natural resources and providing access to nature, Metro has tried to strategically locate trails in less sensitive habitat and to ensure that human activity is as non-disruptive as possible. Part of that strategy has been to allow public access, while limiting certain activities such as bringing dogs into natural areas.

The evidence that dogs negatively impact wildlife is overwhelming. It is clear that people with dogs – on leash or off – are much more detrimental to wildlife than people without dogs. Dogs (*Canis lupus familiaris*) are considered to be a subspecies of wolves (*Canis lupus*), and wildlife perceive dogs as predators.[30] Impacts include:

1. **Physical and temporal displacement** – The presence of dogs causes wildlife to move away, temporarily or permanently reducing the amount of available habitat in which to feed, breed and rest. Animals become less active during the day to avoid dog interactions. Furthermore, the scent of dogs repels wildlife and the effects remain after the dogs are gone.
2. **Disturbance and stress response** – Animals are alarmed and cease their routine activities. This increases the amount of energy they use, while simultaneously reducing their opportunities to feed. Repeated stress causes long-term impacts on wildlife including reduced reproduction and growth, suppressed immune system and increased vulnerability to disease and parasites.
3. **Indirect and direct mortality** – Dogs transmit diseases (such as canine distemper and rabies) to and from wildlife. Loose dogs kill wildlife.
4. **Human disease and water quality impacts** - Dog waste pollutes water and transmits harmful parasites and diseases to people.

INTRODUCTION

Metro owns 17,000 acres of parks and natural areas and does not allow dogs or other pets on the vast majority of these lands. Exceptions include service animals, leashed dogs on some regional trails, Broughton Beach, boat ramps and certain properties managed by others through intergovernmental

agreements that are integrated into larger parks where leashed dogs are allowed (e.g., Forest Park). The policy that prohibits visitors from bringing pets to most of Metro's managed parks and natural areas was initiated by Multnomah County in the 1980s and continued in practice after Metro assumed management of those parks in the early 1990s. After a review of the scientific literature and meaningful public discourse, Metro formally adopted the pets policy into its code in 1997 (Metro Council Regulatory code Title 10.01 adopted in Ordinance 96-659A).

To ensure this decision reflects the most up-to-date information, Metro staff examined 54 peer-reviewed scientific journal articles and several research reports relating to the impacts of dogs in natural areas, including numerous literature reviews on the impacts of various types of recreation on wildlife and habitat.[10, 28, 42,54,61,63, 65,68,71,73,77] The results of our literature review are summarized below.

PHYSICAL AND TEMPORAL DISPLACEMENT

Displacement may be the most significant impact due to the amount of habitat affected. The presence of dogs causes most wildlife to move away from an area, which temporarily or permanently reduces the amount of functionally available habitat to wildlife. The research is clear that people with dogs disturb wildlife more than humans alone.[5,10,33,38,39,41,44,61,68,69] These effects reduce a natural area's carrying capacity for wildlife, and also reduces wildlife viewing experiences for visitors.

Studies on a variety of wildlife in many countries and settings demonstrate that dogs along trails and in natural areas significantly alter wildlife behavior.[9,33,39,41,49,53,58] A 2011 literature review found negative dog effects in all 11 papers that examined such effects.[65] Studies demonstrate dog-specific impacts on reptiles,[29,31,48] shorebirds and waterfowl,[24,32,51,69] songbirds,[5,9,10] small mammals,[33,39,56] deer, elk and bighorn sheep,[4,36,38,44,49,59,63] and carnivores.[22,33,52,58]

A study in France found that two hikers disturbed an area of 3.7 hectares walking near wild sheep, whereas two hikers with dogs disturbed 7.5 hectares around the sheep.[41] In Chicago, migratory songbirds were less abundant in yards with dogs.[9] Dog walking in Australian woodlands led to a 35% reduction in bird diversity and a 41% reduction in the overall number of birds.[5] The same study showed some disturbance of birds by humans, but typically less than half that induced by dogs.

Studies in California and Colorado showed that bobcats avoided areas where dogs were present, including spatial displacement[22,33,52] and temporal displacement in which bobcats switched to night time for most activities.[22] The Colorado study also demonstrated significantly lower deer activity near trails specifically in areas that allowed dogs, and this effect extended at least 100 meters off-trail.[33] This negative effect was also true for small mammals including squirrels, rabbits, chipmunks and mice, with the impact extending at least 50 meters off-trail.

Evidence suggests that some wildlife species can habituate to certain predictable, non-threatening disturbances such as people walking on a trail in a natural area; this effectively lowers the stress response. Part of this adaptation may be due to wildlife learning what is and isn't a threat, and also

avoidance of hunters.[19,55,63,70] Habituated animals still react, but amount of habitat affected is not as large.[55,56,63,70] However, dogs – especially off-leash dogs – may prevent wildlife habituation because wildlife consistently see them as predators. Dog-specific disturbance has been studied for birds, with no evidence of habituation even with leashed dogs, even where dog-walking was frequent; this effect was much weaker for people without dogs.[5]

Even the scent of dog urine or feces can trigger wildlife to avoid an area. Therefore, the impacts of dog presence can linger long after the dog is gone, even days later. One literature review found that predator odors caused escape, avoidance, freezing, and altered behavior in a large suite of wildlife species including scores of amphibian, reptile, bird, and mammal species from other studies.[30] The scent of domestic dogs has been shown to repel American beaver (*Castor Canadensis*), mountain beaver (*Aplodontia rufa*), deer (*Odocoileus* species), elk (*Cerus elaphus*), and a wide variety of wildlife native to other countries.[20,30] Mountain beaver cause economic damage to young tree stands in the Pacific Northwest, and foresters are considering using dog urine as a repellant.[20] An experimental study demonstrated that dog feces are an effective repellent for sheep, with no habituation observed over seven successive days.[1]

One Colorado study showed mixed effects of dogs on wildlife.[44] The study compared effects of pedestrians alone, pedestrians with leashed dogs and unleashed dogs alone on grassland birds. Vesper Sparrows (*Pooecetes gramineus*) and Western Meadowlarks (*Sturnella neglecta*) waited until dogs were closest to flush – that is, they fly or run away. This could be an attempt to remain undetected against the greatest threat, but could also mean that these bird species perceive humans as a greater threat than dogs. However, the same study found strong dog-specific impacts on mule deer in woodlands. A literature review found that ungulates (deer, elk and sheep) had stronger flight responses in open habitats compared to forested habitats.[63] Unlike small ground-nesting songbirds, larger animals would have no cover and could easily be seen in open habitats.

The disturbance effects of off-leash dogs are stronger than on-leash and substantially expand the amount of wildlife habitat affected,[32,59,63,69] and the unpredictability of off-leash dogs may prevent wildlife habituation in large areas of habitat.[5,10,32,61,69] The negative effects are increased even further when dogs and people venture off-trail, probably because their behavior is less predictable.[44,67] Off-leash dogs are likely to reduce the number and types of wildlife in large areas of habitat.

A Colorado study found off-leash dogs ventured up to 85 meters from the trail, although this result was from 1 square meter plots covering a very small percentage of the area.[33] Remote cameras in another study documented the same dog 1.5 miles apart in the same day.[61] In Utah, mule deer showed a 96% probability of flushing within 100 meters of recreationists located off trails; their probability of flushing did not drop to 70% until the deer were 390 meters from the recreationists.[67] A California shorebird study found that off-leash dogs were a disproportionate source of disturbance, and that plovers did not habituate to disturbance; birds were disturbed once every 27 minutes on weekends.[32]

To illustrate the potential of dogs to displace wildlife we explored two well-known local park examples that allow dogs on leash. Forest Park is one of the largest urban parks in the U.S. and was always intended to connect urban dwellers with nature; people have been walking their dogs there since before the park's 1948 dedication. Forest Park covers 5,172 acres of forest, including approximately 80 miles of trails and service. Using a very conservative 25-meter buffer around mapped trails to represent the "human + dog on leash" area of disturbance and assuming 100% compliance with leash rules, the area affected would be 1,406 acres – that's 28% of the entire park. In 651-acre Tryon Creek Natural Area, 207 acres of land (32%) is within 25 meters of a trail.

DISTURBANCE AND STRESS RESPONSE

Stress response is the functional response of an animal to an external stressor, such as seasonal changes in temperature and food availability or sudden disturbance.[3] Specific stress hormones are released to enable the animal to physically respond to the stressor. Acute stress response, when an animal reacts to an immediate situation, can benefit an animal by triggering it to respond appropriately to a threat. However, chronic stress such as repeated disturbances over time may reduce wildlife health, reproduction, growth, impair the immune system and increase vulnerability to parasites and diseases.[16,27,75]

Dogs cause wildlife to be more alert, which reduces feeding, sleeping, grooming and breeding activities and wastes vital energy stores that may mean life or death when resources are low, such as during winter or reproduction.[8,32,40,41,69] Animals release stress hormones and their heart rates elevate in response.[3,27,37,38] When stress becomes too high, animals may flush, freeze, or hide.[26,30]

Several studies document that disturbance reduces reproductive success for some wildlife species.[11,35,40,50,63] Numerous studies found that female deer and elk, and deer and elk groups with young offspring, show greater flight responses to human disturbances than other groups.[63] Stress hormones may cause male songbirds to reduce their territorial defense, females to reduce feeding of their young, nestlings to have reduced weight and poor immune systems, and adult birds to abandon nests.[11,34,35,76] A Colorado study showed that elk repeatedly approached by humans had fewer young.[50] Although research is lacking on whether dogs specifically reduce the reproductive success of wildlife, the fact that humans with dogs create much stronger disturbance effects than without dogs [5,33,38,41,44,61,68,69] implies that these stress effects would be magnified if people had dogs with them.

INDIRECT AND DIRECT MORTALITY

Dogs chase and kill many wildlife species including reptiles, small mammals, deer and foxes.[12,13,29,31,48,58,62] A Canadian study found that domestic dogs were one of the top three predators that killed white-tailed deer fawns.[4] In northern Idaho winter deer grounds, an Idaho Fish and Game conservation officer witnessed or received reports of 39 incidents of dogs chasing deer, directly resulting in the deaths of at least 12 animals.[36] A study in southern Chile revealed that domestic dogs preyed on

most of the mammal species present in the study area.[60] A 2014 literature review of dogs in parks identified 19 studies that investigated the effects of dogs preying on wildlife.[73] Of these, 13 reported observing or finding strong evidence of dog predation on wildlife. The Audubon Society of Portland's Wildlife Care Center took in 1,681 known "dog-caught" injured animals from 1987 through March 2016.[2]

Dogs transmit diseases to wildlife and vice versa including rabies, Giardia, distemper and parvovirus.[18,23,66,74] A Mexico City study concluded that feral dogs continually transmitted parvovirus, toxoplasmosis and rabies to wildlife including opossums, ringtails, skunks, weasels and squirrels.[66] Large carnivores such as cougars are especially vulnerable to domestic dog diseases including canine distemper.[74]

HUMAN DISEASE AND WATER QUALITY IMPACTS

Under the Oregon Department of Environmental Quality (DEQ), Metro is a Designated Management Agency to protect water quality in compliance with the federal Clean Water Act. Limiting dog access at most natural areas is one of Metro's commitments to DEQ, because dog feces pollute water. Feces are often delivered to waterways through stormwater.[57] The average dog produces ½ to ¾ pound of fecal matter each day – a hundred dogs can produce more than 500 pounds of waste per week.[45] The DEQ identifies pet waste as a significant contributor to one of the region's most ubiquitous and serious pollutants, *E. coli* bacteria. Contact with *E. coli*-polluted water can make people sick. Because dog waste can be a relatively simple source to reduce or eliminate exposure to *E. coli*, DEQ considers reducing or eliminating dog waste an important action item in jurisdictions' clean water implementation plans for the Willamette Basin watershed.[47]

Humans can catch parasites and diseases such as hookworms (causes rash), roundworms (may cause vision loss in small children, rash, fever, or cough) and salmonella (causes gastrointestinal illness) from dog waste.[7,57] Aside from potential illnesses, dog waste can negatively affect visitors' experience in a natural area. Dog waste left on the ground is a leading complaint in Portland parks, and violators may be fined up to $150 per incident.[14]

Several examples illustrate local dog impacts. A Clean Water Services DNA study found that dog waste alone accounts for an average of 13% of fecal bacteria in stream study sites in the Tualatin River Basin.[17] Off-leash dog walking is documented to cause erosion in Portland's Marshall Park, creating sediment problems in stream water.[15] In 2014 Portland school administrators expressed concern because playgrounds had become "a minefield for animal waste" from people using school grounds as after hours, off-leash dog parks, threatening the health of school children.[21] The City of Gresham found extremely high levels of *E. coli* bacteria in water quality samples of a very specific stretch of a stream, where dog feces were found along stream banks behind several yards with dogs.[1] The city sent letters to

[1] Personal communication with Katie Holzer, Watershed Scientist at the City of Gresham, Oregon, 4/11/2016.

residents in the neighborhood about the incident and how to properly dispose of dog feces; the levels have not been elevated in follow-up sampling.

BELIEF, BEHAVIOR AND REALITY

People do not always take responsibility for their impacts on wildlife. Several studies demonstrate that natural area visitors, including dog owners, often don't believe they are having much of an effect on wildlife, or assign blame to different user groups rather than accepting responsibility themselves.[6,64,67,68] Some natural area visitors assume that when they see wildlife, it means that they are not disturbing the animals – or worse, that because they didn't see any wildlife, they didn't disturb any.[64]

For example, in Utah, about half of recreational visitors surveyed did not believe that recreation was having a negative impact on wildlife; of those that did, each user group blamed other groups for the strongest impacts.[67] In Austria, 56% of people surveyed at a national park agreed that wildlife is in general disturbed by human activity.[64] However, only 12% believed that they had disturbed wildlife in their visit that day, and dog-walkers ranked their activities as less disturbing than other user groups' activities. When asking different user groups to rate the impacts of overall human disturbance on wildlife, dog-walkers rated the impacts the lowest, at 2.6 out of 5 possible impact points.

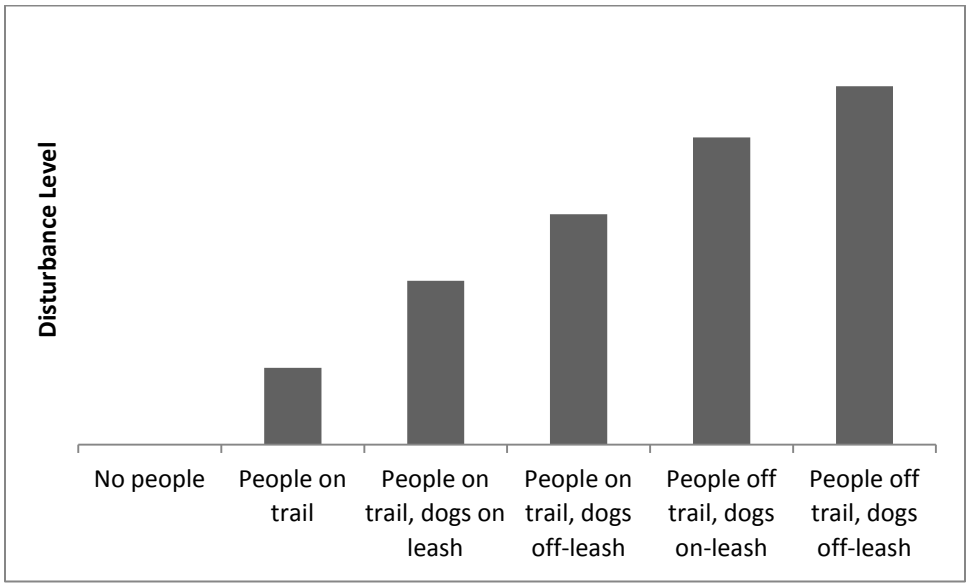
Surveys indicate that many dog owners desire fewer restrictions, while non-dog owners often feel the opposite.[72,73] However dog owners don't always follow the rules, and some dog owners allow their dogs to run free in leash-only natural areas.[32,52,73] In a Santa Barbara study, only 21% of dogs were leashed despite posted leash requirements.[32] And despite regulations and claims to the contrary, dog owners often don't pick up their dog's waste.[6,32] An English study revealed that although 95% of visitors claimed to pick up their dog's waste only 19-46% actually did so, depending on location within the park.[6]

DISCUSSION

In summary, people and their dogs disturb wildlife, and people are not always aware of or willing to acknowledge the significance of their own impacts. Wildlife perceive dogs as predators. Dogs subject wildlife to physical and temporal displacement from habitat, and dog scent repels wildlife with lingering impacts. Dogs disturb wildlife which can induce long-term stress, impact animals' immune system and reduce reproduction. Dogs spread disease to and outright kill wildlife. People with dogs are much more detrimental to wildlife than people alone; off-leash dogs are worse; and off-trail impacts are the highest (Figure 1).

Urban wildlife is subjected to many human-induced stressors including habitat loss, degraded and fragmented habitat, impacts from a variety of user groups, roads, trails, infrastructure, noise and light pollution.[26] These stressors will increase with population; from July 2014 to 2015 the Portland-Vancouver metropolitan region added 40,621 new residents.[43] Current population in the region stands at 2.4 million, with another 400,000 residents expected over the next 20 years.

Figure 1. Conceptual illustration of the relative impacts on wildlife due to people without and with dogs.



Among medium to high density cities, Portland currently ranks second in the total area covered by parks at nearly 18%, and also second in the number of park acres per resident.[25] Of 34 park providers in the Portland region, all but four allow dogs in most or all of their natural areas, typically on-leash; more than two-thirds also offer dog parks or off-leash dog areas (Table 1 at end of document).

Wildlife conservation is not the only valid reason to preserve natural areas. Park providers must weigh the trade-offs between wildlife, habitat, water quality and recreational values. But when considering different types of public access in a natural area, it is important to understand that the research is clear: people with dogs substantially increase the amount of wildlife habitat affected and are more detrimental to wildlife than people without dogs.

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Table 1. Park providers' dog policies in the greater Portland, Oregon metropolitan area.

Parks provider	No dogs allowed	Some parks allow dogs	Dogs allowed	On-leash	Free to roam	Off-leash areas or dog park
Audubon Society of Portland	X					
City of Beaverton		X[2]		X		X
City of Cornelius			X	X[3]		
City of Durham			X	X		X
City of Fairview		X[4]		X		
City of Forest Grove			X	X		X
City of Gladstone			X	X		X
City of Gresham			X	X		X
City of Happy Valley			X	X[5]		X
City of Hillsboro			X	X		X
City of Lake Oswego			X	X		X
City of Milwaukie[6]			X	X		X
City of Oregon City			X	X		X[7]
City of Portland		X		X[8]		X[9]
City of Sherwood			X	X		X
City of Tigard			X	X		X
City of Troutdale		X[10]		X		X[11]
City of Tualatin			X	X		X
City of West Linn			X	X		X[12]
City of Wilsonville			X	X		X
City of Wood Village			X	X		
Clackamas County			X	X		X
Clean Water Services (Fernhill Wetlands)	X					

[2] All parks except fountain provided by Tualatin Hills Parks & Recreation District.
[3] Considering off-leash dog area at Water Park.
[4] Dogs on leash allowed at all parks except Salish Ponds (no dogs).
[5] Dogs on leash except prohibited in playgrounds.
[6] All city parks are operated by North Clackamas Parks and Recreation Department.
[7] The City of Oregon City is currently testing off-leash areas in three parks.
[8] Dogs on-leash except prohibited at Foster Floodplain Natural Area, Tanner Springs Park, Whitaker Ponds Nature Park, Riverview Natural Area, and the amphitheater at Mt Tabor Park.
[9] 33 off-leash dog areas.[46]
[10] Most parks: dogs not allowed. Exception: Sunrise Park and large Beaver Creek Greenway, leash only. Considering two more on-leash dogs allowed parks.
[11] Plans for an off-leash area at Sunrise Park.
[12] One off-leash dog area: field near parking lot at Mary S. Young Park. Off-leash dogs were identified as an issue by parks board.

Parks provider	No dogs allowed	Some parks allow dogs	Dogs allowed	On-leash	Free to roam	Off-leash areas or dog park
Federal / State (Sandy River Natural Area)			X[13]	X	X	X
Metro		X[14]				
N. Clackamas Parks & Recreation			X			X
OR Department of Fish and Wildlife			X	X[15]	X	X
OR Parks & Recreation Department			X	X		X
Port of Portland		X[16]		X		
The Nature Conservancy	X					
The Wetlands Conservancy			X[17]	X	X	
Tualatin Hills Park and Rec. District		X[18]		X		X
U.S. Fish & Wildlife Service	X					
U.S. Forest Service[19]			X	X	X	X

[13] Leashes required only on/near Confluence Trail and in parking area. Leash-off everywhere else. Region's largest off-leash area, and heavily used.

[14] Metro does not allow dogs except for service dogs, leashed dogs on regional trails, Broughton Beach, boat ramps and properties managed by others through intergovernmental agreements that are integrated into larger parks where leashed dogs are allowed (e.g., Forest Park).

[15] All dogs must be on leash, except while hunting during seasons authorized on Sauvie Island Wildlife Area, or pursuant to a valid "Competitive Hunting Dog Trial Permit" or "Sauvie Island Wildlife Area Individual Dog Training Permit."

[16] Includes Vanport Wetlands and mitigation sites. No dogs allowed except Government Island State Recreation Area (leased to Oregon Parks Department).

[17] No formal policy.

[18] Dogs allowed on-leash except Tualatin Hills Nature Park and Cooper Mountain Nature Park.

[19] Refers specifically to the Sandy River Delta, owned and administered by the National Forest Service, Columbia River Gorge National Scenic Area.