SOUTH FORK DOGFISH CREEK RESTORATION MASTER PLAN

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Acronyms and Abbreviations

BMPs	best management practices
LID	low impact development
LiDAR	light detection and ranging
LWD	large woody debris
NRCS	Natural Resources Conservation Service
PMC	Poulsbo Municipal Code
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WWHM	Western Washington Hydrology Model

Chapter 1
Introduction

1.1 Purpose

South Fork Dogfish Creek flows from its headwaters to the confluence with the mainstem of Dogfish Creek passing through the heart of the Poulsbo. The stream and its surrounding watershed have been affected by land management and development over the past one hundred years. The South Fork Dogfish Creek was the City's historical fresh water source, and the original water intake structures are still visible in Wilderness Park.

The City of Poulsbo (City) is recognizing an opportunity to enhance one of the unique resources of the Pacific Northwest—a salmon bearing stream that flows through the heart of an urban area—by developing the South Fork Dogfish Creek Restoration Master Plan.

The City's Public Works Department initiated the development of this Restoration Master Plan to help understand how its municipal actions affect South Fork Dogfish Creek and to foster increased stewardship of this unique resource by the City and its residents. This Restoration Master Plan has been prepared to guide the City's management of the South Fork Dogfish Creek and its subbasin.

The Restoration Master Plan identifies restoration actions at the basin scale as well as site-specific projects that can result in:

- reduced urban flooding through stormwater management;
- improved water quality;
- increased stream quality and fish habitat conditions;
- improved riparian, floodplain, and wetland conditions; and
- renewed opportunities for educational, recreational, and aesthetic improvements in the quality of life provided by a healthy stream in an urban environment.

By analyzing the existing conditions of the creek and those factors limiting a healthy stream condition, the Master Restoration Plan has identified available opportunities to improve South Fork Dogfish Creek. This document is intended to be used over time and can implemented as funding is secured for the range of restoration actions and projects described in Chapter 4. Funding opportunities are discussed in Chapter 5.

The improvement programs and projects described in this Restoration Master Plan are intended for eventual incorporation into the City's principal planning document, the Comprehensive Plan. Capital improvement projects and non-capital programs will be included in the Comprehensive Plan at the discretion of the City Council and staff as the Comprehensive Plan is reviewed and annually amended. Capital projects will be included in the City's annual Capital Improvement Program as funding sources are identified.

1.2 Approach

A two phase approach was pursued. Phase 1 focused on a compilation of available information and data gap analysis. Phase 2 followed in which the plan development approach was determined, field work was conducted, and the Restoration Master Plan was developed. Phase 1 of the Restoration Master Plan, completed in February 2009, focused on locating, compiling, and reviewing available background resources and GIS data layers to determine the extent, nature, and types of data already documented for South Fork Dogfish Creek. The Phase 1 Data Gap memo identified the level and quality of information available on various physical and biological, elements and identified elements for which significant data gaps existed (ICF Jones & Stokes 2009).

ICF Jones & Stokes compiled and reviewed reports and data that addressed the hydrologic, hydraulic, water quality, and biological conditions in the South Fork Dogfish Creek subbasin. In collaboration with the Suquamish Tribe, available GIS data was compiled into base maps illustrating the geographic extent and configuration of existing GIS data layers across the subbasin.

This review identified data gaps for existing conditions, limiting factors, and opportunities and constraints—areas where additional information was needed in order to craft a Restoration Master Plan that addresses the City's generally articulated dual goals of restoring stream channel habitat for salmonids and improving flood conveyance.

The breadth of data gaps led the City to pursue a broad and comprehensive, but more qualitative, Restoration Master Plan that prioritizes future efforts in support of the City's goals.

Phase 2 began in the spring of 2009 with formalizing the City's intent to take an integrated, landscape-scale approach to restoring the ecology of the creek and reducing the frequency and severity of flooding within the subbasin. The interdisciplinary project team of City Public Works staff, Suquamish Tribal biologist, and ICF team, collaborated to draft a framework outlining the level of detail in the Restoration Master Plan and its areas of focus. Based on that framework, a suite of actions and projects was developed and prioritized to guide the City in proactively addressing its goals.

1.3 Scope of Analysis

This Restoration Master Plan:

- identifies goals and objectives specific to restoring stream ecology and reducing flooding;
- describes the existing conditions in the subbasin;
- identifies the limiting factors in the subbasin;
- identifies and prioritizes specific actions and projects to address the goals and objectives;
- identifies grant funding opportunities that may be leveraged to implement these actions/projects; and
- provides recommendations on next steps, based on this information.

Chapter 2
Restoration Master Plan Goals and Objectives

During Phase 1, the City identified a desire to integrate ecological principles with urban stream management and to take a strategic approach to managing the South Fork Dogfish subbasin. Two basic goals and a related series of objectives were identified and developed by the project team.

The City identified dual goals for any actions/projects identified in the Restoration Master Plan:

1. Restore stream ecology.
2. Reduce flood damage and/or redirect flooding from the most developed portions of the floodplain, as defined below.

2.1 Restore Stream Ecology

This analysis interprets "restore stream ecology" to mean restoration/creation of conditions within the stream channel and its immediate riparian zone and floodplain that are conducive to the resident and anadromous salmonids that currently inhabit South Fork Dogfish Creek. Improving conditions for salmonids (whether wild or hatchery) also improves habitat conditions for most other aquatic and riparian flora and fauna. This, in turn, supports the larger aquatic and riparian food chain. Stream ecology includes parameters such as stream hydrology and water quality, as well as floodplain conditions such as extent and condition of riparian vegetation and associated wetlands.

Because significant residential and commercial development has already occurred in the subbasin, complete restoration to predevelopment conditions was not an explicit goal of the analysis. Rather, restoration to a self-sustaining condition in the context of the urbanization of Poulsbo was considered a feasible goal. Toward that end, current conditions were analyzed compared to conditions in the least developed portions of the subbasin. These "reference conditions" formed the basis for judging the extent and nature of degradation in the subbasin and for determining limiting factors currently degrading the stream ecology of South Fork Dogfish Creek.

The project team identified the following objectives for determining limiting factors in the South Fork Dogfish Creek subbasin, identifying opportunities and constraints, and evaluating the potential of particular actions/projects to achieve this goal.

- Remove, repair, and replace barriers to fish migration.
- Restore/create off-channel rearing and high-flow refuge habitat.
- Increase instream habitat complexity (e.g., install LWD, create pools).
- Improve low-flow water quality conditions (e.g., temperature and dissolved oxygen).
- Improve high-flow water quality conditions (e.g., sediment and chemical pollutants in stormwater).

- Improve connection to the floodplain (i.e., restore natural planform and reduce channel incision).
- Restore riparian habitat (e.g., restore native plant species, increase interspersion of different plant communities).
- Restore connection to floodplain wetlands.
- Enforce existing regulations that protect stream ecology.

2.2 Reduce Flooding

Flood damage reduction includes reduction in the frequency, duration, and depth of flooding in the most developed portions of the floodplain. The City identified the portion of the subbasin between Lincoln Road and Bond Road as the priority area for consideration of this goal.

The elimination of flooding was not considered an achievable goal due to the degree and extent of effective impervious surface immediately adjacent to the channel and the proximity of the creek channel to significant infrastructure and commercial development. Instead, this goal focused on identifying actions that could reduce flooding and/or direct it toward less developed portions of the floodplain.

The project team identified the following objectives for determining limiting factors, identifying opportunities and constraints, and evaluating the potential of particular actions/projects to achieve this goal. Many of these objectives align with the increasing use of low impact development (LID) techniques throughout Kitsap County and Poulsbo.

- Increase stormwater detention storage.
- Improve stormwater conveyance.
- Update stormwater standards for new development.
- Retrofit existing development with stormwater treatment and detention facilities.
- Develop basin-wide programmatic actions to reduce flooding (e.g., maintenance program for storm drains and catch basins, retrofit existing impervious surface area with stormwater detention and treatment facilities).

Chapter 3
South Fork Dogfish Creek Overview

An understanding of the historic conditions and watershed context is important to establishing a theoretical "reference condition" for restoration. As noted previously, restoration to predevelopment conditions is not a realistic goal in an urbanized city. Thus, goals and objectives, as well as limiting factors and opportunities and constraints must be evaluated in light of those aspects of historic conditions that are still achievable. A healthy condition for South Fork Dogfish Creek is defined herein as one that provides the water flow, water quality, and riparian habitat conditions that support a native suite of resident and anadromous salmon, as well as other native aquatic species known to have occurred in South Fork Dogfish Creek (e.g., native freshwater mussels that depend on healthy anadromous salmonid populations for their reproduction).

3.1 Historic Conditions

South Fork of Dogfish Creek is a tributary to Dogfish Creek, which discharges to Liberty Bay on the east side of the Kitsap Peninsula (Figure 1). The South Fork Dog Fish Creek subbasin lies within the Puget Sound lowlands portion of the Western Hemlock Zone (Franklin and Dyrness 1988), a vegetative complex that occupies extensive lowlands and foothills of western Washington. The 1860 Government Land Survey map of Township 26, Range 1 East illustrates the South Fork Dogfish Creek as meandering across the area between approximately SR 305 and Caldart Avenue (General Land Office 1860).

Plant communities not altered by logging or other disturbances normally consist of western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), and western redcedar (*Thuja plicata*), with an understory of western swordfern (*Polystichum munitum*), vine maple (*Acer circinatum*), and salmonberry (*Rubus spectabilis*). In this vegetative zone, riparian and wetland plant communities tend to be dominated by red alder (*Alnus rubra*) and black cottonwood (*Populus balsamifera ssp. trichocarpa*) trees, with an understory dominated by salmonberry (Franklin and Dyrness 1988).

The Poulsbo area has a long and extensive history of settlement and use by Native Americans, centered on the value of local natural resources including fresh water and adjacent terrestrial and marine food resources. The City of Poulsbo is within the traditional lands of the Suquamish Tribe, a Looshootsheed-language-speaking people. Precontact Suquamish settlements were often located on major waterways, at the heads of bays or inlets, and the people engaged in a seasonal lifestyle centered on hunting, fishing, and cultivating native plants (Ruby and Brown 1992). Winter village settlements and seasonal temporary camps were both used in this area. Early Euroamerican settlement began in the late 1800s with reconnaissance of the area for timber and the arrival of Poulsbo's first permanent resident in 1883, the Norwegian Jorgen Eliason.

Fueled by logging, fishing, and shellfisheries, Poulsbo developed first along its waterfront with Liberty Bay, but soon expanded inland. Proximity to naval facilities at Keyport and Bangor also stimulated development in the area during and after the World Wars. Development has continued to expand outward from the historic downtown up into the upper portions of the South Fork Dogfish Creek subbasin (Figure 2).

3.2 Watershed Context

Approximately 90% of the 706-acre South Fork Dogfish Creek subbasin is located within the jurisdictional boundary of the City of Poulsbo (Figure 1). The lower reaches of the subbasin are relatively flat as the stream flows through a broad valley (Figure 2); the middle reaches (Wilderness Park area) are relatively steep, with gradients as steep as 8 to 9%; the upper reaches, upstream of Wilderness Park, are also relatively flat. South Fork Dogfish Creek is approximately 2.6 miles long, extending from headwater springs originating in Wilderness Park (elevation 272 feet) (Bremerton Kitsap County Health Department 2002) and from a bioswale and seasonal channel located to the west of Caldart Avenue NE above Wilderness Park (Figure 2).

Fishman (2003) summarized existing conditions into five main stream reaches (including the estuary), as part of the City's use of "best available science" in the adoption of its Critical Areas Ordinance in 2007. Fish and wildlife resource functions/issues identified in the South Fork Dogfish Creek subbasin included: instream and base flow, fish passage, water quality/urban contaminants, spawning habitat, rearing habitat, and wildlife habitat/habitat connectivity (Fishman 2003).

Background research conducted during Phase 1 indicated that development throughout the subbasin has led to a decline in naturally vegetated areas and a corresponding increase in impervious surface. Typically this results in increased peak flow during the fall/winter as more water rushes through the system during storm events, and decreased base flow in the creek in the summer months due to reduced storage and infiltration. However, much of the data that exists on the hydraulics, hydrology, and biological conditions of the creek and its floodplain is qualitative.

These conditions appear to have caused channel scour and bank erosion in the upper subbasin and sediment deposition in the lower subbasin. The channel scour has resulted in decreased floodplain connectivity, and the sediment deposition has filled pools and created a wide, braided channel form and contributed to increased flooding in the lower subbasin. These changes have degraded instream and riparian habitat for native fish and wildlife species.

3.2.1 Fish and Wildlife Populations

Phase 1 background research indicated that coho salmon are documented in the lower 1.31 miles of South Fork Dogfish Creek and chum salmon are documented in the lower 1.16 miles. Annual returns of adult coho salmon are typically small, with less than 100 fish observed; annual returns of adult chum salmon are similarly small, with around 100 fish observed. Both anadromous and resident cutthroat trout have been reported in South Fork Dogfish Creek by tribal, state, and other biologists. Tribal biologists have observed adult steelhead in Dogfish Creek from 1977 through 1984, but no adult steelhead or redds have been observed since then (Dorn pers. comm.). The South Fork would have contributed historical spawning and rearing habitat for steelhead. The location of specific salmonid spawning areas and the quality and quantity of rearing habitat are also not well documented. While no comprehensive survey or inventory of fish species presence or occurrence has been completed recently, other native resident fish have also been identified by scientists from the tribe, Washington Department of Fish and Wildlife (WDFW), and the Native Fish Society (e.g., three species of sculpin, brook lamprey, three-spine stickleback) as well as cutthroat trout and coho salmon (Native Fish Society 1989).

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South Fork Dogfish Creek Sub-Basin Boundary (6/14/2010)

City of Poulsbo

Figure 1.
Vicinity Map
South Fork Dogfish Creek Restoration Master Plan

June 2010

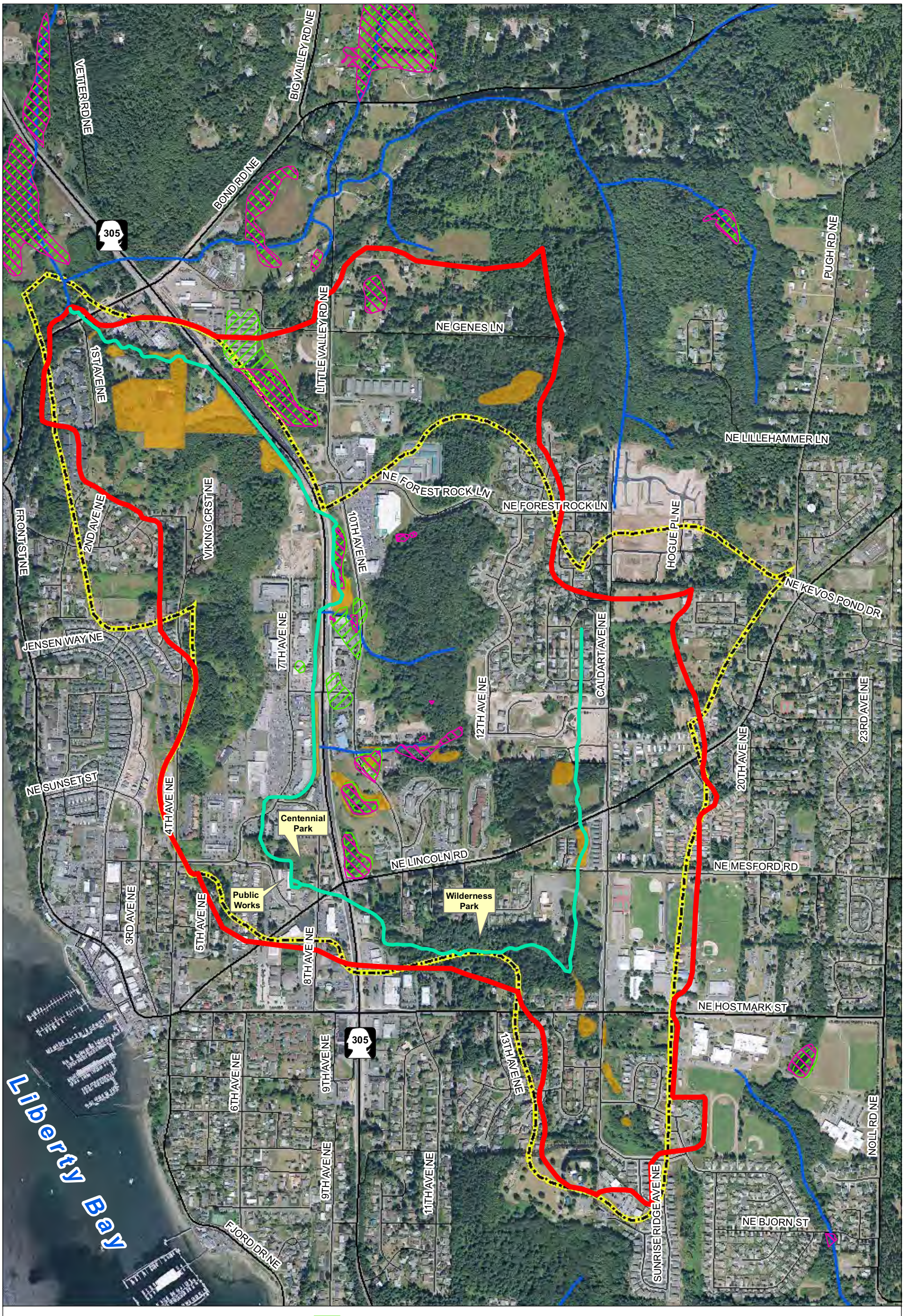

Figure 2.
Existing Conditions
South Fork Dogfish Creek
Restoration Master Plan

July 2010

Additionally, the Suquamish Tribe has released salmonids into the South Fork in the past and anticipates that the South Fork may receive coho strays in the future from the tribe's Agate Pass sea pens. The purpose of the tribe's salmon enhancement program is to reintroduce naturally spawning salmon populations to Dogfish Creek to coincide with salmon restoration efforts that have been underway throughout the watershed since 1982 (Dorn pers. comm.).

The Suquamish Tribe has released fall Chinook, coho, and chum salmon into the mainstem and several tributaries of Dogfish Creek beginning in 1982. In total, approximately 20,000 to 100,000 coho fry, 200,000 to 250,000 Chinook fry, and a couple million chum fry have been released by the Suquamish Tribe (Dorn pers. comm.). Unmarked coho fry (fed) were planted into the South Fork and throughout the watershed beginning in 1982. Coho fry (fed) were raised in Dove Pond (mainstem Dogfish Creek headwaters) beginning in 1997 and released in the winter months throughout the watershed, including the South Fork. The Dove Pond coho fry were adipose clipped (i.e., marked as hatchery origin salmon) beginning in 2000. Adult coho strays from the Agate Pass sea pens were documented in the South Fork by tribal biologists based on coded wire tag recoveries from 1982 to 2003, coinciding with the operation of the sea pen facility (Dorn pers. comm.).

Chum salmon (unfed) were released directly into the South Fork beginning in 1984. Most of the tribal chum releases were in the mainstem and larger tributaries. Fall Chinook have been reared to smolt size in the North Fork with a cooperative program with the landowner and North Kitsap Trout Unlimited from 1984 to the present. Fall Chinook adults are observed periodically in the lower South Fork, but generally continue upstream into the main stem (Dorn pers. comm.).

The western pearlshell (*Margaritifera falcata*), a freshwater mussel found in Pacific drainages from California to British Columbia and southern Alaska, is also prevalent in the lower subbbasin. It prefers cold, clean creeks and rivers that support salmonid populations, preferring sand, gravel, and cobble substrates in stable areas of the stream bed. It does not tolerate sedimentation (Nedeau et al. 2009). The western pearlshell depends on anadromous salmonids, including native cutthroat trout, Chinook salmon, coho salmon, sockeye salmon, rainbow trout, and nonnative brook and brown trout, to complete its lifecycle; the gills of these fish provide a host for the mussel's larval stage. It does not reach sexual maturity for 9 to 12 years and has an average lifespan of 60 to 70 years. It is capable of living over 100 years, making it one of the longest-lived animal species on Earth (Nedeau et al. 2009). The western pearlshell is considered an indicator of stream health, water quality, and suitability for salmonids. No surveys of extent or population size of western pearlshells in South Fork Dogfish Creek have been conducted; however, locations and numbers of western pearlshells were noted during the stream surveys conducted as part of the existing conditions documentation, as described in section 3.4.

Virtually no locally specific data exists on the types, extent, or use of the South Fork Dogfish Creek subbasin by wildlife. WDFW Priority Habitats and Species database contains no records of priority wildlife or habitat polygons in the subbasin, except for the estuary and shoreline of Liberty Bay, which supports eagle nests, marine mammal haulouts, and shellfish and has been surveyed for forage fish spawning. In the past, WDFW habitat biologists have issued HPAs (hydraulic project approvals) to remove active beaver dams constructed at the upstream end of culverts under Highway 305. However, no beaver activity has been reported in the past 5 years (Dorn pers. comm.)

Urban adapted and riparian associated wildlife (e.g., coyote, opossums, raccoons, deer, and various songbirds, frogs, and reptiles) likely occur in the less disturbed portions of the subbasin such as in

the forests of Wilderness Park and the area surrounding the estuary, but no inventories have been conducted.

3.2.2 Wetlands and Native Plant Communities

Very little data exists on the extent to which wetlands function as headwater hydrological sources and/or floodplain storage areas for the creek. The National Wetland Inventory and local wetland inventory document a series of palustrine depressional wetlands along the eastern side of State Route (SR) 305 between NE Lincoln Road to the south and Bond Road NE to the north, some of which have been filled and replaced with impervious surfaces and developments. No wetlands were recorded in the upper portion of the subbasin or along the stream channel until it reaches the estuary at Liberty Bay. However, inventories are frequently based on aerial photo interpretation, which are frequently outdated because wetlands grow and shrink over time. Thus uninventoried wetlands frequently exist where none have been previously mapped.

No rare plants or rare plant associations have been mapped in the basin by the Washington Department of Natural Resources (WDNR) Natural Heritage Inventory Program. However, the suite of native riparian and wetland plants historically associated with the creek and its basin tributaries is not specifically documented.

The riparian floodplain likely supported a variety of wetlands prior to the arrival of the early settlers and subsequent agricultural and urban development. Wetland understory species typically include skunk cabbage (*Lysichiton americanum*) and slough sedge (*Carex obnupta*), as well as lady-fern (*Athyrium felix-femina*), water parsley (*Oenanthe sarmentosa*), youth-on-age (*Tolmiea menziesii*), hedge nettle (*Stachys spp*.), miterwort (*Mitella* spp.), and a great density and variety of shrubs including Sitka willow (*Salix sitchensis*), salmonberry, and Douglas spirea (*Spirea douglasii*) (Franklin and Dyrness 1988).

A wetland reconnaissance was conducted as part of our field investigation of existing conditions, as described in section 3.3.8 below, to determine the location and extent of previously unrecorded potential wetlands areas in the subbasin.

3.3 Existing Conditions—Subbasin Scale

Much of the data that exists on the hydraulics, hydrology, and biological conditions of the creek and its floodplain is currently very qualitative. Phase 1 of the project identified several data gaps that were determined to be essential to understanding the current dynamics of the creek and thus to determining restoration opportunities and constraints.

Phase 2 focused on gathering missing data at both the subbasin scale and the stream-reach scale, because an understanding of basin-scale conditions and processes is required to prioritize, locate, and design effective projects on a stream-reach scale. For example, land use and stormwater delivery directly affect the planform and ecology of streams. Data collected at both scales is necessary to determine current limiting factors and restoration potential.

3.3.1 Channel Location and Configuration

The lack of accurate information regarding the location and condition of the streambed was a critical data gap identified in Phase 1 Data Gap memo (ICF Jones & Stokes 2009). Phase 1 identified areas

where the mapped location of the creek channel was incorrect compared to known locations. ICF Jones & Stokes refined the creek channel location based on existing LiDAR (light detection and ranging) topographic data and field verification conducted along the entire length of the creek.

Methods

To accurately map the stream channel, the interdisciplinary team walked the entire length of South Fork Dogfish Creek, from its headwaters downstream to a point near the confluence with Dogfish Creek. Using GPS, points were collected at both ends of every culvert on the main channel and at significant changes in the channel alignment. The GPS points collected during the field inspection were the basis for the refined channel alignment shown in the figures in this report.

Results

Figure 2 shows the stream channel location.

3.3.2 Subbasin Boundary

The subbasin boundary for South Fork Dogfish Creek was determined to establish the limits of the study area. Once the subbasin boundary is defined, it is possible to calculate parameters within the subbasin that influence stormwater runoff, such as area contributing runoff, the percentage of the subbasin that remains undeveloped, and the percentage of impervious surface. A defined boundary allows identification of existing stormwater treatment best management practices (BMPs) in the subbasin and potential locations for new stormwater BMPs.

Methods

The subbasin boundary was developed based on a combination of topographic mapping, a map of the City's stormdrain system, and refinement of the boundary by City engineers based on their firsthand knowledge of the stormdrain system. The ground topography, derived from surface elevation points using LiDAR as a means for data collection, was used to define a boundary around the area that contributes surface water runoff to South Fork Dogfish Creek. LiDAR data was supplied by the Suquamish Tribe. Then the existing stormdrain system (Parametrix 2008) was overlaid on the subbasin boundary, and the boundary was adjusted in areas where the stormdrain system either brought runoff into the subbasin from areas where the natural ground flowed away, or where storm drains were directing surface runoff from inside the subbasin to a discharge point outside of the subbasin. The eastern edge of the boundary was then adjusted by City engineers based on their knowledge of the operational characteristics of stormwater infrastructure in the area.

Results

The subbasin boundary is illustrated on Figure 2. Figure 2 also illustrates the historical (i.e., without storm drains) subbasin boundary to illustrate stormwater system modifications to historical conditions. Stream reaches are described in section 3.4.1 and illustrated on Figure 3.

3.3.3 Stormwater Detention and Treatment Analysis

An analysis was performed to assess the level of treatment provided by the existing stormwater BMPs in the South Fork Dogfish Creek subbasin. Figure 3 shows the locations of existing stormwater treatment facilities, based on data provided in the City's Stormwater Management Plan (Parametrix 2008) and data provided by the City's engineers based on recent revisions and

additions to that system. Limited field verification of the location and size of stormwater facilities was performed by ICF. The purpose of the analysis was to determine how close the existing treatment in the subbasin is to current standards, and how much effort in the form of capital projects would be required to upgrade the existing treatment to match current standards.

Treatment included both flow control through stormwater detention and water quality treatment through BMPs such as biofiltration swales.

Methods

The methodology for providing stormwater treatment described in the Washington State Department of Ecology (Ecology) (2005) *Stormwater Management Manual for Western Washington* (2005 Ecology Stormwater Manual) is currently considered the minimum standard that should be applied to developed areas to prevent degradation of ecology in the receiving stream. This analysis considered the 2005 Ecology Stormwater Manual as the design standard condition and compared it to the existing conditions in the subbasin.

The existing land use within the subbasin was categorized into four general types: commercial, high-density residential, low-density residential, and open space. Figure 4 shows the areas covered by each land use category. Impervious area for each type of land use was measured from a recent aerial photograph of Poulsbo. Underlying soils information was obtained from the soil survey maps available on the Natural Resources Conservation Service (NRCS) website (2009).

The Western Washington Hydrology Model (WWHM) was used to calculate runoff for existing conditions and forested conditions using the parameters described in the previous paragraph as input. The WWHM is a continuous simulation hydrology model and has precipitation values coded into the program that the user accesses by inputting the location of the study area; also, soil storage/runoff characteristics are coded into the program and accessed by inputting NRCS soil types found in the study area. A separate model was created to analyze each land use type. After calculating runoff values, the WWHM model was used to calculate the amount of detention storage necessary to reduce runoff under existing conditions to match runoff rates with forested conditions covering the subbasin.

Results

Stormwater Detention

The modeling indicates 152 acre-feet of storage is required to reduce runoff from existing conditions to that of forested conditions. If this amount of storage was present in the subbasin, then flow rates in the creek would be similar to the flow rates that occurred when the subbasin was in a completely natural and forested condition.

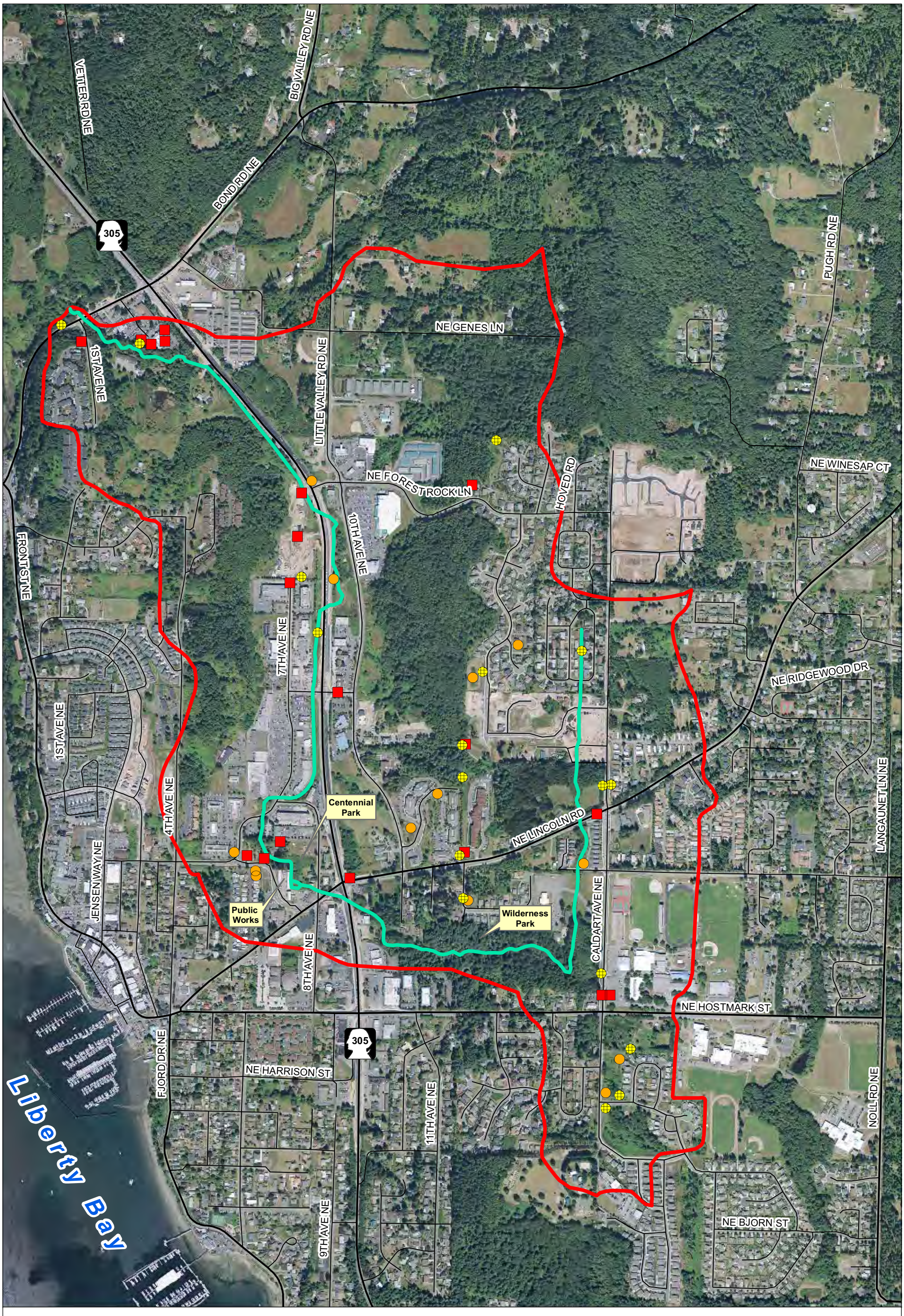

Figure 3.
Stormwater Treatment Facilities
South Fork Dogfish Creek
Restoration Master Plan

June 2010

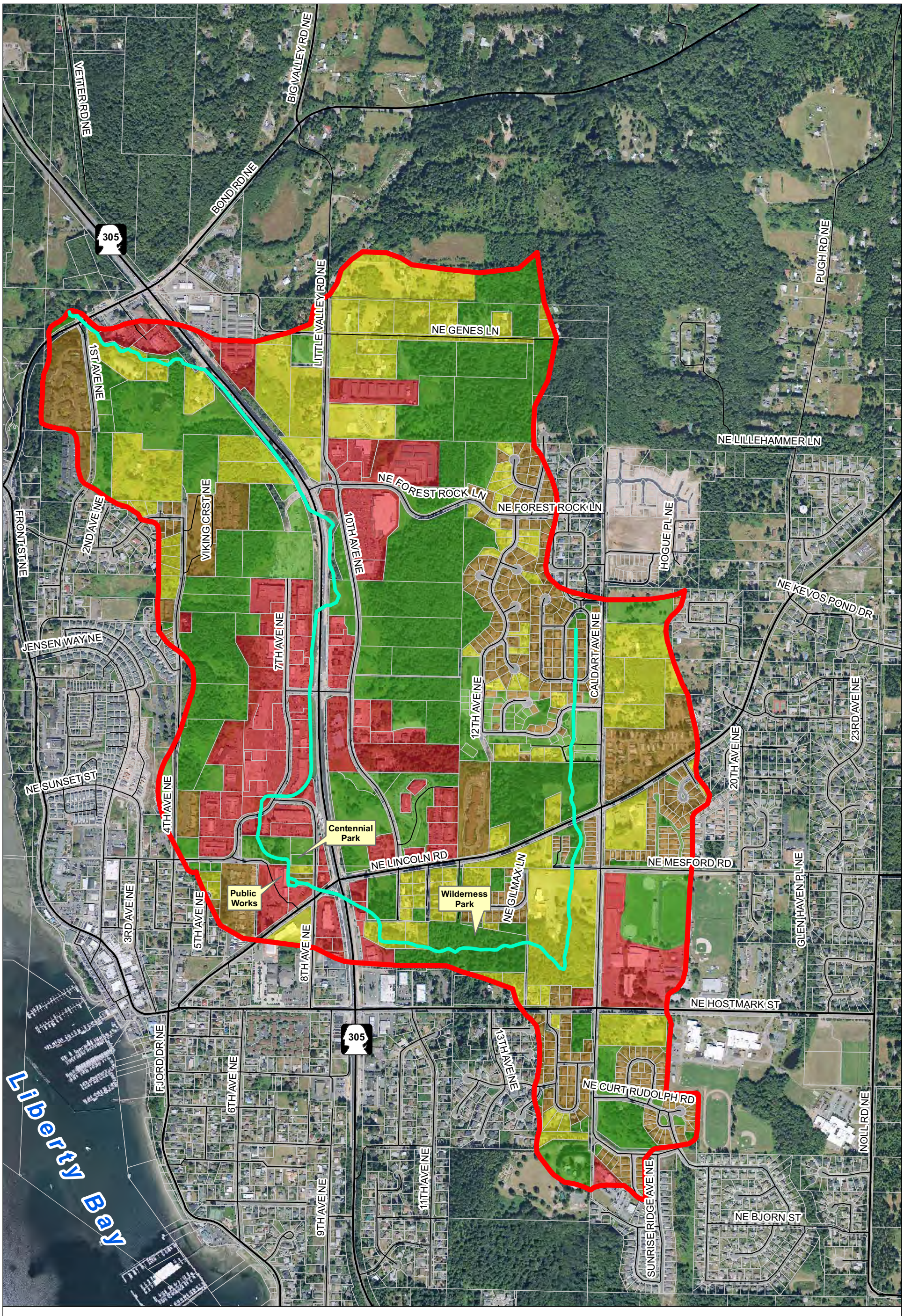

Figure 4.
Existing Land Use
South Fork Dogfish Creek
Restoration Master Plan

June 2010

The flow conditions created under natural forested land cover are considered appropriate for the channel morphology. They should lead to minimal erosion or sedimentation, and should provide the appropriate flow regime to support native fish and plant species.

Review of maps of the City's stormdrain system and data collected during the site inspection identified 11.8 acre-feet of storage in existing detention ponds and detention vaults. Thus, about 8% of the detention storage that is recommended under current standards for western Washington is currently being provided under existing conditions by the developed areas in the subbasin.

Most of the subbasin was developed prior to the implementation of the current stormwater treatment standards, when development was not required to provide stormwater detention storage to the degree currently recommended. Understanding of urban stormwater runoff and effective methods for its treatment have improved significantly during the last decade. This has lead to major changes in treatment standards during the last few years.

Stormwater Quality Treatment

Using the same site characteristic parameters that were the basis for the stormwater detention analysis, an analysis of existing water quality treatment conditions and stormwater quality treatment BMPs was performed to compare existing conditions to current standards. Review of the existing stormwater drainage system indicates there is a combined 5,500 square feet of biofiltration swales in the subbasin. In addition, there are a couple small wet ponds in the subbasin and a portion of the water quality treatment for the recent Washington State Department of Transportation (WSDOT) SR 305 project used dispersion, so those BMPs are providing treatment equivalent to large biofiltration swales. The existing level of water quality treatment of urban stormwater runoff is thus only about 5% of the amount of treatment required under current standards in western Washington.

Potential Benefits of Low Impact Development

Both the stormwater detention analysis and stormwater quality treatment analysis described above assumed that all runoff was collected in storm drains and conveyed to large treatment BMPs such as stormwater ponds, underground vaults, or biofilters (i.e., one or two BMPs to treat runoff from each housing subdivision or commercial development, not necessarily a single BMP for the entire subbasin). There is currently an emphasis with newer stormwater treatment methods to treat runoff using many smaller BMPs located closer to the source of the runoff. This approach is often included in the guidelines for LID and can be effective at reducing the cost of providing treatment and reducing the area which would be required for large treatment BMPs.

In a residential subdivision, one way to apply LID techniques to the analysis discussed in the previous paragraphs would be to route all runoff from roofs and driveways to infiltration trenches and/or rain gardens (i.e., small detention and infiltration areas built with specially selected vegetation) on each specific residential lot. Such an approach leaves only road runoff to be treated in larger regional BMPs. Implementing this basic LID approach would reduce the size of regional storage and biofiltration/treatment BMPs to about one-third of the size that would be necessary if all runoff was treated only by large regional BMPs.

LID approaches can be used in various combinations, with varying results, but it is important to note that they can significantly reduce the size of regional BMPs needed to achieve stormwater treatment to current standards. For example, an LID approach would require that approximately 51 acre-feet

of storage and 75,000 square feet of biofiltration be accomplished in larger, regional BMPs (compared to needing approximately 152 acre-feet of storage and 225,000 square feet of biofiltration based on the design procedure in the 2005 Ecology Stormwater Manual).

3.3.4 Land Use and Zoning Analysis

Information regarding current land use, extent of impervious surface, and current zoning were used to analyze future development potential within the subbasin. This information was also used to qualitatively identify opportunities to utilize alternative stormwater management approaches to improve water quality and minimize flooding from future development.

Methods

Total impervious area and effective impervious area within the subbasin was estimated using standard relationships between land use and impervious area within the subbasin. Effective impervious area is that portion of total impervious area that is hydraulically connected to a stormwater system that discharges to a surface water body; hence, effective impervious area directly affects the flow of the receiving water (e.g., South Fork Dogfish Creek).

To convert the land use interpretations into estimates of total and effective impervious area, hydrologists have developed standard relationships based on land use (Thurston County Regional Planning Council 2003). For example, these relationships outline the typical amount of impervious area in various land use categories such as residential areas with a range of dwellings/acre densities, commercial areas, forested areas, or school/church areas. Estimates of total and effective impervious area within a basin are typically calculated by multiplying total area in each land use class by these generally accepted conversion factors (Thurston County 2003).

Our calculations were based on the generally accepted relationships between land use and total and effective impervious areas for the given land uses that occur within the South Fork Dogfish Creek subbasin (Brascher 2001, as cited in Thurston County Regional Planning Council 2003).

Results

Figure 4 illustrates the various land use categories present within the subbasin. The South Fork Dogfish Creek subbasin encompasses approximately 706 acres. Approximately 106 acres of the subbasin is high-density residential, and approximately 144 acres is low-density residential. Commercial land use encompasses approximately 121 aces. In addition, the subbasin also includes approximately 86 acres of roadway, city streets, and road right-of-way. Thus, approximately 458 acres of the subbasin (i.e., 65%) is developed.

The majority of the upper subbasin is high-density residential, whereas the majority of the lower subbasin and immediate floodplain of South Fork Dogfish Creek is commercial development (Figure 4). The subbasin contains approximately 248 acres of undeveloped land (i.e., parks, cemeteries, wooded lots, vacant parcels, and other areas designated as “common open space” and “open land”). Undeveloped forested areas are concentrated upslope of 10th Avenue NE and on the forested slope to the east of 4th Avenue NE above Poulsbo Village.

As illustrated in Figure 4, the degree of commercial and residential development within the South Fork Dogfish Creek subbasin is extensive. Total impervious area is estimated to be 38% and effective impervious area is estimated to be 32% of the subbasin. While a detailed hydrologic analysis of South Fork Dogfish Creek has not been performed, anecdotal information (see section

3.3.5) indicates that the stream responds quickly and dramatically to periods of intense rainfall and has experienced flash flooding, particularly below NE Lincoln Road and SR 305. As little as a 10% increase in impervious area can change a stream's hydrograph, resulting in greater peak flow and decreased base flow (Booth 2000).

Figure 5 illustrates the City's current zoning categories. All of the remaining forested portions of the South Fork Dogfish Creek subbasin are zoned to allow development; however, these properties may be subject to protection under Poulsbo Municipal Code, Title 16 Environment, Chapter 16.20 Critical Areas. The forested slopes along 10th Avenue NE are zoned commercial and the forested slopes along 4th Avenue NE are zoned high-density residential. All of the currently undeveloped parcels in the upper watershed are zoned low-density residential.

3.3.5 Flood Events

Anecdotal hydrologic information regarding recent flooding events was collected by interviewing select property owners along the creek. These interviews were conducted to provide information on the sequence and degree of flooding along the creek. The data collected was used to inform the development of the limiting factors and project prioritization matrix described in sections 3.4.2 and 4.1.

Methods

Interviews were conducted in person during the June 1, June 2, and July 2, 2009, field investigations and by telephone. The City provided appropriate contacts within the Public Works Department based on longevity and familiarity with flooding of Public Works property. We spoke with Mr. Dan Wilson and Mr. Keith Svarhumle of Public Works, and interviewed the current residents of the rental homes located immediately north of the Public Works office along 8th Avenue NE (19159 and 19177 8th Avenue NE). We also interviewed Dr. Eldin Larson, DDS, and several of the office staff of the Poulsbo Dental Center (19170 8th Avenue NE), which is located immediately east of the Public Works office, as well as the receptionists in two of the offices located adjacent to the Centennial Park portion of the stream. We interviewed Mr. Harold Dailey, a long-time resident and owner of the largely undeveloped property located at the northwest corner of the intersection of NE Lincoln Road and Caldart Avenue NE. We attempted to contact other residents along the upper portion of the stream, but were not successful in making contact with anyone who had resided in the area for more than one winter.

Results

Information obtained through these interviews is summarized below.

- Public Works staff reported that flooding at Poulsbo Village generally occurs when the storm drains/catch basins are not cleaned out prior to a significant storm event. Flooding of Poulsbo Village is not caused by South Fork Dogfish Creek over-topping its banks. Opinion of staff was that maintenance of open storm drains/catch basins by Poulsbo Village owners/occupants would alleviate flooding of the parking lots at Poulsbo Village.
- WSDOT recently completed improvements to SR 305 through the City of Poulsbo. As part of these improvements WSDOT replaced nine culverts within the lower reaches of South Fork Dogfish Creek (described in section 3.4.1 below as Reaches 2, 3 and 4). Some of the original culverts were undersized and created constrictions during storm events. Since these culverts

were replaced, Public Works staff reported that the City has not experienced a large enough storm event comparable to ones in the past that would have caused flooding. The replacement culverts may convey flow better and alleviate some flooding, but the extent of improvement attributed to the new culverts is unknown at this time.

- The one culvert not replaced by WSDOT conveys South Fork Dogfish Creek beneath 8th Avenue NE, immediately east of the Public Works buildings. This culvert is a 30-inch round precast concrete pipe and is considered undersized (Appendix A, Photo 1). Two culverts upstream, at Iverson Road NE and SR 305, which were replaced by WSDOT, have spans of 10 feet and 13 feet, respectively. These culverts will convey water downstream more efficiently (Appendix A, Photos 2 and 3).

- The houses along 8th Avenue NE did not experience flooding in the winter of 2008/2009; current residents were not renting these properties during prior winters. The property owner's contact information was not publicly available.

- Both the office park staff and the staff of the Poulsbo Dental Center reported that the December 2007 storm was the worst flooding they had seen along South Fork Dogfish Creek. Dr. Larson indicated it was the only flood event since about 1980 (his period of occupancy at the Center) where water went over the roadway of 8th Avenue NE. The December 2007 event flooded the vicinity of 8th Avenue NE and Iverson "up to point water would stall your car," the roads were closed and they reported logs floating in the roadway. Gravel from the Poulsbo Dental Center parking lot was transported off their property by the flooding.

- Mr. Dailey indicated that the area surrounding the northern end of the stream on his property becomes quite wet in the winter and spring. The stream channel through his property is incised, reducing flooding of his yard during the winter. He indicated the stream channel has been in that condition since his parents owned the property (more than 20 years ago).

3.3.6 Culvert Inventory

The lack of data regarding the location and nature of stream culverts, including pipe dimensions and conditions was a data gap identified in the Phase 1 of the project. The storm drain inventory map reviewed during Phase 1 did not include culverts that convey the main channel flow. While its appeared that all catch basins and drain pipes leading to the creek were included in the inventory map, and all stormwater outfalls to the creek had been mapped, no data was available regarding the locations of culvert inlets and outlets, invert elevations, pipe dimensions, pipe material type, or condition of the culverts.

Similarly, the level to which the creek's culverts allow fish passage (both for spawning adult salmonids and for rearing and out-migrating juvenile salmonids) had not been analyzed using a consistent methodology. An inventory of culverts and the level to which they contribute to flooding problems and/or allow fish passage was necessary to specifically identify and evaluate problem culverts.

A culvert inventory was conducted as part of our field investigation to determine the location and contribution of existing stream culverts to stream habitat conditions and flooding problems.

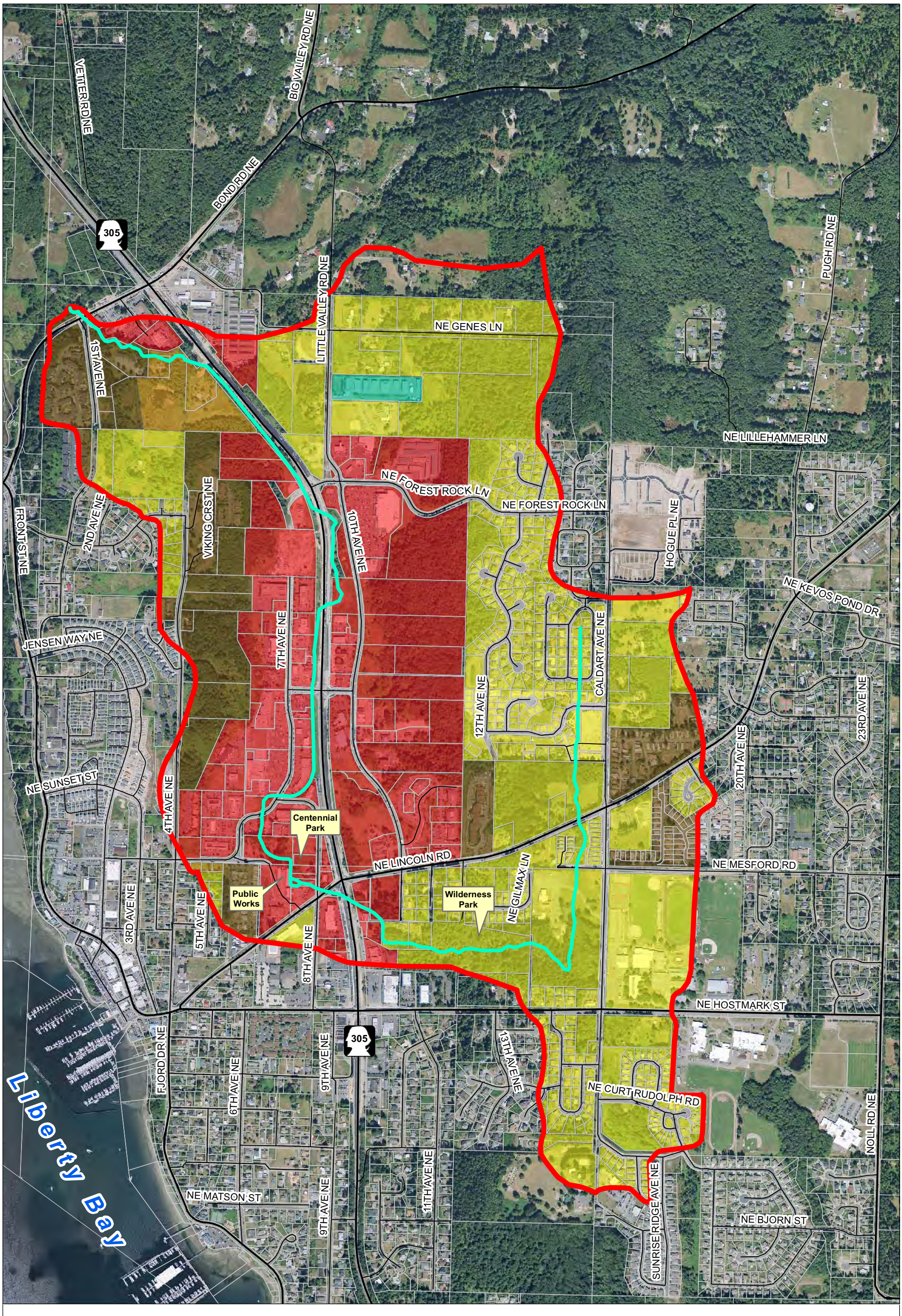

Figure 5.
Current Zoning
South Fork Dogfish Creek
Restoration Master Plan

June 2010

Methods

An inventory of the culverts in the main channel of South Fork Dogfish Creek was performed as part of the site inspection in June 2009. Data was collected from all culverts encountered, including culvert location, size, material, slope, if natural substrate was present, and the presence of any obvious fish passage barriers like a drop at the outlet. Culvert locations were collected using GPS and are depicted in Figure 6.

Results

Table 1 provides key information on the culverts inventoried on the main channel of South Fork Dogfish Creek, starting at the headwaters. Figure 6 shows the location of each of the culverts identified in Table 1.

Table 1. South Fork Dogfish Creek Culvert Inventory

Culvert ID	Road Crossing	Culvert Description	Culvert Dimensions
1	Stavanger Loop NE	Round CMP	18 inches
2	NE Wetland Street	Round CMP	18 inches
3	NE Odessa Way Pvt	Round CMP	18 inches
4	NE Fontaine Way Pvt	Round PVC	18 inches
5	NE Lincoln Road	Round PCC	24 inches
6	NE Mesford Road	Round CMP	36 inches
7	Driveway Access to Church	Round PVC	24 inches
8	SR 305	Bottomless Box PCC	13 x 3.5 feet
9	Iverson Street/ NE Lincoln Road	Round CMP partially filled with gravel	10 feet
10*	8th Avenue NE	Round PCC	30 inches
11	7th Avenue NE	Round CMP partially filled with gravel	8 feet
12	7th Avenue NE	Round CMP partially filled with gravel	11 feet
13	Liberty Road NE	Round CMP partially filled with gravel	11 feet
14	SR 305	Pipe Arch CMP partially filled with gravel	9.3 x 6.3 feet
15	SR 305	Pipe Arch CMP partially filled with gravel	9.3 x 6.3 feet
16	NE Forest Rock Lane	Round CMP partially filled with gravel	8.5 x 4 feet
17	Private Driveway #2	Round CMP partially filled with gravel	9 feet
18	Private Driveway #1	Round CMP partially filled with gravel	9 feet
19	Bond Road	Bottomless Box PCC	14 x 6.5 feet

*This is the only culvert in South Fork Dogfish Creek identified as a potential/partial barrier in the fish-bearing portion of the stream. The culvert is undersized.

South Fork Dogfish Creek passes through 19 culverts, nine of which were recently replaced by WSDOT as part of their improvements to the SR 305 corridor in 2006. All nine of the replaced culverts are located downstream of Wilderness Park. Improvements in fish passage have consequently occurred as a result of replacement of these culverts concentrated within the lower reaches of the subbasin (see Section 3.4.1 for description of stream reaches 2B, 3 and 4).

Only one culvert downstream of Wilderness Park was not replaced by WSDOT as part of the SR 305 improvements: culvert #10 at 8th Avenue NE. During this study, the culvert at 8th Avenue NE was identified as undersized and appears to be at least a partial barrier to both juveniles and adult

salmonids and may be a full barrier to juvenile fish passage as well, based on its narrow diameter (30-inch) which concentrates flow and creates high water velocities. Discussions with City of Poulsbo Public Works staff indicate the 8th Avenue culvert has been overwhelmed with flow in the past during periods of heavy precipitation, and during those times the stream flows over the paved surface of the road at 8th Avenue NE.

During such events, stream flows also flood the Public Works offices, shop and yard, and flood the basements of homes along 8th Avenue NE (Appendix A, Photo 4).

3.3.7 Water Quality Conditions

Water quality in urbanized streams can be degraded through both point and nonpoint discharges such as stormwater pipes, local discharge of contaminants from residences and businesses, as well as from diffuse/unmanaged stormwater runoff, erosion/sedimentation and removal of the riparian canopy. Urbanized streams typically experience lower base flows, higher water temperatures, and lower dissolved oxygen levels in the summer, and higher turbidity/suspended sediments and higher chemical contaminates such as copper and zinc during fall/winter high-flow periods. Thus, water quality conditions can compromise the stream ecology and create habitat conditions unsuitable to salmonids and other aquatic fish and wildlife species.

Methods

Historical water quality studies have concentrated on the mainstem and East and West Forks of Dogfish Creek and on Liberty Bay. Water quality data collected from South Fork Dogfish Creek is very limited. We reviewed publicly available documents to describe water quality conditions and trends. Documents reviewed described water quality conditions in South Fork Dogfish Creek based on data collected by the Bremerton–Kitsap County Health District (2002), the Washington State Department of Ecology (2004), and the Kitsap County Health District (2006, 2007, and 2009).

Results

The mainstem of Dogfish Creek has documented fecal coliform and turbidity contamination and is listed on the 1998 Washington State Clean Water Act Section 303(d) List of Impaired Waters. Fecal coliform pollution sources in the mostly rural basin include failing on-site sewage systems and improper animal waste management (Bremerton–Kitsap County Health District 2002).

In contrast, South Fork Dogfish Creek is not 303(d) listed, but has had a record of poor water quality and exceedances of state and federal water quality parameters for fecal coliform, turbidity and dissolved oxygen, as documented by Kitsap County (Kitsap County Health District 2006, 2007, and 2009). Potential nonpoint pollution sources include stormwater discharges, failing on-site sewage systems, and poorly managed construction activities (Bremerton–Kitsap County Health District 2002).

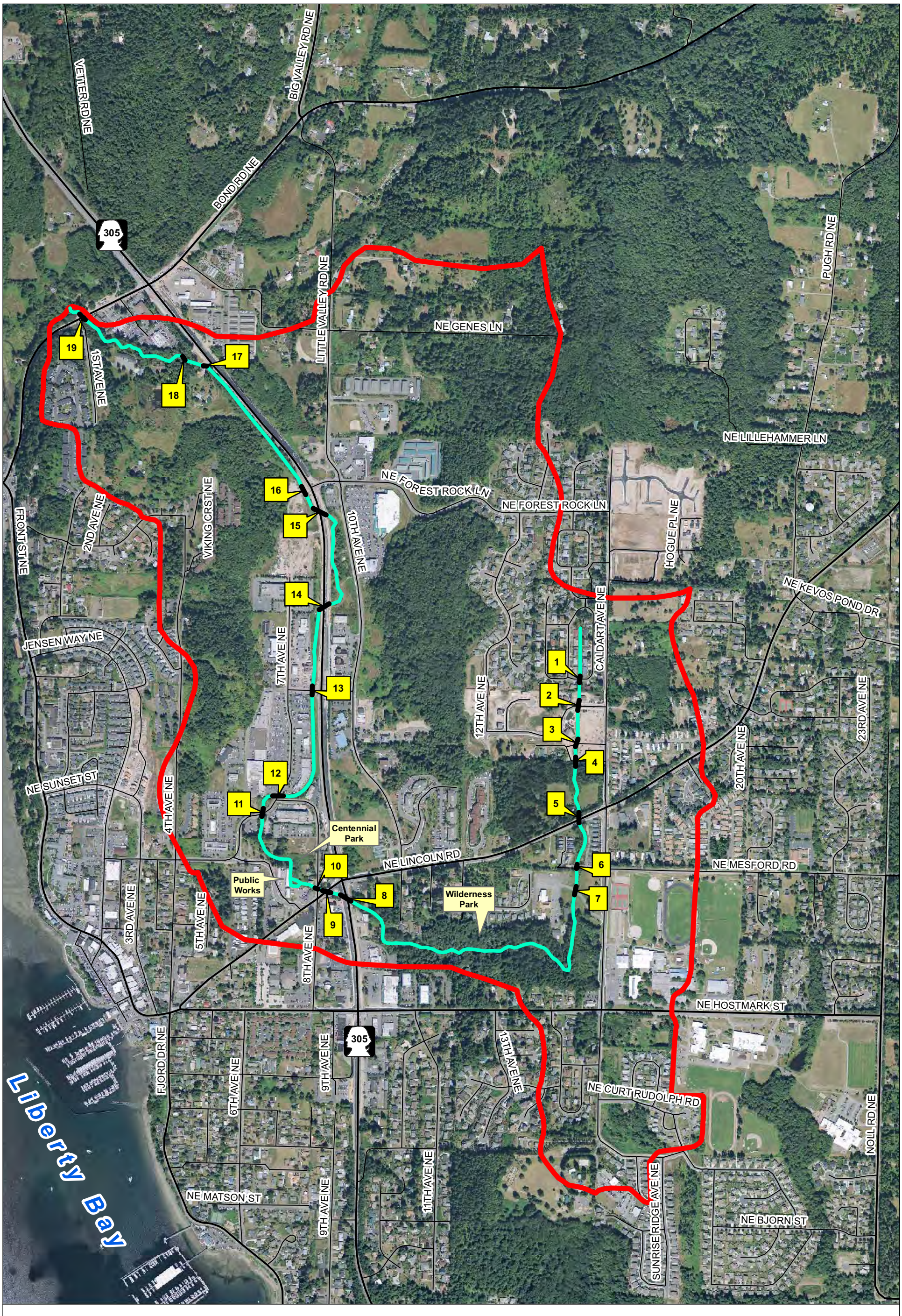

Figure 6.
Culverts
South Fork Dogfish Creek
Restoration Master Plan

June 2010

Increased efforts and focus on identification and correction of water quality pollution in South Fork Dogfish Creek has been occurring since 1997 via cooperation between the Bremerton–Kitsap County Health District and the City of Poulsbo (Bremerton–Kitsap County Health District 2002), including inspection of 19 properties identified as having on-site sewage systems, 11 stormwater outfalls and 213 stormwater systems that discharge into the stream. Water quality samples collected at the stream mouth at Bond Road (sample station SF01) between January 1997 and September 2001 show nearly all samples met state standards for temperature and pH during that time period. However, more than half of the samples collected during that period exceeded state standards for fecal coliform levels and dissolved oxygen and exceeded health district standards for turbidity (Bremerton–Kitsap County Health District 2002). While fecal coliform levels showed a declining trend between 1997 and 2001, water quality in South Fork Dogfish Creek is still considered poor, with the creek meeting state standards for fecal coliform levels 0 times in 11 years of monitoring (Kitsap County Health District 2006). Stormwater, both direct discharges to the creek, as well as non-point/diffuse flow off of the highly urbanized portions of the subbasin were found to directly contribute fecal coliform, zinc, and suspended solids (i.e., turbidity) to the stream (Bremerton–Kitsap County Health District 2002).

Sampling conducted in 2002 at eight stormwater outfalls also indicated elevated levels of total zinc and turbidity (i.e., total suspended solids) just downstream of Bond Road (Bremerton–Kitsap County Health District 2002). Elevated levels of zinc can occur in stormwater runoff from roofs, parking areas, and landscaped areas. Elevated levels of dissolved zinc and copper in stormwater are an emerging concern in the western United States because they have been shown to negatively affect juvenile salmonid predator avoidance and olfactory (i.e., smell) sense (Sprague 1968 and Sandahl et al. 2007).

Monitoring since 2006 indicates water quality conditions remain relatively poor, with periods of elevated fecal coliform levels and low dissolved oxygen levels (Kitsap County Health District 2006). Fecal coliform levels were higher in 2009 than in 2008, indicating that while the South Fork Dogfish Creek appears to be following a trend of generally improving long term water quality conditions, there have been recent short-term declines in water quality. Investigations into sources of these elevated conditions are being investigated by the Kitsap County Health District (Kitsap County Health District 2009).

Recommendations made in the 2002 Bremerton–Kitsap County Health District study included:

- Perform an illicit connection survey of the stormwater system in the subbasin.
- Create a public education program regarding impacts from nonpoint source pollution as a result of “everyday activities.”
- Conduct regular inspections of private stormwater systems and oil/water separators and stormwater detention ponds and bioswales.
- Continue water quality sampling at stormwater outfalls and stream stations utilized in the 2002 study to evaluate water quality trends.

3.3.8 Wetlands

Data regarding the extent and nature of wetlands, particularly existing headwater wetlands that supply baseflow to South Fork Dogfish Creek and store precipitation during storm events, is

important to understanding how the subbasin is currently functioning. Information regarding the location, size, and nature of the subbasin's wetlands can be an important component in determining the extent and nature of specific projects to remedy problems such as flooding.

A wetland reconnaissance was conducted as part of our field investigation of existing conditions to determine the location and extent of previously unrecorded potential wetlands areas in the subbasin.

Methods

We conducted a reconnaissance of the South Fork Dogfish Creek subbasin on July 2, 2009, for previously unidentified potential wetlands. Our investigation focused on identifying potential wetland areas on properties for which we were granted access based on suitable topography and evidence of hydrophytic vegetation. No investigation of soils or hydrology was conducted and no delineation was performed. Potential wetlands located along the South Fork Dogfish Creek channel are described in section 3.4.1 according to their respective stream reaches. Potential wetlands located away from the immediate stream channel are described below.

Results

Five potential wetland areas were identified in the upper subbasin, concentrated at the intersection of NE Hostmark Street and Caldart Avenue NE (Figure 2). These potential wetlands appear to be headwater tributaries to South Fork Dogfish Creek via culverts that connect them to each other and to the upper end of the creek in Wilderness Park. The northernmost potential wetland is located north of NE Hostmark Street between two residences and appears to be a broad, relatively deep depression sloping north into the Park (Appendix A, Photo 5). All of these potential wetland areas are forested depressions dominated by red alder and Pacific willow trees with mixed understories dominated by salmonberry (*Rubus spectabalis*), Himalayan blackberry (*Rubus armeniacus*), and emergents such as horsetail (*Equisetum arvense*).

A second series of four potential wetlands not directly aligned with the South Fork Dogfish Creek channel is located between SR 305 and 12th Avenue NE, north of the SR 305 and NE Lincoln Road intersection (Figure 2). Three of these four potential wetlands occur in areas previously identified as wetland by the National Wetland Inventory and the fourth has been previously included in an inventory conducted by the Suquamish Tribe. This portion of the subbasin slopes from east to west down toward SR 305. The uppermost potential wetland occurs as two forested arms that join and form a narrow forested area and small tributary stream which terminates into the stormwater system via a stormdrain at the corner of 10th Avenue NE and the entrance to the office park and Sunrise Properties development (Figure 2) (Appendix A, Photo 6). The upper portion of this potential wetland is dominated by western redcedar trees while the lower portion is a red alder and salmonberry dominated area. A second potential forested occurs along the eastern side of 10th Avenue NE and is dominated by red alder and salmonberry; it occurs immediately behind the entrance sign to Sunrise Properties (Appendix A, Photo 7).

The third and fourth potential wetlands are located between 10th Avenue NE and SR 305 and are slope areas, dominated by interspersed patches of western redcedar, willow and soft rush/sedges (Figure 2) (Appendix A, Photo 8). These potential wetlands slope from east to west down toward a series of check-dams in the roadside ditch along SR 305. Water from these areas appears to be routed into the stormwater system, but it was unclear whether these stormdrains route this water directly into the channel of South Fork Dogfish Creek.

3.4 Existing Conditions—Reach Scale

The lack of data regarding the existing reach-scale hydraulic and habitat conditions of the channel and its adjacent riparian floodplain was identified in Phase 1. Such data is necessary to analyze the limiting factors within the basin for restoring instream habitat and for identifying adjacent areas for additional floodplain storage and off-channel rearing habitat for salmonids. Riparian habitat conditions can directly affect instream habitat conditions (e.g., input of organic matter from leaf-fall, shading of stream channel, flood flow and erosion reduction). Information regarding stream channel conditions helps identify any areas with high quality reference conditions that can be used as a target condition for restoring more degraded reaches. Reach-scale data also allows opportunities and constraints to be developed which target particular juvenile salmonid life-history stages such as off-channel habitats for summer rearing or areas providing winter high-flow refugia.

To address this data gap and improve understanding of the existing conditions in South Fork Dogfish Creek and its floodplain, we conducted a field survey of select biological and geomorphic conditions of the creek and floodplain from its headwaters upstream of Wilderness Park and Lincoln Road downstream to its confluence with the mainstem northwest of Bond Road. ICF Jones & Stokes defined distinct stream reaches based on LiDAR topographic data, geomorphic, hydrologic, and stream habitat features to determine approximate stream reaches.

Stream channel and riparian floodplain, conditions relevant to stream ecology and use by native fish and wildlife were inventoried for each reach, including nature, size class, and abundance of any large woody debris in or immediately adjacent to the creek channel; the relative amount and diversity of native riparian vegetation; relative degree of colonization by invasive plants in and adjacent to the stream channel; and the degree of channel shading provided by streamside vegetation. Hydrogeomorphic class, habitat conditions, and relative functional value were also noted in the limited areas where potential wetlands were noted along the stream channel or on the adjacent floodplain.

Width and general character of the riparian zone, degree of vegetative diversity, and types of wildlife habitat were also recorded based on best professional judgment.

3.4.1 Reach Conditions

Methods

The project team walked South Fork Dogfish Creek from its headwaters downstream to a point near the confluence with Dogfish Creek in June 2009 and collaborated to establish the reach breaks, described below (Figure 7). The project team included a fisheries biologist, a wetland biologist, a hydraulic engineer, and a geomorphologist. The majority of the stream was walked, although some portions were inaccessible due to a lack of permission to enter private property.

The reaches were initially established based on the reach breaks described in the *Report on Best Available Science and Recommended Protection Measures for Fish and Wildlife Habitat* (Fishman Environmental 2003). The reach breaks were found to provide good boundary definition of large-scale channel characteristics along the creek, and thus were maintained for this study. The reach breaks described by Fishman Environmental (2003) were further refined to provide more specific definition of channel characteristics for this study based on geomorphic conditions

(primarily channel slope, channel sinuosity, and channel substrate material), potential fish use/habitat, and hydraulic capacity conditions.

Additionally, existing information and documents providing background information related to the subbasin were reviewed. Topics included: habitat conditions, fish use, water quality conditions, recent land development permitting, WSDOT SR 305 corridor improvements (e.g., Biological Assessment, Wetland Mitigation Plan), and the planning documents related to the Centennial Park Master Plan.

Results

In general, fish and wildlife habitat conditions within the subbasin have been degraded as a consequence of urbanization and development. Changes noted throughout the subbasin include: reduced riparian zone widths, reduced diversity of native plants, increased channel and bank erosion, restricted channel migration, disconnected floodplains and wetlands, and loss of adjacent wetlands and off-channel rearing habitat for juvenile salmonids.

The lack of accurate geomorphic data regarding the existing conditions of the creek channel was a critical data gap identified in Phase 1. ICF Jones & Stokes defined distinct stream reaches based on LiDAR topographic data, and the geomorphic, hydrologic, and stream habitat data gathered during the field investigation.

Four main stream reaches were defined, and were then further subdivided as appropriate. The reaches included:

1—Headwaters

2A—Upper Wilderness Park

2B—Lower Wilderness Park to Iverson Road

3A—Public Works Office and Shop

3B—Centennial Park and Kim Property

3C—Poulsbo Village

4A—Along SR 305

4B—Behind North Kitsap Medical Center

4C—Bond Road to the Confluence

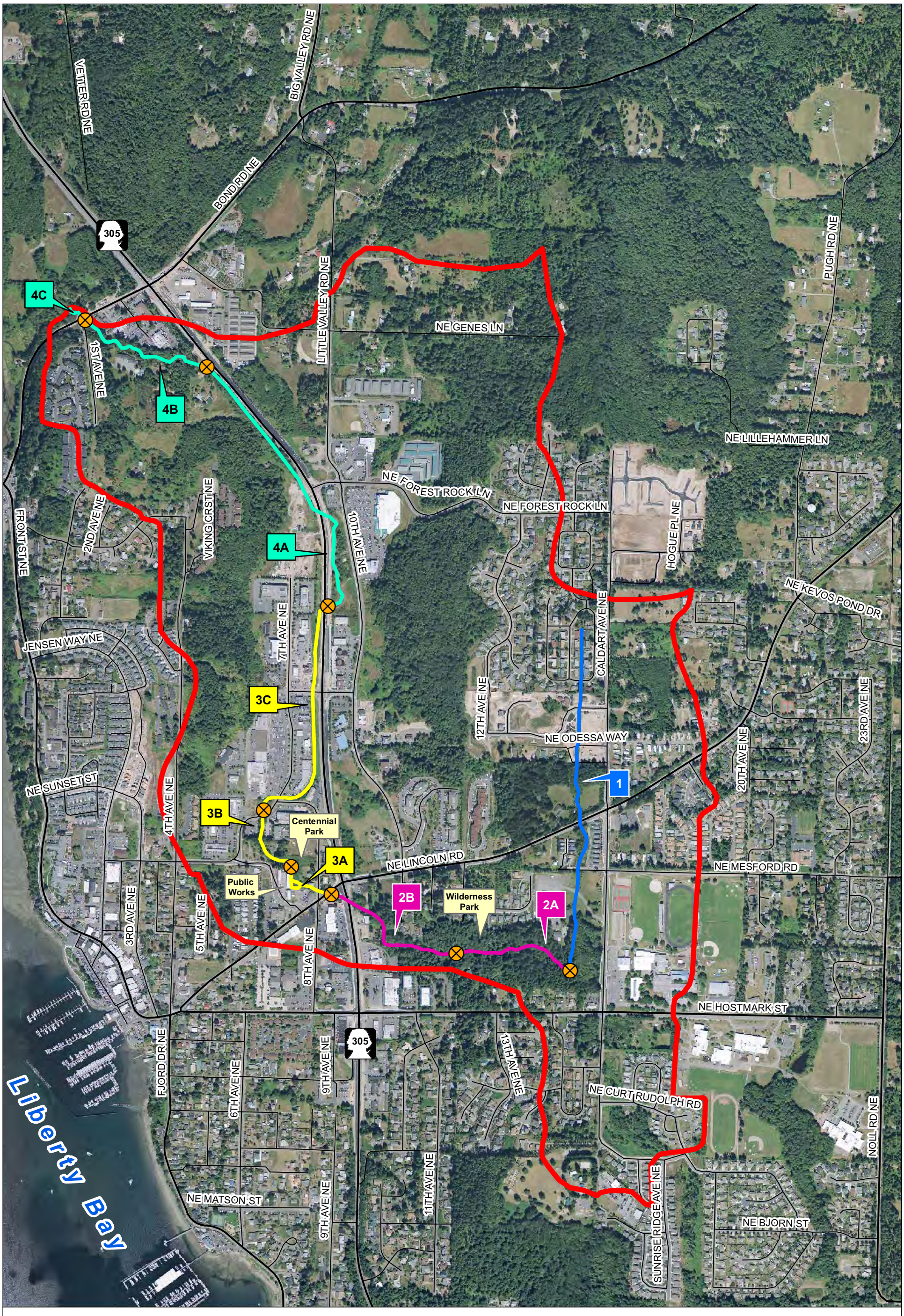

Figure 7.
Sub-Reaches
South Fork Dogfish Creek
Restoration Master Plan

June 2010

Reach 1—Headwaters

South Fork Dogfish Creek originates within a residential development as water collected in a stormwater biofiltration swale upstream of Stavanger Loop NE (Figure 7). The stream becomes a more natural channel as it progresses downstream through Reach 1. This reach flows approximately 3,200 feet (0.60 mile) to the south, mostly through areas of residential development. It also includes three less developed areas—the Dailey property (northwest corner of NE Lincoln Road and Caldart Avenue NE); St. Olaf's Roman Catholic Church property (just west of Caldart Avenue NE, just upstream of Wilderness Park); and the upper (eastern) portion of Wilderness Park (northwest corner of NE Hostmark St. and Caldart Ave. NE)—which account for approximately 1,400 feet (0.26 mile), or 44% of the length of this reach.

The Dailey property encompasses approximately 14 acres, with the western half maintained in a forested condition and the eastern half maintained for yard, lawn, and a walking path.

Features of the St. Olaf's Roman Catholic Church property include an access road that provides access to the church from Caldart Avenue NE, a parking lot, the church and related buildings. South Fork Dogfish Creek flows through a large area of maintained lawn between the church and Caldart Avenue NE.

Wilderness Park is located between NE Lincoln Road to the north, NE Hostmark St. to the south, SR 305 to the west and Caldart Avenue NE to the east (Figure 7). The stream flows through the upper (eastern) portion of Wilderness Park from north to south. Wilderness Park is undeveloped, steeply sloped toward the stream, and is forested principally with conifers native to the area.

Stream Channel Conditions

Anadromous fish are absent from Reach 1, and were likely absent historically due to the steep channel gradient present downstream through Wilderness Park (Reach 2A). However, conditions in this reach affect instream habitat conditions downstream (e.g., riparian habitat can affect water temperature and groundwater storage and the rate of discharge to surface waters).

The reach lacks a defined bed or bank within the bioswale portion north of Stavanger Loop NE, but the dense emergent vegetation in this portion provides stormwater storage and water quality treatment (Appendix A, Photo 9). A narrow stream channel (approximately 9–12 inches wide and 6 inches deep) begins south of Mosjon Circle NE and is characterized by a mud and scattered gravel bed (Appendix A, Photo 10). The stream channel continues as a narrow, somewhat incised channel south to a culvert which conveys flow into the forested portion of the Dailey property.

Through the Dailey property, the stream channel has been straightened and is regularly maintained by Mr. Dailey as a linear, incised channel (approximately 24–30 inches deep) to control seasonal flooding of the property (Dailey pers. comm.).

The stream channel changes to a braided planform and spreads flow through a shrubby thicket of red alder, black cottonwood, and willow between NE Lincoln Road and NE Mesford Road before possibly connecting to a pair of water quality ponds (whether the channel flows into or adjacent to the ponds could not be determined in the field due to restricted access in that area) and then crossing onto the St. Olaf's Church property. As the stream passes through the church property, the channel is narrow and incised and appears to be regularly mowed (Appendix A, Photo 11).

Riparian Floodplain Conditions

Riparian floodplain conditions along this reach are generally poor and the channel is disconnected from its floodplain by development on both sides of the stream channel, with the exception of the shrubby thicket/potential wetland between NE Lincoln Road and NE Mesford Road and the narrow corridor of trees and shrubs along the channel on the Dailey property. The riparian floodplain on the St. Olaf's Roman Catholic Church property appears to be actively maintained/mowed down to and across the stream channel. Thus, this area lacks the shade and organic input which would typically be provided if riparian vegetation were allowed to establish.

Wetland Conditions

The headwater bioswale is approximately 30 feet wide and is dominated by a diverse mixture of emergent wetland plants adapted to life in saturated soils, including mannagrass (*Glyceria* spp.), creeping spikerush (*Eleocharus palustris*), common timothy (*Phelum pretense*), creeping buttercup (*Ranunculus repens*), tapered rush (*Juncus acuminatus*), sawbeak sedge(*Carex stipata*), speedwell (*Veronica* spp.), daggerleaf rush (*Juncus ensifolius*), and cattail (*Typha latifolia*) (Figure 2).

The northern end of the Dailey property supports a community of native species typically associated with forested wetlands, including red alder, salmonberry, and slough sedge.

Vegetation typically associated with wetlands also exists along the stream channel as it crosses the area between the Dailey property and NE Mesford Road (Figure 2). This area is a forested thicket along the stream channel and its adjacent floodplain and is characterized by a mixture of red alder, black cottonwood, Pacific willow, Sitka willow, and western crabapple (*Malus fusca*) trees with a shrubby understory of salmonberry, Douglas spirea, lady-fern and scattered Himalayan blackberry.

Seep wetlands characterized by skunk cabbage and youth-on-age contribute water to the stream channel as it descends through the upper portion of Wilderness Park.

Reach 2A—Upper Wilderness Park

Reach 2A of South Fork Dogfish Creek flows approximately 1,200 feet (0.22 mile) from east to west through the densely forested central portion of Wilderness Park (Figure 7). A series of earthen pedestrian trails wind through the park parallel to the southern edge of the stream.

Stream Channel Conditions

Reach 2A has a relatively steep gradient (5–9%) through the central portion of Wilderness Park and the channel in the upper half of this reach is deeply incised. Channel incision appears to be the result of significant stream flow that occurs during storm events. These flows have scoured the channel and banks down to hardpan (Appendix A, Photo 12).

Suitable salmonid spawning substrate is absent from Reach 2A, and this reach is characterized as a transport reach, with sediment and substrate material transported through the reach, and little if any deposition of sediment or substrate material occurring.

Historically, the upstream extent of fish presence within the subbasin was likely somewhere in Reach 2A. Instream habitat conditions are appropriate for coho salmon throughout the lower half of Reach 2A and in Reach 2B. Suitable spawning habitat is, however, limited in the lower half of Reach 2A.

Riparian Floodplain Conditions

Riparian habitat conditions within this reach are exceptional, as both sides of the stream are densely forested for 200 feet or more extending upslope from the stream (Appendix A, Photo 13). The forested community is a diverse mix of native trees and shrubs, including western redcedar, big-leaf maple (*Acer macrophyllum*), red alder, salmonberry, Indian plum (*Oemleria cerasiformis*), trailing blackberry (*Rubus ursinus*), red elderberry (*Sambucus racemosa*), hazelnut (*Corylus* L.), Cascade Oregon-grape (*Mahonia nervosa*), lady-fern, Pacific bleeding heart (*Dicentra formosa*), and youth-on-age. Virtually no invasive plant species are present in this area.

Within this reach, the channel runs through a relatively narrow and steep walled valley, with moderate quantities of large woody debris (LWD). Numerous snags (standing dead trees) and downed logs are also present along the stream channel, many with recent signs of woodpecker excavations. The stream channel is characterized primarily by step-pool habitat (steep gradient habitat consisting of cascades and plunge pools).

Wetland Conditions

Seep wetlands extend along the forested slopes beneath the canopy of western redcedar and red alder trees, contributing water to the stream channel. These areas are characterized by skunk cabbage and youth-on-age beneath patches of salmonberry (Appendix A, Photo 14).

Reach 2B—Lower Wilderness Park to Iverson Road

Reach 2B is located within the lower, western end of Wilderness Park (Figure 7), where the stream gradient is not as steep as it is in the upper portion; the gradient in Reach 2B ranges from 2 to 5%. This reach flows approximately 1,400 feet (0.27 mile) to the west, mostly through the forested lower end of Wilderness Park and then through a commercial area along SR 305.

Stream Channel Conditions

Instream habitat conditions are generally good, with spawning-size sediment, gravel and cobbles having been deposited within this reach, as well as LWD. Reach 2B is considered a transition reach, transitioning between the upstream transport reach and a depositional reach located further downstream. Areas of channel and bank erosion/scour are evident within this reach (Appendix A, Photo 15), particularly the area of 19062 SR 305, immediately upstream (east) of SR 305, where a vehicle bridge and pedestrian footbridge have been recently condemned due to severe bank erosion from the November 2008 storm undermining the footings of these bridges (Shea pers. comm.).

Riparian Floodplain Conditions

As described for Reach 2A, riparian floodplain conditions are quite good in the upper half of the reach, within Wilderness Park. The potential for off-channel habitat suitable for salmonid rearing is naturally limited in this reach, as due to channel confinement between its valley walls. An extensive cleared area in the forest is located near the break between Reaches 2A and 2B and has been colonized by Himalayan blackberry.

Downstream of Wilderness Park, channel and habitat conditions are more degraded (i.e., reduced riparian cover and increased clearing of the riparian zone) as the channel again enters a developed portion of the subbasin, with increased impervious surface area and consequently decreased riparian vegetation.

Wetland Conditions

As described for Reach 2A, seep wetlands also extend down to the stream channel from the forested slopes, contributing water to the stream channel. These seep areas are characterized by skunk cabbage and youth-on-age beneath patches of salmonberry.

Reach 3A—Public Works Office and Shop

The upstream end of Reach 3A is located at the intersection of NE Lincoln Road, Iverson Road NE, and 8th Avenue NE (Figure 7). This reach flows approximately 700 feet (0.13 mile) to the northwest, through a highly developed portion of the subbasin. The stream flows through the recently replaced large culverts beneath SR 305 and Lincoln Avenue NE and then from Iverson Rd. NE, beneath 8th Ave. NE onto the Public Works and neighboring residential property to the north. The stream is then routed north behind the Public Works shop building and then passes into Centennial Park. The culvert at 8th Avenue NE was not replaced during recent improvements to SR 305.

Stream Channel Conditions

Stream channel in the upper portion of Reach 3A is wide and shallow as it flows through the recently replaced large culverts beneath SR 305, Lincoln Avenue NE, and Iverson Rd. NE. Current distribution of coho salmon in the subbasin extends up to NE Iverson Rd. according to WDFW (2009). Immediately upstream of the 8th Avenue NE culvert, the stream channel is narrow, with a gravel bed. Instream habitat conditions have been significantly degraded (Appendix A, Photo 16), with substantial sediment deposition in the stream channel downstream of 8th Ave. NE, and residential development adjacent to the stream channel.

Downstream of 8th Avenue NE, the channel begins to lose definition (i.e., lacks an obvious bed and bank) as it flows through an area of dense emergent vegetation in the western half of the residential property north of the Public Works offices (Appendix A, Photo 17). During the June 2009 site visit, the stream was observed flowing subsurface through a large deposit of gravels and cobbles behind the house. Interviews with Public Works and Poulsbo Dental front-desk staff indicate much of this material was washed from Reach 2A (areas of channel and bank scour, as well as gravel from the Poulsbo Dental parking lot immediately across 8th Avenue NE) during the December 2007 storm that flooded and closed 8th Avenue NE.

Water returned to the surface via small surface flows out of the south and west sides of the residential lot, flowing onto the paved surface of the Poulsbo Public Works office parking lot and into a deeply trenched channel located behind the Public Works shop. At the time of our field visit, stream flow was partially contained along the edge of the parking lot by sandbags and an asphalt berm, both of which have been placed along the edge of the parking lot to contain the stream flow and convey it off the parking lot (Appendix A, Photo 18) (Public Works staff pers. comm.). Behind the shop, the channel has been deeply trenched to convey flow away from the shop and back into the historic channel within Centennial Park.

Discussions with City of Poulsbo Public Works staff indicate that salmon swim through their parking lot during periods of high stream flows and they have in the past collected salmon from the parking lot and place them back in the stream. In addition, observed field conditions indicate that 8th Avenue NE may be the current upstream extent of anadromous fish distribution.

Riparian Floodplain Conditions

Little riparian vegetation has developed along the portion of the reach between SR 305, Lincoln Avenue NE, and Iverson Road. NE, but recent plantings in this area are native species and are likely to provide some riparian floodplain functions as they mature. The riparian vegetation along the channel upstream of the 8th Avenue NE culvert appears to be regularly mowed to and across the stream channel. Watercress was noted within the steam channel in this area, a plant typically indicative of perennial stream flows.

Substrate deposition downstream of the 8th Avenue NE culvert has resulted in subsurface stream flows, and many of the trees and shrubs along the channel have recently been cleared. Riparian vegetation in this area is now primarily a mixture of reed canarygrass, yellow buttercup, and watercress. No riparian vegetation is present along the Public Works parking lot or adjacent to the trench behind the shop.

Reach 3B—Centennial Park and Kim Property

Reach 3B includes the stream as it flows through Centennial Park and the Kim property, the parcel immediately downstream of Centennial Park (just north of 7th Avenue NE). This reach flows approximately 700 feet (0.13 mile) to the west and north, mostly through these largely undeveloped parcels.

Stream Channel Conditions

The stream channel through Centennial Park has a meandering planform, with an appropriate width to depth ratio and entrenchment ratio for the channel slope and contributing basin area. While the adjacent floodplain is narrow, this reach has good connectivity between the channel and its floodplain. The stream channel is in relatively good condition, with gravels, LWD, and dense riparian vegetation. Juvenile salmonids were observed within the Centennial Park portion of Reach 3B on June 1, 2009.

Approximately 300 linear feet of channel flow through the Kim property. Although the streambed in this area has some gravels, it is completely unshaded due to recent clearing of the riparian vegetation, as described below.

Riparian Floodplain Conditions

Once the stream leaves Reach 3A and enters Centennial Park habitat conditions improve considerably. Centennial Park is forested along most of the channel, although the forested segment of the riparian corridor is relatively narrow throughout this reach (widths vary from 5 feet to 30 feet). Riparian vegetation is relatively good, providing shade to the channel. Some instream cover is available in the form of overhanging grasses and undercut banks, although these features are limited and overall stream bank conditions are good. No off-channel habitat or refuge is available in this reach.

Much of the riparian vegetation, including second growth conifers (Dorn pers. comm.), has been cleared from the Kim property and recent replanting with trees and shrubs has not developed to the point of providing shade to the stream channel. Riparian habitat conditions have been substantially degraded and it will be some time before the replanted vegetation provides the level of shade, external inputs of insects and detritus, and potential LWD recruitment that was previously provided in this reach. Invasive plants (e.g., bindweed [*Convolvulus spp.*] and Himalayan blackberry)

dominate most of the ground cover on the Kim property and appear to be outcompeting/smothering many of the installed trees and shrubs.

Reach 3C—Poulsbo Village

Stream Channel Conditions

Downstream of the second crossing of 7th Avenue NE, South Fork Dogfish Creek flows south to north and is channelized and confined between SR 305 to the east and Poulsbo Village shopping center and parking lot to the west (Figure 7). This reach flows approximately 2,300 feet (0.43 mile) to the north, through dense commercial development. From 7th Avenue NE downstream (north) to NE Liberty Road, Reach 3C is very narrow, confined between retaining walls, and densely vegetated with willows (Appendix A, Photo 21). Businesses located within Poulsbo Village trim the willows to ensure exposure of their business' roadside signs to travelers on SR 305. Other native and nonnative vegetation is present and quite dense within the confined channel, and the channel thalweg is not well defined as a result. Overhead and instream cover for juvenile salmonids is very good. This is a low gradient reach, thus substrate material is comprised primarily of fine sediment with some gravel.

Downstream of NE Liberty Road the stream channel is well defined with a silt and gravel bed and shallowly sloped banks which were restored as part of the mitigation for development of the current Tap Rock Restaurant parcel. The channel is still confined by SR 305 to the east and commercial development to the west, but is broader, more sinuous, and contains LWD keyed into the banks (Appendix A, Photo 22). Reach 3C ends at the second crossing of SR 305, approximately 700 feet north of NE Liberty Road.

Riparian Floodplain Conditions

This reach affords no off-channel habitat or floodplain connectivity, thus no refuge from high flows is available for fish or other wildlife. Riparian vegetation is dense upstream of NE Liberty Road and is primarily willows and more sparse downstream of NE Liberty Road, consisting of grasses, sedges and small shrubs and trees planted as part of the mitigation project. Riparian conditions may improve as these plantings grow and spread, ultimately providing some shade and organic input into the stream in the portion downstream of NE Liberty Road.

Reach 4A—Along State Route 305

Stream Channel Conditions

This reach flows generally north and northwest for approximately 2,800 feet (0.53 mile). Reach 4A has a 0.5% gradient and sand sized bed material that is consistent with this slope. The planform of Reach 4A appears to be straightened, likely at the time the adjacent road was constructed, consequently the natural slope of the stream was likely flatter than its current slope.

Approximately the upper third of Reach 4A is a WSDOT wetland and stream mitigation project associated with recent roadway improvements to SR 305 and associated impacts on South Fork Dogfish Creek (Figure 7). The stream channel is less confined than in Reach 3C and provides some sinuosity, LWD, deeper pool habitat and riffles, as well as instream and overhead cover for juvenile fish (Appendix A, Photo 23). This portion of the reach may provide refuge for fish during periods of high flow.

The lower two-thirds of this reach, downstream of NE Forest Rock Lane and the third crossing of SR 305, the channel is confined in a relatively narrow and deep channel between SR 305 to the east and the forested hillslope to the west; in this portion of the reach the stream channel lies some 12 to 15 feet below the elevation of SR 305.

With the exception of the WSDOT mitigation segment, the reach is generally disconnected from the floodplain and highly channelized along the western edge of SR 305. No off-channel habitat or refuge from high flows is present downstream of NE Forest Rock Lane for fish or wildlife.

Riparian Floodplain Conditions

Within the WSDOT mitigation site, a diversity of native plant species have been planted, but are currently of relatively low stature and thus provide little shade to the stream channel. As vegetation becomes established, riparian conditions should improve in this portion of the reach.

Despite the proximity of SR 305, riparian vegetation is dense and diverse downstream of NE Forest Rock Lane, with willow and red alder trees (6–12 inches diameter at breast height) present along much of the length. Shrub species include Indian plum and salmonberry, although Himalayan blackberry and nonnative herbaceous plants are present, mainly along the shoulder of SR 305.

Wetland Conditions

The WSDOT mitigation site includes and is adjacent to areas previously mapped as emergent wetland. These areas are dominated by soft rush with patches of Douglas spirea and willow. The WSDOT mitigation site was planted with a mixture of native wetland tree, shrub, and emergent species to provide a diverse community.

Seep wetlands extend down to the west side of the stream channel downstream of NE Forest Rock Lane from the forested slopes, contributing water to the stream channel. These seep areas are generally characterized by youth-on-age beneath patches of salmonberry.

Reach 4B—Adjacent to North Kitsap Medical Center

Stream Channel Conditions

This reach flows generally northwest for approximately 1,350 feet (0.25 mile). The upstream portion of Reach 4B begins as the stream channel turns to the west, away from SR 305 (Figure 7). Reach 4B is not channelized and remains in a relatively undisturbed condition, with gravels across portions of its bed and banks with dense riparian cover. Reach 4B has a 1.5% gradient and gravel bed material that is consistent with this slope. The planform of Reach 4B appears natural and the slope appears to be the natural slope of the stream. Two driveway culverts (Table 1, culverts 17 and 18) were inventoried in this reach, but neither present barriers to fish passage.

The most significant anthropogenic influences include two rock/boulder weirs that span the entire channel behind the Bondwood Apartments and the North Kitsap Medical Center (Appendix A, Photo 24). These weirs have created large pools, with little flow and silty bottoms (Appendix A, Photo 25). Both rock weirs have partially failed and fallen into the channel; they appear to create partial barriers to fish passage (WDFW 2009). The pools created by the rock weirs are partially filled with sediment and are relatively shallow.

Downstream of the rock weirs, the channel is in excellent condition, with a gravel and fine sediment bottom, pools, riffles, bends, undercut banks, some LWD, and a dense forested canopy. Western

pearlshell mussels were observed lining the bed in dense patches in this area (Appendix A, Photo 26). The majority of the mussels were 4 to 6 inches wide. Off-channel areas were narrow, but are present at some of the bends in the channel.

Riparian Floodplain Conditions

Overall, riparian habitat conditions in Reach 4B are excellent, with large conifers (mainly western redcedar) mixed with red alder and big-leaf maple trees along both banks. Understory species are native, predominately salmonberry, Indian plum, sword fern, salal, lady-fern, and youth-on-age. Floodplain connectivity is good, with no modifications noted (e.g., levees or berms) which would separate the stream from its floodplain (Appendix A, Photo 27).

Some property owners adjacent to the stream actively manage/remove riparian and wetland vegetation along the stream to create/maintain views of and access to the stream channel, effectively degrading riparian habitat conditions.

Portions of the floodplain near the Bondwood Apartments are managed as residential lawn down to and including the edge of the stream channel, which has removed the native riparian vegetation.

Wetland Conditions

Seep wetlands extend down to the stream channel from the forested slopes along either side, contributing water to the stream channel. These seep areas are generally characterized by youth-on-age and skunk cabbage beneath patches of salmonberry.

Seep wetlands also extend down to the southern edge of the stream channel from the lawn behind the Bondwood Apartments. Mowed remnants of wetland vegetation were observed interspersed with the lawn and included skunk cabbage, small-fruited bulrush, and lady-fern (Appendix A, Photo 28).

Reach 4C—Bond Road to Confluence with Dogfish Creek

Downstream of Bond Road, conditions were visually assessed from the roadside due to property access restrictions. Based on aerial photograph interpretation, this reach flows generally northwest for approximately 200 feet (0.03 mile) before the confluence with the mainstem of Dogfish Creek.

A scour pool is present immediately downstream of the culvert at Bond Road. The stream channel has a very flat gradient and appears to be tidally influenced, with a defined bed and very shallow banks dominated by native trees and shrubs. Substrate material consists of patches of gravel and fine sediment (Appendix A, Photo 29).

Habitat conditions appear to be excellent in this reach, with no barriers to floodplain connectivity and dense, mature riparian vegetation observed from the roadside.

3.4.2 Limiting Factors Summary

Based on the field investigation and analysis of historic and existing conditions in the subbasin and individual stream reaches, we identified the discrete conditions (i.e., limiting factors) that characterize those aspects most important to restoring stream ecology and reducing flooding.

The limiting factors affecting South Fork Dogfish Creek include a mix of site-specific physical features (e.g., an undersized culvert), as well as broader physical conditions (e.g., the degree of

stormwater detention and treatment, and loss of floodplain connectivity), and social conditions (e.g., individual landowner practices) which currently limit the ecological functioning and create conditions for flooding in the lower subbasin.

Factors limiting the ecological functioning of the stream and contributing to flooding in the lower subbasin include:

Reduced Floodplain Connectivity

The lower reaches of South Fork Dogfish Creek have been disconnected from their historic floodplain, including Reaches 3B, 3C, and 4A. Development within the floodplain has substantially reduced the extent of floodplain connectivity that was present historically, based on the flat topography of the lower subbasin along both sides of the stream channel. The reduction in floodplain connectivity reduces rearing habitat for juvenile salmonids (e.g., off-channel habitat and high-flow refuge) and increases flow velocity within the stream channel. Increased flow velocity can increase streambank erosion rates and remove or cover gravels suitable for salmonid spawning on the bed of the channel.

Limited Riparian Habitat

Streamside riparian habitat has been substantially degraded in much of the subbasin by commercial, residential and infrastructure development. Two notable exceptions include Wilderness Park (Reach 2A and the upper2/3s of Reach 2B), the northern half of the Dailey property (middle of Reach 1), and Reach 4B. Reaches 3C and 4A are confined to narrow corridors, flowing adjacent to SR 305 with limited opportunity for riparian vegetation to become established to any significant extent. Upstream, Reach 1 has significant lengths of channel with very limited riparian vegetation, specifically: from the headwaters downstream to the Dailey property and the section passing through the St. Olaf Roman Catholic Church property.

Obstructed Fish Passage

A culvert conveying South Fork Dogfish Creek beneath 8th Avenue NE (Table 1, culvert 10) creates a barrier to fish passage. This culvert is the only remaining culvert within the fish-bearing reaches of the South Fork Dogfish Creek identified as a barrier to fish passage. The culvert is undersized (only 30 inches in diameter, appropriately sized culverts in this reach are about 120 inches in diameter). Two recently replaced culverts located just upstream of 8th Avenue NE (Table 1, culverts 8 and 9) can convey water downstream at a rate that exceeds the capacity of the 8th Avenue NE culvert. Water has been observed flowing over the roadway at this location during periods of heavy precipitation.

The channel downstream of 8th Avenue NE begins to lose definition (i.e., lacks an obvious bed and bank) as it flows through an area of dense emergent vegetation in the western half of the residential property north of the Public Works offices. It was observed flowing subsurface in June 2009 through a large deposit of gravels and cobbles behind the house and then resuming a surface discharge directly onto the parking lot of the City of Poulsbo Public Works Offices and Shop and into the ditch/trench along the east side of the shop. The stream is confined to the edge of the parking lot by sandbags and directed to the ditch/trench and from there into Centennial Park. It is likely extremely difficult for salmon to negotiate this segment of the South Fork Dogfish Creek, making it at least a partial barrier to fish passage.

Two rock weirs located in Reach 4B also create partial barriers to fish passage (WDFW 2009). The rock weirs span the entire channel and were installed to create pools upstream of the structures. Over time these rock weirs have collapsed and partially failed, creating partial barriers that may hinder adult migration during high-flow events and likely prevent juvenile movements upstream during low-flow events.

Altered Stream Hydrograph

The amount of commercial and residential development within the South Fork Dogfish Creek subbasin, coupled with the overall lack of floodplain connectivity, riparian vegetation and stormwater detention facilities, creates increased peak flow during periods of precipitation and decreased base flow during dry periods compared to natural forested conditions in the subbasin. This modification to the hydrograph limits the production of salmonids and can negatively affect other fish and wildlife species. Increased peak flows limit salmonid production by weakening adult fish migrating within the subbasin during periods of intense peak flows, scouring out gravels from suitable spawning areas, scouring redds, and flushing juvenile fish out of the subbasin before they're ready to outmigrate. Increased peak flows also erode streambanks and incise the stream channel, depositing fine sediments downstream. Decreased base flow can concentrate juvenile fish within the reduced area of the active channel and limit food resources available. Additionally, decreases in groundwater inputs from the floodplain and riparian zone may cause increased water temperatures and decreased dissolved oxygen, as groundwater generally provides inputs of cool waters with relatively high concentrations of dissolved oxygen.

Degraded Stream Channel Conditions

The amount of development in the South subbasin, coupled with causes and consequences of a modified stream hydrograph, creates degraded stream channel conditions. The altered stream channel planform of some reaches rapidly routes water downstream, particularly during periods of heavy precipitation. Many of the reaches lack spawning substrates appropriate for anadromous salmonids and thus limit the capacity of the stream to support salmonids, as well as resident fish and wildlife. Similarly, the channel lacks the LWD, which typically creates bed and bank complexity, in all reaches except 2A and portions of 2B. Being disconnected from its floodplain in many reaches, the stream channel also lacks off-channel habitat suitable for juvenile salmonid summer rearing and winter high-flow refugia. Such off-channel habitats also typically support a diverse mixture of native vegetation and resident fish and wildlife species.

Insufficient Stormwater Treatment

The majority of the subbasin has already experienced residential and commercial development. Much of the development occurred prior to the recent research into stormwater treatment and associated regulations governing how stormwater runoff from new development is treated. Because of this, the amount of stormwater treatment provided to runoff from developed areas is a fraction of what is necessary to maintain natural hydrologic conditions in the stream. Stormwater treatment of urban runoff using modern techniques can help maintain natural conditions in a stream. Stormwater detention decreases peak runoff rates during a storm event to be similar to peak rates that occur with forested ground cover. Stormwater infiltration replenishes groundwater aquifers which then provide cool water inflow to the stream during summer months. Stormwater water quality treatment BMPs remove pollutants such as hydrocarbons and heavy metals that were introduced to the runoff by factors associated with development, which prevents the pollutants from reaching the stream. All of these types of treatment are lacking, so the stream receives

increased peak flow rates during storm events, has diminished groundwater recharged, and receives pollutants associated with urbanization. Because most of the subbasin has experienced development prior to current stormwater regulations, the only way to get an adequate amount of stormwater water treatment in the near future will be to retrofit existing developed areas with new treatment BMPs.

Periodically Degraded Water Quality

Water quality in South Fork Dogfish Creek is periodically poor, as a result of high levels of fecal coliform bacteria, low dissolved oxygen levels, and spikes in turbidity. These conditions have been related to the amount of commercial and residential development and pollution generating impervious surface areas within the subbasin and the extent of stormwater treatment facilities within the subbasin. However, water quality conditions have been improving over time and the stream does support western pearlshell mussels in Reach 4B and Reach 4C, which are considered indicators of relatively good water quality due to their need for cold, clear water in streams that support salmonids and have stable substrates.

3.4.3 Summary of Opportunities and Constraints

The limiting factors affecting South Fork Dogfish Creek include a mix of site-specific physical features, as well as broader physical and social conditions which currently limit the ecological functioning and create conditions for flooding in the lower subbasin. Based on these limiting factors, a suite of opportunities and constraints was identified to guide the identification of potential restoration actions and projects within the subbasin. These opportunities and constraints are presented both generally and relative to the limiting factors.

General Opportunities

- The subbasin is small and is located almost entirely within City of Poulsbo's jurisdiction.
- Cooperative relationship with the Suquamish Tribe supports restoration in the subbasin.
- Grant funding sources are available to implement some types of actions and projects that would address with the subbasin's limiting factors.
- Recently completed work in Fish Park downstream of the South Fork Dogfish subbasin indicates an interest and willingness by residents to support restoration in Poulsbo.
- Portions of the stream flow through publicly owned property.

General Constraints

- The lack of federally endangered or threatened fish or wildlife in the subbasin may reduce attractiveness of South Fork Dogfish Creek subbasin projects to some grant funding sources.
- Remaining undeveloped portions of the subbasin are zoned for residential or commercial development.

Reduced Floodplain Connectivity and Limited Riparian Habitat

Opportunities

- City owns large portions of subbasin in key locations (i.e., Wilderness Park, Public Works office/shop and Centennial Park).
- Undeveloped portions of subbasin remain in moderate to good condition (i.e., Dailey Property, properties downslope of 12th Avenue NE, section behind Kitsap Medical Center).
- The largest remaining wetlands in the subbasin are concentrated near the intersection of NE Lincoln Road and SR 305.
- A series of headwater wetlands is concentrated near the intersection of NE Hostmark Street and Caldart Avenue NE, which is zoned low-density residential.
- High quality seep wetlands are protected from future development in Wilderness Park.

Constraints

- Approximately 65% of land is developed and includes significant infrastructure (e.g., SR 305, Poulsbo Village).
- In many areas, the stream retains only a narrow riparian corridor with limited native plant species.
- The subbasin has few headwater wetlands and very few remaining floodplain wetlands to provide stormwater storage and water quality functions.
- The remaining wetlands concentrated near the intersection of NE Lincoln Road and SR 305 are zoned for commercial development.
- The high quality seep wetlands that feed water to the lowest stream reaches (near where the western pearlshell mussels exist) are zoned as high-density residential.

Altered Stream Hydrograph, Degraded Stream Channel Conditions, and Obstructed Fish Passage

Opportunities

- Projects and actions targeted toward improving salmonid habitat conditions would also improve habitat conditions for other aquatic and riparian species.
- Few fish passage barriers are present within the subbasin.
- Instream, floodplain, and riparian habitat restoration and improvement projects align well with current grant funding priorities.
- Many locations exist where the channel is not extremely degraded and improvements could be realized with minimal to moderate amount of cost/effort.

- Confirmation of the location and extent of western pearlshell mussel populations provides information to guide preservation actions and provides an indicator organism for water quality conditions.

Constraints

- Stream channel is disconnected from its floodplain, which has been highly developed between NE Lincoln Road and Bond Road NE.
- Erosion and sedimentation have resulted in limited areas with gravels suitable to salmonids.

Insufficient Stormwater Treatment

Opportunities

- Implementing LID techniques, including retrofitting residential and commercial properties with small, diffuse stormwater features such as raingardens can provide significant stormwater detention and treatment while having minimal impact on use of the existing development.
- Large parking lots near the creek could be retrofitted with pervious pavement or underground treatment BMPs which would provide significant reduction to pollutants entering the stream and reduce peak flows.
- Stormwater treatment improvement projects align well with current grant funding priorities.
- Grants are available to develop LID programs.

Constraints

- Approximately 65% of land is developed and includes significant infrastructure (e.g., SR 305, Poulsbo Village), limiting available space for regional stormwater facilities.
- Residential development is concentrated in upper subbasin with limited stormwater storage and treatment.
- Commercial development is concentrated in lower subbasin along stream channel and in floodplain with minimal stormwater treatment.
- Existing conditions provide approximately 8% of the stormwater detention storage and approximately 5% of the water quality treatment that would be expected with implementation of the 2005 Ecology Stormwater Manual.
- Most of the land has been developed so future stormwater treatment regulations that are applied to new development will affect only a minimal portion of the total runoff.

Periodically Degraded Water Quality Conditions

Opportunities

- Recent water quality sampling indicates that South Fork Dogfish Creek has had a long-term trend of improving water quality conditions.

- The subbasin contains areas that could receive retrofitted stormwater treatment BMPs.
- Water quality improvement projects align well with current grant funding priorities.
- The City has good records and institutional knowledge of onsite sewage systems within the South Fork subbasin, including the number and location of failing systems. This will be helpful toward addressing fecal coliform pollution in the subbasin.

Constraints

- Minimal detention and water quality treatment exists compared to amount of impervious surface area in the subbasin.

Chapter 4
Evaluation and Prioritization of Potential Actions and Projects

4.1 Evaluation and Prioritization Process

Potential restoration actions and projects which could be undertaken to meet the City's goals and objectives for restoring South Fork Dogfish Creek were identified through the evaluation of historic and existing conditions and the determination of limiting factors. These actions and projects were evaluated and ranked based on a set of evaluation features which were considered important based on the best professional judgment and experience of the project team.

The actions and projects were then ranked first by lowest to highest cost and then by greatest benefits (highest score); Appendix B, Table B-1 presents the evaluation and prioritization matrix.

4.1.1 Evaluation Features

The specific features on which each potential project/action was evaluated and ranked were chosen based on the goals and objectives, as described in Chapter 1, and on collaboration between the ICF Jones & Stokes and Poulsbo Public Works team members.

The evaluation features were:

1. Reduces flooding/increases detention
2. Improves water quality/increases treatment
3. Improves infiltration
4. Improves salmonid habitat
5. Improves habitat for other fish and aquatic species (e.g., freshwater mussels) and wildlife
6. Minimizes impacts on existing resources
7. Provides educational/outreach potential
8. Time to implementation (once funding is secured)
9. Has low relative costs
10. Addresses operation and maintenance needs
11. Is technically and logistically feasible
12. Aligns with grant funding priorities
13. Provides recreational opportunities or links

4.1.2 Scoring Criteria

Each evaluation feature was considered based on the degree to which it could have a positive effect on the limiting factors identified for the subbasin. Each factor was assigned a score of 1, 2, 3, or 4, according to the following criteria, which were developed based on the best professional judgment and experience of the project team.

1. **Reduces flooding/increases detention:** 4=large scale, direct benefits throughout or high in watershed (above SR 305); 3= direct benefits low in watershed (below SR 305) or high in watershed but limited in scale; 2=indirect benefits, throughout or high in watershed; 1=indirect benefits, low in watershed

2. **Improves water quality/increases treatment:** 4=large scale, direct benefits throughout or high in watershed (above SR 305); 3= direct benefits low in watershed (below SR 305) or high in watershed but limited in scale; 2=indirect benefits, throughout or high in watershed; 1=indirect benefits, low in watershed

3. **Improves infiltration:** 4=large scale, direct benefits throughout or high in watershed (above SR 305); 3= direct benefits low in watershed (below SR 305) or high in watershed but limited in scale; 2=indirect benefits, throughout or high in watershed; 1=indirect benefits, low in watershed

4. **Improves salmonid habitat:** 4=direct benefits to multiple life history stages; 3=direct benefits to single life-history stage; 2=indirect benefits landscape scale; 1=indirect site-specific scale benefits

5. **Improves habitat for other fish and aquatic species (e.g., freshwater mussels) and wildlife:** 4=direct benefits to multiple species; 3=direct benefits to single group or limited benefits due to location; 2=indirect benefits landscape scale; 1=indirect site-specific scale benefits

6. **Minimizes impacts on existing resources:** 4=no impacts on quality habitat/resources; 3=indirect impacts only; 2= direct impacts, minimized via project design; 1=direct, unavoidable impacts

7. **Provides educational/outreach potential:** 4=high visibility; directly engages students; 3= high visibility, larger project or City wide action; 2=visible but small project; 1=small, not publicly accessible/visible project or action

8. **Time to implementation (once funding is secured):** 4=<2 years; 3=2-3 years; 2=4-6 years; 1=>6 years

9. **Has low relative costs:** 4= <$50,000; 3=$50,000–100,000; 2=$100,000–200,000; 1=>$200,000

10. **Addresses operation and maintenance needs:** 4=essentially self-sustaining system; 3= <10 years maintenance and monitoring needed or occasional maintenance needed; 2= >10 years maintenance/upkeep required or costs for ongoing established program; 1= ongoing, annual maintenance or annual program updates required

11. **Construction feasibility:** 4=publicly owned land, few construction issues; 3= largely private, but potentially willing partners; 2=private, unknown interest; 1=construction challenges or unwilling private owner

    Construction feasibility was not assessed for basin-wide/programmatic actions.

12. **Aligns with grant funding priorities:** 4=aligns with several grant sources; 3=aligns with specific grant source; 2=aligns with general objectives of funding groups; 1=not aligned with currently known/available grants

    Grant sources are described in detail in section 5.2 and Table B-2.

13. **Provides recreational opportunities or links:** 4=current public park/trail location; 3= location and project compatible with future City recreation plans; 2=location compatible with general passive recreation; 1=project compatible with recreation, but no links exist

    Ability to provide recreational opportunities or links was not assessed for basin-wide/programmatic actions.

4.1.3 Weighted Scores

Four of the factors were weighted in importance based on the goals and objectives and input from the Poulsbo Public Works team. The weighting was accomplished by multiplying the score for these factors as follows:

1. Reduces flooding/increases detention (weighted 1.5 times due to lack of detention in basin and degree of flooding)

2. Improves water quality/increases treatment (weighted 1.3 times due to lack of stormwater treatment in basin and degree of flooding)

3. Improves salmonid habitat (weighted 1.1 times due to desire to restore anadromous salmonids, which would also improve conditions for fresh-water mussels since they depend on healthy salmonid populations)

Aligns with grant funding priorities (weighted 1.2 times due to desire to leverage City funds to achieve greater outcomes)"Potential to improve infiltration" was not weighted because improving infiltration already contributes to flood reduction and improvement in water quality, and so the additional benefit of infiltration projects was already captured in the weighting of the flood reduction and water quality improvement factors.

4.2 Prioritization of Restoration Actions and Projects

By incorporating the above features, scoring criteria, and weighted scores, we developed a matrix of potential restoration actions and projects in ranked order from highest to lowest. Basin-wide actions are presented separately from basin projects and projects associated with a particular stream reach, because they were not ranked on all of the factors used for specific projects (i.e., recreational opportunities and construction feasibility were not applicable to basin-wide actions).

Prioritized rankings are thus summarized below and in Appendix B, Table B-1, within two categories:

1. Basin-wide/programmatic actions
2. Specific basin or stream-reach projects

Per the preference of the City, basin- and stream-reach-specific projects are prioritized by *lowest cost* and *independent of* stream reach (i.e., prioritized by score).

All of the actions/projects described are conceptual at this point and would need to be further developed according to more refined, project-specific goals and objectives developed by the City. Cost categories are based on the project team's best professional judgment based on recent (i.e., 2008–2010) costs for similar projects.

The matrix of potential actions/projects does not include the four flood control projects recommended in the *Final Stormwater Management Plan* (Parametrix 2008). These four projects were structured with multiple actions lumped together, rather than as separable elements which could be evaluated in the ranking matrix. Additionally, these projects contain some elements that overlap with the potential actions considered in the matrix (e.g., replacement of the 8th Avenue culvert), but also contain other elements that we cannot recommend to the City because they would be impractical to permit (e.g., dredging of the stream channel).

In addition, actions to preserve currently forested habitat conditions at the South Fork/mainstem Dogfish Creek confluence could be considered as a potential future project. However, because of limited access to this area, and thus limited information with which to rank this as a project, this potential action was not ranked in the matrix.

4.3 Prioritized Basin-wide/Programmatic Actions

Some actions that can be implemented to improve stream ecology and reduce flooding are programmatic, associated more with the entire subbasin than with a particular location. These types of actions typically relate to the implementation, adoption, or creation of regulations or programs which affect how development and redevelopment occurs.

4.3.1 Projects with Estimated Costs Less than $50,000

Increase Enforcement of Critical Areas Regulations (34.4 points)

Restores Riparian and Wetland Habitat

Poulsbo Municipal Code Title 16 Environment, Chapter 16.20 Critical Areas provides the regulatory protection for fish and wildlife habitat and wetlands, including stream and wetland buffers. Increasing enforcement of City of Poulsbo regulations would directly help restore stream resource management areas (RMAs)/buffers and wetlands that are currently being disturbed or encroached upon (e.g., areas along Reaches 1, 3A, and 4B where mowing is occurring to and across the stream channel and adjacent wetlands).

Increasing enforcement would also directly provide benefits to the fish and wildlife that rely upon these critical areas, particularly if restoration is required for clearing of critical areas. Restoration of

vegetation which moderates stream temperature, provides LWD recruitment, provides water storage, and improves water quality.

The width of the RMA, or buffer, along each side of South Fork Dogfish Creek is based on the stream reach, plus a 25-foot setback, as described in PMC 16.20.315 (Table 2). Based on this system, Reach 1 corresponds to the headwaters RMA, Reach 2A and 2B to the canyon RMA, Reach 3A, 3B, 3C, and the upper portion of Reach 4A correspond to the urban/commercial RMA, and Reach 4B corresponds to the lower forested RMA. Reach 4C to the confluence with the mainstem of Dogfish Creek corresponds to the tidewater/estuary RMA. Additional protections are also required for properties within 300 feet of South Fork Dogfish Creek (PMC 16.20.315), including maintaining no-cut areas on both sides of the stream and maintaining vegetation on hillsides adjacent to the stream.

Table 2. Fish and Wildlife Habitat Conservation Area Development Standards—PMC 16.20.315 (table 4)

Standard Buffers and Setback Requirements		
Freshwater Streams		
Stream Water Type	Buffer Width (feet, each side of stream)	Setback from RMA
2	200	25
3	150	25
4	100	25
5	75	25
Saltwater Shorelines and Lakes		
Shoreline Environment	Buffer Width (feet above ordinary high water mark)	Setback from RMA
Urban, Semi-Rural, Conservancy, and lakes	100	25
Stream Reach Specific Resource management Area and Setback Requirements Additional protections are required from development subject to the following RMA Requirement. Letters listed after the RMA width in parentheses indicate which protections are applicable to the particular stream reach. Protections are listed below.		
Stream Reach	Resource Management Area (feet, each side of stream)	Setback from RMA
South Fork Dogfish Creek		
RMA determined by stream reach as follows:		
Tidewater/Estuary	100 (a, b)	25
Lower Forested	75, or top of adjacent slope, whichever is greater (a, b, c, d)	25
Urban/Commercial	50 for new development and redevelopment; extent of existing constraints for existing development (b, e)	25
Canyon	Park boundary or top of slope, whichever is closest to stream, otherwise 100 feet or top of steep slope, whichever is greater (a, b, f, g)	25
Headwater	50 (b, h, i)	25

Additional Protections Required for Properties within 300 feet of the South Fork of Dogfish Creek
(a) Maintain a 50-foot no-cut area on both sides of stream, measured from outer edge of riparian area. Edge of riparian area shall be determined in the field by a qualified biologist where there is existing forest.
(b) Maximum stormwater treatment required for new construction; retrofit existing impervious areas with minimum stormwater treatment when expansions or alterations trigger a major site plan amendment.
(c) Maintain vegetation on hill slopes adjacent to stream.
(d) Retain curb along SR 305 to direct stormwater runoff, and provide stormwater treatment facilities prior to runoff entering creek.
(e) Pruning of riparian vegetation is prohibited. Removal of invasive species and replanting of existing buffer areas with native riparian vegetation may be required at the time of major site plan amendments or redevelopment.
(f) No tree cutting (except for removal of danger trees in accordance with PMC 16.20120(H)) on canyon side slopes and bottom in Wilderness Park.
(g) No tree cutting (except for removal of danger trees in accordance with PMC 16.20.120(H)) or land clearing along both sides of stream between Wilderness Park and SR 305.
(h) Retain forested wetland at downstream side of Lincoln Road.
(i) Require onsite infiltration of stormwater, where soils area appropriate, for new construction; establish downspout disconnection program for existing development.

Wildlife Habitat Conservation Areas	
Class 1	RMA widths and setbacks will be determined through mandatory Habitat Plan.
Class 2	Site-specific conditions will determine the need for preparation of a Habitat Plan for RMA widths and setbacks.

Area of Rare Plant Species and High Quality Ecosystems
RMA widths and setbacks will be determined through mandatory Habitat Plan.

Wetland buffer widths also vary, depending upon the category of wetland as defined in PMC 16.20.215. The City of Poulsbo has adopted Ecology's *Washington State Wetland Rating System for western Washington* (Washington State Department of Ecology 2004), as amended, to categorize wetlands and establish buffer widths, wetland uses, and mitigation ratios for wetlands. Wetland buffers vary from no buffer for small (1,000 square feet or less) isolated wetlands to 300 feet for Category I wetlands with a habitat score from 29 to 36 points.

While restoration of the required buffer all along the stream channel could be accomplished on an individual parcel basis, it would still cumulatively improve the condition of the riparian floodplain over time. Protection and restoration of wetlands within the South Fork Dogfish Creek subbasin is an achievable goal given the relatively small number of wetlands remaining.

Develop a Critical Areas Training Program (32.2 points)

Educates and Improves Stewardship

Field surveys along the creek revealed numerous areas where stream and wetland buffers have been cleared or encroached and where riparian and wetland vegetation is being mowed. This indicates there may be a lack of public understanding about the functions and values of critical areas such as wetland, streams, and their buffers, as well as about the requirements of the City's critical areas ordinance.

Developing a training program about critical area functions and how they related to the City's critical areas ordinance would educate citizens, as well as City staff and the engineers, architects, and consultants employed for projects within Poulsbo. Such a training program would also afford the City the opportunity to encourage development applications which protect and restore critical areas as part of project design and would likely result in more complete applications. A training program should be designed to engage engineers, consultants, and developers, as well as local residential and commercial property owners within the subbasin and could include handouts available from the City to assist in the development of permit applications.

Collect Water Quality Baseline Data (23 points)

Improves Decision-Making and Project Prioritization

To make informed decisions on the best actions to improve water quality and restore South Fork Dogfish Creek, baseline water quality data is important. For instance if the primary water quality limiting factor of a creek is high temperatures during the summer then riparian planting is likely to be the best action to implement to solve the problem. In contrast, if that same creek was instead limited due to high copper concentrations in the water, then diffuse stormwater treatment of existing roadway runoff is more likely a better action to implement. Similarly, if a creek has high concentrations of pollutants toxic to fish, then actions that reduce pollutants should be implanted first before fish habitat structures are built that attract fish to live in the creek.

There is very little water quality data specific to South Fork Dogfish Creek. Collecting baseline data would help clarify which, water quality parameters are most affecting the ecology of the creek and its fish and wildlife. This information would allow the City to focus on basin-wide actions targeted toward improvement in the specific parameters most affecting the creek.

In addition, improvements in surface and stormwater quality indirectly benefit water quality and habitat conditions in Liberty Bay. The Puget Sound Partnership (http://www.psparchives.com/our_work/stormwater/stormwater_wycd.htm) provides information on LID actions individual citizens can take to improve water quality.

4.3.2 Projects with Estimated Costs between $50,000 and $100,000

Develop a Diffuse Stormwater Management Program (33.2 points)

Increases Stormwater Treatment and Improves Water Quality

Diffuse stormwater management includes LID techniques such as raingardens, curb bumpouts, and planted medians, which are designed to capture and slow stormwater in many small places on the landscape.

Diffuse stormwater management is one of the options provided in the 2005 Ecology Stormwater Manual, but it is not a requirement. On top of reducing flooding and removing pollutants similar to other BMPs, diffuse stormwater treatment encourages infiltration which benefits groundwater recharge and can improve base flow in the creek during summer months. This action could also be considered a subset/spin off adopting the 2005 Ecology Stormwater Manual for new construction and redevelopment projects (as described below). This action would include adoption of the 2005

Ecology Stormwater Manual standards, and would go further by limiting the selection of treatment BMPs to those that promote infiltration. Adoption of such a program could reduce the stormwater related impacts of future development on flooding and stream ecology.

Under this action the City could implement a program to retrofit, where practicable, existing development in the upper/headwater portions of the South Fork Dogfish Creek subbasin to include diffuse stormwater treatment. This would provide stormwater quantity and quality treatment in areas that have no existing treatment, and would target the upper subbasin area first, which inherently provides benefits downstream. Stormwater treatment in the upper basin benefits the entire downstream basin by improving pollutant removal, flow reduction, and groundwater recharge before stormwater reaches the lower portions of the basin where the commercial resources currently affected by seasonal flooding are concentrated.

Conduct Outreach to Encourage Use of LID Techniques (27.1 points)

Increases Stormwater Treatment and Improves Water Quality

City could develop a program to encourage incorporation of LID techniques into new development, urban retrofits, and redevelopment projects. Developing such a program would enable the City to promote and support strategically locating dispersed stormwater treatment in the subbasin and to customize such features to the hydrology and water quality considerations specific to South Fork Dogfish Creek. Such a program could incorporate education on the effectiveness of both structural and nonstructural LID approaches to reducing stormwater runoff and flooding, improving water quality in receiving waters such as South Fork Dogfish Creek, and the economic and 'quality of life' benefits (e.g., aesthetic improvements, enhanced property values, decreased flooding, enhanced wetland and stream protection) that can result from adoption of LID approaches throughout Poulsbo.

LID approaches that could be implemented by the City and/or private developers include:

- Encouraging an increased use of native coniferous trees such as Douglas-fir and western hemlock in drier areas or western red cedar and Sitka spruce in wetter areas to intercept and slow precipitation before it enters the stormwater system
- Retrofitting existing stormwater ponds with a fringe of wetland vegetation to improve water quality
- Investigating the practicality of staged drainage of stormwater ponds after storm events to increase capacity and reduce seasonal flooding

4.4 Basin and Reach Projects

Figure 8 illustrates the locations of the potential basin and specific stream-reach projects described below. Projects are presented by estimated cost, and then by highest total score within each cost category (see Appendix B, Table B-1). Implicit in all described projects is the need for open communication between the City and local property owners, including the owners of adjacent properties, and the requirement that property owners be willing to allow actions on their property.

North Kitsap Medical Center Parking Lot Retrofit
Bondwood Apartments Wetland and Riparian Enhancement
Rock Weir Removal
Channel Complexity Improvement
Poulsbo Village Parking Lot Retrofit
Riparian Vegetation Improvement
Kim Property Restoration
Tributary and Wetlands Connection
Dailey Property Restoration
Centennial Park Master Plan
8th Avenue NE Culvert Replacement
St. Olaf's Church Restoration
Lincoln/Hwy 305 Parking Lot Restoration
Public Works Relocation and Restoration
Educational Signage
North Kitsap High School LID Demonstration Projects
Grade Control Structures
Austurbruin Park Floodplain Storage and Wetlands
VETTER RD NE
BIG VALLEY RD NE
BOND RD NE
305
LITTLE VALLEY RD NE
NE GENES LN
PUGH RD NE
NE LILLEHAMMER LN
NE FOREST ROCK LN
FRONT ST NE
2ND AVE NE
VIKING CRST NE
10TH AVE NE
NE LINCOLN RD
7TH AVE NE
CALDART AVE NE
NE LAURIE VEI LOOP
12TH AVE NE
1ST AVE NE
3RD AVE NE
20TH AVE NE
23RD AVE NE
JENSEN WAY NE
NE MESFORD RD
4TH AVE NE
8TH AVE NE
NE HOSTMARK ST
NE MEADOWRUN DR
6TH AVE NE
13TH AVE NE
9TH AVE NE
11TH AVE NE
NOLL RD NE
NE MT KAMELA CT
NE BJORN ST
FJORD DR NE
Liberty Bay
ICF INTERNATIONAL
N
0 500 1,000
Feet
South Fork Dogfish Creek Sub-Basin Boundary (6/14/2010)
South Fork Dogfish Creek Stream Alignment
Potential Projects
NWI Palustrine Wetlands
Locally Inventoried Wetlands (Suquamish Tribe)
Additional Potential Wetlands (ICF Jones & Stokes 2009)

Figure 8.
Potential Projects
South Fork Dogfish Creek Restoration Master Plan

June 2010

4.4.1 Projects with Estimated Costs Less than $50,000

Install Educational Signage in Wilderness Park (28.4 points)

Reach 2A encompasses the upper portion of Wilderness Park, from a point where the stream begins flowing west, downstream to a point near the City water tower and the old City water intake facility, which are still located within and adjacent to the channel. This reach of South Fork Dogfish Creek is a transport reach, experiencing flows with significant energy capable of scouring channel bed and bank and transporting substrate material downstream.

Historically, salmon use in South Fork Dogfish Creek likely extended to a point somewhere in this reach. Currently, salmon are not documented this far upstream in South Fork Dogfish Creek.

Educates and Fosters Stewardship

Wilderness Park provides walking trails for the public and an opportunity for the City to provide educational signage related to watersheds and stream ecology, native plants, fish and wildlife, stormwater systems, nonpoint source pollution, and LID methods used to reduce impacts from development.

Educational opportunities could be targeted toward stream ecology and flooding issues (causes of flooding within the subbasin and ongoing and future plans to reduce flooding), specific both to Wilderness Park and the subbasin as a whole. The educational signage could be targeted toward building community support for specific projects or future efforts to restore stream ecology and reduce flooding and potentially foster greater community involvement/participation in achieving restoration actions within the subbasin.

4.4.2 Projects with Estimated Costs between $50,000 and $100,000

St. Olaf's Church Restoration (39.4 points)

South Fork Dogfish Creek flows south of NE Mesford Road through the St. Olaf's Roman Catholic Church property, just north of Wilderness Park. The stream flows through maintained lawn. Other vegetation growing along the channel is also actively managed through mowing, which reduces its ability to provide shade, terrestrial input of nutrients, water quality improvement, or reductions in water velocity during high-flow events.

Restores Stream Channel, Riparian Zone, and Floodplain Connectivity

This potential project was tied as the second highest ranked basin/reach-specific project in the subbasin.

Restoration actions could include: excavation to broaden the channel and/or create depressional off-channel areas for increased habitat complexity, which could also act to increase flood storage capacity; and restoration of riparian vegetation in a broad swath along the stream channel to provide shade, LWD recruitment, moderate groundwater inputs and provide terrestrial inputs of nutrients and organic matter.

Restoration of the stream channel could include creating sloped banks, or the creation of a low-flow channel with an upper high-flow bench to increase floodplain connectivity and improve riparian habitat condition/function. Enhances Wetlands for Habitat and Water Quality

Creation of depressional wetland features on the floodplain and adjacent to the stream channel could improve wetland functions (e.g., water storage, water quality improvement, habitat) in the headwaters of the stream.

North Kitsap High School LID Stormwater Demonstration Projects (38.0 points)

Demonstrates LID Approaches, Educates, and Inspires

The high school property includes a large amount of impervious surface, including pollution generating impervious surfaces in the parking lots. The research, design, and implementation of LID-type BMPs such as bioswales, native landscaping, and raingardens could decrease pollutant loading to the stream and decrease flooding. A LID retrofit project could also importantly serve as an educational tool to involve and educate students regarding watersheds and stream ecology, stormwater systems, nonpoint source pollution, and LID methods used to reduce impacts from development. Because the high school property spans the South Fork Dogfish basin boundary, such a project would benefit adjacent subbasins as well.

Such a project could also serve as a demonstration project for broader implementation of LID retrofit projects throughout the basin, as described in section 4.2.

Centennial Park Master Plan (34.4 points)

Centennial Park is owned by the City of Poulsbo, and is partially forested, primarily along the stream corridor and juvenile salmonids were observed in the stream channel within the Park.

Restores Stream Channel, Riparian Zone, and Salmonid Rearing Habitat

Implementation of the City's *2007 Master Plan for Centennial Park* would improve stream channel, riparian zone, and salmonid rearing habitat. The Master Plan includes restoration of native vegetation along the stream channel and a designated 50-foot buffer zone and creation of off-channel pools surrounded by wetland vegetation. Centennial Park would include stream overlooks, a network of pervious pavement trails and parking areas, and grass meadows in the floodplain. It would incorporate raingardens with rock weirs to provide stormwater treatment for the parking areas.

One parcel of property recently acquired by the City has a vacant house with a wooden deck that extends over the stream channel. Removal of the wooden deck and replanting along the stream is included within the Centennial Park Master Plan design.

Install Grade Control Structures in Wilderness Park (28.8 points)

Reach 2A encompasses the upper portion of Wilderness Park, from a point where the stream begins flowing west, downstream to a point near the City water tower and the old City water intake facility, which are still located within and adjacent to the channel. This reach of South Fork Dogfish Creek is a transport reach, experiencing flows with significant energy capable of scouring channel bed and bank and transporting substrate material downstream. The gradient in this reach averages 7 to 8% and many of the steeper portions of the reach are scoured to bedrock/hardpan.

Historically, salmon use in South Fork Dogfish Creek likely extended to a point somewhere in this reach. Currently, salmon are not documented this far upstream in South Fork Dogfish Creek.

Restores Stream Channel and Reduces Erosion

Installation of grade control structures would create step-pool habitat conditions, which would improve habitat for resident fish within this reach, retain substrate material and decrease the energy of the stream during flood flows. This could reduce erosion and downstream sedimentation that can negatively affect water quality and instream habitat in downstream reaches.

Bondwood Apartments Wetland and Riparian Enhancement (24.4 points)

Reach 4B is unconfined with good instream and riparian habitat quality, including areas with well defined streambed and banks, dense native riparian vegetation, good instream habitat conditions, appropriate gravel substrate, and dense instream and overhead cover. Juvenile salmonids and western pearlshell mussels were both observed in this reach in June 2009. Reach 4B and 4C are the only reaches within the subbasin where freshwater mussels were observed.

Residential properties along the south bank have managed lawns that extend down to the stream channel, with consequently degraded riparian habitat conditions along this bank for approximately 400 feet of the reach.

Restores Native Plants and Improves Stream Ecology

Restoring native wetland plants to the slope and stream buffer behind the Bondwood Apartments would provide increased habitat functions and increased native plant diversity. This could be accomplished by a combination of installing native plants and working with the property manager and residents to protect the stream buffer and not mowing the area. Restoration of trees along the edge of the stream channel would restore shading and organic matter input into the channel (Appendix A, Photo 33).

4.4.3 Projects with Estimated Costs between $100,000 and $200,000

Restore Single Stream Channel between 8th Avenue NE and Centennial Park (41 points)

Interim actions could also be pursued at or adjacent to the Public Works office and shop if relocation/restoration is not possible or would not be feasible for many years. Restoration of a single stream channel connecting from the culvert under 8th Avenue NE to the channel in Centennial Park would provide interim benefits to the stream while/until a more comprehensive restoration could be accomplished by removing development from the Public Works property.

Restores Stream Channel, Riparian Zone, and Floodplain Connectivity

Restoration of a single stream channel through the Public Works shop and adjacent residential properties would improve degraded habitat conditions, particularly for resident and anadromous salmonids and would better connect the upper and central reaches of the stream. Such a project would focus on the fragmented habitat conditions and lack of a defined surface channel which

currently degrade habitat conditions in this reach. Restoration of the stream channel profile and alignment could be accomplished to convey flows within a defined channel with improved bed and bank conditions.

Lincoln/State Route 305 Parking Lot Restoration (39.4 points)

Reach 2B includes the lower portion of Wilderness Park, from the water tower downstream to Iverson Road. This reach is a transition zone between the transport reach located upstream (Reach 2A) and a depositional reach located downstream (Reach 3A).

Deposition was noted at the upper end of this reach, where the gradient between Reach 2A decreases at the break with Reach 2B. Bank erosion is evident just upstream of SR 305. The parking lot and two bridges that provide access to the parking lot from businesses on the south side of the stream have been condemned due to recent undermining during winter high flows of the parking lot and bridge footings adjacent to the stream.

The parking lot near the southeastern corner of NE Lincoln Road and SR 305, on the north side of the stream could be removed and the area graded.

Increases Floodplain Storage and Salmonid Rearing Habitat

This potential project was tied as the second highest ranked basin/reach-specific project in the subbasin.

The parking lot's concrete surface could be removed and the area graded to create an off-channel, floodplain storage area to provide increased stormwater storage during flood events and year round off-channel rearing and high-flow refuge habitat for juvenile salmon. Additionally, the stream channel could be restored through this area to provide sinuosity and decrease the energy exerted on the left (south) bank, where adjacent commercial office space is located.

The benefits of increasing stormwater storage within the floodplain could include: creation of off-channel refuge and over-wintering habitat for juvenile salmonids, and the potential for an incremental decrease in the severity of flooding downstream of this reach, due to stormwater detention during flood events.

Dailey Property Restoration (36.4 points)

The Dailey property is located at the northwestern corner of NE Lincoln Rd and Caldart Avenue NE and is the largest parcel of private land within the upper subbasin (Figure 8). South Fork Dogfish Creek runs north-south through the eastern portion of the property. Within the property, the stream is deeply channelized within a vertically banked channel that is cleared on an annual basis. This isolates the stream from the floodplain and eliminates the potential for stormwater storage, wetland habitat, and riparian zone functions.

Restores Stream Channel, Riparian zone, and Floodplain Connectivity

Restoration of the more sinuous, broader, less channelized stream channel could improve stormwater storage, wetland habitat, and riparian zone functions in the headwaters of South Fork Dogfish Creek. Restoration could include creating sloped banks, or the creation of a low-flow channel with an upper high-flow bench. Minor grading within the floodplain and replanting with native wetland and riparian vegetation could increase floodplain connectivity and improve riparian habitat conditions and functions.

Enhances Wetlands for Habitat and Water Quality

Enhancement planting beneath the trees at the northern end of the Dailey property could improve the habitat value and related water quality functions in the headwaters of the stream.

Kim Property Restoration (34 points)

The Kim property is a private parcel located immediately downstream of Centennial Park, south of 7th Avenue NE. The Kim property has been recently replanted with native shrubs and small trees, but they were observed to be in poor condition and are currently of insufficient stature to provide riparian functions to the stream channel.

Restores Stream Channel, Riparian Zone, and Salmonid Rearing Habitat

Acquisition of the Kim property could provide the City with an opportunity to restore the stream channel and create floodplain storage and wetlands in this central reach of the stream. Such an area could also function as off-channel rearing habitat for juvenile salmonids which must traverse this parcel to reach Centennial Park where they were observed in June 2009.

Channel restoration could include installation of instream structures (e.g., LWD, boulders) to create pools and provide appropriate substrate and habitat conditions for spawning. Additional, larger stature native riparian vegetation could be planted, including larger trees and shrubs that would overhang the stream channel, creating overhead cover. Grading could connect the stream channel with its floodplain and create stormwater storage and wetland habitat. By creating stormwater detention within the floodplain, an incremental decrease in flooding downstream may be realized.

Channel Complexity Improvement Downstream of Forest Rock Lane (29.8 points)

Reach 4A along SR 305 extends from the second SR 305 crossing downstream to a private driveway (Table 1, culvert 17), where South Fork Dogfish Creek flows away from SR 305 into a more natural channel and is no longer confined against the side of SR 305.

Downstream of the WSDOT mitigation site, the stream is channelized, and confined by a hillslope to the west and SR 305 to the east (i.e., the right bank is largely the road shoulder of SR 305).

Improves Channel Complexity and Floodplain Connectivity

Discrete sites exist within the lower portion of the reach along SR 305, where small meanders could be created and areas of floodplain connection could be expanded or developed through excavation. These actions could increase channel complexity and attenuate flows, as well as provide some increased water storage during periods of high flow. Increasing channel complexity and attenuating flows would improve conditions for migrating adult salmon, providing resting areas within the lower portion of the reach. Increasing floodplain connection and capacity could also provide stormwater storage, as well as potential off-channel refuge habitat for juvenile salmonids during high flows.

Riparian Vegetation Improvement along Poulsbo Village (28.5 points)

Poulsbo Village Shopping Center is constructed within the floodplain and historic channel of South Fork Dogfish Creek. South Fork Dogfish Creek is channelized between the commercial space and parking lots of Poulsbo Village to the west and SR 305 to the east. South Fork Dogfish Creek is confined to a relatively narrow channel for a distance of approximately 1,800 feet (0.34 mile) in the

upper portion of this reach. Reach 3C is relatively flat with a gradient of 1 to 2%. The floodplain is completely disconnected and developed with roads, parking lots and commercial buildings.

Through the upper half of the reach, the stream flows through a dense thicket of willows, which are periodically trimmed by the adjacent business owners to provide views of their signage and businesses to traffic traveling on SR 305.

Improves Habitat Complexity and Low-Flow Conditions

Restoration of the upper section of the reach could include constructing benches along the channel to provide a more defined low-flow channel. During high flows, the benches would act as constructed floodplains, providing flow attenuation and additional habitat complexity (e.g., boulders, LWD, instream and overhead cover) and an area for conifers to become established.

Native conifers such as Sitka spruce and western red cedar could be installed in locations that would not ultimately block highway exposure for the businesses or interfere with the overhead power lines along SR 305. This type of project would include clearing and/or thinning of the willows along the channel and establishing other, lower growing species of native vegetation such as red-osier dogwood or Pacific ninebark which tend not to spread laterally when trimmed.

This type of project could result in increased habitat complexity (e.g., more defined channel/floodplain benches, LWD, boulders), increased water depth during periods of low flow within a more defined low-flow channel, and a more complex and diverse riparian zone.

4.4.4 Projects with Estimated Costs greater than $200,000

Public Works Relocation and Restoration (42.1 points)

Reach 3A is that portion of South Fork Dogfish Creek from Iverson Road NE downstream to Centennial Park. The stream flows through the recently replaced large culverts beneath SR 305 and Lincoln Avenue NE and then from Iverson Rd. NE, beneath 8th Ave. NE onto the Public Works and neighboring residential property to the north. The stream is then routed north behind the Public Works shop building and then passes into Centennial Park.

The Public Works Office and Shop and the adjacent residential properties immediately north of it lie in a low, depositional reach of the stream. Observed field conditions indicate that 8th Avenue NE may be the current upstream extent of anadromous fish distribution. The stream channel and its floodplain have been seriously altered in this area, to the point that stream flows move subsurface and then resurface to flow on top of the asphalt surface of the Public Works Shop parking lot. The area experiences regular flooding to the point that adult salmon swim through the parking lot during periods of high stream flows and have to be collected place them back in the highly modified stream channel.

Restores Stream Channel, Riparian Zone, and Floodplain Connectivity

Relocating the Public Works Office and Shop, as well as potentially the adjacent residences, would allow restoration of this central reach of the stream. This potential project was the highest ranked basin/reach-specific project within the subbasin.

Restoring the historic channel profile and alignment while simultaneously creating floodplain storage would restore ecological function to this central reach of the stream. Restoration of the

stream channel profile and alignment could be accomplished to convey flows within a defined channel with improved bed and bank conditions. Floodplain storage and wetland habitat could be restored at the site as well, providing off-channel habitat for juvenile salmonids as well as increasing stormwater detention during high-flow events. By creating stormwater detention within the floodplain, an incremental decrease in flooding downstream may be realized.

It should be noted that conversion of the Public Works site to park or open space (as part of a relocation/restoration project) would likely involve financial compensation to the City.

8th Avenue NE Culvert Replacement (38.5 points)

The culvert at 8th Avenue NE was not replaced during recent improvements to SR 305. The culvert that conveys the stream beneath 8th Avenue NE is the only culvert inventoried that was identified as a potential barrier to fish passage. The culvert is a round precast concrete culvert measuring 30 inches in diameter. Every other culvert inventoried within the fish-bearing reaches of the stream was eight feet in diameter or larger and countersunk a minimum of 20%, and had gravel substrate through the culvert creating a natural bed that assists fish migration.

Reduce Flooding and Improve Fish Passage

This potential project was the third highest ranked basin/reach-specific project within the subbasin.

Replacing this culvert with a larger diameter culvert, similar to the other culverts found within the fish-bearing reaches of the stream, would likely improve both adult and juvenile fish passage and reduce flooding across 8th Avenue NE and onto the Public Works Office and Shop and adjacent residential properties.

Replacement of this culvert should coincide with restoration of the channel downstream of the culvert (as described below), to ensure the stream channel is capable of conveying water during high-flow events and to reduce flooding experienced at the Public Works Office and Shop and adjacent residential properties.

Poulsbo Village Parking Lot Retrofit (36 points)

Poulsbo Village Shopping Center is constructed within the floodplain and historic channel of South Fork Dogfish Creek). South Fork Dogfish Creek is channelized between the commercial space and parking lots of Poulsbo Village to the west and SR 305 to the east. South Fork Dogfish Creek is confined to a relatively narrow channel for a distance of approximately 1,800 feet (0.34 mile) in the upper portion of this reach. Reach 3C is relatively flat with a gradient of 1 to 2%. The floodplain is completely disconnected and developed with roads, parking lots and commercial buildings.

The parking lot of the Poulsbo Village commercial development is a large area of impervious surface that contributes stormwater runoff to the creek with no treatment (Appendix A, Photo 32). Retrofitting this commercial development with typical BMPs is not practical because of a lack of space for stormwater detention ponds. However, the parking lot could be retrofitted with LID stormwater reduction features such as pervious pavement, raingardens, and/or biofiltration swales to provide stormwater treatment.

Reduces Peak Flows and Improves Water Quality

Removal of the existing asphalt in the parking lot and replacement with pervious pavement that allows rain to infiltrate into the native soil would increase infiltration and stormwater storage. This

could reduce peak flow in the stream, reduce the amount of pollutants washed into the stream from the parking lot, and promote groundwater recharge. Pervious pavement can also improve safety by eliminating puddles during times of heavy rainfall. Once constructed, such a retrofit would not substantially affect the parking lot capacity.

North Kitsap Medical Center Parking Lot Retrofit (36.0 points)

The parking lot at the North Kitsap Medical Center is a large area of impervious surface that contributes stormwater runoff to the stream after some treatment provided by underground vaults and a biofiltration swale. The existing system provides a basic level of treatment to stormwater runoff; however, the parking lot could be retrofitted with LID stormwater reduction features such as pervious pavement, raingardens, and/or additional biofiltration swales to provide a higher level of stormwater treatment. Because the North Kitsap Medical Center property spans the South Fork Dogfish and the mainstem subbasin boundaries, this project would benefit the mainstem of Dogfish Creek as well.

Reduces Peak Flows and Improves Water Quality

Removal of the existing asphalt in the parking lot and replacement with pervious pavement that allows rain to infiltrate into the native soil would increase infiltration and stormwater storage. This could reduce peak flow in the stream, reduce the amount of pollutants washed into the stream from the parking lot, and promote groundwater recharge. Pervious pavement can also improve safety by eliminating puddles during times of heavy rainfall. Once constructed, such a retrofit would not substantially affect the parking lot capacity.

Austurbruin Park Floodplain Storage and Wetlands (35.4 points)

Austurbruin Park lies within the upper watershed, but is not directly connected to the South Fork channel. A large depression exists along the south side of Austurbruin Park (Appendix A, Photo 30). This area is currently almost exclusively Himalayan blackberry, but could be restored to native vegetation. A small wetland area within Austurbruin Park is located downslope from this area, indicating groundwater may be close enough to the surface to support a wetland community within the depression as well.

Creates Floodplain Storage and Wetlands

Grading and restoration of this depression with native wetland vegetation (presuming a suitable water source is present) would create floodplain storage and increase the area of wetlands in the upper subbasin. This could increase wetland functions and values, including stormwater storage, water quality improvement, and wildlife habitat.

Tributary and Wetlands Connection along 10th Avenue NE (34.6 points)

The forested wetland and small tributary stream that drains the southern end of the forested hillside between 12th Avenue NE and 10th Avenue NE currently discharges into the stormwater system via a stormdrain at the corner of 10th Avenue NE and the entrance to the office park and Sunrise Properties development. Another potential forested wetland that lies immediately behind the entrance sign to Sunrise Properties on 10th Avenue NE also appears to connect to the stormwater system.

Creates Floodplain Storage and Wetlands

Connecting these potential wetlands and associated tributary to the floodplain of South Fork Dogfish creek could be accomplished by routing this water under 10th Avenue NE. Creating wetlands south of the fire station based on this water (Appendix A, Photo 31) would increase the area of wetlands in the subbasin and thus increase wetland functions and values, which could include stormwater storage, water quality improvement, and wildlife habitat.

Rock Weir Removal (25.2 points)

Reach 4B is unconfined with good instream and riparian habitat quality, including areas with well defined streambed and banks, dense native riparian vegetation, good instream habitat conditions, appropriate gravel substrate, and dense instream and overhead cover. Juvenile salmonids and western pearlshell mussels were both observed in this reach in June 2009. Reach 4B and 4C are the only reaches within the subbasin where freshwater mussels were observed.

Two rock weir structures span the channel and create at least partial barriers to fish passage behind the North Kitsap Medical Center.

Improves Fish Passage

Two rock weirs located within this reach create partial barriers to fish migration within the subbasin (WDFW 2009). The weirs are likely complete barriers during low-flow conditions. The rock weirs create pools upstream, which provide high quality rearing habitat for juvenile fish. Efforts to remove the weirs or to make them passable year-round to all life history stages of salmonids should consider a design that would maintain the pools and prevent the discharge of accumulated sediment in the pools from washing downstream. This sediment transport could have an impact on the western pearlshell mussels downstream of the weirs.

Fish passage improvements that could be considered include a series of smaller steps and pools created upstream of each step, or perhaps some type of fishway that allows fish to pass upstream of the structures but maintains the pool habitat.

Chapter 5
Funding Opportunities

Based on the conceptual actions/projects identified in Chapter 4, a matrix was developed of potential sources of grants that fund the specific types of projects/actions outlined herein. Appendix B, Table B-2, provides this matrix, which was developed using GrantStation.com, a comprehensive online database of granting agencies.

5.1 Identifying Funding Opportunities

Actions/projects that require commitment of staff time or additional staff may be the most difficult to fund through grants. For example, increasing enforcement of critical areas regulations aligned only with the funding priorities of Puget Sound Watershed Management Assistance through the U.S. Environmental Protection Agency (EPA) and the development of a diffuse stormwater management program aligned only with the Stormwater and LID Retrofit grant program through Ecology.

In contrast, larger scale, more site-specific projects and projects that target several different types of restoration (e.g., fish passage improvements, stream restoration, and wetland restoration) fall under the funding priorities of a larger number of grants. For example, St. Olaf's Church restoration, Dailey property restoration, relocation and restoration of the Public Works property, replacement of the 8th Avenue NE culvert, restoration at the Kim property, channel complexity improvements along SR 305, and removal of the rock weirs align with several different grant priorities. In addition, larger projects may also be more competitive when considered with other projects competing for federal grant dollars.

The current focus both in Washington State and nationally on stormwater treatment creates grant opportunities that match well with several actions/projects applicable to the South Fork Dogfish Creek subbasin. For example, replacement of the 8th Avenue Culvert; development of a diffuse stormwater management plan; adoption of Ecology stormwater standards; outreach to encourage LID; the Poulsbo Village Parking Lot retrofit; the Kitsap Medical Center Parking Lot retrofit; and the High School LID demonstration align well with the priorities of four different Ecology-administered grants designed to improve stormwater treatment and water quality.

Finally, projects that are tiered off an adopted Master Plan are frequently scored higher during the grant application review process. The background research, limiting factors analysis, and prioritization that are inherent in the master planning process are viewed positively by grant funding sources. Perhaps more importantly, by adopting a Restoration Master Plan, a local government is indicating a commitment to the plan's goals and this is interpreted by grant funding sources as a commitment to accomplishing proposed projects.

5.2 Description of Available Funding Opportunities

2010 Open Rivers Initiative, Department of Commerce, National Oceanic and Atmospheric Administration (NOAA). Support for the implementation of locally-driven projects to remove dams

and other river barriers, in order to benefit living marine and coastal resources, particularly diadromous fish. Deadline for 2009 was November 16. Funding may be available again in 2010.

Salmon Recovery Grants, Washington Recreation and Conservation Office, Salmon Recovery Funding (SRF) Board. Administers grants for the protection and restoration of salmon habitat. The board also supports feasibility assessments for future projects and other activities. Requires coordination through the local lead entity, in this case, Westsound Lead Entity. Lead entities have spring deadlines for considering which projects to recommend; SRFB application deadline is early September. This is an annual grant and funding is available each year.

Federal Aid in Wildlife Restoration (Pittman-Robertson), U.S. Fish and Wildlife Service (USFWS) and WDFW. Funds restoration of wild birds and mammals and acquisition, development and management their habitats. Annual Grant.. Applications for next round are due January 10, 2010.

National Coastal Wetlands Conservation Act Grants, USFWS and WDFW. Funds acquisition, restoration and enhancement of wetlands of coastal states and the trust territories. Annual Grant. Applications due to USFWS in June of each year.

North American Wetlands Conservation Act, USFWS. Grant provides matching grants to organizations and individuals who have developed partnerships to carry out wetland conservation projects in the U.S., Canada and Mexico for the benefit of wetlands associated migratory birds and other wildlife. Annual Grant: Standard Grants due in March and July; Small Grants due in October. Matching funds are a requirement of this grant.

FY 2010–11 Water Quality Financial Assistance Guidelines, Ecology. Ecology administers three grant programs:

- **Centennial Clean Water Program (Centennial)** provides grants and low-interest loans to eligible governments for wastewater treatment facilities and for certain activities that reduce nonpoint sources of water pollution. Annual Grant. Applications due February of each year.
- **Clean Water Act Section 319 Nonpoint Source Grant Program** provides grants to eligible governments and 501©3 non-profit organizations for implementation of activities that reduce nonpoint sources of water pollution. Annual Grant. Applications due February of each year.
- **Washington State Water Pollution Control Revolving Fund** provides low-interest loans to eligible governments for projects that improve and protect the state's water quality. Annual Grant, applications due February of each year.

  Ecology identifies the following as the types of projects funded:

  - Planning, design and construction of wastewater and stormwater treatment facilities
  - Agricultural best management practices projects
  - Stream and salmon habitat restoration
  - Local loan funds for water quality projects
  - Watershed planning
  - Water reuse planning and facilities

- Water quality monitoring
- Lake restoration
- Wellhead protection
- Acquiring wetland habitat for preservation
- Construction of public boat pump-outs
- Public information and education projects

Stormwater Retrofit and LID Grant Program. Provides funds stormwater retrofit projects that provide an improvement in site hydrology or water quality, new development or redevelopment projects that implement LID practices. Projects with measurable improvements and those that have started or completed SEPA and Cultural Resources review at the time of application will score more points in the application review process.

National Fish Passage Program, USFWS. Provides funding for fish passage restoration by removing or bypassing barriers to fish movement (e.g., dam removal, culvert renovation, fishways and barrier inventories). Annual Grant. Applications due end of September.

Partners for Fish and Wildlife Program Grant, USFWS. Provides assistance to private landowners, Tribal, local and state governments, educational institutions and organizations who want to restore, enhance or manage fish and wildlife habitats on their lands. Annual Grant. Applications due end of September.

Kitsap Community Foundation Grants, Kitsap County. Provides grants to non-profits and government agencies for projects related to the following categories:

- Civic and community improvement
- Education
- Health and social services
- Recreation
- Environment
- Youth

The Kitsap Community Foundations Grants are Annual Grants. Due date is end of January each year.

Whole Watershed Restoration Initiative, NOAA. Program is focused on restoration of anadromous fish habitat, but projects may include feasibility analysis, design, outreach, education and monitoring. 2009 proposal deadline was November 20. NOAA cannot yet verify that this grant will be available again in 2010.

NOAA/American Rivers Partnership Funding, NOAA. Program is focused on projects that protect and restore riverine habitat and foster river stewardship. Three distinct project phases may be funded:

- Feasibility analysis

- Engineering design
- Construction

Project solicitation cycles are scheduled annually for April and November.

Bay Watershed Education and Training Program, NOAA. Program supports an environmental education program promoting locally relevant, experiential learning in the K-12 environment. Most recent proposal deadline was October 8, 2009. Annual Grant. NOAA cannot yet verify that this grant will be available again in 2010.

Puget Sound Watershed Management Assistance Grants, EPA. Program provides assistance to help integrate watershed protection and land use decisions. Can be applied to on-the-ground water restoration or protection projects, water quality monitoring, local ordinances passed aimed at protection and restoration of water quality and aquatic resources, and enhanced public participation and awareness of water quality issues at the community level. Annual Grant.

Chapter 6
Conclusions and Recommendations

6.1 Conclusions

South Fork Dogfish Creek and its subbasin offer the City many opportunities to implement restorative actions and projects that could help meet the City's goals of restoring stream ecology and reducing flooding. Most of these actions and projects align with at least one source of grant funding, which could allow the City to leverage its available funds to accomplish projects throughout the subbasin. The types of actions recommended would improve stream ecology and habitat conditions in South Fork by addressing the limiting factors identified in the stream reaches. Particular actions, for example removing fish barriers at the rock weirs, would directly improve access to the stream for salmonids, which would likely result in an increase in their numbers and upstream distribution.

Implementation of this Restoration Master Plan will take time, money, and perhaps most importantly, the energy and commitment of City staff, citizens, and City partners. The City can begin taking steps to implement the Restoration Master Plan based on the matrix of potential actions and projects and the associated alignment with grant funding sources.

6.2 Recommended Next Steps

Following formal adoption by the City Council, we recommend that the City begin implementing this Restoration Master Plan by pursuing the following recommended next steps.

Step 1: Foster Public Support and Involvement

An active plan for public involvement to foster support for the Restoration Master Plan is critical to the successful implementation of the projects and actions outlined herein. The degree, nature, and timing of public involvement are extremely important considerations in restoration projects. Public support and stewardship is necessary for basin-wide actions to be successful and to raise matching funds which can be required as part of grant applications. In addition, projects on and adjacent to private property typically require easements for construction, maintenance, and monitoring. Projects undertaken by the City will also typically require a public process during design and permitting. Consequently, early and proactive engagement with the public is strongly recommended. This can be accomplished on a number of levels:

- Stream stewardship kickoff meetings
- Establishment of a stream stewardship website, social networking group, and/or blog to keep citizens up to date
- Encouragement of neighborhood- or reach-specific community groups to increase stewardship and generate support at public meetings and with grant funding groups
- Outreach directly to private property owners with identified projects (e.g., St. Olaf's church, Dailey property, Kim property)

- Design workshops to advance conceptual ideas for projects
- Mailing of fact sheets as projects advance through design and permitting stages
- Public meetings and workshops as projects advance through design and permitting stages

Step 2: Focus on Inexpensive but Important Actions

Following implementation of a public involvement plan, we recommend the City focus on the following two priority actions which have lower costs and are ranked as high-value actions. These actions dovetail with a public involvement/public interest plan that focuses on increasing the understanding of watershed functions, critical areas, and the impact/importance of individual actions among the City's citizens.

1. Increase the enforcement of critical areas regulations to restore streamside buffers, riparian habitat, and wetlands.
2. Develop a critical areas training program to educate citizens about stream and wetland functions related to water quality and stormwater retention/flood reduction, and to foster increased stewardship and public support of restoration actions within the subbasin.

Step 3: Focus on Other Basin-wide Actions and Early Action Projects

Next, we recommend the City focus on other important basin-wide actions and early-action projects to maintain public interest and awareness. Implementation of basin-wide actions can increase the public's awareness of the City's focus on increasing stewardship of the stream and critical areas within Poulsbo. Implementation of early-action projects can help build public support and increase stewardship in the subbasin, which can improve conditions while longer-term projects are in the design and permitting stages.

Actions and projects that can be accomplished quickly, are publicly coordinated, and actively supported and promoted can increase the willingness of private property owners to participate in subsequent projects. Meanwhile, grant applications can be prepared and project design and permitting can be pursued for projects further out in time. Some important basin-wide actions are inherently complex and require research and development to create programs that will meet the specific goals of the City (e.g., development of a diffuse stormwater system and outreach to encourage LID approaches in design). However, because these are among the most important actions to restore South Fork Dogfish Creek, we recommend the City begin pursuing them as soon as early action projects are beginning.

1. Develop a diffuse stormwater management program to increase stormwater treatment in the subbasin and foster increased interest in and support for reducing stormwater and water quality impacts on the stream and its subbasin.
2. Install educational signage regarding stream and forest ecology in Wilderness Park.
3. Work with the high-school to implement LID demonstration projects such as rain gardens, bioswales, and native landscaping.
4. Implement the Centennial Park Master Plan.

5. Collect water quality baseline data.

6. Improve riparian vegetation along Poulsbo Village/ SR 305.

Implementation of the Centennial Park Master Plan and installation of educational signage in Wilderness Park are also highly visible projects. As such, they pair well with other actions like critical areas training and enforcement/education about the City's critical areas regulations, which would increase public awareness of the condition of and efforts to restore the South Fork Dogfish Creek subbasin.

Development of a diffuse stormwater management program and outreach to the design community to encourage LID approaches naturally follow the recent (February 2010) adoption of the 2005 Ecology stormwater standards and may be accomplishable in less than 4 years, depending on the nature and extent of the program developed and how quickly it is adopted by the development community.

Step 4: Focus on Longer-Term, Highly Ranked Projects

Next, we recommend the City focus on acquiring grand funds to pursue the most highly ranked projects. Top ranking projects can be selected as City funds and matching grant funding allows. These projects ranked high in their overall scores and would have positive benefits in terms of flood reduction, water quality improvement, increased infiltration and/or improved fish and wildlife habitat. Projects that require detailed design and permitting generally take between 2 and 6 years to reach construction, depending on their size and complexity. These projects include restoration actions in the stream's headwaters (e.g., St. Olaf's, Dailey property), as well as projects in highly visible locations (e.g., replacement of 8th Avenue culvert).

1. Work with St. Olaf's church on stream, floodplain, riparian zone, and wetland restoration.

2. Work with the Dailey's to restore and protect the headwaters of South Fork.

3. Pursue replacement of the 8th Avenue NE culvert.

4. Pursue reestablishment of a single channel from 8th Avenue NE to Centennial Park to restore stream channel, riparian zone, and floodplain connectivity in a central and highly visible portion of the subbasin (or relocation/restoration of the Public Works office and shop if feasible).

5. Retrofitting of Poulsbo Village and North Kitsap Medical Center parking lots with LID approaches such as pervious pavement, bioswale planting strips, and raingardens.

Projects like relocating the Public Works office and shop require ecological design, planning, and permitting, but also property acquisition and building replacement. Although this action is a longer-term project, it was the top-ranked reach-specific project in the subbasin because of its location in the basin and the potential improvement to the stream and floodplain that could be accomplished in this location.

6.3 Consider Project Sequencing and Coordination

We strongly caution the City to consider project sequencing when prioritizing actions/projects. It is important to capitalize on project sequencing opportunities and be aware of sequencing pitfalls to accomplish the actions and projects outlined in this Restoration Master Plan efficiently and effectively.

Consideration of sequencing and coordination is important because some actions can be best accomplished only after other actions or projects are installed and/or their design needs to incorporate or consider the potential future implementation of other projects. Actions such as enforcing critical areas regulations and creating training programs can precede most projects. Sequencing and coordination should be carefully considered for actions at similar locations in the subbasin to ensure that construction actions for one project do not complicate other projects or require wasted effort.

For example, replacement of the 8th Avenue NE culvert, restoration of a single channel between the 8th Avenue NE culvert and Centennial Park, and/or relocation or restoration of the Public Works property should be considered in context of each other so that roadwork to replace the culvert does not have to be redone during restoration of the Public Works property. Similarly, implementation of the Centennial Park Master Plan should be considered in coordination with the potential for additional restoration actions immediately downstream on the Kim property. Installation of educational signage and grade control structures in Wilderness Park are another example of projects which should be coordinated to avoid duplicative or wasted efforts and resources.

Finally, if a project involves federal permitting for work in wetlands or streams, some aspects of project permitting are fixed, regardless of the size of the project (i.e., the same documents are required and the same coordination process is required). Thus, grouping several smaller actions together that require such permitting can save time and money. For example, improving channel complexity along the western side of SR 305 might be accomplished in multiple phases in several areas, which could all be part of the same federal permit application.

Chapter 7
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Appendix A. Photos

Photo 1. Undersized culvert at 8th Avenue NE, facing downstream

Photo 2. Culvert beneath SR 305 and Iverson Road NE facing upstream

Photo 3. Culvert beneath SR 305 and Iverson Road NE facing downstream

Photo 4. Public Works parking lot, flooding November 19, 2009 (photo from City of Poulsbo)

Photo 5. Potential headwater wetland tributary into upper Wilderness Park

Photo 6. Downstream end of potential wetland tributary at 10th Avenue NE

Photo 7. Potential wetland at Sunrise Properties, just east of 10th Avenue NE

Photo 8. Potential wetland between 10th Avenue NE and SR 305, south of fire station

Photo 9 Headwaters of stream, facing upstream

Photo 10. Stream channel downstream of Mosjon Circle , facing downstream

Photo 11. Stream channel through St. Olaf's Church property, facing downstream

Photo 12. Stream channel through Wilderness Park

Photo 13. Forested riparian zone in Wilderness Park

Photo 14. Wetland seep in Wilderness Park

Photo 15. Stream channel downstream of Wilderness Park, near NE Lincoln Road and SR 305 intersection

Photo 16. Riparian zone surrounding undersized culvert at 8th Avenue NE, facing downstream

Photo 17. Stream channel loses definition, residential property adjacent to Public Works office on 8th Avenue NE

Photo 18. Stream channel through Public Works shop area

Photo 19. Stream channel through Centennial Park

Photo 20. Stream channel through Kim property

Photo 21. Stream channel between Poulsbo Village and SR 305

Photo 22. Stream channel north of Liberty Road, facing downstream

Photo 23. Stream channel through WSDOT mitigation site between east side of SR 305 and west side of 10th Avenue NE

Photo 24. Rock weir and stream channel

Photo 25. Pool behind upstream rock weir

Photo 26. Western pearlshell mussels in stream bed, behind North Kitsap Medical Center

Photo 27. Dense native riparian vegetation along stream behind North Kitsap Medical Center

Photo 28. Potential wetland seep area behind Bondwood Apartments

Photo 29. Stream channel downstream of Bond Road NE

Photo 30. Depression above Austrubruin Park

Photo 31. Potential wetland creation area to south of fire station

Photo 32. Flooding in Poulsbo Village, November 19, 2009 (photo from City of Poulsbo)

Photo 33. Cleared bank of stream behind Bondwood Apartments, facing downstream

Appendix B. Matrices of Potential Actions/Projects and Grant Funding Sources

Appendix B
Prioritization Matrix of Actions/Projects Ranked by Total Score

Table Notes

Flood reduction/increases detention (weighted 1.5 times due to lack of detention in basin and degree of flooding): 4=large scale, direct benefits throughout or high in watershed (above SR 305); 3= direct benefits low in watershed (below SR 305) or high in watershed but limited in scale; 2=indirect benefits, throughout or high in watershed; 1=indirect benefits, low in watershed

Water quality improvement/increases treatment (weighted 1.3 times due to lack of stormwater treatment in basin and degree of flooding): 4=large scale, direct benefits throughout or high in watershed (above SR 305); 3= direct benefits low in watershed (below SR 305) or high in watershed but limited in scale; 2=indirect benefits, throughout or high in watershed; 1=indirect benefits, low in watershed

Improves infiltration (not weighted because improving infiltration already contributes to flood reduction and improvement in water quality): 4=large scale, direct benefits throughout or high in watershed (above SR 305); 3= direct benefits low in watershed (below SR 305) or high in watershed but limited in scale; 2=indirect benefits, throughout or high in watershed; 1=indirect benefits, low in watershed

Improves salmonid habitat (weighted 1.1 times due to desire to restore anadromous salmonids, which would also improve conditions for fresh-water mussels since they depend on healthy salmonid populations): 4=direct benefits to multiple life history stages; 3=direct benefits to single life-history stage; 2=indirect benefits landscape scale; 1=indirect site-specific scale benefits

Improves habitat for other fish and aquatic species (e.g. freshwater mussels) and wildlife: 4=direct benefits to multiple species; 3=direct benefits to single group or limited benefits due to location; 2=indirect benefits landscape scale; 1=indirect site-specific scale benefits

Minimizes impacts to existing resources: 4=no impacts to quality habitat/resources; 3=indirect impacts only; 2= direct impacts, minimized via project design; 1=direct, unavoidable impacts

Provides educational/outreach potential: 4=high visibility; directly engages students; 3= high visibility, larger project or City wide action; 2=visible but small project; 1=small, not publically accessible/visible project or action

Time to implementation (once funding is secured): 4=<2 years; 3=2-3 years; 2=4-6 years; 1=>6 years

Low relative costs: 4= **<**$50,000; 3=$50,000-$100,000; 2=$100,000-$200,000; 1= **>**$200,000

Operation and maintenance needs: 4=essentially self-sustaining system; 3= <10 years maintenance and monitoring needed or occasional maintenance needed; 2= >10 years maintenance/upkeep required or costs for ongoing established program; 1= ongoing, annual maintenance or annual program updates required

Feasibility: 4=publically owned land, few construction issues; 3= largely private, but potentially willing partners; 2=private, unknown interest; 1=construction challenges or unwilling private owner

Aligns with grant funding priorities (weighted 1.2 times due to desire to leverage City funds to achieve greater outcomes): 4=aligns with several grant sources; 3=aligns with specific grant source; 2=aligns with general objectives of funding groups; 1=not aligned with currently known/available grants

Provides recreational opportunities or links: 4=current public park/trail location; 3= location and project compatible with future City recreation plans; 2=location compatible with general passive recreation; 1=project compatible with recreation, but no links exist

Notes on Alignment with Grants:

A. Department of Commerce 2010 Open Rivers Initiative

B. Salmon Recovery Grants

C. Federal Aid in Wildlife Restoration (Pittman-Robertson)

D. National Coastal Wetlands Conservation Act Grants

E. North American Wetlands Conservation Act, USFWS

F. FY 2010-11 Water Quality Financial Assistance

   a. Centennial funds are used to provide grants and sometimes low-interest loans to public bodies. Examples include:

      1) Construction or improvement of water pollution control facilities where the applicant meets financial hardship criteria

      2) Nonpoint source water pollution control activities projects. Although loans can be made through Centainnial, most dollars are distributed as grants.

      3) On-site septic system repair and replacement

      4) Stormwater activities not identified in a permit.

   b. Section 319 funds are used to provide grants for planning or to implement strategies identified in the State's nonpoint source pollution control plan

   c. Revolving fund provides low-cost financing (sometimes refinancing) for projects that improve and protect the State's water quality. Projects may include publicly-owned wastewater or stormwater treatment facilities, nonpoint source pollution control projects, and comprehensive estuary conservation and management programs.

G. National Fish Passage Program supports efforts to reconnect fish species to historic habitats

H. Partners for Fish and Wildlife Grants provides assistance to private landowners who want to restore or improve habitat on their property (local governments are eligible)

I. Kitsap Community Foundation favors projects that promotes community, youth, education, collaboration, volunteerism, etc.

J. Whole Watershed Restoration Initiative is focused on restoration of anadromous fish habitat, but projects may include feasibility analysis, design, outreach, education and monitoring.

K. NOAA/American River Partnership Funding is focused on projects that protect and restore riverine habitat and foster river stewardship.

L. NOAA PNW Bay Watershed Education and Training Grants.

M. EPA Puget Sound Watershed Management Assistance Grants.

Table B-1. Prioritization Matrix Factors and Projects/Actions Ranked by Total Score, Independent of Reach

Relative weighting	**(x1.5)**	**(x1.3)**		**(x1.1)**								**(x1.2 if >1)**		
Total points possible	**6**	**5.2**	**4**	**4.4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4.8**	**4**	**56.4**
Scale: 4=high, 1=low	**Flood reduction/increases stormwater detention**	**Water quality improvement/increases stormwater treatment**	**Improves infiltration**	**Improves salmonid habitat**	**Improves fish and wildlife habitat**	**Minimizes impacts to existing resources**	**Provides educational or outreach potential**	**Time to implementation**	**Low Relative Cost[1]**	**Low operation & maintenance needs**	**Construction Feasibility**	**Aligns with grant funding priorities**	**Provides recreational opportunities or links**	**Total Weighted Points**
BASINWIDE/PROGRAMMATIC ACTIONS														
Increase enforcement of critical areas regulations reg buffers and clearing streams and wetlands (increased staff to conduct enforcement)	2 (3)	4 (5.2)	4	2 (2.2)	2	4	3	4	4	2		1 (M)		**34.4**
Develop diffuse stormwater management program (e.g. raingardens, curb bumpouts, medians etc.) for new construction and existing upper basin parcels	3 (4.5)	3 (3.9)	3	2 (2.2)	2	4	4	2	2	2		3 (3.6) (F,M)		**33.2**
Develop critical areas/watershed functions training program	2 (3)	2 (2.6)	2	2 (2.2)	2	4	4	4	4	2		2(2.4) (M)		**32.2**

[1] Low relative costs: 4= <$50,000; 3=$50,000-$100,000; 2=$100,000-$200,000; 1= >$200,000

Relative weighting	(x1.5)	(x1.3)		(x1.1)								(x1.2 if >1)		
Total points possible	**6**	**5.2**	**4**	**4.4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4.8**	**4**	**56.4**
Scale: 4=high, 1=low	**Flood reduction/increases stormwater detention**	**Water quality improvement/increases stormwater treatment**	**Improves infiltration**	**Improves salmonid habitat**	**Improves fish and wildlife habitat**	**Minimizes impacts to existing resources**	**Provides educational or outreach potential**	**Time to implementation**	**Low Relative Cost[1]**	**Low operation & maintenance needs**	**Construction Feasibility**	**Aligns with grant funding priorities**	**Provides recreational opportunities or links**	**Total Weighted Points**
Outreach to design community to encourage LID elements in new construction and to retrofit existing	2 (3)	3 (3.9)	3	2 (2.2)	2	4	3	2	2	1		1 (M)		**27.1**
Collect South Fork water quality data (incl. chemical constituents) to establish baseline		2 (2.6)				4	4	4	4	2		2 (2.4) (I, M)		**23**
BASIN AND REACH PROJECTS														
Public Works Relocation and Restoration: Channel, floodplain storage, riparian & wetland restoration at Public Works property (and relocate PW)	4 (6)	3 (3.9)	3	4 (4.4)	4	4	3	1	1	3	1	4 (4.8) (A, B, C, D, G, H, J, K,L)	3	**42.1**
Restore single channel from 8th Avenue NE culvert to Centennial Park	3(4.5)	1(1.3)	3	4(4.4)	4	4	3	2	2	3	1	4 (4.8) (A, B, C, D, G, H, J, K,L)	3	**40.0**
St. Olaf's church: Stream channel, floodplain, riparian zone & wetland restoration	3 (4.5)	3 (3.9)	3	2 (2.2)	4	3	2	3	3	3	3	4 (4.8) (C, D, E, H, M)		**39.4**
Floodplain storage and channel restoration at Lincoln/Hwy 305 parking lot	3 (4.5)	3 (3.9)	3	4 (4.4)	3	2	3	3	2	3	2	3 (3.6) (B, C, H, J, K, M)	2	**39.4**

[1] Low relative costs: 4= <$50,000; 3=$50,000-$100,000; 2=$100,000-$200,000; 1= >$200,000

Relative weighting	**(x1.5)**	**(x1.3)**		**(x1.1)**								**(x1.2 if >1)**		
Total points possible	**6**	**5.2**	**4**	**4.4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4.8**	**4**	**56.4**
Scale: 4=high, 1=low	**Flood reduction/increases stormwater detention**	**Water quality improvement/increases stormwater treatment**	**Improves infiltration**	**Improves salmonid habitat**	**Improves fish and wildlife habitat**	**Minimizes impacts to existing resources**	**Provides educational or outreach potential**	**Time to implementation**	**Low Relative Cost[1]**	**Low operation & maintenance needs**	**Construction Feasibility**	**Aligns with grant funding priorities**	**Provides recreational opportunities or links**	**Total Weighted Points**
Replace 8th Ave NE culvert	4 (6)	1 (1.3)		4 (4.4)	4	4	2	3	1	3	4	4 (4.8) (A, B, F, K, G)	1	**38.5**
High school LID Demonstration rain gardens; bioswales, native landscaping demonstration project	3 (4.5)	3 (3.9)	3	2 (2.2)	3	4	4	3	3	2	3	2(2.4) (F, I, L, M)	2	**38.0**
Dailey Property Restoration: Stream channel, floodplain, riparian zone & wetland restoration	3 (4.5)	3 (3.9)	3	2 (2.2)	4	2	1	3	2	3	3	4 (4.8) (C, D, E, H, M)		**36.4**
Retrofit Poulsbo Village parking lot with pervious pavement, bioswale planting strips, raingardens	3 (4.5)	3 (3.9)	3	2(2.2)	2	4	3	4	1	2	2	2(2.4) (F, M)	2	**36.0**
Retrofit Medical Center parking lot with pervious pavement, bioswale planting strips, raingardens, detention	3 (4.5)	3 (3.9)	3	2(2.2)	2	4	3	4	1	2	2	2 (2.4) (F, M)	2	**36.0**
Create floodplain storage/wetlands in upper Austurbruin Park	2 (3)	2 (2.6)	2	2 (2.2)	2	3	3	3	1	3	3	3 (3.6) (D, E, M)	4	**35.4**

[1] Low relative costs: 4= <$50,000; 3=$50,000-$100,000; 2=$100,000-$200,000; 1= >$200,000

Relative weighting	**(x1.5)**	**(x1.3)**		**(x1.1)**								**(x1.2 if >1)**		
Total points possible	**6**	**5.2**	**4**	**4.4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4.8**	**4**	**56.4**
Scale: 4=high, 1=low	**Flood reduction/increases stormwater detention**	**Water quality improvement/increases stormwater treatment**	**Improves infiltration**	**Improves salmonid habitat**	**Improves fish and wildlife habitat**	**Minimizes impacts to existing resources**	**Provides educational or outreach potential**	**Time to implementation**	**Low Relative Cost[1]**	**Low operation & maintenance needs**	**Construction Feasibility**	**Aligns with grant funding priorities**	**Provides recreational opportunities or links**	**Total Weighted Points**
Tributary and Wetland Connection: Reconnect tributary and wetlands along 10th Ave to stream and/or floodplain	2 (3)	2 (2.6)	2	2 (2.2)	3	2	3	3	1	3	3	4 (4.8) (B, C, D, E, H, K, M)	2	**34.6**
Implement Centennial Park Master Plan	1	1	1	4	3	2	3	4	3	2	4	2 (2.4) (F, L, I)	4	**34.4**
Acquire Kim property, restore channel, create floodplain storage, plant native veg, create educational signage	1 (1.5)	1 (1.3)	1	4 (4.4)	3	2	3	3	2	3	2	4 (4.8) (B, C, D, G, H, J, K,L)	3	**34.0**
Channel Complexity Improvement: Create meanders and broaden floodplain to west downstream of Forest Rock Lane intersection	3	1	2	4	3	1	1	2	2	3	2	4 (4.8) (B, H, J, K, I)	1	**29.8**
Install grade control log/boulder structures in Wilderness Park	2 (3)	2 (2.6)		2 (2.2)	1	2	2	3	3	4	1	1	4	**28.8**

[1] Low relative costs: 4= <$50,000; 3=$50,000-$100,000; 2=$100,000-$200,000; 1= >$200,000

Relative weighting	**(x1.5)**	**(x1.3)**		**(x1.1)**								**(x1.2 if >1)**		
Total points possible	**6**	**5.2**	**4**	**4.4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4.8**	**4**	**56.4**
Scale: 4=high, 1=low	**Flood reduction/increases stormwater detention**	**Water quality improvement/increases stormwater treatment**	**Improves infiltration**	**Improves salmonid habitat**	**Improves fish and wildlife habitat**	**Minimizes impacts to existing resources**	**Provides educational or outreach potential**	**Time to implementation**	**Low Relative Cost[1]**	**Low operation & maintenance needs**	**Construction Feasibility**	**Aligns with grant funding priorities**	**Provides recreational opportunities or links**	**Total Weighted Points**
Riparian Vegetation Improvement: Clear willows, create benches for conifers, LWD, & boulders along channel on east side of Poulsbo Village	3 (4.5)	1 (1.3)		3 (3.3)	3	1	2	4	2	3	2	2 (2.4) (I, J)		**28.5**
Install educational signage regarding stream and forest ecology in Wilderness Park						3	4	4	4	3	4	2 (2.4) (F, I, L, M)	4	**28.4**
Remove rock weirs, create stepped grade behind Medical Center				4 (4.4)	4	2	1	3	1	3	2	4 (4.8) (A, G, H, J, K)		**25.2**
Bondwood Apartments Wetland and Riparian Enhancement	1 (1.5)	1 (1.3)	1	2 (2.2)	2	2	1	3	3	3	2	2 (2.4) (I, J)		**24.4**

[1] Low relative costs: 4= <$50,000; 3=$50,000-$100,000; 2=$100,000-$200,000; 1= >$200,000

Table B-2. Grant Funding Sources

Table B-1code	Grant	Agency	Amount		Deadline	Website and Contact	Type of Projects Funded								Applicable Actions/Projects
			Funds Available	Grant Range			Fish Passage	Water Quantity	Water Quality	Stormwater	Fish & Wildlife Habitat	Stream Restoration	Outreach & Education	Wetland Restoration	
A	2010 Open Rivers Initiative	U.S. Department Commerce/NOAA	$6 Million	$100,000–3 Million	Nov 16**	Steve Drescher; steve.j.drescher@noaa.gov http://www.nmfs.noaa.gov/habitat/restoration/projects_programs/crp/partners_funding/callforprojects3.html Also via grants.gov	X								Rock Weir Removal; 8th Avenue Culvert Replacement; Public Works Relocation and Restoration; Restore single channel from 8th to Centennial Park
B	Salmon Recovery Grant Program (requires coordination through Westsound Lead Entity)	WRCO, SRF Board and Westsound Lead Entity		$100,000–500,000	Spring to lead entity; early Sept to SRFB	http://www.rco.wa.gov/srfb/grants/salmon_recovery.htm Westsound Lead Entity: Kathy Peters 360-337-4679, kpeters@co.kitsap.wa.us	X				X	X			Public Works Relocation and Restoration; Restore single channel from 8th to Centennial Park Channel Complexity Improvement at Forest Rock Lane; 8th Avenue culvert replacement; Lincoln/305 Parking Lot Restoration; Kim property; Tributary and Wetlands Reconnection at 10th Avenue
C	Federal Aid in Wildlife Restoration (Pittman-Robertson)	U.S. Department of the Interior/U.S. Fish and Wildlife Service and Washington Department of Fish and Wildlife		$50,000–1 Million	Jan 10	http://wdfw.wa.gov/grants/wildlife_restoration/index.html					X				Tributary and Wetlands Reconnection at 10th Avenue; St Olaf's Restoration; Dailey Property Restoration; Lincoln/305 Parking Lot Restoration; Kim Property Restoration; Public Works Relocation and Restoration; Restore single channel from 8th to Centennial Park
D	National Coastal Wetlands Conservation Act Grant Program	U.S. Department of the Interior/ U.S. Fish and Wildlife Service and Washington Department of Fish and Wildlife	$19.2 Million	$200,000–1 Million	June	Bill Brooks, 360-902-2433, brookwcb@dfw.wa.gov http://wdfw.wa.gov/grants/wildlife_restoration/index.html								X	Tributary and Wetlands Reconnection at 10th Avenue; St Olaf's Restoration; Dailey Property Restoration; Public Works Relocation and Restoration; Restore single channel from 8th to Centennial Park; Austurbruin Park Floodplain Storage and Wetlands; Kim Property
E	North American Wetlands Conservation Act	U.S. Department of the Interior/ U.S. Fish and Wildlife Service		$1 Million*	Mar, Jul & Oct	703-358-1784 or dbhc@fws.gov								X	Tributary and Wetlands Reconnection at 10th Avenue; St Olaf's Restoration; Dailey Property Restoration; Public Works Relocation and Restoration; Restore single channel from 8th to Centennial Park; Austurbruin Park Floodplain Storage and Wetlands
F	Centennial Clean Water Program	Washington State Department of Ecology		Varies	Dec 1 2009 for FY 2011 work	Jeff Nejedly 360-407-6566 jnej461@ecy.wa.gov			X	X		X	X		8th Avenue Culvert Replacement; Develop diffuse SW management plan; Outreach to encourage LID; Poulsbo Village Parking Lot retrofit; Kitsap Medical Center Parking Lot retrofit; High School LID demonstration; Centennial Park; Wilderness Park Signage
F	Clean Water Act Section 319 Nonpoint Source Grant Program	Washington State Department of Ecology		Varies	Dec 1 2009 for FY 2011 work	Alice Rubin 360-407-6429 arub461@ecy.wa.gov			X	X		X	X		8th Avenue culvert replacement; develop diffuse SW management plan; adopt Ecology SW standards; outreach to encourage LID; Poulsbo Village parking lot retrofit; Kitsap Medical Center parking lot retrofit; High School LID demonstration; Centennial Park; Wilderness Park Signage

Table B-1code	Grant	Agency	Amount		Deadline	Website and Contact	Type of Projects Funded								Applicable Actions/Projects
			Funds Available	Grant Range			Fish Passage	Water Quantity	Water Quality	Stormwater	Fish & Wildlife Habitat	Stream Restoration	Outreach & Education	Wetland Restoration	
F	Washington State Water Pollution Control Revolving Fund	Washington State Department of Ecology		Varies	Dec 1 2009 for FY 2011 work	Cindy Price 360-407-7132 cpri461@ecy.wa.gov			X	X		X	X		8th Avenue Culvert Replacement; Develop diffuse SW management plan; Outreach to encourage LID; Poulsbo Village Parking Lot retrofit; Kitsap Medical Center Parking Lot retrofit; High School LID demonstration; Centennial Park; Wilderness Park Signage
F	Stormwater Retrofit and LID Grant Program	Washington State Department of Ecology	$4.3 million	Up to $500,000*	Dec 1 2009 for FY 2011 work	http://www.ecy.wa.gov/programs/wq/funding/2011/index.html		X	X	X					Develop diffuse SW management plan; Outreach to encourage LID; Poulsbo Village Parking Lot retrofit; Kitsap Medical Center Parking Lot retrofit; High School LID demonstration
G	National Fish Passage Program	U.S. Department of the Interior/ U.S. Fish and Wildlife Service		Varies	Sept 30		X								Rock Weir Removal; 8th Avenue Culvert Replacement; Public Works Relocation and Restoration; Restore single channel from 8th to Centennial Park
H	Partners for Fish and Wildlife Program	U.S. Department of the Interior/ U.S. Fish and Wildlife Service	$9 Million	Up to $25,000	Sep 30	David Gordon: 703-358-2025 http://www07.grants.gov/search/search.do?&mode=VIEW&flag2006=false&oppId=47672					X	X		X	Rock Weir Removal; Tributary and Wetlands Reconnection at 10th Avenue; St Olaf's Restoration; Dailey Property Restoration; Public Works Relocation and Restoration; Restore single channel from 8th to Centennial Park; Lincoln/305 Parking Lot Restoration; Kim Property Restoration; Channel Complexity Improvement at Forest Rock Lane
I	Kitsap Community Foundation Grants	Kitsap Community Foundation		$500–2,500	Jan 21, 2010	(360) 698-3622, e-mail kcf@kitsapfoundation.org or visit www.kitsapfoundation.org/							X	X	Wilderness Park Signage; Centennial Master Plan; Water Quality Monitoring; Channel Complexity Improvement; High School LID Demonstration; Riparian Vegetation Improvement; Bondwood Apartments Wetland and Riparian Enhancement
J	Whole Watershed Restoration Initiative	U.S. Department Commerce/NOAA		$20,000–100,000*	Nov 20**	Polly Hicks, 206-526-4861; polly.hicks@noaa.gov	X				X	X	X		Rock Weir Removal; Public Works Relocation and Restoration; Restore single channel from 8th to Centennial Park; Channel Complexity Improvement at Forest Rock Lane; Riparian Vegetation Improvement; Bondwood Apartments Wetland and Riparian Enhancement; Lincoln/305 Parking Lot Restoration; Kim Property Restoration;
K	NOAA/American Rivers Partnership Funding	U.S. Department Commerce/NOAA		Up to $100,000	Apr & Nov	Jason Lehto, 206-526-4670; Jason.a.lehto@noaa.gov	X				X	X	X		Rock Weir Removal; Public Works Relocation and Restoration; Restore single channel from 8th to Centennial Park; Channel Complexity Improvement at Forest Rock Lane; Lincoln/305 Parking Lot Restoration; Kim Property Restoration; 8th Avenue Culvert Replacement; Tributary and Wetland Reconnection at 10th Avenue
L	Bay Watershed Education and Training (B-WET) Program	U.S. Department Commerce/NOAA	$700,000	$25,000–60,000	Oct 8**	Steve Drescher; steve.j.drescher@noaa.gov http://www07.grants.gov/search/search.do?&mode=VIEW&flag2006=false&oppId=48542							X		High School LID Demonstration; Public Works Relocation and Restoration Restore single channel from 8th to Centennial Park; Channel Complexity Improvement at Forest Rock Lane; Wilderness Park Signage; Centennial Park Master Plan; Kim Property Restoration

Table B-1code	Grant	Agency	Amount		Deadline	Website and Contact	Type of Projects Funded								Applicable Actions/Projects
			Funds Available	Grant Range			Fish Passage	Water Quantity	Water Quality	Stormwater	Fish & Wildlife Habitat	Stream Restoration	Outreach & Education	Wetland Restoration	
M	Puget Sound Watershed Management Assistance Grants	EPA Office of Ecosystems, Tribal, and Public Affairs	$10 million	$300,000 to 1 million		Daniel Steinborn, 206-553-2728; Steinborn.daniel@epa.gov http://yosemite.epa.gov/r10/water.nsf/Office+of+Water/WEI09RFP#desc			X		X	X	X		Critical Areas Training Program; Critical Areas Code Enforcement (if includes education component); Water Quality Monitoring; Develop diffuse SW management plan; Outreach to encourage LID; Poulsbo Village Parking Lot retrofit; Kitsap Medical Center Parking Lot retrofit; High School LID demonstration; St Olaf's Restoration; Dailey Property Restoration; Wilderness Park Signage; Lincoln/305 Parking Lot Restoration; Austrubruin Park; Tributary and Wetland Reconnection at 10th Avenue

*Require matching funds

**Deadline for 2009 grant applications