City of Lakewood

Grant No. G1000045

Shoreline Analysis Report

Including Shoreline Inventory and Characterization for City of Lakewood Shorelines

Draft

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TABLE OF CONTENTS

Figures

Tables

Appendices

1.0 INTRODUCTION

1.1 BACKGROUND AND PURPOSE

The City of Lakewood (City) obtained a grant from the Washington Department of Ecology (Ecology) to conduct a comprehensive Shoreline Master Program (SMP) update. The first step of the update process is to inventory the City's shorelines as defined by the State's Shoreline Management Act (SMA) (RCW 90.58). The inventory was conducted according to direction provided in the Shoreline Master Program Guidelines and includes areas within current City limits. The shoreline inventory included in this Report describes existing biological and physical conditions, and uses Ecology's guidance to assess the baseline conditions for the qualitative extent of ecological functions provided via landscape-scale processes. Threats to these functions are provided, where evident, as well as recommendations for restoring processes and functions, where feasible. Ecology's Guidelines require that the City demonstrate that its updated SMP results in "no net loss" in ecological functions in the shoreline relative to the baseline at the time of its implementation. The following concepts are incorporated in Ecology's guidance for no net loss:

- The existing condition of shoreline ecological functions should not deteriorate due to permitted development. The existing condition or baseline is documented in the shoreline inventory and characterization. Shoreline functions may improve through shoreline restoration.
- New adverse impacts to the shoreline environment that result from planned development should be avoided. When this is not possible, impacts should be minimized through mitigation sequencing.
- Mitigation for development projects alone cannot prevent all cumulative adverse impacts to the shoreline environment, so restoration is also needed.

A list of potential information sources related to shorelines within the City was compiled and an information request letter was distributed to potential interested parties and agencies that may have relevant information (Appendix A). Collected information was supplemented with other resources such as City documents, GIS information, scientific literature, aerial photographs, internet data, and a site visit. The analysis follows the guidance established by Ecology. All maps are located in Appendix C.

1.2 SHORELINE JURISDICTION

As defined by the Shoreline Management Act of 1971, lands subject to Shoreline jurisdiction include "waters of the state plus their associated "shorelands". At a minimum, waters of the state are streams whose mean annual flow is 20 cubic feet per second (cfs) or greater, and lakes whose area is greater than 20 acres. In RCW 90.58.030, Shorelands are defined as:

> "Those lands extending landward for 200 feet in all directions as measured on a horizontal plane from the ordinary high water mark; floodways and contiguous floodplain areas landward 200 feet from such floodways; and all wetlands and river deltas associated with the streams, lakes, and tidal waters which are subject to the provisions of this chapter…Any

> county or City may determine that portion of a one-hundred-year-floodplain to be included in its master program as long as such portion includes, as a minimum, the floodway and the adjacent land extending landward two hundred feet there from… Any City or county may also include in its master program land necessary for buffers for critical areas."

The lakes and streams in the City's shoreline jurisdiction were originally part of Pierce County's Shoreline Master Program that was first adopted in 1978 prior to the incorporation of the City of Lakewood. At the time of incorporation, the shoreline areas for Chambers Creek were designated as *Conservancy* beginning from the outlet of Chambers Creek on the north shoreline of Lake Steilacoom and as *Natural* on the south bank where the creek intersects the east line of the northeast quarter of Section 28, Township 20, Range 2E and downstream to the intersections with Chambers Creek Road Bridge (LMC 14.34.010). Shoreline areas associated with American Lake, Gravelly Lake, Lake Louise, and Lake Steilacoom were designated as *Urban*. Waughop Lake shoreline area was designated as *Conservancy*. Within the City of Lakewood, Clover Creek was designated as *Urban*.

1.2.1 Shorelines of Statewide Significance

The SMA further designates some shorelines as shorelines of statewide significance. Shorelines of statewide significance include portions of Puget Sound and other marine water bodies, rivers with mean annual flow of 1,000 cfs or greater, and freshwater lakes 1,000 acres or larger. American Lake is approximately 1,125 acres in size and is therefore considered a Shoreline of Statewide Significance. WAC 173-26-251 establishes specific principles for SSWSs and sets forth Shoreline Master Program provisions that must be addressed in the analysis and regulation of adopted SMPs. These principles are:

(1) Recognize and protect the statewide interest over local interest;
(2) *Preserve the natural character of the shoreline;*
(3) *Result in long term over short term benefit;*
(4) *Protect the resources and ecology of the shoreline;*
(5) *Increase public access to publicly owned areas of the shorelines;*
(6) *Increase recreational opportunities for the public in the shoreline;*
(7) *Provide for any other element as defined in RCW 90.58.100 deemed appropriate or necessary.*"

1.3 STUDY AREA

The City of Lakewood is located in Pierce County, and has been incorporated since 1996. The City is bordered by the Town of Steilacoom and unincorporated Pierce County to the west, Joint Base Lewis McChord (JBLM) and Camp Murray to the south and southeast, University Place to the north, Tacoma to the northeast, and unincorporated Pierce County to the east. Interstate 5 (I-5) passes through the City along the eastern border, and a number of major arterials crisscross throughout the City. The City encompasses approximately 20 square miles. The City's Potential Annexation Areas (PAAs) encompass another 13,276 acres. The study area for this report includes all land currently within the City's existing shoreline jurisdiction (Figure 1, Appendix C). The total area subject to the City's updated SMP is approximately 61.6 acres, and encompasses approximately

73,676 lineal feet (14 miles) of lakeshore and stream shoreline.

1.4 CHAMBERS-CLOVER WATERSHED (WRIA 12)

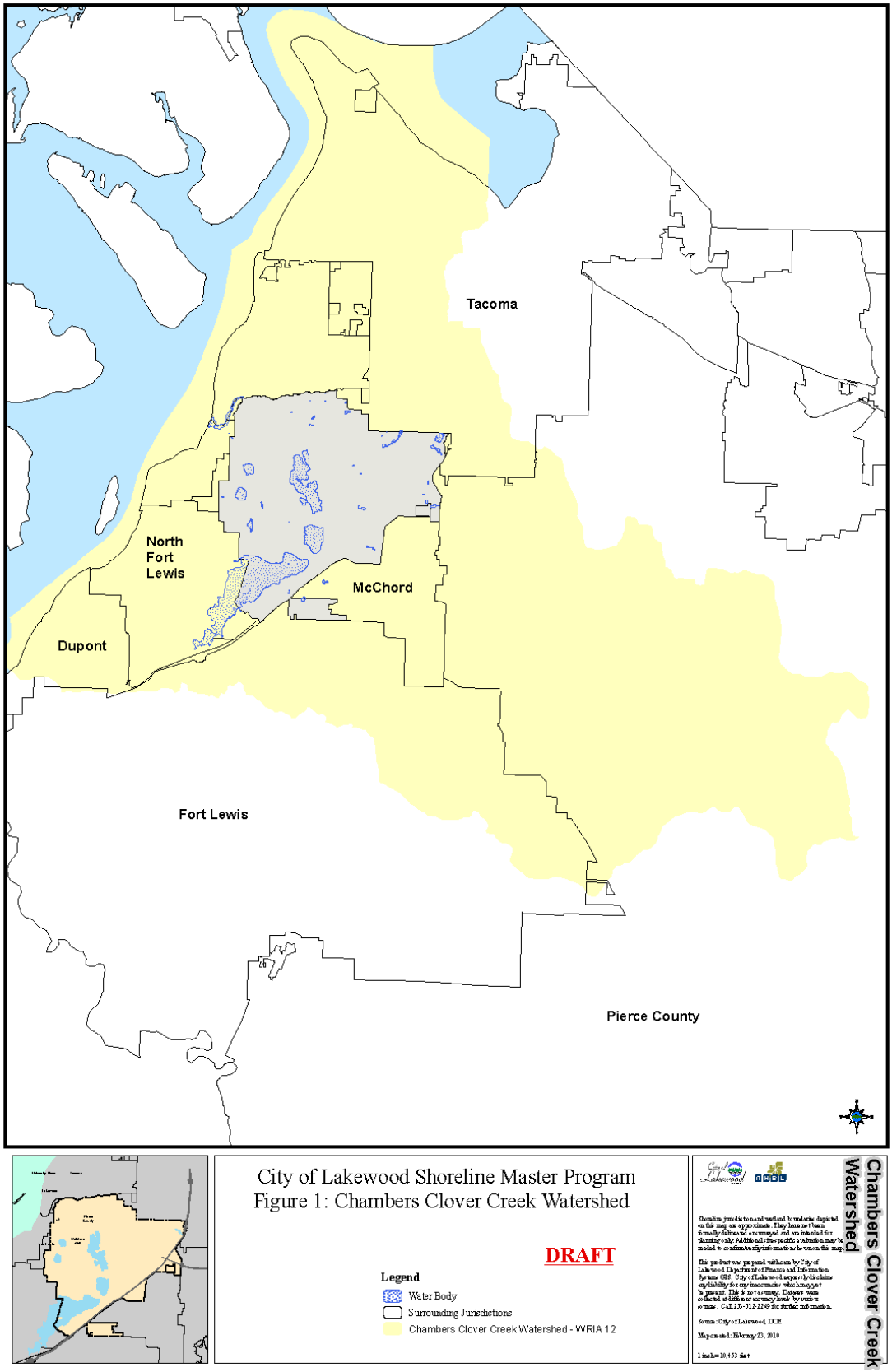
1.4.1 Geographic Context

The City of Lakewood is located within Water Resource Inventory Area (WRIA) 12 (Figure 1) with all areas draining through Chambers and Clover Creeks and then into the Puget Sound. WRIA 12 is a somewhat triangular shape bounded by Puget Sound to the west, the Puyallup River Basin to the east, and the Nisqually River Basin to the South (Chambers-Clover Technical Assessment Final Report 2003). WRIA 12 is approximately 180 square miles in size and is broken down into three Basins; Clover Creek Basin, American Lake Basin, and Chambers Bay Basin. These basins are further broken down into five sub-basins: American Lake, Chambers Creek, Clover Creek, Gravelly Lake, and Lake Louise.

The lakes that are included in the City's shoreline jurisdiction are American Lake, Gravelly Lake, Lake Steilacoom, Lake Louise, and Waughop Lake. Portions of Clover Creek and Chambers Creek are also included in the City's shoreline jurisdiction; as are wetlands associated with the lakes and streams. Lakewood City limits and Fort Lewis Military Reservation limits cut through American Lake. American Lake shoreline areas outside Lakewood City limits are not included in this report.

Seeley Lake is also located in the City of Lakewood. The lake is not considered to be in the City's shoreline jurisdiction because it has less than 20 acres of open water, which was confirmed using aerial photos. There is very little open water, and the remainder of the original lake bed area (approximately 41 acres) is covered with aquatic bed and emergent vegetation.

Figure 1. Chambers-Clover Watershed Boundary Map



1.4.2 Historic Geology, Topography, and Drainage Patterns

The City of Lakewood is located in fairly level flatlands approximately 200 feet in elevation above the Puget Sound. The land generally drains west/northwest to the Puget Sound. The terrain was formed as a result of glacial deposition or erosion and distinct channels (including Clover and Chambers Creeks) were cut through the area by high-velocity glacial meltwater (Tetra Tech KCM 2002). In some areas, these channels are lined by steep slopes or bluffs, which is the case along portions of Chambers Creek. American Lake (American Lake subwatershed) drains to the southwest via Sequalitchew Lake and Sequalitchew Creek, also eventually draining into the Puget Sound. There is a manmade weir and canal that drains water from American Lake when the water surface level exceeds 233 feet above mean sea level. This feature is located outside the City of Lakewood.

All of the lakes in the City of Lakewood receive the majority of their water input from natural groundwater springs. Lake Steilacoom was created in 1852 when a dam was built at the outlet to Chambers Creek, causing the large wetland complex to become flooded, creating what is now a large, but fairly shallow lake.

1.4.3 Major Land Use Changes and Current Shoreline Condition

Lakewood has been one of the fastest growing cities in Pierce County. The City is highly developed with single family housing, particularly near the City's shorelines, and commercial and industrial businesses being located closer to I-5. Housing construction in the shoreline jurisdiction since the early to mid 1900s has resulted in most of the shoreline areas being completely built out. The only exceptions to this are Waughop Lake at Fort Steilacoom Park and portions of Chambers Creek that are within a ravine. Housing construction also resulted in heavy shoreline modification in the way of bulkheads, boat docks, and the compaction of adjacent land for the construction of houses, decks and patios, as well as the installation of lawns and gardens.

1.4.4 Development History

European settlement began in the Lakewood area in the early 1830s when it was used as a fur trading post by the Hudson Bay Company. Farming began on the prairie soon after and Fort Steilacoom was used to quell Indian uprisings in the 1850s. The north end of Lake Steilacoom was home to the area's first grist, saw, and flour mills in the early to mid 1850s. In 1855 the Lakewood area had the first school built north of the Columbia River. The western terminus of the Northern Pacific Railway was completed in 1873 near Clover Creek.

By the late 1800s, the prairie had begun to vanish, replaced with homes and roads. In 1894 the Tacoma Golf and Country Club was built on the shores of American Lake and was the first Country Club west of the Mississippi River. In the early 1900s many estates were built along the shorelines of the City's many lakes and by the 1920s many residents were converting summer homes to year-round residences. Other interesting features in the City included the Tacoma Speedway, constructed in the early 1900s, and the inner grasslands of the track served as a landing strip for aircraft. The

adjacent military installations of Fort Lewis and McChord Air Force Base (now referred collectively as Joint Base Lewis McChord) were constructed in the 1910s and 1930s, respectively, both playing a prominent role in the community (Lakewood Historical Society 2010).

Between 1939 and 1949, the population in the Lakewood area jumped from 3,000 to 17,000. Since the 1950s development has continued as shopping centers, hospitals, libraries, and colleges have helped shape the community of Lakewood. In 1996, the area was incorporated from Pierce County into the City of Lakewood. By 2000, the City had approximately 60,000 residents and supported almost 1,100 businesses – making it the second largest City in Pierce County behind Tacoma (City of Lakewood 2010).

Table 1 provides a summary of shoreline permit applications submitted to the City between the years 1996 and 2009. There has been a modest level shoreline development activity over the last 13 years. The most common activity specifically noted is pier construction (51 new or replacement piers). A large number of permits are noted for the "Other" category and it is not clear from the data what these permits were for. Thirty-six Shoreline Substantial Development Permits were issued over the 14-year period covered by the data, volumes ranged between one to five permits per year. Twenty-seven permits were issued for exempt activities, which under state law currently includes (but is not limited to) the construction of the normal protective bulkhead common to single family residences, docks that do not exceed a cost of $10,000 and any development which does not exceed a cost of $5,000. There have been only three permits issued for bulkhead modification during this same 14 year period, which is an unexpected finding given the large number of properties with bulkheads. The number of Conditional Use Permits and Variances issued was low, indicating that most permit applicants have been able to comply with current City standards. The amount of new upland development has been modest, with 11 permits for residential structures and five permits for multifamily or commercial structures, reflecting the largely developed nature of a shoreline area that has seen only limited incremental change in recent years.

Table 1
Shoreline Permit History in the City of Lakewood since Incorporation

Year	Pier		Bulkhead Mod.	Upland Residential Structure	Upland Com/MF Structures	Utilities	Other	Permit Type			
	Extension / Mod.	New/ Replace						Exemption	SSDP[1]	CUP[2]	Variance
1996	0	4	1	0	0	0	3	0	3	0	1
1997	0	1	0	1	0	0	0	0	1	0	0
1998	0	3	0	0	0	0	3	0	3	0	0
1999	2	0	0	0	0	0	2	0	2	0	0
2000	2	2	0	0	0	0	4	0	4	0	0
2001	1	3	0	0	0	0	4	0	4	0	0
2002	1	3	0	1	0	0	3	2	1	0	1
2003	0	2	0	2	1	3	0	2	4	0	0
2004	0	5	0	0	1	0	5	1	4	1	0
2005	1	4	0	1	0	0	4	3	1	0	1
2006	1	7	1	1	2	0	5	4	5	1[3]	1[3]
2007	0	4	1	1	1	0	3	4	2	1[3]	0
2008	0	6	0	3	0	0	5	5	1	0	0
2009	0	7	0	1	0	1	5	6	1	0	1[3]
TOTAL	**8**	**51**	**3**	**11**	**5**	**4**	**46**	**27**	**36**	**3**	**5**

[1] Shoreline Substantial Development Permit

[2] Shoreline Conditional Use Permit

[3] Land use application approval was associated with a SSDP

1.4.5 ESA Listings

Steelhead of the Puget Sound Distinct Population Segment (DPS) (U.S. Federal Register, 11 May 2007) is the only federally listed salmonid species that occurs in the City of Lakewood. Steelhead presence is documented in Chambers Creek and their presence is assumed in Lake Steilacoom and Clover Creek (StreamNet 2010). Additionally, Puget Sound-Strait of Georgia coho salmon also occur in the basin and are listed as a Species of Concern (U.S. Federal Register, 15 April 2004), indicating that they are under less active consideration for formal listing. Coho spawn in Chambers and Clover Creeks and their presence is documented in Lake Steilacoom (StreamNet 2010). Critical habitat for Puget Sound steelhead has not yet been designated but is under development. There are specific regulations outlining the designation of critical habitat after a species has been listed. Some of the considerations taken into account for designating critical habitat include economic impacts, impacts on national security, and other relevant impacts of specifying any particular area as critical

habitat (NOAA 2010). It is not known if there will be critical habitat for steelhead included in the City of Lakewood. All fish that utilize Chambers Creek, Lake Steilacoom, and Clover Creek are present because they are captured at the mouth of Chambers Creek and released upstream of the fish barrier. Chinook salmon are not released upstream, but are taken to Garrison Springs Hatchery for egg harvest (Pierce Conservation District 2003). The Garrison Springs Hatchery is located in the City of Lakewood near Chambers Creek.

2.0 CURRENT REGULATORY FRAMEWORK SUMMARY

2.1 CITY OF LAKEWOOD

Upon incorporation, the City of Lakewood adopted by reference Pierce County's Title 20 Shoreline Master Program (SMP) to regulate shoreline development (Lakewood Municipal Code (LMC), Title 14 - Environmental Protection). Most of the uses, developments, and activities regulated in the City's SMP are also subject to the City's Comprehensive Plan, Zoning Code, the International Building Code and various other provisions of City, State and Federal laws, as discussed in Section 2.2. An applicant must comply with all applicable laws prior to commencing any use, development, or activity. Lakewood ensures consistency between the SMP and other City codes, plans and programs by reviewing each for consistency during periodic updates of the City's Comprehensive Plan as required by State statute.

Upon incorporation, Lakewood also adopted regulations to designate and protect critical areas pursuant to the Washington State Growth Management Act (GMA) (RCW 36.70A). In response to later GMA amendments, the City adopted a revised Critical Areas Code (CAC) in 2004 consistent with best available science and all other requirements of the GMA. All activities which fall within critical areas and their buffers in the SMA are reviewed under the City's CAO for consistency. If there is a conflict between the CAO and SMP, the regulations that offer the greatest environmental protection apply. After the SMP is updated with appropriate inclusion of SMP-specific critical areas regulations, critical areas within shoreline jurisdiction will be reviewed only under the updated SMP. Critical areas in the City of Lakewood include wetlands, critical aquifer recharge areas, fish and wildlife habitat areas, geologically hazardous areas, flood hazard areas, and mineral resource lands (LMC Title 14A).

General zoning and development standards are contained in LMC Title 18A – Land Use and Development Code. Public works standards are contained in LMC Title 12A. Stormwater management is regulated by LMC Chapter 12A.11, the DOE Stormwater Management Manual for Western Washington and the City of Lakewood Engineering Standards Manual. The DOE Stormwater Management Manual for Western Washington includes provisions for low impact development (LID), a specific stormwater management strategy that emphasizes conservation and use of existing natural site features integrated with distributed, small-scale stormwater controls to more closely mimic natural hydrologic patterns in developed settings.

2.2 STATE AND FEDERAL REGULATIONS

State and federal regulations most pertinent to development activities on lands subject to the City's Shoreline provisions include:

- Section 404 of the Clean Water Act;
- Endangered Species Act;
- Section 401 Water Quality Certification; and
- Washington State Hydraulic Code.

There are additional federal regulations which may come to bear on lands within the Shoreline zone of the City, however, there is less potential for those federal laws to be brought to bear. These regulations could include the National Environmental Policy Act (NEPA), the Anadromous Fish Conservation Act, the Clean Air Act, or the Migratory Bird Treaty Act. In most instances these Federal regulations would only be implemented if an action was either federally initiated, federally funded, or required some other Federal permit.

There are other Washington State laws that are applicable to the City and its planning process such as the Washington State Growth Management Act; however these laws are not directly initiated by site specific land-use actions with the City's Shorelines. The City implements the State Environmental Policy Act (SEPA) directly through its own SEPA official. Implementation of SEPA assures that projects throughout the City abide by City and State policies regarding critical areas, noise, air and water quality, and other environmental concerns.

There are a multitude of Federal and State regulations that may be relevant within the Shoreline zones of the City. A summary of those regulations follow. Where reasonable and prudent, the update to the City's Shoreline Master Program will consider, and may incorporate, some of the relevant aspects of these other regulations to assure clarity for applicants. It is not necessary for the City's Shoreline Master Program to reflect all of the provisions of these state and federal regulations; however an applicant remains legally responsible to assure that proposed actions within the City that trigger state and federal regulations also obtain those relevant permits in addition to applicable City permits.

In general, an application within the City's Shoreline zone will trigger a permit or review from the U.S. Army Corps of Engineers, National Marine Fisheries Service, U.S. Fish and Wildlife Service, Washington Department of Ecology, and/or Washington Department of Fish and Wildlife only if the action is below the Ordinary High Water Mark of a Water of the U.S. or a Water of the State; or it poses some risk to a federally listed species or its critical habitat. Involvement by these state and federal agencies would most often be triggered by discharge of fill or pollutants into water or wetlands, as well as construction of a dock, bulkhead, or other over-water structure.

Provided below is a summary of the key state and federal regulations pertaining to water or habitat within Shoreline zones within the City. An applicant may be subject to one or more of these regulations, in addition to the City's Shoreline Master Program.

Section 404 of the Federal Clean Water Act

The Army Corps of Engineers (the Corps), regulates the "discharge of dredged or fill material into waters of the United States, including wetlands". The Seattle District of the Corps has an extensive regulatory program with multiple sources of guidance located here: (http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=REG&pagename=Home_Page). The Corps' legal authority to regulate fill or discharges in "waters of the U.S." overlaps some of the City's shoreline provisions; there may be instances of actions that the City's shoreline code

allows but which the Corps implementation of Section 404 of the Clean Water Act may preclude or severely limit. An applicant who is proposing any fill or discharge into a waterbody under the City's shoreline jurisdiction, or its associated wetlands or tributary streams, will have a high probability of requiring an application and review by the Corps. Examples of common activities within Shoreline jurisdiction that typically require a Corps permit would include placement or replacement of a bulkhead, placement or replacement of an over-water structure; repair or installation of discharge pipes or fill for drainage systems, filling or grading wetlands, floodplains, or streams associated with the lakes. Even activities that are undertaken to restore or create habitat improvements in these aquatic settings may require review and approval by the Corps of Engineers.

The Corps requires applicants to document in sequence, the following actions: avoidance of adverse impacts to "waters", re-design of projects to minimize impacts to "waters", restoration of impacts to waters after the project is completed, and finally compensation for unavoidable adverse impacts. If a Corps permit is required for a project, the applicant may also be required to submit documentation to the National Marine Fisheries and/or NOAA Fisheries Service relative to the potential of their project to effect federally listed endangered species (see below for more detail). In addition, the requirement of a Corps permit also would trigger the need for the project to meet the provisions of the Sect. 106 of the Historical Preservation Act.

Endangered Species Act (ESA)

The Endangered Species Act (http://www.epa.gov/lawsregs/laws/esa.html) is carried out by the National Marine Fisheries Service (NOAA Fisheries) and the U.S. Fish and Wildlife Service (USFWS) (both, together known as The Services); each Service is responsible for a sub-set of the listed species. The ESA prohibits "take" of listed species or habitat critical to that species survival. "Take" within the ESA is defined as: "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." In general, the provisions of the ESA are triggered when an activity has the potential to affect federally listed species; or the action requires a Federal permit (e.g., a Corps permit); or the project receives Federal funding (e.g., FHWA funding of public road project), is proposed by a Federal agency; or occurs on Federal land. Within the City of Lakewood, it is most likely that a project within Shoreline jurisdiction would trigger the provisions of the ESA (and require consultation with the Services) if it also triggered a Section 404 permit from the Corps.

Section 401 Water Quality Certification

Washington State has been delegated authority to implement Section 401 of the federal Clean Water Act by the Corps of Engineers (http://apps.ecy.wa.gov/permithandbook/permitdetail.asp?id=43). The Department of Ecology reviews, conditions, approves or denies certain actions that may result in discharges to "state waters", which includes wetlands. Washington State has state water quality standards that must be met; and actions which result in impacts to waters of the state can be subject to the provisions of Section 401 standards. Discharge of pollutants (or the potential there-of), filling, grading, or other alterations to lakes, streams or wetlands under the City's shoreline jurisdiction (and tributary streams above shoreline jurisdiction) may be subject to review and approval to meet Ecology's 401 provisions.

Hydraulic Code

Washington Department of Fish and Wildlife (WDFW) (http://wdfw.wa.gov/hab/hpapage.htm) regulates aquatic habitats through Chapter 77.55 RCW (Revised Code of Washington) (the Hydraulic Code). The code gives the state the authority to review, condition, approve or deny "any construction activity that will use, divert, obstruct, or change the bed or flow of state waters." As applicable to the City of Lakewood's shoreline jurisdiction, actions that occur below the Ordinary High Water Mark (OHWM) of lakes, streams, or associated wetlands under the City's shoreline jurisdiction (or their tributaries outside Shoreline jurisdiction) will trigger the need to obtain a Hydraulic Project Approval (HPA) from the WDFW. Examples of activities include: stream alteration, culvert installation or replacement, pier and bulkhead repair or construction, dock repair or construction, etc.

3.0 ELEMENTS OF THE SHORELINE INVENTORY

3.1 INTRODUCTION

Development of a shoreline inventory is intended to record the existing or baseline conditions upon which the development of shoreline master program provisions will be examined to ensure the adopted regulations provide no net loss of shoreline ecological functions. The following discussion identifies each of the required inventory elements for the jurisdictional shoreline (Table 2), sources of information for each element, and provides a City-wide narrative for each element. Shoreline-specific discussions, as needed, are found in Chapter 4.0. Photographs are included in Appendix B. Figure 15 in Appendix C shows these planning segments.

Table 2
Shoreline Planning Segments

Segment	Approximate (feet)	Approximate Area (acres)
1—Chambers Creek	14,334	17.3
Segment 1A	8,055	11.8
Segment 1B—includes Chambers Creek Park	4,994	4.7
Segment 1C—Wetland at Game Reserve)	1,283	0.8
2—Clover Creek	7,089	9.4
3—American Lake	27,768	11.2
3A—Residential	21,802	9.2
3B—City Parks (American Lake North, Lakeland, and Harry Todd Parks)	985	0.4
3C—Tacoma Golf & Country Club	270	0.2
3D—Silcox Island	3,284	1.0
3E—Open space (south of Silcox island)	1,427	0.4
4—Lake Steilacoom	32,669	13.2
4A—Residential	31,745	12.8
4B—Edgewater Park	924	0.4
5—Gravelly Lake	10,932	4.8
5A—Residential	10,462	4.6
5B—Lakewold Gardens	470	0.2
6—Lake Louise	4,975	2.4
7—Waughop Lake	4,670	3.5
TOTAL	**81,014 feet**	**61.6 acres**

3.2 DATA GAPS

GIS information was largely available for most of the shoreline inventory elements. Much of this information, i.e. land use, transportation, utilities was available at the City or through the County. Notable gaps in local GIS data include:

- Impervious surfaces data is from a national data (NLCID 2006) set based on aerial photo interpretation. This information provides a reasonable visual impression of impervious surface coverage on a map, but may not be entirely reliable for true calculations.
- Vegetation data was not available locally, and national land cover data is of such marginal reliability that it was not mapped.

3.3 LAND USE PATTERNS

Land use patterns were derived from GIS mapping of assessor land use data, City zoning classifications, future land use designations, and from review of aerial photography from 2008. Table 3 identifies the relative percentages of existing land uses, zoning classifications, and future land use designations within the shoreline jurisdiction.

Table 3
Land Use, Zoning, and Shoreline Environments

Shoreline Area	Existing Land Use (acres)		Zoning Classification (acres)		Comprehensive Plan Designation (acres)		Existing Shoreline Designation
Chambers Creek	P	13.5	OS	103.2	OS	65.9	Conservancy, Natural
	RES	81.7	SF	68.3	SF	68.3	
	VAC	30.5	MF	0.2	MF	0.2	
	COM	0.1	COM	1.1	COM	1.1	
Clover Creek	P	0.1	OS	0.3	OS	0.3	Urban
	RES	65.6	SF	54.6	SF	54.6	
	VAC	3.6	MF	24.2	MF	24.2	
	COM	6.0	COM	8.0	COM	8.0	
	OTHER	2.6	-	-	-	-	
American Lake	P	3.5	OS	9.6	OS	9.6	Urban
	RES	98.0	SF	107.4	SF	107.4	
	VAC	6.6	MF	3.2	MF	3.2	
	COM	1.0	COM	0.0	COM	0.0	
Lake Steilacoom	P	0.8	OS	0.1	OS	0.0	Urban
	RES	128.8	SF	130.0	SF	130.2	
	VAC	0.1	MF	4.0	MF	4.0	
	COM	0.0	COM	0.0	COM	0.0	
	M	0.1	-	-	-	-	
Gravelly Lake	P	0.0	OS	2.3	OS	2.3	Urban
	RES	49.3	SF	49.5	SF	49.5	
	VAC	1.5	MF	0.0	MF	0.0	
	COM	0.0	COM	0.0	COM	0.0	
Lake Louise	P	0.0	OS	0.0	OS	0.0	Urban
	RES	21.0	SF	23.2	SF	23.0	
	VAC	0.5	MF	0.0	MF	0.0	
	COM	0.0	COM	0.0	COM	0.0	
Waughop Lake	P	13.7	OS	37.3	OS	37.3	Conservancy
	SF	0.0	SF	0.0	SF	0.0	
	VAC	0.0	MF	0.0	MF	0.0	
	COM	0.0	COM	0.0	COM	0.0	

Key:

Existing Land Use	Zoning Classifications	Comprehensive Plan Designations
P: Park, Public	SF-Single-Family Residential: R1, R2, R3, R4	SF - Single-Family Residential (SF, OVER)
RES: Residential M : Mobile Home	MF-Multi-famil Residential: MF1, MF2, MR2	MF - Mulit-Family Residential (MF, MR, HD)
VAC : Vacant land	OS-Open Space: OSR1, OSR2	OS - Open Space
COM: Commercial	COM-Commercial: NC1, NC2, C1, ARC	COM - Commercial (CC, NBD, ATC)

Existing Land Use

Land use around American Lake, Lake Steilacoom, Gravelly Lake, and Lake Louise consists primarily of residential single family development. A majority of these parcels include bank armoring, boat piers, and/or swim platforms. Clover Creek has a significant amount of single family housing that has encroached upon the stream buffer resulting in a narrowed, or in some cases, non-existent riparian zone. There is also a greater variety of land uses, including commercial uses, along the eastern portion of Clover Creek. Chambers Creek has some single family housing within the shoreline jurisdiction along the north/south oriented segment. Much of the north/south oriented segment has been modified by individual homeowners. These modifications include channelizing the stream, armoring the bank with rocks, and eliminating or reducing the riparian vegetation (Pierce Conservation District 2003). The east/west segment has little or no development in the shoreline area and a significant portion of it is a park. Waughop Lake is fully contained within Fort Steilacoom Park, and does not have any homes or buildings built around it. However, it does have a paved trail that goes around the lake and is within the shoreline jurisdiction.

Zoning Classifications

American Lake and Lake Steilacoom are primarily zoned Residential One (R1), Two (R2), and Three (R3) with a few areas zoned as Open Space & Recreation One (OSR1) and Two (OSR2), and two small areas consisting of multiple parcels on each lakes' shoreline that are zoned as Multifamily One (M1). Lake Steilacoom also has a small portion of a parcel in its shoreline area that is zoned as Neighborhood Commercial Two (NC2) and a small portion of a parcel zoned Arterial Commercial (AC).

Gravelly Lake is completely zoned as R1 and R2, except for one parcel that is zoned as OSR2. Lake Louise is zoned as R3 and R4. Waughop Lake and its associated wetland are completely zoned as OSR1.

The Clover Creek shoreline area west of I-5 is primarily zoned as R2, with a small area of NC 1 and Mixed Residential 2 (MR2). On the east side of I-5 the shoreline area consists of Multifamily Two (MF2) and Three (MF3), and NC2 zoned areas.

The majority of Chambers Creek is zoned as R2 and Open Space & Recreation One (OSR1). Other small portions are zoned as R3 and R4 and MF1. A small area where the Chambers Creek shoreline area meets the Lake Steilacoom shoreline area is zoned AC.

3.4 TRANSPORTATION

The majority of roads located in the shoreline jurisdiction are minor roads that provide access for homes. There are a few arterials that cross, either over or under, Chambers Creek. Clover Creek crosses under Gravelly Lake Drive SW, Pacific Highway and under I-5. According to the City's Six Year Comprehensive Transportation Program for 2010-2015, there are numerous projects that appear to occur within or very close to the shoreline jurisdiction. Most of the projects are minor

improvements that will occur throughout the City and include replacing or adding signals, upgrading existing facilities to current ADA standards, adding bike lanes and sidewalks, and conducting bridge inspections. Some of the projects that may include additional impervious surface in or near the shoreline jurisdiction include roadway restoration and improvements along Steilacoom Boulevard, some of which is in the shoreline jurisdiction. The improvements include replacing an existing traffic signal, installing a traffic barrier curb and overlay of the existing asphalt. One non-motorized trail is proposed around Gravelly Lake as an expansion of the existing road, however based on the available information, it does not appear that this trail will be located within the shoreline jurisdiction. Beyond the improvements mentioned previously, there are no proposed road expansions, new roads, or other expansions that would create significant amounts of impervious surface within the City's shoreline jurisdiction.

3.5 WASTEWATER AND STORMWATER UTILITIES

Two primary utilities have the ability to significantly impact (directly and indirectly) jurisdictional shorelines: wastewater and stormwater. The City of Lakewood (Surface Water Management division) operates and maintains the City's stormwater collection system and facilities, while Pierce County Public Works and Utilities is responsible for the City's wastewater conveyance and treatment. The City is currently constructing a sewer extension project near the shores of American Lake that will convert the neighborhood from on-site sewage disposal to public sanitary sewer service. In different areas of the City, the Lakewood Water District, Parkland Water District, and Tacoma Water together serve the residents of Lakewood with drinking water.

While there are numerous water bodies in the City's shoreline jurisdiction that have Category 5 waters on Ecology's 303(d) list, none of the water bodies in the City of Lakewood yet have an active TMDL. Per Ecology's Water Quality Assessment website: "*Washington's Water Quality Assessment lists the status of water quality for a particular location in one of 5 categories recommended by EPA. This Assessment represents the Integrated Report for Sections 303(d) and 305(b) of the Clean Water Act. The 303(d) list reports on category 5 waters, the impaired waters of the state. Waters placed on Category 5 require the preparation of a plan to improve water quality by limiting pollutant loads. "Total Maximum Daily Loads" (TMDLs) are a key tool in the work to clean up polluted waters*" (Ecology 2010). Additional information regarding general water quality in the City of Lakewood is located in Section 3.5.2 below. Information regarding water quality in specific waterbodies is found throughout Section 4.

3.5.1 Wastewater Utilities

The City's wastewater is treated by Pierce County Public Works and Utilities Department, with discharge into Puget Sound. The Chambers Creek Regional Waste Water Treatment Plant is responsible for collecting, treating, and discharging the waste from the City of Lakewood. Discharges from this plant is regulated by the Washington Department of Ecology (Ecology) under National Pollutant Discharge Elimination System (NPDES) permits, which includes performance standards and monitoring requirements. The Chambers Creek Regional Waste Water Treatment Plant is located just outside of Lakewood City limits, near the mouth of Chambers Bay. Figure 7 in

Appendix C shows the location of the sanitary sewer facilities in relation to the City's jurisdictional shorelines.

Areas in the City or areas upstream where sanitary sewer service is not available present a risk to the water bodies in terms of failure of the onsite septic systems that serve these areas. An area of approximately 40 acres located just north of Lake Louise and southwest of Lake Waughop, but outside the proposed SMA of either lake, contains 93 single-family residences that rely on on-site sewage disposal systems. Residences in the Tillicum and Woodbrook portions of the City, south of American Lake, also currently rely on on-site sewage disposal systems, but will soon have public sanitary sewer service provided by Pierce County. While the City of Lakewood is working to transition properties that use on-site sewage disposal systems to sanitary sewer service, it is not in control of what jurisdictions do upstream of their water bodies. Clover Creek and Chambers Creek are on Ecology's 303(d) list for fecal coliform, and Lake Steilacoom is on the list for total phosphorous, both of which are indications that there are likely failing septic systems (in addition to other sources) upstream contributing to the pollutant loading in these water bodies.

3.5.2 Stormwater Utilities

The City has mapped all of its storm drain structures, vaults, storm pipe locations, inlets, and outfalls to water bodies. Figures 8A, 8B, and 8C in Appendix C show the location of these structures in and around the shoreline jurisdiction area. All of the water bodies in the City's shoreline jurisdiction have at least one outfall into the waterbody.

The City received its National Pollutant Discharge Elimination System (NPDES) Phase II permit in January 2007 from Ecology, as did many small towns and cities in the Puget Sound area (Regulated Small Municipal Separate Storm Sewer Systems). The NPDES Phase II permit is required to cover the City's stormwater discharges into surface waters of the State. As part of compliance with the permit, cities are required to develop and implement a Stormwater Management Program (SWMP). A SWMP is a set of actions and activities necessary to meet the requirements of the Phase II permit, including reducing discharge of pollutants from the regulated small sewer systems to the maximum extent practicable; implement all known, available and reasonable technologies (AKART) to prevent, reduce and treat pollution; and protect water quality (Washington Department of Ecology 2007). The SWMP includes provisions for public education, outreach, and involvement; detection and elimination of illicit discharges; runoff control for construction and new development; and a pollution prevention and operation and maintenance program for municipal operations. The SWMP must also include any additional actions necessary to meet the requirements of any applicable TMDLs issued by Ecology. Compliance with the permit is phased over five years, with full compliance required by 2012.

As part of the NPDES Phase II permit compliance, the City currently has various programs to control stormwater pollution through maintenance of public facilities and inspection of private facilities, as well as conducting construction site inspections and requiring appropriate spill control and response measures. The City is continuing to work towards meeting the requirements of the NPDES permit by 2012. Some of the current goals the City is working towards include establishing

updated maintenance standards for facility function, performing maintenance within required timeframes, annual inspection of all municipally owned or operated permanent stormwater treatment and flow control facilities, conducting checks of potentially damaged stormwater facilities after major storm events, and several activities and educational opportunities relating to public involvement and participation (City of Lakewood 2009).

3.6 IMPERVIOUS SURFACES

Impervious surface is a hard surface area which either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development; and/or a hard surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, gravel roads, packed earth (e.g. lawns, heavily grazed pasture, athletic fields, etc.), and oiled, macadam, or other surfaces which similarly impede the natural infiltration of surface and storm water runoff (Pierce County 2008).

Increases in impervious surface throughout the contributing basin has the potential to impact the jurisdictional shorelines and associated waterbodies, not just the changes in impervious surfaces located directly within the shoreline area. There is substantial documentation on the effects and implication of increased imperviousness on natural aquatic systems. Increases in impervious surface can cause greater quantities of water to be directed towards natural conveyances and receiving bodies (e.g., lakes, streams, and wetlands), flooding, as well as an increased water velocity in streams. Increases in water volume may change the hydroperiod of natural water bodies: meaning that storm events may cause lakes/wetlands to have greater water level fluctuations for a given storm event. Increased water velocity can cause an increase in erosion, sediment deposition, and movement of pollutants associated with stormwater and sediment. Flooding can cause damage to human infrastructure and public/private properties, as well as the deposition of sediment and debris within the floodplain. Storm water carries pollutants and sediment which can eventually reach water bodies such as the lakes, streams, and wetlands in the City of Lakewood. When the water velocity slows, the pollutants and sediment drop out of the water column and settle in the water. Increased sedimentation adversely affects water quality which may impair habitat for aquatic organisms as well as physically change the configuration of the lakeshore causing loss or change in shoreline habitats. In addition, many of the City's waterbodies currently have elevated phosphorous levels which may be attributed to pollutant loading from the surrounding watershed. Continued development in Lakewood as well as in the greater watershed contributes to stormwater runoff that will continue to affect the hydroperiod and habitats of the City's waterbodies.

The readily available public data was insufficient to calculate the amount of impervious surface within the shoreline jurisdiction. Given the extent of parcel development, the removal of natural forest cover and extent of lawn (which functions as "effective" impervious surface) it can be assumed that the percent of effective imperviousness exceeds 20%. Twenty percent imperviousness has been identified by jurisdictions in Western Washington such as King County as the threshold,

above which adverse changes in hydroperiod should be expected. Even parcels that are less developed, such as the parks, have areas of impervious surface in the way of parking lots, access roads, lawn and compacted trails. Based on the percentage of parcels that are built out and an analysis of Figure 9 in Appendix C, it is estimated that at least 90 percent (conservative estimate) of the parcels have greater than 20% effective impervious surface.

Other information available regarding impervious surface is available for the Chambers-Clover Creek watershed, but only provides information for a portion of the City's shoreline areas. It is estimated that approximately one-third of the watershed is built up with residential, commercial, industrial, and other significant urban development. Additionally, the majority of this development is in Lakewood or the surrounding area, while the majority of the undeveloped land in the basin is to the east and south (Tetra Tech KCM 2002). The watershed is divided into five basins, which are then divided into 31 sub-basins. The two basins in the City are Lake Steilacoom and Lower Clover Creek. When the basin characterization report was completed in 2002, these two basins had approximately 40% and 30% effective impervious surface, respectively. Based on projected land use plans, and assuming the area would be fully developed, the future impervious surface for the Lake Steilacoom basin is estimated at 66 percent effective impervious surface, and 65% effective impervious surface in the Lower Clover Creek basin, based on averages of the sub-basins (Tetra Tech KCM 2002).

3.7 SHORELINE MODIFICATIONS

Shoreline modifications can include features such as levees, dikes, bridges, dredging, road embankments, utility crossings, bulkheads, docks or piers, a variety of armoring types (some associated with fill), and other in-water structures such as boatlifts, boathouses, and moorage covers. In lake and stream environments, these types of modifications strongly influence the landscape-scale processes which then alter the functions of lakes and streams. Shoreline modifications influence functions by changing erosion patterns and sediment movement; affect or limit the presence or distribution of over-hanging or aquatic vegetation; and are often accompanied by upland vegetation loss. Information about shoreline modifications on the lakes and streams located in the City's shoreline jurisdiction was derived from interpretation of aerial photographs.

Known shoreline modifications on and around American Lake, Gravelly Lake, Lake Steilacoom, and Lake Louise include significant bulkheading around the perimeter shoreline, docks, and boatlifts. Another notable feature is the bridge that crosses Lake Steilacoom. To a lesser extent there are boathouses over the lakes. Waughop Lake has little or no bulkheading based on what can be seen from aerial photography. Approximately 20% of lake parcels (175 parcels) within the proposed shoreline management area do not have docks, piers or recreational floats. The percentage of parcels that have artificially armored shoreline ranges from 34% on Gravelly Lake to approximately 66% on American Lake. Shoreline modifications on each of the five lakes in the SMA are detailed below in Table 4.

Table 4 – Shoreline Modifications by Water Body

Water body	Segment	Percent Armoring by Segment	Percent Armoring by Water body	Percentage of Parcels with Docks by Segment	Percent of Parcels with Docks by Water body
American Lake	3A	62	66	90	92
	3B	35		100	
	3C	100		0	
	3D	38		100	
	3E	30		66	
Lake Steilacoom	4A	64	62	79	77
	4B	0		0	
Gravelly Lake	5A	36	34	86	85
	5B	0		0	
Lake Louise	6	72	72	51	51
Waughop Lake	7	0	0	0	4

Known shoreline modifications on Clover Creek include channel straightening, armoring along the banks, and portions of the Creek that have been placed in pipes and culverts. The longest segment of the Creek that is placed in a pipe in shoreline jurisdiction is the point where it is located beneath I-5. The longest piped segment is outside of shoreline jurisdiction, and is located on McChord Air Force Base (now JBLM), where there are twin 12-foot diameter corrugated metal pipe culverts that run beneath the airport runways for a distance of 2,500 feet each. There are several other locations where the creek crosses under roadways both in pipes and in the modified channel. In several areas (particularly neighborhoods) there are sections of the stream that have been channelized or ditched between parcels.

Chambers Creek has experienced fewer modifications. One road (Steilacoom Boulevard) crosses the creek where it outlets from Lake Steilacoom. Portions of the stream are down in a steep ravine (steep slopes are mapped on Figure 12 in Appendix C).

3.8 EXISTING AND POTENTIAL PUBLIC ACCESS SITES

There are several areas providing public access to the City's shorelines, mainly along the shores of the City's numerous lakes. Known public access sites and potential access sites are shown in Figure 11 in Appendix C and are listed below.

American Lake

- American Lake North Park
- Harry Todd Park
- Street end at Wadsworth Street – potential public access point (see street ends discussion below)
- Street end at Lake City Boulevard - potential public access point (see street ends discussion below)

- Lakeland Ave. Park/street end – potential public access point (see street ends discussion below). Parcel is owned by the City. Pierce County designated it as a park prior to incorporation. Site is undeveloped, partially concealed by vegetation and contains a winding trail to the water.

Gravelly Lake

- Shoreline access for visitors of Lakewold Garden on the western shore
- Two public street ends on east/southeast shore – Hilltop Lane and Linwood Lane

Lake Steilacoom

- Edgewater Park
- Street end at Beach Lane -- potential public access point (see street ends discussion below)
- Street end at Westlake Avenue -- potential public access point (see street ends discussion below)
- Three additional public street ends on eastern shore – Lake Ave., 100th Street and Holly Hedge Lane (see street ends discussion below)
- One additional public street end on western shore – Mt. Tacoma Drive (see street ends discussion below)

Waughop Lake at Fort Steilacoom Park

- Shoreline trail provides viewing and there is a gravel access point on the eastern shore for access for swimming, fishing, and canoes or kayaks.

Lake Louise

- Street end at 104th Street - potential public access point (see street ends discussion below)
- Street end at Holden Street - potential public access point (see street ends discussion below)

Chambers Creek

- According to the Chambers Creek Properties Master Site Plan[1], the following public access facilities are planned:
    - New trail segments will link existing informal segments through the Chambers Creek Canyon area
    - New Trailhead with parking at Zircon Dr SW in the vicinity of Oakbrook Golf & Country Club
    - New Trailhead with parking at Phillips Rd SW
    - Trail access at 91st Avenue Ct SW
- Street end at 75th Street West – potential public access point (see street ends discussion below)

Clover Creek

- There are no existing public access points.
- Street end at 47th Ave. SW – potential public access point (see street ends discussion below)
- Street end at Addison Dr SW – potential public access point (see street ends discussion below)

[1] Chambers Creek Properties Master Site Plan, Pierce County Public Works and Utilities, Parks and Recreation, February 2007.

Street Ends

The City's Parks and Recreation Advisory Board (PRAB) hired a consultant to analyze 14 of the shoreline street ends. Using this analysis, the PRAB developed a set of recommendations in 2008 for what should be done with each of these 14 public properties. The PRAB recommended that the following sites should be maintained, improved, or developed for public access:

- Westlake Ave (Lake Steilacoom)
- Beach Lane (Lake Steilacoom)
- Edgewater Park/Foster St (Lake Steilacoom)
- Lake City Blvd (American Lake)
- Wadsworth St (American Lake)
- Lakeland Ave (American Lake) (Note: the City's Parks and Recreation Master Plan recommends the City dispose of this property)
- 104th St (Lake Louise)
- Holden St (Lake Louise)

Additionally, the PRAB recommended the following:

- Develop a formal master plan for each site designated for "maintain, improve or develop"
- Create signage and a management plan for each site that is designated for "maintain, improve or develop"
- Use existing waterfront parks as 'anchors from which to expand use through acquisition.
- Consider eminent domain to increase lakefront access and to expand existing lake front parks.
- Pursue public/private partnerships to increase access to Gravelly Lake.

Several street ends were not analyzed by the PRAB, including 47th Ave. SW (Clover Creek), Addison Dr. SW. (Clover Creek) and 75th St. W. (Chambers Creek). These street ends should be reviewed by the City to determine their potential for improved public access. Clover Creek currently does not have any designated and improved public access points. Public access improvements are planned for Chambers Creek (see discussion on page 24).

3.9 CRITICAL AREAS

The inventory of critical areas was based on a wide range of information sources. A complete listing of citations used to compile information on critical areas is included in Section 8.0. The primary source for GIS data relating to critical areas was from Pierce County and the City of Lakewood. Critical Areas and Natural Resource Lands mapping and identification includes geologically hazardous areas, wetlands, streams, habitat conservation areas, flood hazard areas, and critical aquifer recharge areas. This information was supplemented with maps or reports obtained from the Washington Department of Fish and Wildlife (WDFW), Washington Department of Natural Resources (DNR), Ecology. Soils mapped by the Natural Resource Conservation Service (NRCS) are shown on Figure 12 in Appendix C.

Critical areas are described as they relate to the project segments in Chapter 4.0 and illustrated on

Figures 2, 12, and 13 in Appendix C.

3.9.1 Geologically Hazardous Areas

The City of Lakewood regulations address three types of hazards: erosion, landslide, and seismic. They are defined in the City's Environmental Protection of Critical Areas Chapter 14A as follows:

> Erosion Hazard Areas: *"Erosion hazard areas are those areas that because of natural characteristics, including vegetative cover, soil texture, slope, gradient, and rainfall patterns, or human-induced changes to such characteristics, which create site conditions which are vulnerable to erosion."*
>
> Landslide Hazard Areas: "*Landslide hazard areas are areas potentially subject to risk of mass movement due to a combination of geologic, topographic, and hydrologic factors. Landslide hazard areas are those areas meeting any of the following criteria:*
> *1. Areas of historic failures, including areas of unstable old and recent landslides;*
> *2. Areas will all three of the following characteristics:*
> *a. Slopes steeper than 15%; and*
> *b. Hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock; and*
> *c. Springs or groundwater seepage.*
> *3. Slopes that are parallel or sub-parallel to planes of weakness, such as bedding planes, joint systems, and fault planes, in subsurface materials;*
> *4. Slopes having gradients steeper than 80% subject to rockfall during seismic shaking;*
> *5. Areas potentially unstable as a result of rapid stream incision, stream bank erosion, and undercutting by wave action;*
> *6. Areas located in a canyon or on an active alluvial fan, presently or potentially subject to inundation by debris flows or catastrophic flooding;*
> *7. Any area with a slope of 30 percent or steeper and with a vertical relief of ten or more feet. A slope is delineated by establishing the toe and top and measured by averaging the inclination over at least ten feet of vertical relief;*
> *8. Areas which have a "sever" limitation for building site development because of the slope conditions, according to the Soil conservation Service."*
>
> Seismic Hazard Areas: "*Seismic hazard areas are generally those areas susceptible to ground failure during seismic events. Failure can consist of soil liquefaction, slope failure, settlement, ground rupture, or lateral displacement. Settlement and soil liquefaction conditions occur in areas underlain by cohesionless soils, usually fine sand, of low density, typically in association with a shallow groundwater table."*

The City has mapped steep slopes, but relies on other map sources, including the Soil Survey of Pierce County (USDA, 1979), the Coastal Zone Atlas for Washington (WA Dept of Ecology), and other data that has been mapped by the USGS or WA DNR, to determine geologically hazardous areas. Geologically hazardous areas for the shoreline jurisdiction are discussed further in Chapter 4.0 and steep slopes are identified on Figure 12.

3.9.2 Wetlands

There are three mapped wetlands within the City's shoreline jurisdiction (NWI 2010). Wetlands are regulated by the City of Lakewood through Title 14A Environmental Protection, Chapter 14A.162. The wetland boundaries in Figure 2 (in Appendix C) are approximate as they were not formally delineated for this project. Additional wetlands may be found as development occurs on currently undeveloped properties. Soils mapped in and around the shoreline area are shown on Figure 12 in Appendix C (NRCS 2009). Soil types classified as "hydric" may be indicative of wetlands; there is a small area of mapped as Dupont Muck in the vicinity of the wetland associated with Waughop Lake. The two main soil series in the shoreline jurisdiction are Alderwood-Everett Gravelly Sandy Loam and Spanaway Gravelly Sandy Loam.

The largest of the mapped wetlands is associated with Chambers Creek and is in the vicinity of Chambers Creek Park. Towards the western end of the stream, and closer to the City limits, the wetland is mapped by NWI as an intertidal emergent estuarine wetland that is regularly flooded. Moving further east, as the stream loses its tidal influence, the wetland is mapped as a palustrine scrub shrub wetland that is seasonally flooded.

The second mapped wetland in the shoreline jurisdiction is also associated with Chambers Creek, and is located adjacent to and within the South Puget Sound Urban Wildlife Interpretive Area. The wetland is mapped by NWI as a palustrine emergent wetland that is seasonally flooded.

Two wetlands appear to be associated with Waughop Lake. However, there is conflicting information regarding the wetlands. The NWI maps indicate there is a wetland along the western shore of the lake, while the City/County maps (and supported by aerial photos) indicate that there is a large wetland complex that extends along the eastern shore and continues to the north. The wetland mapped by NWI on the western shore is mapped as a palustrine emergent wetland that is semi-permanently flooded. Without field verification it is difficult to confirm the presence, types, and extent of these wetlands. From the use of aerial photos, it appears both of these areas are wetlands. Additional information from the City or field verification would aid in the identification and classification of the wetland located on the east side of the lake.

Wetlands are categorized based on scores using the latest version *Washington State Wetland Rating System for Western Washington* published by the Washington State Department of Ecology. Buffers widths are assigned by the City based on these scores and as outlined in LMC 14A.162.080. The buffer widths range from 200 feet for a Category I wetland down to 50 feet for Category IV wetlands.

3.9.3 Streams

Information regarding streams was gathered from WDFW's Priority Habitats and Species (PHS) maps and reports (WDFW 2007) and other resources. Streams are regulated by the City of Lakewood under Title 14A Environmental Protection, Chapter 14A.154 Fish and Wildlife Habitat Areas. Two streams, Clover Creek and Chambers Creek, are in the City's shoreline jurisdiction

because their mean annual flow is equal to, or greater than the minimum requirement of 20 cubic feet per second (cfs) (RCW 90.58.030). Flett Creek and Leach Creek are tributaries to Chambers Creek. Leach Creek is located just outside of the City of Lakewood in University Place, while Flett Creek is located in the City limits. Other streams located in the City include Ponce de Leon Creek which flows into Lake Steilacoom on its southeastern shore and Garrison Springs, a stream located northwest of Waughop Lake. Flett Creek, Ponce de Leon Creek, and Garrison Springs do not meet the criteria for mean annual flow and are therefore not included in the City's shoreline jurisdiction.

Both of the City's streams in the shoreline jurisdiction are associated with Lake Steilacoom. Clover Creek drains into the lake and Chambers Creek is the outlet from the lake, eventually discharging into the Puget Sound. There is an outlet control at the outlet from Lake Steilacoom that regulates flow in Chambers Creek (Robinson and Noble 2003). No streams flow into Gravelly Lake, Waughop Lake, or Lake Louise. Murray Creek discharges into American Lake, but this feature is outside of the City limits.

Habitat protection is provided for rivers and streams through buffers (LMC 14A.154.050). Stream buffers are determined in a number of different ways. In particular, buffers are applied to Chambers and Clover Creeks based on their importance to anadromous fish and subsequently, the Puyallup Indian Tribe. Due to these important factors, these streams require larger buffers than other streams in the City. Per LMC 14A.154.050(B), Chambers Creek has a 150-foot buffer and Clover Creek has a 50-foot buffer.

3.9.4 Other Fish and Wildlife Habitat Areas

Fish and Wildlife Habitat

Fish and wildlife habitat areas in Lakewood include the shorelines of the state such as the lakes and streams detailed in this report. Other habitat areas include habitats and species of local importance as well as *"…specific habitat types which are infrequent in occurrence in Pierce County and Lakewood, and may provide specific habitats with which endangered, threatened, sensitive, candidate, or monitor species have a primary association, such as breeding habitat, winter range, and movement corridors"* (LMC 14A.154.020B). Priority Habitat and Species (PHS) are included on Figure 13 in Appendix C.

All of the shorelines of the lakes and streams detailed in this report are considered fish and wildlife habitat areas as they are also shorelines of the state. Other fish and wildlife habitat areas include the lake waterbodies because they provide habitat features for waterfowl concentrations. Chambers and Clover Creeks as well as Lake Steilacoom provide habitat for fish (including endangered species) and are therefore considered fish and wildlife habitat areas. The wetlands associated with the game refuge support western pond turtle and are considered a fish and wildlife habitat area.

Lakes

Lakes are also considered fish and wildlife habitat areas and their habitat is protected under Chapter 14A.154.060 of the LMC. Per LMC 14A.154.060A, there are four lakes in the City that are considered urban in character. These four lakes are American, Gravelly, Louise, and Steilacoom. Per

the LMC, lakes that are urban in character are not subject to the buffering requirements. Additionally, proposed regulated activities on lakes that are subject to the State Shoreline Management Act, habitat protection shall be provided through education, voluntary agreements, and existing laws as referenced in 14A.154.030.B, and regulation via the City's Shoreline Master Program and Shoreline Management Regulations.

3.9.5 Critical Aquifer Recharge Areas

The City of Lakewood regulates critical aquifer recharge areas. Aquifer Recharge Areas are defined by the City as "…areas where the prevailing geologic conditions allow infiltration rates which create a high potential for contamination of groundwater resources or contribute to the replenishment of groundwater." As categorized in its critical areas ordinance (14A.150.020), critical aquifer recharge areas are categorized as follows:

1. *"The boundaries of the two highest DRASTIC zones which are rated 180 and above on the DRASTIC index range, as identified in Map of Ground Water Pollution Potential, Pierce County, Washington, National Water Well Association, US Environmental Protection Agency;*
2. *The Clover/Chambers Creek Aquifer Basin boundary, as identified in Draft Clover/Chambers Creek Basin Ground Water Management Program and Environmental Impact Statement, Brown and Caldwell for Washington State Department of Ecology; and*
3. *Any site located within the Clover/Chambers Creek Basin boundary or the two highest DRASTIC zone boundaries is included in the aquifer recharge area."*

According to the Aquifer Recharge Areas map on Pierce County's website, the entire City of Lakewood is considered to be an aquifer recharge area and the City's primary source of water is from these aquifers. Aquifers are essentially underground rivers and are susceptible to contamination. The water district monitors water quality in the aquifers in order to protect the integrity of drinking water for the community (Lakewood Water District 2010).

3.10 FLOODPLAIN AND CHANNEL MIGRATION ZONE

3.10.1 Floodplain

Floodplains are "synonymous with 100-year flood plain and means that land area susceptible to inundation with a one percent chance of being equaled or exceeded in any given year. The limit of this area shall be based upon flood ordinance regulation maps or a reasonable method which meets the objectives of the act" (WAC 173-26-020). The City has mapped the floodplains via data from the Federal Emergency Management Agency (FEMA). Mapped floodplains within the City's shoreline jurisdiction are discussed in Section 4 and are mapped on Figure 2 in Appendix C. There is mapped floodplain along the northern banks of Clover Creek. The floodplain extends further north of the shoreline jurisdiction on the east side of I-5 and approximately mid-way between I-5 and Lake Steilacoom. Other than these two larger sections, the floodplain is mostly confined to the shoreline jurisdiction that extends 200-feet from the edge of the stream. No other water bodies in the City of Lakewood have mapped floodplain.

3.10.2 Flood Hazard Areas

"Frequently flooded areas" are those areas within the 100-year floodplain and any other areas subject to flooding (WAC 365-195-090(4)). According to Chapter 14A of the Lakewood Municipal Code, all areas of Special Flood Hazard shall be as identified in the scientific and engineering report entitled "The Flood Insurance Study for Pierce County," dated August 19, 1987, or as amended, with accompanying Flood Insurance Rate Maps (FIRM) prepared by the Federal Emergency Management Agency (FEMA). Potential Flood Hazard Areas were mapped by Pierce County in 2004, and are based on or derived from FEMA and FIRM data. The map was obtained from Pierce County's website and it maps all of the lakeshores and streams in the City of Lakewood as Potential Flood Hazard Areas.

3.10.3 Channel Migration Zone

According to definitions in Washington's Shoreline Master Program Guidelines (WAC 173-26-020), "'Channel migration zone (CMZ)' means the area along a river within which the channel(s) can be reasonably predicted to migrate over time as a result of natural and normally occurring hydrological and related processes when considered with the characteristics of the river and its surroundings." A formal and comprehensive channel migration zone study has not been conducted. A map was provided by the Department of Ecology (Olson 2010) that outlines potential CMZ areas within Chambers Creek. The potential CMZ area for Chambers Creek includes the entire east/west segment of the creek and a portion of the north/south segment. However, the map does not provide a delineation of how far from the edge of bank the CMZ is located (Figure 12 in Appendix C).

Based on guidance from WAC 173-26-221 regarding the channel migration zone, "areas separated from the active river channel by legally existing artificial channel constraints that limit channel movement should not be considered within the channel migration zone." Due to project and budget limitations, this project did not include time to field confirm where artificial channel constraints may or may not exist. There is also a data gap regarding how flow is metered over the dam from Lake Steilacoom during major storm events.

Channel migration zones do not apply to lakes.

3.11 HISTORICAL OR ARCHAEOLOGICAL SITES

The Washington State Department of Archaeology and Historic Preservation (DAHP) WISAARD (Washington Information System for Architectural and Archaeological Records Data) website was searched to identify known historical or archaeological features. The DAHP has record of several historic sites or structures in the City's shoreline jurisdiction.

The largest historical site is Fort Steilacoom where Waughop Lake is located. The entire property and its buildings are considered a historical site as the Fort Steilacoom Historic District. Other

properties include Lakewold Gardens (house and gardens open to the public) on the west shore of Gravelly Lake, the Rhodesleigh property (a private home) on the southwest shore of Lake Steilacoom, and Thornewood Castle (operated as an inn open to the public) on the southeast shore of American Lake.

Internet search results reveal the Lakewood area has a strong Native American and European settlement history. The area was called The Prairie and was dotted with lakes, rivers and stands of Gerry oak trees. Prior to European settlement, the Steilacoom and Nisqually Indians used the area for food sources and gatherings. Settlers set up farms on the Prairie and Fort Steilacoom (location of Waughop Lake) was used to quell Indian uprisings. In the early to mid 1850s several mills were set up in the area now known as the Chambers Creek Estuary at the north end of Lake Steilacoom (Lakewood Historical Society undated).

In general, there are few areas within Lakewood's shoreline area that have not been previously graded or excavated. As stated above, there are several historic properties and grounds that have been set aside for historical preservation. The extensive development in the shoreline jurisdiction does not preclude the possibility of finding artifacts and the Shoreline Master Program should provide clear direction regarding circumstances when a special study may be necessary, and what action to undertake in the event of an unexpected discovery.

3.12 OTHER AREAS OF SPECIAL INTEREST

Areas of special interest not included in the other elements of the inventory, such as rapidly developing waterfronts, eroding shorelines, or other degraded sites with potential for ecological restoration were identified based on the references described above, through aerial photos, and other information gathering.

3.12.1 Water-Oriented Uses

According to Ecology's SMP Guidelines (173-26-020 WAC), "water-oriented use means a use that is water-dependent, water-related, or water-enjoyment, or a combination of such uses." The five lakes in the City's shoreline jurisdiction provide extensive boating, fishing, and other water-oriented activities. Key water-oriented sites include:

- Boat launch and swimming beach at American Lake Park
- Boat launch at Edgewater Park
- Fishing pier and swimming beach at Harry Todd Park
- Planned fishing piers at Waughop Lake

3.12.2 Toxic or Hazardous Waste Sites

One hazardous site was identified in Lakewood on the Washington Department of Ecology's *Hazardous Sites List* (dated August 20, 2009). The site is located at I-5 and New York Avenue SW where a commercial dry-cleaning business operated for many years. While the actual site does not appear to be within the shoreline jurisdiction, the regional aquifer contains a groundwater plume

extending approximately 2,000 feet down-gradient of the site. The mapped area of the plume includes portions of Clover Creek, Gravelly Lake, and Lake Steilacoom. Sampling of drinking water wells in the area indicated that two City wells were contaminated with volatile organic compounds (VOCs).

The site is currently ranked as a 0 by Ecology. According to Ecology the status of the site is "Construction Complete, O & M underway" (Ecology 2009). An Ecology ranking of "0" indicates that the site is a superfund site and is managed through the Superfund Program. Ecology is managing the long term O & M, or Operation and Maintenance, on behalf of the Superfund Program. Through the O & M status, the site has a long-term pump and treat action in place that removes and treats the contaminated groundwater. The pump and treat action will be in place until the site achieves clean-up levels, at which time the site will be eligible to be removed from the Hazardous Sites List (Pers. Comm. with Rebecca Lawson).

According to the U.S. Environmental Protection Agency's (EPA) Envirofacts Data Warehouse website (http://www.epa.gov/enviro/), there are numerous sites that are listed as being regulated by EPA. The majority of these sites are not within the shoreline jurisdiction. In addition to the site mentioned above, the other sites that appear to be within or very near to the shoreline jurisdiction include:

- Pierce County Public Works facility on Chambers Creek Road W for a leaking storage tank (located north of Chambers Creek).
- Former Oakbrook Chevron site on Steilacoom Boulevard SW for a leaking storage tank (located north/northwest of Lake Steilacoom).
- Century 21 FAC STORA on Pacific Avenue South, for an undetermined cause (located adjacent to Clover Creek).
- Former Chevron USA site on Gravelly Lake Drive for a leaking storage tank (located adjacent to Clover Creek).

Many of the sites mentioned may no longer function as described by the EPA (e.g., gas station), however, the site is likely to remain listed by the EPA until the site achieves certain clean-up levels. While many of the sites listed are not within the shoreline jurisdiction, it does not preclude the toxins from flowing "downstream" towards the jurisdictional shorelines. Toxins from commercial, industrial, and residential (septic systems) uses located well outside of the City's shoreline jurisdiction areas still have the capacity to greatly impact water quality for all waterbodies.

Figure 6 in Appendix C shows active and inactive State cleanup sites in relation to wellhead protection area.

3.13 OPPORTUNITY AREAS

Ecology's *Shoreline Master Program Guidelines* (173-26 WAC) include the following definition:

> "Restore," "Restoration" or "ecological restoration" means the reestablishment or upgrading of impaired ecological shoreline processes or functions. This may be accomplished through

> measures including but not limited to re-vegetation, removal of intrusive shoreline structures and removal or treatment of toxic materials. Restoration does not imply a requirement for returning the shoreline area to aboriginal or pre-European settlement conditions.

Consistent with Ecology's definition, use of the word "restore," or any variations, in this document is not intended to encompass actions that re-establish historic conditions. Instead, it encompasses a suite of strategies that can be approximately delineated into three categories: creation (of a new resource), restoration (of a converted or substantially degraded resource), and enhancement (of an existing degraded resource).The City can encourage applicants to implement restoration actions that will improve ecological functions relative to the applicant's pre-project condition. As stated in WAC 173-26-201(2) (c):

> It is intended that local government, through the master program, along with other regulatory and nonregulatory programs, contribute to restoration by planning for and fostering restoration and that such restoration occur through a combination of public and private programs and actions. Local government should identify restoration opportunities through the shoreline inventory process and authorize, coordinate and facilitate appropriate publicly and privately initiated restoration projects within their master programs. The goal of this effort is master programs which include planning elements that, when implemented, serve to improve the overall condition of habitat and resources within the shoreline area of each City and county."

The Opportunity Areas discussions in section 4.1.6 present options for restoration and preservation that would improve ecological functions. Enhancement of lakeshore vegetation, reductions or modifications to shoreline hardening, and minimization of in- and over-water structures would each increase one or more ecological parameters of the City's shoreline. These options could be implemented voluntarily by the City or City residents or, depending on specific project details, could be required to mitigate adverse impacts of new shoreline projects.

Opportunity areas were initially identified during the review of the reference materials, review of aerial photographs, and a brief site visit in December 2009. More detailed descriptions of each area can be found in Section 4.0 below. Restoration and preservation opportunities on public lands exist at the City-owned parks in the shoreline jurisdiction. Opportunities on private property would likely occur only through voluntary means or through re-development proposals.

A Restoration Plan document will be prepared in 2010 or 2011 as a later phase of the Shoreline Master Program update process, consistent with WAC 173-26-201(2)(f). The Restoration Plan will "include goals, policies and actions for restoration of impaired shoreline ecological functions. These master program provisions should be designed to achieve overall improvements in shoreline ecological functions over time, when compared to the status upon adoption of the master program."

4.0 CONDITIONS BY INVENTORY SEGMENT

Seven distinct planning segments have been defined within Lakewood's shoreline jurisdiction. (see Figure 15 in the Map Folio in Appendix C) These segments are based on the level of ecological functions provided by each segment, as well as existing land uses and zoning as directed in the guidance from Ecology (http://www.ecy.wa.gov/programs/sea/sma/st_guide/SMP/env_designations/index.html).

A summary discussion is provided for each shoreline planning segment followed by a more detailed discussion of specific shoreline inventory elements. Inventory maps are included in the Map Folio, Appendix C.

Table 5
Lakewood Inventory and Planning Segments

Segment	Approximate (feet)	Approximate Area (acres)
1—Chambers Creek	14,334	17.3
Segment 1A	8,055	11.8
Segment 1B—includes Chambers Creek Park	4,994	4.7
Segment 1C—Wetland at Game Reserve)	1,283	0.8
2—Clover Creek	7,089	9.4
3—American Lake	27,768	11.2
3A—Residential	21,802	9.2
3B—City Parks (American Lake North, Lakeland, and Harry Todd Parks)	985	0.4
3C—Tacoma Golf & Country Club	270	0.2
3D—Silcox Island	3,284	1.0
3E—Open space (south of Silcox island)	1,427	0.4
4—Lake Steilacoom	32,669	13.2
4A—Residential	31,745	12.8
4B—Edgewater Park	924	0.4
5—Gravelly Lake	10,932	4.8
5A—Residential	10,462	4.6
5B—Lakewold Gardens	470	0.2
6—Lake Louise	4,975	2.4
7—Waughop Lake	4,670	3.5
TOTAL	**81,014 feet**	**61.6 acres**

4.1 CHAMBERS CREEK

It is estimated that approximately one-third of the Chambers-Clover watershed is developed with residential, commercial, industrial, and other significant urban uses. Additionally, the majority of this development is in Lakewood or the surrounding area, while the majority of the undeveloped land in the basin is to the east and south (Tetra Tech KCM 2002). While the development has altered many functions of Chambers Creek, portions of the stream and its riparian areas remain mainly undisturbed. During the watershed characterization in 1997, it was noted that Chambers Creek has more riparian habitat along its length than any other stream in the watershed (Pierce Conservation District 2003). It should be noted that when referencing the right bank or left bank of a stream, it is a general rule that this is looking downstream (LDS). For Chambers Creek, the segments were chosen based primarily on the physical and biological conditions, with secondary consideration based on current and planned future land use.

4.1.1 Land Use

Segment 1A: Segment A of Chambers Creek is generally oriented north/south and begins at the outlet of Lake Steilacoom. At the northern end of the stream it heads west towards Puget Sound. Segment A continues on the south side of the stream for a several hundred feet after it heads west, and the north side is outside of City limits. Just south of the bend in the stream is the confluence with Flett Creek which is not in shoreline jurisdiction. Per Title 14, Chapter 14.34 of the Lakewood Municipal Code, the legal description for this segment is as follows:

> *"Beginning at the outlet of Chambers Creek on the north shoreline of Steilacoom Lake in the northeast quarter of Section 34 T20 R2E, thence downstream along said Chambers Creek to its point of intersection with the east line of the northeast quarter of Section 28 T20 R2E."*

Current land use within this segment is primarily single family residential with a smaller number of parcels in use as multi-family, parks/open Space, or undeveloped. A very small area adjacent to Steilacoom Blvd consists of commercial uses. Future land use designation for this segment is zoned as Residential Estate, Arterial Corridor, and Open Space.

Twenty-seven percent of the area within this reach is mapped as floodplain/floodway.

Segment 1B: The majority of Segment B is located within Chambers Creek Park and is located entirely on the south bank of the stream until it reaches the City limits near Chambers Bay. The shoreline area in Segment B is undeveloped open space. Per Title 14, Chapter 14.34 of the Lakewood Municipal Code, the legal description for this segment is as follows:

> *"South Bank: Beginning at a point where Chambers Creek intersects the east line of the northeast quarter of Section 28 T20 R2E, thence downstream along said Chambers Creek to a point where said Chambers Creek intersects the Chambers Creek Road Bridge in the northeast quarter of Section 29 T20 R2E."*

One percent of the area within this reach is mapped as floodplain/floodway.

Segment 1C: Segment C is a wetland on the left bank of Chambers Creek located approximately midway up the north/south portion of Segment A. The wetland is located in a 100-acre open space area managed by the State Department of Fish and Wildlife. The area offers a trail system for walking and bicycling. The current and future land use zoning for the area is as Open Space/Recreation. The wetland is mapped by NWI as a palustrine emergent wetland that is seasonally flooded.

4.1.2 Water Quality

There are numerous stormwater outfalls that discharge into Chambers Creek. Chambers Creek is on Ecology's 303(d) list for a variety of contaminants (Ecology 2010a). In February 1999, the EPA issued a TMDL for copper for Chambers Creek (that includes Lake Steilacoom). Lake Steilacoom experiences blooms of toxic blue-green algae and an over-abundance of aquatic plants. Former treatment methods have been unsuccessful and it is the use of copper in the former treatment methods that have resulted in the TMDL for copper mentioned above for both Chambers Creek and Lake Steilacoom. The most recent samples and listings are from 2008 and are as follows:

- Fecal coliform – Category 5
- Bioassessment – Category 5
- Copper – Category 4A
- Temperature – Category 2

Clover Creek is also listed as a Category 5 water for fecal coliform. Fecal coliform contamination typically comes from failing septic systems, agricultural areas upstream, and pet waste. Because Chambers Creek is linked to Clover Creek (via Lake Steilacoom), the contamination in Chambers Creek may be coming from further upstream in Clover Creek as well as from local contamination from failing septic systems.

The bioassessment classification relates to a study that concluded there is definitive biological degredation of aquatic life based on the River Invertebrate Prediction and Classification System (RIVPACS). The high water temperature, fecal coliform, and copper are likely causing degredation to aquatic life.

Category 2 waters are defined by Ecology as waters of concern, where there is some evidence of a water quality problem, but not enough to require production of a water quality improvement project (TMDL). Category 4A waters have a TMDL. Category 5 waters are defined as polluted waters that require a TMDL (Ecology 2010b).

4.1.3 Shoreline Modifications

Of all of the waterbodies in the City's shoreline jurisdiction, Chambers Creek appears to have the most intact, least modified shoreline. According to aerial photos, extensive portions of the shoreline

have forested riparian areas with intact buffers. It appears the portion of the creek that runs east/west (Segment 1B) has very little development in the 200-foot buffer and the portion that runs north/south has had some development that has impacted the forested canopy, and includes the installation of bank armoring and straightening of the channel. Even with these modifications, it is estimated that Chambers Creek has approximately 76%-100% shade cover in the riparian corridor (Pierce Conservation District 2003).

4.1.4 Critical Areas

Two streams enter into Chambers Creek. Flett Creek enters Chambers Creek on the right bank just south of where Chambers Creek begins to flow west. Flett Creek is not part of the City's shoreline jurisdiction because its mean annual flow does not meet the minimum threshold of 20 cfs (WAC 173-18-310). Another stream, Leach Creek, enters Chambers Creek on the right bank at the bend in the stream (WAC 173-18-310). This stream is located outside of City limits, in University Place.

Many fish use Chambers Creek for migratory and spawning purposes. Due to a complete fish blockage (a dam) near the mouth of the river, WDFW captures the fish and releases them upstream of the dam. Chinook salmon are also captured; however, they are transported to the hatchery for egg harvesting. Other fish that occupy the stream include coho, steelhead, and chum.

The wetland associated with the WDFW Game Reserve/Hatchery (Segment 1C) is mapped by NWI as a palustrine emergent wetland that is seasonally flooded. There are other wetlands associated with Chambers Creek as well, and they are located within in the 200-foot shoreline jurisdiction. One is located approximately 1,500 feet north of Lake Steilacoom. According to NWI, the wetland is mapped as an excavated palustrine wetland that is permanently flooded. According to aerial photography, the ponded area is mostly vegetated. A large wetland complex is mapped by NWI near the mouth of Chambers Creek. Portions of the wetland are mapped as palustrine scrub-shrub that is seasonally flooded. Closer to Chambers Bay, the wetland is classified as intertidal estuarine emergent wetland that is regularly flooded. Moving closer to the Bay and located just west of the City limits, the wetland is classified as a subtidal estuarine wetland with unconsolidated bottom. It is likely that the estuarine wetlands would be rated as Category I wetlands, resulting in a 200-foot buffer (LMC 14A.162.080)

Portions of Segments 1A and 1B are mapped as having steep slopes greater than 40 percent (Figure 12 in Appendix C). The steep slopes are associated with the ravine surrounding Chambers Creek. Steep slopes and their associated buffers are regulated as Geologically Hazardous Areas under LMC 14A.146.

4.1.5 Public Access Sites

Public access along Chambers Creek is limited to Chambers Creek Park. Chambers Creek Park is a large park providing trail access through the forested riparian buffer. Additional information regarding the Park is outlined below in Section 4.1.6. At this time there are no other public access points along Chambers Creek.

4.1.6 Opportunity Areas

Chambers Creek Park is managed by Pierce County and lies within the Cities of Lakewood and University Place. The Chambers Creek Master Site Plan outlines how the county will develop the park to fit within future development while preserving and restoring nearly 1,000 acres. The site will provide balanced uses which include government services, public access uses, and revenue generating uses. Over the next 50 years, the Master Site Plan proposes to provide, *"A broad mix of uses are proposed for the long term. Future utility uses include an expanded wastewater treatment plant, production nursery, water reclamation and water production areas, surface water management facilities, and maintenance and administrative facilities for site uses. Future recreational site uses include an arboretum, botanical garden, and trails intermingled with a public golf course, multi-purpose playfields, urban and nature trails, beach and pier access, passive open space, and boat launch. Commercial and recreational uses which would generate revenue are also included to offset costs of non-revenue generating recreational facilities."* Preservation of the currently intact riparian zone will ensure no net loss of the functions provided by the floodplain, channel migration zone, adjacent wetlands, and forested areas. Ongoing planning and interagency coordination is encouraged between the stakeholders with shoreline jurisdiction within Chambers Creek Park.

Preservation and restoration of the property managed by WDFW (Segment 1C) would provide enhanced habitat and potentially could provide habitat connectivity between the wetland and Chambers Creek.

4.2 CLOVER CREEK

Clover Creek flows generally northwest for 13.8 miles, with a 74-square mile drainage basin, and outlets into Lake Steilacoom. The Lower Clover Creek sub-basin receives all discharge from the upstream drainage areas, and water quality in the drainage area reflects an integration of the upstream factors affecting water quality (Tetra Tech KCM 2002). Clover Creek has been highly altered as it runs through approximately 0.6 miles of pipes under the McChord Air Force Base as well as through extensive culvert systems under I-5 and other City streets. Additional water quality information is described below. The segment for Clover Creek was based primarily on existing land use and the physical and biological conditions that have resulted from the residential, commercial, and transportation uses of the segment surrounding the Creek.

4.2.1 Land Use

Approximately one-third of the Clover Creek Basin is developed with residential, commercial, industrial, and other significant urban development, with the northwestern portion (City of Lakewood) of the basin being highly urbanized. The majority of the undeveloped land in the basin is to the east and south. Current land uses in the Clover Creek shoreline area west of I-5 are predominantly single-family residential, and a mix of commercial, multi-family and single-family residential uses east of I-5. The Lower Clover Creek sub-basin has approximately 36 percent (2002 estimation) impervious surface (Tetra Tech KCM 2002).

4.2.2 Water Quality

There are numerous stormwater outfalls that discharge into Clover Creek. Many of these outfalls are in the commercial areas of the City. Clover Creek is on Ecology's 303(d) list for a variety of contaminants (Ecology 2010a). Ecology has not issued a TMDL for Clover Creek. The most recent samples and listings are from 2008 and are as follows:

- Fecal coliform – Category 5
- Temperature – Category 5
- Dissolved Oxygen – Category 2
- Lead – Category 2
- Mercury – Category 2
- pH – Category 2

Fecal coliform levels are likely high in Clover Creek from upstream agricultural practices as well as from failing septic systems. Upstream of lower Clover Creek, outside of City limits, there is documented use of livestock with access to the riparian and wetland areas associated with the mainstem of Clover Creek (Tetra Tech KCM 2002). While this area is outside of the City limits, as well as the shoreline jurisdiction, it is an example of how upstream uses in the watershed are likely impacting shoreline conditions in Lakewood. Water temperature levels are high because the stream's riparian buffer has been heavily modified and degraded, leaving little vegetation to shade the water.

Category 2 waters are defined by Ecology as waters of concern, where there is some evidence of a water quality problem, but not enough to require production of a water quality improvement project (TMDL). Category 5 waters are defined as polluted waters that require a TMDL (Ecology 2010b).

4.2.3 Shoreline Modifications

The removal of native riparian vegetation along the lower portions of Clover Creek has decreased the available cover used by small fish used to avoid predation, as well as severely decreasing the amount of shade, resulting in increased water temperature and lower dissolved oxygen levels. The construction of residential development in the lower portions of Clover Creek has resulted in the near elimination of riparian habitat, and replacement with riprap, concrete and other materials that have been installed for bank protection (Tetra Tech KCM 2002). Significant portions of lower Clover Creek have been straightened, further eliminating habitat as meanders, side channels, and pools are eliminated. The channel realignment also causes increased flow velocity which can lead to downcutting and undercutting of the banks.

4.2.4 Critical Areas

Forty-three percent of the area within the proposed Clover Creek SMA that is within City limits is mapped as floodplain. These areas are on the north side of the creek.

4.2.5 Public Access Sites

Currently there are no developed public access points to Clover Creek. However, a small portion of Springbrook Park is located within the eastern portion of the shoreline management area, south of the creek. There is also undeveloped open space on the north side of the creek. The City plans to make improvements to the Park, including acquiring adjacent land and developing a trail and creek crossing to connect to the open space area.

4.2.6 Opportunity Areas

The majority of Clover Creek is lined by private parcels. Consequently, the majority of opportunity areas for restoration are on private properties. These areas could be enhanced by encouraging private homeowners to remove bank modifications and shoreline enhancement projects (including installation of native vegetation). Homeowner education should also focus on discouraging the use of chemicals on lawns and shrubs.

Areas on the east side of I-5 are mostly zoned multi-family and commercial. Future redevelopment should require shoreline enhancement and the use of LID techniques, particularly for parking lots and other stormwater management.

The City should conduct an analysis of areas where the creek is crossed by streets to determine the feasibility of developing public access at these locations. The City should also move forward with its plan to acquire land adjacent to Springbrook Park in order to connect to the larger Springbrook Open Space and provide public access to the creek.

4.3 AMERICAN LAKE

American Lake is approximately 1,125 acres in size and its shoreline length in the City limits is nearly 28,000 feet. American Lake is located both in the City of Lakewood (the northeast portion of the lake) as well as Joint Base Lewis-McChord (JBLM). American Lake is heavily developed with residential housing, golf courses, and a VA hospital. Several parks (in Lakewood and JBLM) provide the community with extensive use of the lake, including park facilities, playgrounds, boat launches, swimming, and picnic facilities. Groundwater from the shallow aquifer is the primary source of water flowing into and out of American Lake. Approximately two-thirds of the annual inflow into the lake is from this shallow aquifer (Woodward-Clyde 1998). The segments for American Lake were chosen based on the existing land use and how these land uses have impacted the physical and biological characteristics of the shoreline. Due to its size, American Lake is considered a Shoreline of Statewide Significance.

4.3.1 Land Use

Segment A: Segment A comprises the majority of the American Lake shoreline area and primarily contains single-family residential uses. Current and future zoning has the majority of the land use zoned as Residential with the remaining parcels zoned as Open Space or Multi-family.

Approximately 7% of residential parcels with shoreline frontage are vacant. Approximately 74% of these parcels have modified shorelines in the way of bulkheads; additionally approximately 90% of parcels have overwater structures such as boat docks and swim platforms. Lot widths generally range between 50 and 100 feet, with the majority of lots being closer to 100 feet. A smaller number of parcels are under 50 feet or over 100 feet in width. Lot depth generally ranges between 200 and 400 feet. A relatively small number are less than 200 feet in depth.

Segment B: Segment B is comprised of the three City-owned properties located in the shoreline jurisdiction, two of which provide public access to the shoreline. American Lake North Park is located in the north-central portion of the lake and provides a swimming area, facilities for park users, and a public boat launch. Approximately 28% of this park's shoreline is armored, and the park has one dock. Harry Todd Park is located on the east-central side of the lake and provides a swimming area and facilities for park users. Approximately 77% of the shoreline in Harry Todd Park is armored and there are four docks. All of the parks provide other forms of recreation such as tennis courts, sports fields, play structures, parking areas, and picnicking areas. The third property, Lakeland Ave/Park, was designated as a Park by Pierce County before the City incorporated and is currently not an official City park, although a winding trail through overgrown vegetation provides access to the shoreline. The City's Park Plan states that this property will be disposed of.

Segment C: Tacoma Golf and Country Club occupies a small part of the shoreline area where there is a large clubhouse, swimming pool, dock, and manicured lawn and gardens. The actual golf course is set back from the lake and is not within the shoreline jurisdiction. Physically being located outside of the shoreline jurisdiction does not preclude this property from having an impact on the water quality of the lake, for example stromwater run-off from the golf course may contain pesticides and fertilizers. Tacoma Golf and Country Club recently installed a rain garden facility that treats the run-off from a portion of the parking area. One hundred percent of the shoreline in this segment is armored.

Segment D: Silcox Island is located in the south central portion of American Lake, adjacent to the City limits. The island is approximately 13.5 acres in size and is zoned single family. The majority of the island has been built out and access to the island is restricted to boats and sea planes. Many of the waterfront homes also have modified shorelines and/or boat docks.

Segment E: The open space known as Eagle Point located south of Silcox Island is approximately 3.95 acres in size, and is a special tract recorded as private open space for the adjacent subdivision. There is a boat launch that provides lake access to residents of the subdivision, but not the general public. This area is designated as Open Space for future land use.

4.3.2 Water Quality

American Lake is on Ecology's 303(d) list as a Category 5 water for high levels of total phosphorus, dieldrin, and PCB. Ecology has not issued a TMDL for American Lake. The southern shore of

American Lake is one of the last neighborhoods in Lakewood to not be connected to the sanitary sewer system. The City is currently installing the sewer lines in this neighborhood. The connection of these homes to the sanitary sewer system may help improve water quality in American Lake. Presumably, the homes on Silcox Island will not be connected to the City's sanitary sewer system. The southern portion of the lake has numerous stormwater outfalls that enter the lake. Interestingly, the northern and eastern shores do not have any mapped stormwater outfalls (Figure 8B, Appendix C).

Previous water quality studies of the lake indicate that fluctuating phosphorus levels result in intermittent blue-green algal blooms. Water clarity is generally good during the summer and declines during the winter (Woodward-Clyde 1998). The report also noted that long-time residence of the lake have observed little change in the visual appearance of the lake over the last 30-50 years. In addition to the immediate area surrounding the lake that is heavily developed, it is likely that water quality in American Lake is further impacted by pollutants that flow into the lake from higher in the watershed via Murray Creek.

4.3.3 Shoreline Modification

The shoreline of American Lake has been significantly altered through the construction of bulkheads that line the majority of the parcels. (Figure 14, Appendix C). In addition, the majority of parcels have docks or piers resulting in a density of overwater structures of approximately 50 per mile (Figures 10D & 10E). Within City limits approximately 66% of the shoreline is armored and 92% of parcels have a boat dock and/or swim platform. In most cases, the homes have been built to the maximum extent possible within the property boundaries and have large manicured lawns with a lack of native shoreline vegetation.

4.3.4 Critical Areas

There are not any streams that outlet into American Lake within the Lakewood City limits. Additionally, there are no mapped wetlands with surface water connections to American Lake.

4.3.5 Public Access Sites

In addition to the public parks located on American Lake that provide public access to the shoreline (described above in Section 4.3.1 Segment B), there is a boat launch facility managed by WDFW just southwest of the City limits. In addition, there are two street ends with public access potential pursuant to the recommendations of the Parks and Recreation Advisory Board. One is located at the Lake City Boulevard street end and is located approximately midway between American Lake North Park and Lakeland Park. The other potential access point is at the Wadsworth Street end located south of Harry Todd Park. Harry Todd Park is also home to the Commencement Bay Rowing Club. Per LMC 8.60.450, American Lake is a Class A lake that covers more than 500 acres. As such there are specific boating rules for motorized boats using the lake which includes speed limits.

The Lakeland Avenue street end is currently an undeveloped property that was formally designated as a Park by Pierce County before incorporation. The site is currently overgrown with vegetation through which a trail winds, providing informal access to the shoreline. The City's Parks Plan includes an action to dispose of this property because of its small size and encroachment from adjacent property owner. The City would use proceeds from the sale of this property to expand current waterfront areas or for other park acquisitions.

4.3.6 Opportunity Areas

A very high percentage of the lake is surrounded by privately-owned parcels; consequently, the restoration opportunities are concentrated on private properties. These areas could be enhanced by encouraging private homeowners to implement bulkhead removal and shoreline enhancement projects (including installation of native vegetation) and replace deteriorating piers. New construction should be discouraged from installing bulkheads or other forms of shoreline modification and more natural shorelines should be encouraged. The replacement of armoring with bioengineered approaches that use vegetation, logs, etc. should be strongly encouraged. Regulations can also address the installation or replacement of one dock for use by two parcels. Homeowner education should also focus on discouraging the use of chemicals on lawns and shrubs.

Restoration or redevelopment at any of the City parks should focus on shoreline restoration using native plants and removing bulkheads when feasible. This is particularly true for American Lake North Park and Harry Todd Park as these are the two City parks with extensive shoreline use and access. If new facilities are constructed at any of the parks, the City should employ LID and green building techniques for the buildings and parking areas. The peninsula is zoned as future open space and the City is encouraged to preserve that large parcel in its forested condition.

4.4 Lake Steilacoom

4.4.1 Land Use

The two segments selected for Lake Steilacoom were chosen based on existing land use and how the land use has impacted the physical and biological characteristics of the shoreline. Other than a lack of structures, the park has similar ecological functions as the residential portion of the lake including compacted soils and lawn, impervious surfaces for parking and boat launch, and lack of a forested canopy. While Edgewater Park is small in comparison to the shoreline as a whole, it was chosen to be a separate segment because this park provides the only public shoreline access on Lake Steilacoom.

Segment A— Residential

Lake Steilacoom was created in 1852 when a dam was constructed across Chambers Creek, resulting in the inundation of a wetland. The lake is heavily used by lakeshore residents for recreation. It is estimated that there are over 280 dwellings around the 5.7-mile shoreline, and other than the park, the shoreline is zoned as residential. Approximately 1% of the parcels with shoreline frontage within this segment are vacant. Lot widths generally range between 50 and 100 feet with a handful of

parcels that are under 50 feet or over 100 feet. Lot depth generally ranges between 200 and 400 feet, and some lots have been subdivided, and thus are not as deep. During a 2002 study, it was estimated that the Lake Steilacoom sub-basin had approximately 39 percent effective impervious surface (Tetra Tech KCM 2002). Rainbow trout are often released in the lake by WDFW and Coho from Minter Hatchery are released into Lake Steilacoom, providing a recreational opportunity for fishing on the lake. The shoreline is heavily modified with armoring and boat docks (Figure 10B, Appendix C).

Segment B— Edgewater Park

Edgewater Park is located in the northeast section of the lake, and is the only park in the Lake Steilacoom shoreline area providing shoreline access. There is a public boat launch, but no designated swimming area associated with this park. The park has some shoreline armoring, and has some shrubs along the shoreline. Slightly set back from the shoreline there is a large area of mowed lawn and some large trees, however, in some areas, the mowed lawn comes to the edge of the lakeshore. Adjacent to the park is the street. Due to the small size of the park in relation to the overall amount of shoreline, and that the park has a modified shoreline in the way of a boat launch, some bulkheading, and mowed lawn, the park generally provides the same or similar functions as the residential segment.

4.4.2 Water Quality

Lake Steilacoom is on Ecology's 303(d) list as Category 5 water for high levels of total phosphorus. In 2000 the EPA set TMDL criteria for total phosphorus levels in the lake, but in 2002 the TMDL was vacated due to disputed data in the studies (Tetra Tech KCM 2002). Ecology has not issued an updated TMDL for Lake Steilacoom for phosphorous levels. In addition to the lake receiving phosphorus from Clover Creek and areas higher in the watershed, it is likely the lake also received phosphorus and other toxins as direct runoff from the bridge that crosses the central portion of the lake. Lake Steilacoom is included in the Chambers Creek TMDL for monitoring copper levels. There are numerous stormwater outfalls that enter the lake (Figures 8A and 8B, Appendix C)

Lake Steilacoom also experiences blooms of toxic blue-green algae and an over-abundance of aquatic plants. This has resulted in reduced recreational use of the lake as well as poor aesthetic quality. Former treatment methods have been unsuccessful and it is the use of copper in the former treatment methods that have resulted in the TMDL for copper mentioned above. Calcium hydroxide treatments were conducted in the lake in 2008 and the amount of calcium oxide that was applied to the lake was not sufficient enough to have a significant impact on reducing the blue-green algae blooms (Herrera 2009).

Water quality in Lake Steilacoom, and subsequently downstream in Chambers Creek, is unlikely to improve if there are not significant changes in land use upstream. This would include significant water quality improvement projects (sanitary sewer and stormwater treatment) outside of the City of Lakewood that may mean discontinuing or drastically restructuring agricultural use.

4.4.3 Shoreline Modification

Like most of the other lakes surrounded by residential housing in the City, the shoreline is heavily armored as landowners have constructed bulkheads. Approximately 62% of the lake's shoreline is armored and 77% of parcels have docks, piers, and/or swim platforms, resulting in a heavily modified shoreline (Figures 10A, 10B, & 14). In addition to the bulkheads, many of the properties also have boat docks and/or swim platforms. There are approximately 49 overwater structures per mile within this water body. In most cases, the homes have been built to the maximum extent possible within the property boundaries and have large manicured lawns with a lack of native shoreline vegetation.

4.4.4 Critical Areas

Fish and Wildlife Habitat Areas

Ponce De Leon Creek outlets into Lake Steilacoom on its central eastern shore. Ponce De Leon Creek is not part of the City's shoreline jurisdiction because its mean annual flow does not meet the minimum threshold of 20 cfs. The entire lake is mapped for waterfowl concentrations per WDFW (Figure 13, Appendix C).

4.4.5 Public Access Sites

Lake Steilacoom has one public park (Edgewater Park) which is located in the northeast corner of the lake. The park is long and narrow, sandwiched between the lakeshore and the street. According to the Parks and Recreation Advisory Board's *Waterfront Street Ends Recommendations to the City Council*, there are two public street ends that could be feasible for future public access to the shoreline. Both are located on the western shore. One is located towards the northwest (end of Westlake Avenue), while the other is centrally located just south of the bridge (end of Beach Lane). There is a public boat launch associated with Edgewater Park. Per LMC 8.60.460, Lake Steilacoom is a Class B lake that covers less than 500 acres, but more than 100 acres. As such there are specific boating rules for motorized boats using the lake which include speed limits. In addition to speed limits for power boats, the LMC lists additional specific regulations for power boats that include how a boat approaches the bridge, speed and entrance into specific coves or lagoons, and the maximum length of the vessels allowed on the lake.

4.4.6 Opportunity Areas

Other than Edgewater Park, the lake is surrounded by private parcels. Consequently, the majority of opportunity areas for restoration are on private properties. These areas could be enhanced by encouraging private homeowners to implement bulkhead removal and shoreline enhancement projects (including installation of native vegetation) and replacing deteriorating piers. New construction should be discouraged from installing bulkheads or other forms of shoreline modification and more natural shorelines should be required where feasible. The replacement of armoring with bioengineered approaches that use vegetation, logs, etc should be strongly encouraged and required where feasible. Regulations can also address the installation or

replacement of one dock for use by two parcels. Homeowner education should also focus on discouraging the use of chemicals on lawns and shrubs.

Due to limited shoreline access, the City should consider the construction of an additional park or the expansion or enhancement of one or more of the street end access points at Lake City Boulevard and Wadsworth streets.

The City should also consider whether it is feasible to provide stormwater treatment to runoff from the bridge if the bridge undergoes construction for upgrades or requires other major maintenance actions.

4.5 GRAVELLY LAKE

The two segments for Gravelly Lake were chosen based on existing land use and the basis that the entire shoreline area is under private ownership. The residential nature of the land use has shaped the physical and biological characteristics of the shoreline environment. Historically, Lakewold Gardens was a private residence, but it is zoned as future open space and provides the only point of public access to the shoreline area.

4.5.1 Segment A—Residential

The majority of Gravelly Lake is surrounded by single family homes with approximately two percent of parcels with shoreline frontage being vacant. Approximately 36% of properties have armoring; however there is a beach between the water's edge and the armoring when the water draws down during the summer. Most of the properties (approximately 86%) also have a boat dock, swim platform, or other over-water structure (Figure 10B, Appendix C), resulting in a density of 37 overwater structures per mile. In general, the shoreline is heavily modified with homes, decks/patios, driveways, and manicured lawns. Lot widths range from 60 to over 200 feet. Narrower lots (in the 60-foot range) tend to occur more on in the southern portion of the lake. There are several parcels greater than 300 feet in width, which are distributed around the lake. Lot depth generally ranges from 350 to 500 feet.

Two areas on the southeast shoreline of the lake have mapped catch basins and inlet/outfall structures (Figure 8B, Appendix C). These may be areas where stormwater outlets into Gravelly Lake from the surrounding developed areas. Gravelly Lake is not included on Ecology's 303(d) list for water quality impairment. Several properties, including Lakewold Gardens, have water rights to Gravelly Lake. This allows property owners to withdraw water from the lake for irrigation purposes.

4.5.2 Segment B—Lakewold Gardens

The Lakewold Gardens parcel is ten acres in size and, while privately owned, it is open to the public. Those visiting the gardens can also access the shoreline for viewing purposes. Shoreline modifications include a bulkhead and a floating dock. There is a beach area between the water's edge and the bulkhead.

It is likely that the manicured gardens and lawn are treated with nutrients that can make their way into the water. There is a house, drive, and outbuildings on the property. The parcel is zoned as Open Space.

4.5.3 Water Quality

Due to the nearly solid presence of residential housing that surrounds Gravelly Lake, it is not surprising that the lake has suffered from water quality issues. However, little recent information was found regarding the water quality in the lake. The most recent information was found on the Department of Ecology website and includes data from water quality sampling in 1997. Due to high phosphorus levels in the lake (and subsequent algal blooms); the lake was treated with copper-sulfate. Gravelly Lake is not included on Ecology's 303(d) list for impaired water bodies and no additional information was found regarding further treatment or monitoring of the lake.

4.5.4 Shoreline Modifications

The shoreline of Gravelly Lake has been heavily modified by the installation of bulkheads, boat docks, and swim platforms. Approximately 34% of the shoreline is armored and 85% of the parcels have a boat dock or swim platform resulting in a density of overwater structures or approximately 37 per mile (Figures 10F & 14).

4.5.5 Public Access Sites

Lakewold Gardens is the only access point within the shoreline jurisdiction that is open to the general public; however there is an admission fee for non-members. This facility is open five days a week between 10am and 4pm April through September and has slightly more restricted hours during other months. Per the LMC 8.60.460, Gravelly Lake is a Class B lake that covers less than 500 acres, but more than 100 acres (Gravelly Lake is approximately 160 acres in size). As such there are specific boating rules for motorized boats using the lake which include speed limits.

4.5.6 Opportunity Areas

One hundred percent of the lake is surrounded by private parcels; consequently, the restoration opportunities are concentrated on private properties. These areas could be enhanced by encouraging private homeowners to implement bulkhead removal and shoreline enhancement projects (including installation of native vegetation) and replace deteriorating piers. New construction should discourage the installation of bulkheads or other forms of shoreline modification. Regulations can also address the installation or replacement of one dock for use by two parcels. Homeowner education should also focus on discouraging the use of chemicals on lawns and shrubs. Additional homeowner education can include the benefits of leaving woody debris in the water, particularly near the shoreline.

If possible, the City should explore opportunities for providing a public park on Gravelly Lake or enhancing a street end for improved public access. The City should work with the Lakewold

Gardens Board of Directors to work towards common goals for the health of the lake as well as potential for increased public access at this site.

4.6 LAKE LOUISE

4.6.1 Land Use

Lake Louise is surrounded by single family residential housing and provides limited public access to the shoreline. There are no vacant parcels with shoreline frontage. Approximately 51% of parcels have a boat dock or other over-water structures and 72% have some kind of shoreline armoring. The density of overwater structures is approximately 51 per mile. (Figure 10A, Appendix C. As with many lake shorelines, the parcels are developed with homes, driveways, decks/patios, and manicured lawns. The impervious surface and lawns increase the toxins and nutrients that can enter the lake. Lot widths are generally more uniform compared to other lakes in the shoreline jurisdiction and range from 40 to 60 feet with a handful of lots that are in the range of 80 to 100 feet. Lot depth ranges from 170 to 400, with most lots being on the higher end of the range.

4.6.2 Water Quality

Pollution-generating impervious surfaces and lawns increase the toxins and nutrients that can enter the lake. Lake Louise has a beach area between the water's edge and the bulkheading that has been installed on many properties. The beach area may help capture this runoff and help limit the amount of toxins and nutrients that enter the water column during the summer. The presence of the beach area that is visible in aerial photos indicates that the water level draws down in the summer months. This draw down is likely due to groundwater fluctuations, but may also indicate the use of lake water by shoreline residents. In the past, Pierce County has monitored Lake Louise for algal blooms, but there was little additional information found regarding the current water quality. Lake Louise is planted with rainbow trout by WDFW.

Additionally, there are numerous stormwater outfalls that discharge into Lake Louise (Figure 8A, Appendix C). Lake Louise is not included on Ecology's 303(d) list for water quality impairment.

4.6.3 Shoreline Modifications

The shoreline of Lake Louise is heavily modified in the form of bulkheads, boat docks, and swim platforms. Approximately 72% of the lake shore has some form of armoring and 51% of the parcels have a boat dock or swim platform, resulting in a density of overwater structures of approximately 51 per mile (Figures 10C & 14).

4.6.4 Public Access

There is currently limited public access, including a primitive gravel boat launch at the terminus of 104th Street SW. According to the Parks and Recreation Advisory Board's *Waterfront Street Ends Recommendations to the City Council*, the street ends associated with 104th Street and Holden Street may hold potential for improved public access in the future.

The lake is used for boating, swimming, and fishing. The lake is stocked with trout by WDFW. Per the LMC 8.60.470, Lake Louise is a Class C Lake (25 acres or more, but less than 100 acres). As such there are specific boating rules for motorized boats using the lake which include speed limits.

4.6.5 Opportunity Areas

One hundred percent of the lake is surrounded by private parcels; consequently, the restoration opportunities are concentrated on private properties. These areas could be enhanced by encouraging private homeowners to implement bulkhead removal and shoreline enhancement projects (including installation of native vegetation) and replace deteriorating piers. New construction should discourage the installation of bulkheads or other forms of shoreline modification. Regulations can also address the installation or replacement of one dock for use by two parcels. Homeowner education should also focus on discouraging the use of chemicals on lawns and shrubs. If possible, the City should explore opportunities for providing a public park on Lake Louise or enhancing a street end for improved public access.

4.7 WAUGHOP LAKE

4.7.1 Land Use

Waughop Lake (approximately 33 acres) and its associated wetlands are completely located within Fort Steilacoom Park; at 340 acres, it is the largest park in Lakewood. The park also offers sports fields, playground, dog park, fishing access, and picnic facilities. The park has historic structures associated with the Fort and the entire park is listed on the State's historic registry.

Waughop Lake is the most natural lake of those in the shoreline jurisdiction in the City of Lakewood. There are no structures around, over, or in the lake and the shoreline has not been modified. There is a paved trail for passive recreation use that circumnavigates the lake. The entire park is designated as Open Space by the City.

4.7.2 Water Quality

There are ongoing water quality issues in Lake Waughop which often results in the local health department closing the lake. The lake frequently has seasonal toxic cyanobacteria blooms resulting in an extreme health risk to humans, pets, and wildlife (Russell and Dorling 2008).

There is one outlet into Lake Waughop that is stormwater runoff from several parking lots located at Pierce College, west of the park (Figure 8A, Appendix C). This stormwater runoff provides phosphate-enriched surface water to the lake. Additionally, it is thought that homes located on higher land south of the park may be contributing effluent to the lake due to failing or inadequate on-site sewage disposal systems.

The lake has warm water fish including largemouth bass, crappie and bullhead catfish. In addition, the lake is planted with rainbow trout on a yearly basis and is the occasional recipient of surplus Coho salmon from the hatchery. Because of the small size of the lake, its shallow depth, and tendency to be eutrophic, the yearly addition of fish causes additional stressors on a lake system that is already compromised.

In 2008 there was an effort to control the toxic algae with applications of calcium hydroxide. These treatments were ineffective and there are ongoing efforts to control the toxic algae (Russell and Dorling 2008).

4.7.3 Critical Areas

As described in Section 3, there are two mapped wetlands along the shores of Waughop Lake. One is located on the western shore and the other is on the eastern shore and continues north in what appears to be a swale or ditch. The wetland on the western shore is mapped as palustrine emergent. The wetland on the eastern shore appears to predominantly be palustrine scrub shrub with both emergent and forested components.

4.7.4 Public Access

The entire shoreline is surrounded by a public park and is completely undeveloped. A shoreline trail has been developed around the lake, and there are plans to make improvements to this trail including creating more shoreline access points. The construction of additional fishing piers is also planned. There is a gravel boat launch where small boats, such as kayaks and canoes, can be carried to the water's edge. Per LMC 08.60.480, Waughop Lake is a Class D lake because it is less than 25 acres. The code does not specifically deny the use of the lake by motorized boats, but does state that no watercraft can go more than 5 miles per hour at any time. Additionally, there is no access for the launching of motor boats.

4.7.5 Opportunity Areas

Due to the risk to human health, water quality improvement for Waughop Lake should be a primary focus for the City of Lakewood. One of the first steps towards achieving this is to discontinue the placement of game fish in the lake. Pet waste can also cause water quality issues. If they aren't already provided, pet waste bags and trash cans should be located near the path around the lake.

Other opportunities in the shoreline area for Waughop Lake include educational signage and outreach regarding the park's historic use, as well as education regarding the lake and surrounding wetlands. If warranted, wetland and buffer enhancement around the lake would provide improved water quality, habitat, and volunteer opportunities within the City.

5.0 ANALYSIS of ECOLOGICAL FUNCTIONS and ECOSYSTEM WIDE PROCESSES

Ecology requires a three-step process to determine what ecological processes are occurring within shoreline jurisdiction, determine the existing relationship between those landscape-scale processes and the performance of ecological functions (to qualitatively assess which functions are present, degraded or not present); and then based on existing conditions and potential future conditions, to recommend measures to maintain and/or restore the functions associated with the ecosystem-wide processes. Described below are those three 'steps': an overview of the landscape-scale processes provided in existing conditions, a qualitative assessment of functions (presence/absence or degree of performance) in existing conditions (summarized by Shoreline Segment in Table 6); and lastly recommendations for management actions to maintain or restore landscape-scale processes to positively influence functions performed.

5.1 OVERVIEW OF LANDSCAPE-SCALE PROCESSES

The Washington State SMP guidelines (WAC 173-26-201(3)(d)(i) provides direction on the functions that are to be assessed in relation to providing or impairment by shoreline segment. The functions include hydrologic, vegetation, hyporheic, and habitat. The functions are presented and summarized below for their condition in existing conditions within the shoreline zones. Questions to consider ascertaining the degree that these processes have been impaired (and therefore the ability of the shoreline to provide key functions impaired) are:

- Presence of dams or outlet structures which have changed the hydroperiod;
- The extent of percent imperviousness (effective) in the contributing watershed;
- The presence/absence of flooding problems or connectivity between the shoreline and its floodplain;
- Existence of habitat for listed and priority species;
- Identified or documented water quality problems;
- Do conditions in the contributing area to the City's waterbodies imply the potential for significant sediment or pollutant loading?; and
- Is there evidence of the presence of contaminated sediments?

Surface Water Flow (Hydrologic): Water flow relates to the natural movement of water into the lakes and through streams, the physical complexity of vegetation overhanging the lake shore, and the presence/absence of physical structures that influence water movement in/through the shoreline environments.

For Lake Steilacoom the presence of the outlet dam has created a relatively stable lake water elevation and because the flow control is managed, it has eliminated any floodplain of the lake (high flows into the lake simply pass through it). Increase in the density of development in the watershed

should be assumed to have had impacts on the volume of water entering the lakes and streams, particularly since all of the waterbodies have stormwater outlet structures, and the quality of the water entering the lakes and streams. The lakes are mainly spring fed and experience draw downs during the summer months. The development in the watershed and the straightening and ditching of Clover Creek has increased peak flows and the velocity of the stream.

Vegetation: The presence and condition of native vegetation within the shoreline zone in relation to its ability to filter sediments, influence water temperature, provide structure for wildlife use; provide food sources for wildlife; provide bank stabilization, and provide a source for large woody debris (LWD) recruitment.

The review of background data and current aerial photographs documents that the vast majority of the shorelines of the four developed lakes have been armored with bulkheads of some type; and that nearly 75% of the single family residences have some type of on-water dock or swimming platform in the lake. Natural vegetation within the shoreline zone or overhanging the edges of the lake is significantly absent on the lake margin. The exceptions to this are the natural shoreline of Waughop Lake, the largely forested riparian zone of Chambers Creek, Silcox Island, and the forested peninsula south of Silcox Island. In-water vegetation is present and problematic in Lake Steilacoom; dominated at different times by non-native water lily (Nuphar spp), pondweeds, elodea, filamentous algae, and blue-green algae. For the four developed lakes and along Clover Creek, natural vegetation within the riparian fringe has been altered by use for lawns and developed human uses that it probably serves only limited function for erosion/sediment control through filtering or entrapment. Upland habitats in the vicinity of the lakes and streams have been significantly altered through agricultural practices in the early years, and then development activities to such an extent that the little existing forest functions are likely quite impaired from a habitat perspective. However, due to the direct connection to Chambers Bay and Puget Sound, the forested riparian zone of Chambers Creek probably provides some of the only quality habitat connectivity in the City. Other than Chambers Creek, this dense, urban center provides little habitat in the shoreline areas, and in general, what is present tends to be of low to moderate quality.

Hyporheic Flow and Shallow Groundwater: In order to assess how the streams function in relation to hyporheic flow it must be determined the extent of connectivity that remains between the shoreline water in the immediate vicinity of the streams relative to; influence on shallow groundwater, and water quality. Also assessed is how the shallow groundwater and its connectivity with the lakes influences lake levels, water quality, and late summer recharge.

Lake Steilacoom, American Lake, Gravelly Lake, and Lake Louise have substantial amounts of bulkheading and armoring, ranging from a low of 36% of parcels with frontage on Gravelly Lake to 74% of parcels with frontage on American Lake. Depending on how these physical structures were placed, they can reduce the influence of shallow groundwater on the lakes and severely limit the lakes influence on shallow groundwater because of the shear inability of the water to enter the shallow groundwater zone. It is assumed that in general, the bulkheads were constructed at grade

and then backfilled with soil. This would keep the shallow groundwater layer intact. However, if the ground surface was cut or there was excavation in order to install the bulkheads, the shallow groundwater interface may be disturbed. Due to the armoring and channelization of Clover Creek, the hyporheic flow has also likely been altered. Chambers Creek has had the least amount of alteration, leaving the hyporheic zone largely intact and functioning.

5.2 PROCESSES AND FUNCTIONS

Ecological processes and functions of jurisdictional shorelines within the City of Lakewood are summarized in Table 6, below. Ecology recommends assessing the relative ecological functions that each segment provides for Hydrologic, Vegetation, Hyporheic, and Habitat processes at the landscape scale. We have provided that assessment for each Segment, providing a qualitative rating of Low, Low/Moderate, Moderate, Moderate/High, and High when compared to the other Shoreline Segments in the City of Lakewood, not County-wide. We then assigned a numeric value of 1-5 (low to high) to those qualitative values for each function assessed. Finally, in Table 7, we compare the function "scores" between each segment to illustrate, in a very qualitative way, the relative degree that each segment may provide a particular function compared to other Segments.

Table 6
Functions Summary

Waterbody	Performance of Function by Segment	Score[1]
Segment 1—Chambers Creek Chambers Creek has suffered the effects of urbanization in the upstream portions of the stream reach (Segment 1A), while the downstream portion has remained largely untouched (Segment 1B). Chambers Creek is considered the highest functioning stream in the watershed, and has a largely intact riparian buffer covering the majority of Segment 1B. Segment 1C is an adjacent palustrine emergent wetland on the western bank of Segment 1A.		
Chambers Creek	**Hydrologic:** Transport of water and sediment **Summary:** Chambers Creek drains Lake Steilacoom as it flows over a dam at the Lake's north end; it is a perennial stream that flows directly into Puget Sound after passing over a small dam. The majority of the stream length is situated within a well forested buffer on both banks. In general the stream is contained within an incised valley ravine and housing is situated along the upper portion of the stream. Chambers Creek likely has an altered (urban) hydroperiod that causes more flashy, highly erosive flows leading to down-cutting, and sediment transport. **Segment 1A:** Moderate/High: The stream is unconstricted and carries flows year-round. It likely collects sediment from street-end run-off in the upper portion. **Segment 1B:** Moderate/High: The fully forested buffer surrounding the stream supplies Large Woody Debris (LWD) which functions to	Segment 1A: 4 Segment 1B: 4 Segment 1C: 1

Table 6
Functions Summary

Waterbody	Performance of Function by Segment	Score[1]
	create the opportunity for bed control and sediment entrapment to some degree. LWD is visible in the stream from aerial photography. **Segment 1C:** Low: Small emergent wetland area within the Lakewood State Game Refuge that likely gets its water from precipitation and surrounding surface runoff. The wetland does not contribute significantly to the flows of the Chambers Creek.	
Chambers Creek	**Hydrologic:** Attenuating flow energy **Summary:** The condition of the shoreline to attenuate flow energy is dependent on the presence and extent of intact forest to provide LWD and to stabilize the shoreline. Flashy urban hydroperiods may overcome the beneficial conditions of the shoreline forest and still result in significant down-cutting (evidenced by the sediment/gravel bar accumulations below the Chambers Bay dam as well as above the Creek visible from the aerials). Down-cutting is a geological process that deepens a stream channel by removing material from the stream bed and moving the debris downstream. **Segment 1A:** Low/Moderate: The modified buffer surrounding the stream has limited the supply of LWD which would otherwise function to create the opportunity for bed control and sediment entrapment to some degree. Additionally, some portions of the stream appear to have been straightened and armored in this segment, which heightens flow energy. **Segment 1B:** Moderate/High: The fully forested buffer surrounding the stream supplies LWD which functions to create the opportunity for bed control and sediment entrapment to some degree. **Segment 1C:** Low: This small emergent wetland area within the Lakewood State Game Refuge likely gets its water from precipitation and surrounding surface runoff. The wetland does not contribute significantly to the flows or attenuate the flows of Chambers Creek.	Segment 1A: 2 Segment 1B: 4 Segment 1C: 1
Chambers Creek	**Hydrologic:** Developing pools, riffles, gravel bars **Summary:** The perennial stream has the opportunity to respond to in-stream physical conditions to establish a variable bed condition. As seen in aerial photos and based on the extensive forests along portions of the stream, LWD is present sufficiently to influence pool/riffle formation. Again, urban hydroperiods can 'wipe-out' the benefit of structure in the stream if down-cutting supersedes the ability of LWD to stabilize the channel.	Segment 1A: 3 Segment 1B: 5 Segment 1C: N/A

Table 6
Functions Summary

Waterbody	Performance of Function by Segment	Score[1]
	Segment 1A: Moderate: The less forested buffer in the upper portion of this segment means it has less opportunity for LWD and complexity in the upper reaches. **Segment 1B:** High: The extensive forested buffer provides excellent opportunity for LWD to enter the stream and create the physical complexity for pools, riffles and gravel bars. **Segment 1C:** Not Applicable: The wetland does not have influence on this function.	
Chambers Creek	**Hydrologic:** Recruitment and transport of LWD and other organic material **Summary:** The extensive forests in the buffer zone in the lower ¾ of the stream within the City provide an excellent opportunity for recruitment of LWD. **Segment 1A**: Moderate: The more limited forest and increased urbanization in the upper reach of this segment means less opportunity of LWD recruitment. The metered flow of water over the dam from Lake Steilacoom limits the ability to transport sizable sediment and LWD. **Segment 1B:** High: This segment has a well established forested buffer with high potential for recruitment of LWD along its entire length. **Segment 1C:** Low/Moderate: The lack of forest in the wetland and its buffer eliminates the opportunity for recruitment of LWD; some organic materials may be generated by the wetland and transported into Chambers Creek.	Segment 1A: 3 Segment 1B: 5 Segment 1C: 2
Chambers Creek	**Vegetation:** Maintaining temperature **Summary:** Overhanging vegetation can influence water temperatures to a limited degree; however the extent of impervious surfaces that contribute to flows likely has a greater influence on temperature. Chambers Creek in the majorly of its length is well forested and buffered with mature forest. **Segment 1A:** Moderate: More limited forest in the upper reach of this segment means less opportunity for positive influence on temperature; but the lower reach of the segment has good forested buffer and better shading. **Segment 1B:** High: This segment has a well established forested buffer with high degree of shading along its entire length. **Segment 1C:** Low: The lack of forest in the wetland and its buffer eliminates the opportunity for shading the water and regulating temperature.	Segment 1A: 3 Segment 1B: 5 Segment 1C: 1

Table 6
Functions Summary

Waterbody	Performance of Function by Segment	Score[1]
Chambers Creek	**Vegetation:** Removing excess nutrients and toxic compounds **Summary:** The creek flows through a forested ravine for much of its length however it does not flow through standing emergent or woody vegetation that provides physical filtering of sediment or uptake of nutrients. The forests within the buffer have a limited opportunity to uptake nutrients and toxins. **Segment 1A:** Moderate: The creek does not flow through standing emergent or woody vegetation that provides physical filtering of sediment or uptake of nutrients in this segment. **Segment 1B:** Moderate: The creek flows through a forested ravine for much of its length. There are mapped wetlands in the lower portion of the ravine and depending on the vegetation types; water flowing through standing emergent or woody vegetation likely provides physical filtering of sediment or uptake of nutrients. **Segment 1C:** Moderate/High: The wetland may provide opportunity for filtering and uptake with the standing emergent vegetation.	Segment 1A: 3 Segment 1B: 4 Segment 1C: 4
Chambers Creek	**Vegetation:** Sediment removal and bank stabilization **Summary:** The forested buffers have good opportunity for filtering sediments and providing some bank stabilization along the stream where the forested buffers are fully intact. Banks may or may not be stabilized from the effects of urban hydroperiods, regardless of condition of the vegetation in the buffer. **Segment 1A:** Moderate: The upper portion of the segment doesn't have as extensive forests as the lower reach, however the opportunity for sediment removal is still moderate in that upper section. The forested buffer has the opportunity to effectively filter sediment. It also can contribute to stabilizing the stream bank with the input of LWD and roots. **Segment 1B:** Moderate/High: The extensive forested buffer has the opportunity to effectively filter sediment. It also can contribute to stabilizing the stream bank with the input of LWD and roots. **Segment 1C:** Low/Moderate: It appears that the uplands surrounding the wetlands are old pastures which have some opportunity for sediment filtering and nutrient uptake.	Segment 1A: 3 Segment 1B: 4 Segment 1C: 2
Chambers Creek	**Vegetation:** Attenuation of flow energy **Summary:** If surface flows are directed towards the Creek through the uplands adjacent to it, the vegetation (forests) within the buffer could attenuate flow energy, however the steepness of the ravine may negate the benefit of the forested buffer.	Segment 1A: 3 Segment 1B:

Table 6
Functions Summary

Waterbody	Performance of Function by Segment	Score[1]
	Segment 1A: Moderate: For the upper portion of the reach, flows entering the uplands are not on quite as steep of slopes as lower in the reach and the vegetation is less dense; so the attenuation of energy may be neutral. **Segment 1B:** Moderate: Steep ravine slopes mean that flows entering from above will have the potential for erosive actions in spite of the forested conditions. **Segment 1C**: Moderate/High: Gentler grades surrounding the wetland and the densely vegetated pastures may reduce the potential for erosive flows entering the wetland.	3 Segment 1C: 4
Chambers Creek	**Vegetation:** Provision of LWD and organic matter **Summary:** The upland forested buffers are excellent sources of LWD and organic matter into the Chambers Creek system. **Segment 1A:** Moderate/High: More limited forest in the upper reach of this segment means less opportunity of LWD recruitment; but the lower reach of the segment has good forested buffer and high potential for LWD recruitment. **Segment 1B:** High: This segment has a well established forested buffer with high potential for recruitment of LWD along its entire length. **Segment 1C:** Low/Moderate: The lack of forest in the wetland and its buffer eliminates the opportunity for recruitment of LWD; some organic materials may be generated by the wetland and transported into Chambers Creek.	Segment 1A: 4 Segment 1B: 5 Segment 1C: 2
Chambers Creek	**Hyporheic:** Removing excess nutrients and toxic compounds **Summary:** The forested buffer along much of the creek provides an excellent opportunity for nutrient and toxic removal. The lack of armoring along Segment 1B also helps maintain the hyporheic connection. **Segment 1A:** Moderate: More limited forest in the upper reach of this segment means less opportunity of uptake and filtering, the shoreline armoring also inhibits the hyporheic functions. **Segment 1B:** Moderate/High: This segment has a well established forested buffer and a lack of armoring, creating a high potential for uptake and filtering along its entire length. **Segment 1C:** Moderate/High: The densely vegetated pasture has the opportunity to filter and uptake nutrients.	Segment 1A: 3 Segment 1B: 4 Segment 1C: 4
Chambers Creek	**Hyporheic:** Water storage **Summary:** The walls of the ravine along Chambers Creek are	

Table 6
Functions Summary

Waterbody	Performance of Function by Segment	Score[1]
	likely groundwater discharge zones; there is little opportunity for storage of surface or shallow groundwater along the ravine. **Segment 1A:** Low/Moderate: The stream and its buffer have little opportunity for storage of shallow groundwater or surface water through the ravine. **Segment 1B:** Low/Moderate: The stream and its buffer have little opportunity for storage of shallow groundwater or surface water through the ravine. **Segment 1C:** Moderate: Compared to the stream flowing through the ravine, the wetland has more opportunity for storing surface water modestly.	Segment 1A: 2 Segment 1B: 2 Segment 1C:3
Chambers Creek	**Hyporheic:** Support of vegetation **Summary:** The walls of the ravine along Chambers Creek are likely groundwater discharge zones therefore they may support a forest more adapted to slightly wetter conditions. **Segment 1A:** Moderate: The ravine along the upper portions of this segment is less steep and incised therefore it may have less groundwater discharge occurring and less influence on the vegetation. Additionally, areas with armored banks will have interrupted the natural function of groundwater discharge. **Segment 1B:** Moderate/High: The steep walled and relatively deep ravine in this segment may have more seeps and therefore may have a wetter flora in the bottom of the ravine near the creek. **Segment 1C:** Low/Moderate: Seasonally ponded water in this wetland may slightly influence the adjacent vegetation but given the pervious nature of the substrates there is a low probability that the waters from the wetland are 'driving' the vegetation conditions in the nearby uplands.	Segment 1A: 3 Segment 1B: 4 Segment 1C: 2
Chambers Creek	**Hyporheic:** Sediment storage and maintenance of base flows **Summary:** The deeply incised ravines may have seeps which are fed by groundwater from above; these seeps contribute to base-flow in the stream but it is unknown what their relative percent contribution is compared to flows from Lake Steilacoom, Flett Creek, and Leach Creek. **Segment 1A:** Moderate: Areas adjacent to the upper reaches of this segment have more land-use alternation therefore the soils ability to infiltrate may be diminished; the lower reach of this segment is in a forested ravine where it is assumed that seeps are present at the toe of slopes and these seeps support base-flows in the stream (though modestly).	Segment 1A: 3 Segment 1B: 4 Segment 1C:2

Table 6
Functions Summary

Waterbody	Performance of Function by Segment	Score[1]
	Segment 1B: Moderate/High: This segment is in a forested ravine where it is assumed that seeps are present at the toe of slopes and these seeps support base-flows in the stream (though modestly). **Segment 1C:** Low/Moderate: Given the highly infiltrative nature of the soils in this area it is not assumed that the upland areas surrounding the wetland contribute significantly to baseflows into the wetland.	
Chambers Creek	**Habitat:** Physical space and conditions for life history **Summary:** The extensive upland forests surrounding Chambers Creek and the links between the creek, Lake Steilacoom and Puget Sound create excellent terrestrial corridors across much of the City. Life history needs of aquatic species within the stream are assumed high, with the exception of the influence of the dams on the lower reach impacting upstream movement of fish, as well as the dam at the outlet of Lake Steilacoom. **Segment 1A:** Moderate/High: The forested portions of the riparian corridor provide excellent habitat opportunities; as well as the linkages between major habitat zones. The upper reach of this segment is more impacted by roads and residential development therefore it has less habitat benefit relative to Segment 1B. **Segment 1B:** High: Intact upland forest habitat along the stream provides excellent riparian habitat plus the linkages between freshwater lakes and streams and Puget Sound for terrestrial species. The incision of the ravine gives the habitat areas greater physical protection from frequent human and domestic animal access. **Segment 1C:** Low/Moderate: Lack of physical complexity in the wetland and the upland surrounding it likely limit habitat value for this wetland. As an emergent wetland it has some habitat niches which are different than the riparian conditions of Chambers Creek.	Segment 1A: 4 Segment 1B: 5 Segment 1C: 2
Chambers Creek	**Habitat:** Food production and delivery **Summary:** The perennial nature of Chambers Creek means that it is constantly exporting primary productivity (small organic debris and nutrients) to the nearshore of Puget Sound. The upland habitats surrounding the stream provide input to the stream of organic and physical debris that supports a wide range of food webs.	Segment 1A: 4 Segment 1B: 5 Segment 1C:

Table 6
Functions Summary

Waterbody	Performance of Function by Segment	Score[1]
	Segment 1A: Moderate/High: Water discharged from the lake provides nutrients and organics to the upper reaches of Chambers Creek; and the forested habitats in the riparian zones surrounding the creek contribute to food chain support in this segment. **Segment 1B:** High: Inputs from upstream and the inputs from the forested riparian zones support a wide range of food webs and export primary productivity to the nearshore of Puget Sound. **Segment 1C**: Moderate: The small wetland produces organic debris and nutrient export to Chambers Creek, downstream. Lack of a diverse upland habitat surrounding it limits the productivity of the wetland itself.	3

Waterbody	Performance of Function by Segment	Score[1]
Segment 2—Clover Creek Clover Creek's basin is highly urbanized from the Morey Dam on McChord AFB, to the northwest to its discharge point into Lake Steilacoom. The urban basin causes a flashy hydroperiod: flows are very responsive to storm events and late summer dry creek beds due to lack of base-flow support from the watershed. Much of the stream has been straightened, ditched, and armored along its length; eliminating or reducing riparian buffer/forest which influences stream temperature, dissolved oxygen levels, and food web support. Culverts and fish blockages are present along the stream corridor with the longest culvert in the City being under the SR 99/I-5 corridor crossing. Salmon still get up into the stream however smolt mortality is high due to low-flows, stranding, poor water quality and temperature.		
Clover Creek	**Hydrologic**: Transport of water and sediment Low/Moderate: Clover Creek transports water during and after storm events. Flows start from Morey Pond dam on the AFB, and when summer flows stop overtopping the dam, flows in the stream lack much baseflow support so summer time often sees stretches of dry creek channel.	2
Clover Creek	**Hydrologic**: Attenuating flow energy Low/Moderate: Clover Creek has been culverted and channelized for much of its length; therefore there is little opportunity for channel sinuousity or bank/channel conditions to attenuate flow rate or erosive flows.	2
Clover Creek	**Hydrologic**: Developing pools, riffles, gravel bars Low/Moderate: Clover Creek is highly urbanized, some portions run in asphalt lined channel, and others have been ditched and	2

Waterbody	Performance of Function by Segment	Score[1]
	straightened. In some more natural portions of the channel pools and riffles may be present when water is in the channel, however they do not provide significant habitat benefit due to the seasonal nature of flows in the stream.	
Clover Creek	**Hydrologic:** Recruitment and transport of LWD and other organic material Low/Moderate: Some limited portions of the channel have forested areas near the stream channel, however those reaches are not sufficient to provide significant LWD and organic input into the steam. Food web support is strongly influenced by the seasonal nature of the stream flows; lack of summer flows eliminates transport of small or large woody debris and other organic matter.	2
Clover Creek	**Vegetation:** Maintaining temperature Low/Moderate: The stream riparian zone is variously vegetated; it flows through residential areas, industrial zones, high-volume transportation corridors all with little to no native vegetative cover over the stream.	2
Clover Creek	**Vegetation:** Removing excess nutrients and toxic compounds Low/Moderate: The stream has some zones where it is infested with reed canary grass which is quite effective at trapping sediment and taking up some nutrients; however being an annual, the plant releases those stored nutrients/toxins at the time of fall die-back and they become less effective at controlling flow rate and causing sediment deposition. Other portions of the stream channel have little or no stream-side or in-stream vegetation to assist with this function.	2
Clover Creek	**Vegetation:** Sediment removal and bank stabilization Low/Moderate: The stream has some zones where it is infested with reed canary grass which is quite effective at trapping sediment and taking up some nutrients; however being an annual, the plant releases those stored nutrients/toxins at the time of fall die-back and they become less effective at controlling flow rate and causing sediment deposition. Other portions of the stream channel have little or no stream-side or in-stream vegetation to assist with this function. The abundance of shoreline armoring, mainly with boulders and concrete, precludes the use of vegetation to stabilize the stream bank.	2
Clover Creek	**Vegetation:** Attenuation of flow energy Low/Moderate: Straightened stream channel, ditched flows, asphalt lined channels, and lack of LWD and physical complexity limits the ability of the stream or its riparian zone to	2

Waterbody	Performance of Function by Segment	Score[1]
	attenuate flow energy.	
Clover Creek	**Vegetation:** Provision of LWD and organic matter Low/Moderate: There are areas of native woodlands/forest along the stream channel but they are very limited in extent. Lack of trees and lack of native trees limits the recruitment of LWD. Organic matter from stream-side vegetation is still produced although even from non-native shrub/vine coverage; it would provide some food web support.	2
Clover Creek	**Hyporheic:** Removing excess nutrients and toxic compounds Low: The extensive bank armoring inhibits the flow of water through the hyporheic zone, in turn this inhibits the hyporheic zone from effectively performing this function.	1
Clover Creek	**Hyporheic:** Water storage Low: The stream has several dams and weirs along its length, however water storage in the hyporheic zone is very limited or non-existent due to the highly infiltratable conditions of the soils. Some portions of the channel are asphalt lined to keep flows up on the surface.	1
Clover Creek	**Hyporheic:** Support of vegetation Low: The riparian zone along Clover Creek is impacted by residential, industrial, commercial uses (as well as culverts) that there is little to no opportunity for the stream to influence the riparian vegetation.	1
Clover Creek	**Hyporheic:** Sediment storage and maintenance of base flows Low: There are little or no baseflows to maintain this stream; it runs dry every summer.	1
Clover Creek	**Habitat:** Physical space and conditions for life history Low: Clover Creek is highly urbanized, some portions run in an asphalt lined channel, others have been ditched and straightened. The seasonal nature of flows in the stream cause die-off of smolts and native adult fish. Poor water quality and elevated temperatures limit aquatic habitat benefits. Lack of recruitment of LWD and native riparian vegetation severely limits biotic integrity of the stream.	1
Clover Creek	**Habitat:** Food production and delivery Low: Clover Creek is highly urbanized, some portions run in an asphalt lined channel, others have been ditched and straightened. Lack of recruitment of LWD and native riparian vegetation severely limits biotic integrity of the stream.	1

Waterbody	Performance of Function by Segment	Score[1]
Segment 3—American Lake is the largest lake in the City's shoreline jurisdiction and its jurisdiction is shared with neighboring Fort Lewis. The lake no longer has a natural outlet, and has just one incoming stream, which is outside of the City's shoreline jurisdiction. The lakeshore is heavily modified by residential housing as well as golf courses, and a military hospital for veterans (also outside of the City's shoreline jurisdiction). **NOTE:** For the purpose of rating the functions for American Lake, the Golf Course has been combined with the City Parks due to the similar features in the functions they provide the lake system.		
American Lake	**Hydrologic:** Storing water and sediment Summary: Lakes can provide water storage, depending on the configuration of the outlet and how much storage capacity the lake's physical basin provides. American Lake has a weir and canal system that drains from the lake when its level exceeds 233 feet above mean sea level, therefore it has some capacity to store floodwater or moderate out flows. All lakes have the potential to improve water quality by entrapping sediments and associated toxins that flow into the water body from the surrounding uplands. Undisturbed soils and pervious soils also have the ability to act as a sponge and store water. However, activities on the lake and surrounding land uses can be the source of adverse impacts to water quality from run-off of pollutants, influences on temperature and stratification, and shallow surface water mixing. Additionally, the compacted soils associated with landscaping causes water to rapidly run off into the lake, rather than being stored in the soils. American Lake has some direct discharges of stormwater into the lake on the south end; plus run-off from landscaped lawns may carry fertilizers and heavy metals into the water. **Segment 3A:** Low: The residential segment contains high amounts of impervious surface from roofs, patios, compact lawns, and reduced vegetative cover which interferes with water infiltration and promotes overland flow of water and sediments toward the lake. Presence of dogs and potential use of chemicals (e.g. fertilizers, pesticides, herbicides) to maintain lawns may run directly into the water with rainfall events. **Segment 3B/C:** Low/Moderate: The parks and golf course have more vegetative cover than the residential segment, but still have a considerable amount of impervious surface including, boat ramp, compacted turf and garden areas, parking and some buildings. **Segment 3D:** Low/Moderate: The majority of the island is in a natural forested condition with undisturbed soils. These features allow infiltration of precipitation; however, there is no opportunity for stormwater and sediment to get to the islands for	Segment 3A: 1 Segment 3B/C: 2 Segment 3D: 2 Segment 3E: 3

Waterbody	Performance of Function by Segment	Score[1]
	this function to be performed. Additionally, the development on the island is all along the shoreline, causing any runoff to go directly into the lake, rather than having the opportunity to infiltrate before reaching the lake. Finally, due to the topography and size of the island (lack of low points), the water runs off of the island into the lake. **Segment 3E:** Moderate: The water and sediment storage function of the forested peninsula is high compared to the rest of the lake perimeter due to the low slopes, pervious soils, limited amount of impervious surfaces and abundant vegetative cover. The property appears to contain high amounts of evergreen and deciduous trees, shrubs, and under story vegetation which promote water infiltration and sediment storage. The condition of the forest allows the assumption that native soils predominate which facilitate infiltration and storage potential.	
American Lake	**Hydrologic:** Attenuating wave energy **Summary:** The nearly completely armored condition of the shoreline means that there is little to no opportunity to attenuate wave energy in the lake. It would be assumed that any "unprotected" shoreline of the lake probably experiences a high degree of erosive wave action as wave energy generated from winds or boat wakes, simply amplify as they move around the perimeter of the lake ricocheting off of bulkheads and not finding a zone to release their stored energy. There are only two areas with a significant lack of armoring; these are the south, east and west portions of Silcox Island and the forested peninsula. The remainder of the lake has just small segments without armoring, small enough that they probably do not function to reduce wave action significantly. The lake is heavily used by boaters, causing a significant amount of wave action during the summer months. **Segment 3A:** Low/Moderate: Approximately 66% of the parcels on the shoreline have bulkheads and 92% have boat docks and/or swim platforms. Additionally, the removal of woody debris along the shore has minimized this important component of shoreline roughness and energy attenuation resulting in a reduction in the natural wave attenuation function. **Segment 3B/C:** Low: The vegetation along the shoreline has generally been kept intact in this section, more so than the residential segment. However, the shoreline has still been modified with bulkheads, boat launches, and retaining walls, which negates the function of shoreline vegetation to help attenuate wave energy. Also, given the overall size of these	Segment 3A: 2 Segment 3B/C: 1 Segment 3D: 2 Segment 3E: 4

Waterbody	Performance of Function by Segment	Score[1]
	parcels in relation to the size of the lake, this segment provides little in the way of providing wave attenuation. **Segment 3D:** Low/Moderate: The island shoreline is modified by the installation of bulkheads and boat docks which can intensify wave energy; however, the island does appear to have more shoreline vegetation than the residential segment. Similar to Segments B/C, given the overall size of the island in relation to the size of the lake, this segment provides little in the way of providing wave attenuation. **Segment 3E:** Moderate/High: This shoreline area is in natural condition and significant portions have native vegetation down to the shoreline. Due to the unusual shape of this segment creating a large point out into the lake, and it being unmodified, this segment provides moderate/high function for attenuating wave energy.	
American Lake	**Hydrologic:** Removing excess nutrients and toxic compounds **Summary:** The upland shoreline areas are often a source of nutrients and toxic compounds, via lawn treatment runoff (pesticides, fertilizers, herbicides), road runoff (hydrocarbons, metals), and septic systems (this is the only remaining shoreline area in the City still on septic). The lack of native vegetative cover and lack of wetlands interferes with the natural filtration potential of the landscape. Even though the lake is surrounded by a generally low gradient, low filtration function is expected. **Segment 3A:** Low: Single family residential development dominates this segment and the majority of the lake. The residential segment contains a moderate to high amount of impervious surfaces, reduced vegetative cover, and compacted lawns, all of which inhibit the infiltration and filtering of storm water. Similarly, residential areas are often sources for nutrient and toxic compounds that enter lakes. Additionally, the southern portion of the residential segment is the last remaining area in the City's shoreline area that is still on septic systems which increase nutrient loading when they fail. **Segment 3B/C:** Low/Moderate: Overall, the parks have a moderate amount of impervious surface. The high amount of grass on these parcels likely causes runoff rather than infiltration. While they have a lower percentage of imperviousness and pollution generating surfaces than the roads and driveways/parking areas associated with the residential land uses, the driveway and boat ramp at American Lake Park provide a direct route for stormwater and toxins to discharge directly into the lake. On the shoreline of the golf course there is a large clubhouse, swimming pool, and decks/patios, all of	Segment 3A: 1 Segment 3B/C: 2 Segment 3D: 1 Segment 3E: 4

Waterbody	Performance of Function by Segment	Score[1]
	which contribute stormwater to the lake. **Segment 3D:** Low: The island does not have the opportunity to infiltrate stormwater because it does not receive stormwater runoff. Additionally, any runoff from the houses or decks/patios goes directly into the lake because the development has taken place directly on the shore. It is assumed that the cabins on Silcox Island us septic systems. **Segment 3E:** Moderate/High: The forested peninsula on the lake's southern shore contains significant vegetative cover promoting moderate to high filtration. The nearshore tree and shrub vegetation as well as the extensive upland vegetation likely take up nutrients and other pollutants.	
American Lake	**Hydrologic:** Recruitment of LWD and other organic material **Summary:** The lake likely receives a low amount of organic material input from hydrologic processes due to the limited amount of vegetative cover along the shoreline, except from the island and peninsula. It is not likely that the inflowing streams provide a significant amount of LWD recruitment as it would most often get trapped in the culverts prior to entering the lake. Organic matter recruitment likely occurs during larger storm events capable of producing overland flow to the lake as well as organic matter that is brought in by the streams. In general, large woody debris recruitment is extremely limited by the relative absence of trees along the shoreline. In addition, LWD is often removed from parks and private sites when it does fall because of active lake uses and navigation concerns. **Segment 3A:** Low/Moderate: Organic matter and LWD recruitment in the single family residential areas is limited by the absence of appropriate vegetative cover in close proximity to the water. Similarly, the low rate of shore erosion (otherwise considered to be beneficial) and upland shoreline modifications result in a lower standing crop of trees and vegetation along the shore. **Segment 3B/C:** Low/Moderate: The modified shoreline likely precludes the input of vegetative or organic materials along this portion of the shoreline. Park and golf course maintenance crews are also likely to clean up any debris that might otherwise enter the lake. **Segment 3D:** Moderate/High: The majority of the island has a naturally forested shoreline providing the opportunity to input LWD and other organic material into the lake. The northern shore is heavily modified, but the south, east, and west shores have the opportunity to contribute LWD and organic matter. **Segment 3E:** Moderate/High: The forested peninsula on the	Segment 3A: 2 Segment 3B/C: 2 Segment 3D: 4 Segment 3E: 4

Waterbody	Performance of Function by Segment	Score[1]
	lake's southern shore contains significant amounts of vegetation in close proximity to the shoreline and likely contributes organic material to the lake.	
American Lake	**Vegetation:** Temperature regulation **Summary:** Limited upland portions of the lake are densely vegetated; there is very little vegetation over-hanging the lake margins; and the amount of floating-leaved or emergent wetland vegetation is extremely limited relative to the overall size of the lake and the potential for solar gain. Given the overall size and depth of the lake, the degree to which its shorefront lacks vegetation, and the low percentage of its overall surface area subject to potential shading from the shore, the vegetation that is present likely does not have a measurable effect on lake water temperature. The summer months is when the lake will benefit most from receiving cool water from the incoming stream, however, the amount of water that flows from the stream into the lake during the summer months is probably quite low. **Segment 3A:** Low: Lack of dense shoreline vegetation throughout most of this segment eliminates the potential for some shading of the shallow-water nearshore area greatly limiting the temperature regulation function of this shoreline. **Segment 3B/C:** Low/Moderate: Moderate vegetation densities provide some potential shading, but the armoring along the shore holding back the vegetation likely reduce how much lake temperatures are regulated by this shoreline segment. **Segment 3D:** Low/Moderate: The island generally has dense vegetation along the shoreline; however, due to the size of the island in comparison to the size of the lake, the area subject to potential shading likely does not have a measurable effect on the lake water temperature. It is likely that this area provides cooler water for small fish to take advantage of a small habitat feature. **Segment 3E:** Moderate: The shoreline of the forested peninsula has high amounts of vegetative cover and some potential for shading, however, due to the size of the peninsula in comparison to the size of the lake, the area subject to potential shading likely does not have a measurable effect on the lake water temperature. It is likely that this area provides cooler water for small fish to take advantage of a small habitat feature.	Segment 3A: 1 Segment 3B/C: 2 Segment 3D: 2 Segment 3E: 3

Waterbody	Performance of Function by Segment	Score[1]
American Lake	**Vegetation:** Water quality improvement Summary: Residential and park areas are dominated by lawn, landscaping, and impervious surfaces that typically lack dense native vegetation. As such, the lawns are assumed to be potential sources of water quality contaminants such as fertilizers, herbicides and pesticides. Runoff from the urban impervious surfaces is typically not filtered through vegetation. In addition to the residential pollutants, runoff from roads, driveways and parking lots carries hydrocarbons, metals, sediments and other pollutants. **Segment 3A:** Low: Residential developments with limited vegetative buffer along the shoreline dominate this segment and provide limited opportunities for water quality improvement. Similarly, the lack of nearshore aquatic vegetation also limits the filtering capability of the lake. **Segment 3B/C:** Low/Moderate: The boat launch park shoreline segment is moderately vegetated and provides moderate amounts of water filtration. However the moderate percentage of impervious surfaces, particularly at the golf course, in this segment greatly reduces water infiltration leading to overland flow of storm water and contaminants directly into the lake. **Segment 3D:** Low: The island does not receive a significant amount of stormwater runoff. Any runoff that is generated by the development on the island goes directly into the lake due to the development being situated directly on the shoreline. **Segment 3E:** Moderate/High: The shoreline along the forested peninsula contains high amounts of vegetative cover which likely provide a moderate to high amount of water filtration and water quality improvement.	Segment 3A: 1 Segment 3B/C: 2 Segment 3D: 1 Segment 3E: 4
American Lake	**Vegetation:** Attenuating wave energy **Summary:** Dense aquatic macrophyte beds are present in very limited locations in some shallow portions of the lake shoreline and this submerged vegetation, along with the gradual shoreline grades, could possibly attenuate boat and wind-driven waves in select areas. However, nearly complete shoreline armoring eliminates the opportunity for energy dissipation and in fact results in concentrating wave energy in waves rebounding from the bulkheads. The lakeshore, in the built environments, will have little potential for reducing the natural wave attenuating function of the shoreline. **Segment 3A:** Low: The heavily armored shorelines, lack of in-water structure, and limited shoreline vegetation provide low wave attenuation function in this segment.	Segment 3A: 1 Segment 3B/C: 2 Segment 3D: 2 Segment 3E: 3

Waterbody	Performance of Function by Segment	Score[1]
	Segment 3B/C: Low/Moderate: The parks have some vegetated and beach sections that can attenuate wave energy. The bulkhead at the golf course and the boat ramp accentuates wave energy. **Segment 3D:** Low/Moderate: The vegetated and mostly unmodified shoreline along most of the island has some potential to attenuate wave energy. The small size of the island in relation to the size of the lake is unlikely to have much effect at attenuating wave energy. **Segment 3E:** Moderate: The vegetated and mostly unmodified shoreline along the forested peninsula functionally has the potential to attenuate wave energy. The small size of the peninsula in relation to the size of the lake is unlikely to have much effect at attenuating wave energy.	
American Lake	**Vegetation:** Sediment removal and bank stabilization **Summary:** Under natural conditions, there would be an ongoing, underlying rate of shoreline erosion, which would contribute to maintaining substrate conditions. Instead, the lake shore around most of the lake now has little shoreline vegetation and a significant proportion of it is armored. While this "stabilizes" the banks, it also limits natural recruitment of lakebed materials. **Segment 3A:** Low: Heavily armored shores and absence of LWD and dense vegetation results in a reduction of natural bank stabilization and sediment removal function. **Segment 3B/C:** Low/Moderate: The shoreline in this section has some armoring and in combination with the heavily used boat ramp, likely causes rapid erosion. However the portions that are not armored (beach areas) there is more potential for appropriate sediment to be accumulated. **Segment 3D:** Moderate: The dense shoreline vegetation and semi-natural shorelines that tend to promote natural lake and substrate conditions are present along the majority of the island shoreline. The moderate amount of erosion likely promotes natural substrate conditions in this shoreline area, particularly on the south, east and west shorelines. The heavily modified northern shoreline does little to support this function. **Segment 3E:** Moderate/High: The dense shoreline vegetation and natural shorelines that tend to promote natural lake and substrate conditions are present along the forested peninsula. The moderate amount of erosion likely promotes natural substrate conditions in this shoreline.	Segment 3A: 1 Segment 3B/C: 2 Segment 3D: 3 Segment 3E: 4
American	**Vegetation:** LWD and organic matter recruitment	

Waterbody	Performance of Function by Segment	Score[1]
Lake	**Summary:** Much of the lake shore is developed as single family housing with limited amounts of vegetative cover. The loss of natural, forested shoreline vegetation and its replacement, primarily with lawn and other types of landscaping, has nearly eliminated large woody debris and organic matter recruitment potential along the majority of the lake shore. Any trees or large woody debris that does enter the lake is likely to be quickly removed out of concern for safety to boaters or to reduce the risk of property damage. **Segment 3A:** Low/Moderate: Organic recruitment around the single family homes primarily consists of deciduous leaf input from a limited number of ornamental trees and shrubs. Lawn and other types of landscaping, as well as bank armoring has nearly eliminated large woody debris and organic matter recruitment potential along the lake shore. **Segment 3B/C:** Low/Moderate: Moderate amounts of vegetative cover are present along the park shoreline providing opportunities for organic matter recruitment. Potential organic inputs primarily consist of leaves and conifer needles. The golf course property is not likely to provide much organic debris as the shoreline is heavily armored. Additionally, maintenance crews at the parks and golf course likely clean up any debris that might get to the lake. **Segment 3D:** Moderate: Although armored in many areas, large sections of the island have a naturally forested shoreline providing the opportunity to input LWD and other organic material into the lake. **Segment 3E:** Moderate/High: The shoreline along the forested peninsula contains moderate to high amounts vegetative cover with a mix of second and third growth conifers and deciduous trees as well as shrubs, offering the potential for a substantial amount of LWD potential and organic recruitment.	Segment 3A: 2 Segment 3B/C: 2 Segment 3D: 3 Segment 3E: 4
American Lake	**Groundwater – Surface Water Connection:** Removing excess nutrients and toxic compounds **Summary:** The shallow groundwater zone along the lake shore may have the potential to provide moderate nutrient and toxin removal however that cannot be definitively determined given the data available. The shoreline area of the lake is mapped by NRCS as Spanaway Gravelly Sandy Loam soil which is relatively permeable. However in disturbed conditions (grading for lawns, golf course or backfilling behind bulkheads) the soil permeability should be assumed to be low. It is also not possible to discern what loading is associated with runoff from the residential land-	Segment 3A: 1 Segment 3B/C: 2 Segment 3D: 2 Segment 3E: 3

Waterbody	Performance of Function by Segment	Score[1]
	uses. In cases where active chemical management of various pests, weeds, or fertilizers are regularly applied, the soils may lose their capacity to bind or filter excess loading. Bulk-heading can have several implications on this function: the shallow grades between upland/water surfaces are replaced with abrupt changes; and, lawns and their active treatment regimes can therefore be created/maintained virtually up to the water's edge on soils that are backfilled behind the bulkheads. It should be assumed that areas with bulkheads and active residential lawn establishment cannot provide more than a low rate of this function. Natural shorelines, where the slope gradient is rather gentle and native soils are still present and in a forested condition have a much higher potential for filtering pollutants through the native soils. **Segment 3A:** Low: Residential landscapes containing managed lawn and reduced native vegetative cover may be sources of increased pollutant loading through the shallow groundwater zone. Similarly, depending on how the extensive shoreline armoring was installed, the bulkheads can impede portions of the groundwater flow from the lake, resulting in diminished water exchange and natural process. **Segment 3B/C:** Low/Moderate: The moderate amount of impervious surfaces in this segment has the potential to generate more pollutant loading; it greatly inhibits the opportunity for infiltration; and eliminates the potential of the shallow groundwater zone to remove water-borne compounds. However, the somewhat natural shoreline and moderate vegetated shore (at parks only) may provide some infiltration and exchange between the lake and shallow groundwater zone, resulting in some filtering function. **Segment 3D:** Low/Moderate: There is little pollution generating surfaces on the island. Those that are present are clustered on the edges of the island and likely drain directly into the lake because the surfaces (houses, patios, docks) are right on the shoreline. **Segment 3E:** Moderate: The forested peninsula contains a high amount of vegetative cover and a natural gently sloping shoreline that should increase the ability of the shallow groundwater zone to function to filter storm water. Compared to the other segments around the lake, this segment has the opportunity to perform this function at a high rate. However, it is also true that these forested lands have the least probability of generating pollutants to be filtered by the intact slopes/soils.	
American	**Groundwater – Surface Water Connection:** Water storage	

Waterbody	Performance of Function by Segment	Score[1]
Lake	**Summary:** Storage of water within the shallow groundwater zone is dependent upon appropriate soil types and a lack of effective impervious surfaces within the areas feeding to the lake. In natural conditions there would be a seasonal exchange of sub-surface shallow groundwater between the uplands and the lake: early summer having a discharge of groundwater stored in the soils moving down gradient into the lake; while by late summer/fall, the lake would be recharging to a limited degree the shallow groundwater table as water seeped into the available surrounding shallow groundwater zone. In existing conditions the presence of extensive bank armoring (and assuming grading/backfilling) eliminates the connectivity between the native soils and the lake water. In addition, the presence of effective impervious surfaces precludes infiltration and the recharge of the shallow groundwater to bleed into the lake: surface flows do not infiltrate, they remain on the surface. Lack of native vegetative cover hastens run-off and inhibits infiltration into the shallow groundwater zone. The lake still draws down in the summer and recharges in the winter, indicating that there continues to be groundwater exchange with the lake. However, there is a lack of information to indicate how this may have changed over the years as the area has been developed. **Segment 3A:** Low: The high percentage of effective impervious surface and compacted soils precludes the opportunity for infiltration. **Segment 3B/C:** Low/Moderate: Although the parks and golf course retains open space, it is primarily lawn and effectively imperviousness because it is heavily compacted and therefore compromised in its ability to infiltrate water and create/maintain a seasonal connectivity to shallow groundwater. **Segment 3D:** Moderate: Relative to the other segments around the lake, the mostly naturally forested island retains native soils and vegetation over the majority of the area; this facilitates the natural infiltration of surface waters and maintains a seasonal connectivity between the lake and the shallow groundwater. This function may be slightly hindered by the presence of some bulkheads or other armoring. **Segment 3E:** High: Relative to the other segments around the lake, this naturally forested parcel retains native soils and vegetation over the majority of the area; this would facilitate the natural infiltration of surface waters and maintain a seasonal connectivity between the lake and shallow groundwater.	Segment 3A: 1 Segment 3B/C: 2 Segment 3D: 3 Segment 3E: 5
American Lake	**Groundwater – Surface Water Connection:** Support of vegetation	

Waterbody	Performance of Function by Segment	Score[1]
	Summary: In a natural condition, the vegetated area surrounding a lake may often support a vegetation community that ranges from upland dominants away from the shore; moist-tolerant species just "up" from the water's edge, and wetland vegetation at and out into the lake margin (given appropriate grades and substrates). The shallow groundwater in the will support moist to wet tolerant species up above the lake level, where saturated soils (caused by shallow groundwater moving down towards the lake) are present in the growing season. However, in American Lake extensive backfilling as a result of shoreline armoring has isolated the nearshore from the shallow groundwater and therefore, if vegetation is present at the bulkhead it is not maintained there by shallow groundwater. The physical presence of the bulkhead also precludes the establishment of native riparian vegetation. **Segment 3A:** Low: Residential landscaping and bulk-heading precludes the establishment of native species maintained by shallow groundwater. **Segment 3B/C:** Low: The lawn grass present in these areas is there due to existing use and soil conditions. This could be an area where modest improvement in function could be achieved through intentional plantings and maintenance activities. **Segment 3D:** Moderate: The areas of the island that has not had shoreline modification would be expected to sustain moderate to high amounts of shallow groundwatersupport for native vegetation in the natural shoreline areas. **Segment 3E:** Moderate/High: The forested peninsula is expected to sustain moderate to high amount of shallow groundwater support for native vegetation in the natural shoreline area.	Segment 3A: 1 Segment 3B/C: 1 Segment 3D: 3 Segment 3E: 4
American Lake	**Groundwater – Surface Water Connection:** Sediment storage and maintenance of base flows Summary: American Lake has a large capacity to store sediments that work their way into the lake given the outlet control structure that sets the lake level. However, it is not known if waters from the lake support baseflows as it is dependent on how frequently the water level crests 233 feet above mean sea level. **Segment 3A:** Low: Shoreline armoring can restrict shallow groundwater exchange with the lake. **Segment 3B/C:** Low: The condition of these lands (compacted turf) may inhibit the movement of shallow groundwater into the near shoreline. It is assumed the base flow function is low. **Segment 3D:** Low: There is little in the way of sediment, other	Segment 3A: 1 Segment 3B/C: 1 Segment 3D: 1 Segment 3E: 3

Waterbody	Performance of Function by Segment	Score[1]
	than from the built out area on the shore of the island, which can make their way into the lake from the islands. There is unlikely to be any base flows from the island that supports the lake, as the only water that could flow from the island to the lake is from precipitation. **Segment 3E:** Moderate: The natural shoreline and soils of the mostly naturally forested property would lead to the assumption that this segment maintains its natural level of sediment storage and provides base flow to the lake seasonally.	
American Lake	**Habitat:** Physical space and conditions for life history Summary: American Lake is a large system that is predominantly urbanized around the perimeter with docks, piers and shoreline armoring consisting of bulkheads at a majority of the parcels. There are a few areas of lower density residential, golf course and some parks within the City that provide open space near the shore; but those areas are dominated by managed lawns and/or landscaping, not native forests. Silcox Island has residential uses at slightly lower densities which allow more forested conditions near the shore and Segment 3E is a singular forested peninsula, zoned for Open Space that is in relatively natural condition (compared to the rest of the perimeter of the lake shore). No known wetlands are present along the shore in the City limits. The lake is (has been) stocked with a wide range of non-native sport fish. **Segment 3A:** Low/Moderate: The residential uses strongly influence the vegetation within the shoreline zone with a predominance of grass and other non-natives. The lack of physical structure or native food sources limits the uses for life-history needs in these zones. **Segment 3B/C:** Low/Moderate: The parks influence the vegetation within the shoreline zone with a high predominance of non-natives. The lack of physical structure or native food sources limits the uses for life-history needs in these zones. The golf course overall has a lower density than the surrounding residential zones, however the shoreline is occupied by a very large clubhouse, dock, swimming pool complex that virtually eliminates all native vegetation for much of this zone. Habitat niches and food web support is minimal. **Segment 3D:** Moderate: Lower residential densities along Silcox Island allow more native vegetation down near the shore and the opportunity for recruitment of LWD (unknown if the residents would allow fallen wood to remain in the lake).	Segment 3A: 1 Segment 3B/C: 2 Segment 3D: 3 Segment 3E: 4

Waterbody	Performance of Function by Segment	Score[1]
	Segment 3E: Moderate/High: The peninsula is forested with native species and therefore provides the most potential for physical complexity and food web support for native species within the shoreline zone of the City.	
American Lake	**Habitat:** Food production and delivery Summary: American Lake is a large system that is predominantly urbanized around the perimeter with docks, piers and some shoreline armoring. There are a few areas of lower density residential, golf course and a some parks within the City that a provide a little more open space near the shore; but those areas are dominated by managed lawns and/or landscaping, not native forests. Silcox island has residential uses at slightly lower densities which allow more forested conditions near the shore and Segment 3E is a singular forested peninsula, zoned for Open Space that is in relatively natural conditions (compared to the rest of the perimeter of the lake shore). **Segment 3A**: Low/Moderate: Lack of native forests or wetland vegetation along the shoreline in these residential zones limits the food production and delivery into the lake. **Segment 3B/C**: Low/Moderate: Lack of native forests or wetland vegetation along the shoreline in these park zones limits the food production and delivery to the lake. The golf course has lower density overall but near the lake shore it has a swimming pool, large covered dock, and extensive shoreline management. **Segment 3D**: Moderate: Silcox Island has lower residential density with more remaining larger native forest trees but no wetland habitats to generate food production in the shoreline environs. **Segment 3E**: Moderate/High: This forested peninsula has the most potential to provide natural food web support along the lake shore.	Segment 3A: 2 Segment 3B/C: 2 Segment 3D: 3 Segment 3E: 4
Segment 4—Lake Steilacoom Lake Steilacoom is surrounded by single family housing and a heavily modified shoreline that has resulted in 62% of the shoreline being armored with bulkheads and 77% of the parcels having boat docks and/or swim platforms. The lake has long suffered from significant algae blooms, thought to be caused by high levels of phosphorus. The lake has one City park that has a somewhat natural shoreline, although it has a boat launch and some armoring. **Note:** Because the park (Segment B) occupies such a small portion of the lakeshore, and is not forested, its rating is combined with Segment A for this function.		
Lake Steilacoom	**Hydrologic:** Storing water and sediment **Summary:** Lakes can provide water storage, depending on the	

Waterbody	Performance of Function by Segment	Score[1]
	configuration of the outlet and how much storage capacity the physical basin provides. Lake Steilacoom water levels are controlled by a dam, and it does not have the capacity to store great amounts floodwater. Generally, flows into the lake likely equal the flows out of the lake in typical winter conditions. All lakes have the potential to improve water quality by entrapping sediments and associated toxins that flow into the water body from the surrounding uplands. Activities on the lake and surrounding land uses can be the source of adverse impacts to water quality from run-off of pollutants, influences on temperature and stratification, and shallow surface water mixing. For Lake Steilacoom there are some direct discharges of stormwater into the lake in addition to the stormwater discharge that outlets into Clover and Ponce de Leon Creeks, both of which outlet to the lake; plus run-off from landscaped lawns may carry fertilizers and heavy metals into the water. The surface water inlets from Clover and Ponce de Leon Creeks likely bring a different suite of pollutants from higher in the watershed (agriculture) than what is provided to the other lakes in the City that only receive runoff from the immediately surrounding areas. **Segments A/B:** Low: The residential segment contains high amounts of impervious surface from roofs, patios, compact lawns, and reduced vegetative cover which interferes with water infiltration and promotes overland flow of water and sediments toward the lake. Presence of dogs and potential use of chemicals (e.g. fertilizers, pesticides, herbicides) to maintain lawns may run directly into the water with rainfall events.	Segments A/B: 1
Lake Steilacoom	**Hydrologic:** Attenuating wave energy **Summary:** The nearly completely armored condition of the shoreline means that there is little to no opportunity to attenuate wave energy in the lake. It would be assumed that any "unprotected" shoreline of the lake probably experiences a high degree of erosive wave action as wave energy generated from winds or boat wakes, simply amplify as they move around the perimeter of the lake ricocheting off of bulkheads and not finding a zone to release their stored energy. The lake is heavily used by boaters, causing a significant amount of wave action during the summer months. Because the park (Segment B) occupies such a small portion of the lakeshore, some of which is armored, its rating is combined with Segment A for this function. **Segment A/B:** Low/Moderate: Approximately 90 percent of the parcels on the shoreline have bulkheads and/or boat docks. Additionally, the removal of woody debris along the shore has	Segment A/B: 2

Waterbody	Performance of Function by Segment	Score[1]
	minimized this important component of shoreline roughness and energy attenuation resulting in a reduction in the natural wave attenuation function.	
Lake Steilacoom	**Hydrologic:** Removing excess nutrients and toxic compounds **Summary:** The upland shoreline areas are often a source of nutrients and toxic compounds, via lawn treatment runoff (pesticides, fertilizers, herbicides), road runoff (hydrocarbons, metals), and septic systems. The lack of native vegetative cover and few wetlands interferes with the natural filtration potential of the landscape. Even though the lake is surrounded by a generally low gradient, low filtration function is expected. Because the park (Segment B) occupies such a small portion of the lakeshore, its rating is combined with Segment A for this function. **Segment A/B:** Low: Single family residential development dominates the majority of the lake. The residential segment contains a moderate to high amount of impervious surfaces, reduced vegetative cover, and compacted lawns, all of which inhibit the infiltration and filtering of storm water. Similarly, residential areas are often sources for nutrient and toxic compounds that enter lakes. The bridge over the middle of the lake is likely a big source of road runoff into the lake.	Segment A/B: 1
Lake Steilacoom	**Hydrologic:** Recruitment of LWD and other organic material **Summary:** The lake likely receives a low amount of organic material input from hydrologic processes due to the limited amount of vegetative cover along the shoreline. It is not likely that the inflowing streams provide a significant amount of LWD recruitment as it would most often get trapped in the culverts prior to entering the lake. Organic matter recruitment likely occurs during larger storm events capable of producing overland flow to the lake as well as organic matter that is brought in by the streams. In general, large woody debris recruitment is extremely limited by the relative absence of trees along the shoreline except for the random tree from the residential areas. Any LWD that does end up in the water is likely removed for safety reasons for swimmers and boaters. **Segment A/B:** Low/Moderate: Organic matter and LWD recruitment in the single family residential areas is limited by the absence of appropriate vegetative cover in close proximity to the water. Similarly, the low rate of shore erosion (otherwise considered to be beneficial) and upland shoreline modifications result in a lower standing crop of trees and vegetation along the shore. There are several large trees on the shoreline in the park that have the opportunity to provide LWD to the lake, but this is	Segment A/B: 2

Waterbody	Performance of Function by Segment	Score[1]
	just one property on a large shoreline.	
Lake Steilacoom	**Vegetation:** Temperature regulation **Summary:** Limited upland portions of the lake are densely vegetated; there is very little vegetation over-hanging the lake margins; and the amount of floating-leaved or emergent wetland vegetation is extremely limited relative to the overall size of the lake and the potential for solar gain. Given the overall size and shallow depth of the lake, the degree to which its shorefront lacks vegetation, and the low percentage of its overall surface area subject to potential shading from the shore, the vegetation that is present likely does not have a measurable effect on lake water temperature. The summer months are when the lake will benefit most from receiving cool water from the incoming creeks, however, the amount of water that flows from either creek into the lake during the summer months is probably quite low. Additionally, Clover Creek is listed on Ecology's 303(d) list as a water of concern for the temperature parameter. Because the park (Segment B) occupies such a small portion of the lakeshore, and has little overhanging vegetation, its rating is combined with Segment A for this function. **Segment A/B:** Low: Lack of dense shoreline vegetation throughout most of this segment eliminates the potential for some shading of the shallow-water nearshore area greatly limiting the temperature regulation function of this shoreline.	Segment A/B: 1

Waterbody	Performance of Function by Segment	Score[1]
Lake Steilacoom	**Vegetation:** Water quality improvement **Summary:** Residential and park areas are dominated by lawn, landscaping, and impervious surfaces that typically lack dense native vegetation. As such, the lawns are assumed to be potential sources of water quality contaminants such as fertilizers, herbicides and pesticides. Runoff from the urban impervious surfaces is typically not filtered through vegetation. In addition to the residential pollutants, runoff from roads, driveways and parking lots carry hydrocarbons, metals, sediments and other pollutants. Because the park (Segment B) occupies such a small portion of the lakeshore, and has a large area of mowed lawn adjacent to the shore, its rating is combined with Segment A for this function. **Segment A/B:** Low: Residential developments with limited vegetative buffer along the shoreline dominate this segment and provide limited opportunities for water quality improvement. Similarly, the lack of nearshore aquatic vegetation also limits the filtering capability of the lake.	Segment A/B: 1
Lake Steilacoom	**Vegetation:** Attenuating wave energy **Summary:** Dense aquatic macrophyte beds are present in very limited locations in some shallow portions of the lake shoreline and this submerged vegetation, along with the gradual shoreline grades, could possibly attenuate boat and wind-driven waves in select areas. However, nearly complete shoreline armoring eliminates the opportunity for energy dissipation and in fact results in concentrating wave energy in waves rebounding from the bulkheads. The lakeshore, in the built environment, will have little potential for reducing the natural wave attenuating function of the shoreline. **Segment A/B:** Low: The heavily armored shorelines, lack of in-water structure, and limited shoreline vegetation provide low wave attenuation function in this segment. There is less, but still some, shoreline armoring along portions of the park shore provides low to moderate wave attenuation.	Segment A/B: 1
Lake Steilacoom	**Vegetation:** Sediment removal and bank stabilization **Summary:** Under natural conditions, there would be an ongoing, underlying rate of shoreline erosion, which would contribute to maintaining substrate conditions. Instead, the lake shore around most of the lake now has little shoreline vegetation and a significant proportion is armored. While this "stabilizes" the banks, it also limits natural recruitment of lakebed materials. **Segment A/B:** Low/Moderate: Heavily armored shores and absence of LWD and dense vegetation results in a reduction of	Segment A/B: 2

Waterbody	Performance of Function by Segment	Score[1]
	natural bank stabilization and sediment removal function. Because the park segment of the shoreline has less armoring there is more potential for appropriate sediment to be accumulated, however, it is still limited.	
Lake Steilacoom	**Vegetation:** LWD and organic matter recruitment **Summary:** Much of the lake shore is developed as single family housing with limited amounts of vegetative cover. The loss of natural, forested shoreline vegetation and its replacement, primarily with lawn and other types of landscaping, has nearly eliminated large woody debris and organic matter recruitment potential along the majority of the lake shore. Any trees or large woody debris that enters the lake is likely to be quickly removed out of concern for safety to boaters or to reduce the risk of property damage. **Segment A/B:** Low/Moderate: Organic recruitment around the single family homes primarily consists of deciduous leaf input from a limited number of ornamental trees and shrubs. Lawn and other types of landscaping, as well as bank armoring has nearly eliminated large woody debris and organic matter recruitment potential along the lake shore. Moderate amounts of vegetative cover are present along the park shoreline providing opportunities for organic matter recruitment. The trees along the shore are predominantly shrubs with an over story of conifers. Potential organic inputs primarily consist of leaves and conifer needles. However, the small size of this segment does not contribute significantly to the function of the lake for LWD and organic matter recruitment.	Segment A/B: 2
Lake Steilacoom	**Groundwater – Surface Water Connection:** Removing excess nutrients and toxic compounds **Summary:** The shallow groundwater zone along the lake shore may have the potential to provide moderate nutrient and toxic removal however that can't be confirmed given the data available. The shoreline area of the lake is mapped by NRCS as Spanaway Gravelly Sandy Loam soil which is relatively permeable. The potential to filter runoff is low to moderate in undisturbed conditions based on the mapped soil conditions. However in disturbed conditions (grading for lawns or backfilling behind bulkheads) the soil permeability should be assumed to be low. It is also not possible to discern what loading is associated with runoff from the residential land-uses. In cases where active chemical management for various pests or weeds is regularly applied, the soils may lose their capacity to bind or filter excess loading. Bulk-heading has several implications on	Segment A/B: 1

Waterbody	Performance of Function by Segment	Score[1]
	this function: the shallow grades between upland/water surfaces are replaced with abrupt changes; and, lawns and their active treatment regimes can therefore be created/maintained virtually up to the water's edge on soils that are backfilled behind the bulkheads. It should be assumed that areas with bulkheads and active residential lawn establishment cannot provide more than a low rate of this function. Natural shorelines, where the slope gradient is rather gentle and native soils are still present and in a forested condition have a much higher potential for filtering pollutants through the native soils. **Segment A/B:** Low: Residential landscapes containing managed lawn and reduced native vegetative cover may be sources of increased pollutant loading through the shallow groundwater zone. Similarly, the extensive shoreline armoring can disconnect portions of the shallow groundwater flow from the lake, resulting in diminished water exchange and natural processes. The moderate amount of impervious surfaces (nearby road) in the park segment also has the potential to generate pollutant loading. The majority of the park is turf, which is often compacted and increases runoff. However, the somewhat natural shoreline and moderate vegetated shore may provide some infiltration and exchange between the lake and shallow groundwater, resulting in some filtering function.	
Lake Steilacoom	**Groundwater – Surface Water Connection:** Water storage **Summary:** Storage of water within the shallow groundwater zone is dependent upon appropriate soil types and a lack of effective impervious surfaces within the areas feeding to the lake. In natural conditions there would be a seasonal exchange of sub-surface shallow groundwater between the uplands and the lake: early summer having a discharge of groundwater stored in the soils moving down gradient into the lake; while by late summer/fall, the lake would be recharging to a limited degree the shallow groundwater table as water seeped into the available surrounding soils. Extensive bank armoring (and assuming grading/backfilling) can hinder the connectivity between the native soils and the lake water. In addition, the presence of effective impervious surfaces precludes infiltration and the recharge of the shallow groundwater to bleed into the lake. Surface flows do not infiltrate; they remain on the surface. Lack of native vegetative cover hastens run-off and inhibits infiltration into the shallow groundwater zone. The lake still draws down in the summer and recharges in the winter, indicating that there continues to be groundwater exchange with the lake. However, there is a lack of information to indicate how this may	Segment A/B: 1

Waterbody	Performance of Function by Segment	Score[1]
	have changed over the years as the area has been developed. **Segment A/B:** Low: The shallow groundwater function of this shoreline segment is probably impacted to a modest degree due to the disconnect between the native soils and the water within the lake by the interceding bulkheads and backfilling. In addition, the high percentage of effective impervious surface precludes the opportunity for infiltration. Although the park retains open space, it is primarily lawn and effectively imperviousness because it is heavily compacted and therefore compromised in its ability to infiltrate water and create/maintain a seasonal connectivity to the hyporheic zone.	
Lake Steilacoom	**Groundwater – Surface Water Connection:** Support of vegetation **Summary:** In a natural condition, the vegetated area surrounding a lake may often support a vegetation community that ranges from upland dominants away from the shore; moist-tolerant species just "up" from the water's edge, and wetland vegetation at and out into the lake margin (given appropriate grades and substrates). The shallow groundwater will support moist to wet tolerant species up above the lake level, where saturated soils (caused by shallow groundwater moving down towards the lake) are present in the growing season. However, in Lake Steilacoom extensive backfilling as a result of shoreline armoring has isolated the nearshore from the shallow groundwater and therefore, if vegetation is present at the bulkhead it is not maintained there by shallow groundwater. The physical presence of the bulkhead also precludes the establishment of native riparian vegetation. **Segment A/B:** Low: Residential landscaping and bulk-heading precludes the establishment of native species maintained by shallow groundwater. The lawn grass present in the park segment is there due to existing use and soil conditions. This could be an area where modest improvement in function could be achieved through intentional plantings and maintenance activities.	Segment A/B: 1
Lake Steilacoom	**Groundwater – Surface Water Connection:** Sediment storage and maintenance of base flows **Summary:** Lake Steilacoom is very shallow and has a moderate capacity to store sediments that work their way into the lake given the outlet control at the dam that sets the lake level for flows exiting to Chambers Creek. It is not known if waters from the lake support baseflows in Chambers Creek in a typical summer; no existing baseline data was identified. Flows from the two creeks to the south/southeast do maintain baseflows into	Segment A/B: 1

Waterbody	Performance of Function by Segment	Score[1]
	the lake and help to maintain summer lake levels. **Segment A/B:** Low: Shoreline armoring may modestly restrict the hyporheic exchange with the lake. It is assumed that little or no baseflows are present from the disturbed/compacted soils in the uplands into the lake. The condition of the park segment (compacted lawns) probably inhibits the movement of shallow groundwater into the near shoreline. It is assumed the base flow function is low.	
Lake Steilacoom	**Habitat:** Physical space and conditions for life history **Summary:** With its extensive shoreline armoring Lake Steilacoom likely has little beneficial habitat for near-shore aquatic species. Overall the lake is very shallow, and shallow nearshore areas can provide critical rearing and foraging habitat for fish, as well as rearing/breeding habitat for a variety of aquatic organisms. Shoreline armoring, creates deeper, turbulent nearshore conditions that are inhospitable to aquatic organisms which rely upon emergent aquatic floating leaved vegetation, structural complexity, or just shallow waters. Shoreline armoring can also reduce upwelling/down-welling areas, which are optimal for spawning for some fish. Deep water along the shore allows larger predatory fish to prey on the small/young fish. Aquatic mammals, like muskrats, seem to have adapted to the armored shoreline, and still find den sites in the looser boulder bulkheads. The absence of dense shoreline vegetation is a limiting factor in terrestrial species (birds, mammals, amphibians) use of the shoreline, since cover, food, nesting sites, travel corridors, etc. are absent. Additionally, Lake Steilacoom has ongoing water quality issues particularly pertaining to toxic algae blooms. **Segment A/B:** Low: The heavy shoreline armoring and lack of vegetative cover in the residential areas of the lake provide limited amounts of physical space and conditions for the life histories of most native aquatic and water associated species. The moderate vegetative cover in the park segment should provide some needed physical habitat, primarily for terrestrial species, but the shoreline armoring (although less than the residential segment) can be a barrier for some species, limiting the movement between terrestrial and aquatic habitats.	Segment A/B: 1
Lake Steilacoom	**Habitat:** Food production and delivery **Summary:** Food production from the uplands is limited by the extensive bulk-heading which eliminates the presence of native riparian species along the shoreline and therefore forms a physical barrier for some species. Some domestic fruit trees and	Segment A/B: 2

Waterbody	Performance of Function by Segment	Score[1]
	other non-native vegetation in yards can supply food for wildlife. The absence of emergent wetland areas that provide productive foraging areas for small mammals, wading birds and waterfowl combined with shoreline armoring also limits the food production and delivery function of the shoreline. **Segment A/B:** Low/Moderate: The shoreline armoring and residential density limits the amount of suitable habitat for primary production in the form of aquatic plants and dense terrestrial vegetation. Similarly, the primary consumers who utilize shoreline vegetation for food and shelter are absent, thus limiting the availability, production, and delivery of food resources for use farther up the food chain. The moderately vegetated shoreline and presence of tall trees in the park segment likely provide moderate amounts of food for terrestrial animals. However, during high use times of the year at the park, the terrestrial animals may not use the park. The poor water quality of the entire lake likely inhibits in-water food production.	
Segment 5—Gravelly Lake Gravelly Lake is completely surrounded by residential housing, and subsequently has a highly modified shoreline consisting of bulkheads, boat docks, and swim platforms. Approximately 34% of the shoreline is armored and 85% of the parcels have boat docks and/or swim platforms. The lake receives groundwater and stormwater inputs, but does not have an outlet. Gravelly Lake has not been stocked with rainbow trout for the last several years (as records indicate), but may support a fish population if there was previous stocking practices.		
Gravelly Lake	**Hydrologic**: Storing water and sediment **Summary**: Gravelly Lake is primarily spring feed, and receives stormwater inputs. Therefore it has some potential to store sediment from storm events. Because the primary input is spring-fed, the lake-level tends to drop in the summer months, creating an opportunity for storage. Sediment input occurs mostly during storm events when stormwater discharges into the lake; sediment that does enter the lake is 'trapped' as there is no surface outlet. There is no distinction between the functions provided by the two segments of Gravelly Lake for this function. **Segments A/B:** Moderate/High: Gravelly Lake has no inlet streams, it is fed by seeps and springs, as well as stormwater inputs; and per Ecology's web page, it loses water from infiltration and evapotranspiration. Because the lake itself is a closed basin, it has a very high opportunity for storing sediments which enter the lake from stormwater discharges.	Segment A/ B: 4
Gravelly Lake	**Hydrologic:** Attenuating wave energy **Summary:** The north and south shores of the lake have steeper	

Waterbody	Performance of Function by Segment	Score[1]
	gradients under water than the east and west shores meaning that north or south driven winds will have less lake bottom to diffuse wave energy near the shoreline. The lake shore appears to be armored extensively, however summer low water levels may result in waves washing the exposed shore rather than hitting bulkheads or other armoring. Winter storm-driven waves would be assumed to be at "full pool" and the armoring would preclude wave energy being dissipated. There is no distinction between the functions provided by the two segments of Gravelly Lake. **Segment A/B:** Moderate: The shoreline of Gravelly Lake has a significant amount of armoring; however, in the summer lake levels drop below full pool, due to the lack of surface inputs. Summer recreation activities (boating and jet skis) that may generate waves may cause some degree of sediment suspension as the lower water level exposes the beaches. At the same time, the exposed beaches will function to reduce wave energy in the summer months. In the winter, when storms may cause wind-driven waves it may be assumed that lake levels would be higher, and the shoreline armoring would therefore be 'engaged' to influence wave energy.	Segment A/B: 3
Gravelly Lake	**Hydrologic:** Removing excess nutrients and toxic compounds **Summary:** Nutrients are removed by either uptake and breakdown by vegetation within the lake (or algae in the water column), or by uptake by vegetation along the shoreline. Dense vegetation (native or non-native) in the buffering shoreline of the lake is assumed to provide physical filtering of sediment (and associated heavy metals) and the potential for uptake of nutrients. Toxins can be generated from landscape practices (e.g. application of fertilizers, herbicides, pesticides, etc.) or from untreated stormwater runoff from pollution generating impervious surfaces. Toxins often enter aquatic systems adhered to sediment particles which come in as surface flows, stormwater inputs, or surface sheet flow from the surrounding land-uses. There is no distinction between the functions provided by the two segments of Gravelly Lake. **Segment A/B:** Low/Moderate: The ability of the lake to remove nutrients is dependent upon the amount of natural biotic activity in the lake including the presence of aquatic or wetland vegetation. The lake appears to have no floating or emergent vegetation present (based on recent aerial photos); therefore it is assumed that nutrients that enter the system are likely stored there. But there is no opportunity for uptake or breakdown by aquatic vegetation. Vegetated conditions of the buffer	Segment A/B: 2

Waterbody	Performance of Function by Segment	Score[1]
	surrounding the lake can also filter sediments and assist in the uptake of nutrients. Nutrients and pollutants may enter the lake from stormwater input. The vegetated condition of the lakeshore ranges from highly manicured lawns to slightly less manicured conditions with some over-story of native forest/trees remaining. It is assumed that the majority of the vegetation near the lake is actively managed lawns; and that the portion of the lakeshore that may be more naturally vegetated is not significant enough to warrant a distinction.	
Gravelly Lake	**Hydrologic:** Recruitment of LWD and other organic material **Summary:** Recruitment of LWD comes from the upland areas adjacent to the lake shore. There is no distinction between the segments in this function. **Segment A/B:** Low: All shoreline areas adjacent to Gravelly Lake are privately owned and actively managed. It is highly unlikely that any large (or small) woody debris that falls into the shoreline is allowed to remain there. There is potential for such recruitment, however without an educational opportunity for landowners, it is assumed that there is a very low probability of such recruitment.	Segment A/B: 1
Gravelly Lake	**Vegetation:** Temperature regulation **Summary**: Substantial vegetation near or over-hanging a water body may have some influence on water temperature. This is especially true in riparian settings; less so in lakes. Gravelly Lake has manicured lawns and with some native forest remnants which likely have little to no influence on water temperature. There is no distinction between Segments on this function. **Segment A/B:** Low/Moderate: Vegetation within the shoreline zone likely has no influence on temperatures in Gravelly Lake. However, the lake is spring-fed which generally means cooler water entering the lake and the condition of the shoreline vegetation may have less influence on temperatures. For this function, it has been rated based on the condition of the vegetation within the segments not on the presence of the springs or actual water temperature.	Segment A/B: 2

Waterbody	Performance of Function by Segment	Score[1]
Gravelly Lake	**Vegetation:** Water quality improvement **Summary:** As noted above, the condition of vegetation within the shoreline zone can influence water quality in the lake by biofiltration, nutrient uptake, and filtering of sediments. The ability of the vegetation to provide this function is dependent upon the density of the vegetation, particularly in the herbaceous or ground layers. Vegetation does not need to be native; however it does need to have dense growth patterns, persistent standing biomass, and good soils for filtering. There is no distinction between segments for this function. **Segment A/B:** Low/Moderate: The condition of the vegetation (manicured lawns) surrounding the majority of the lake leads to little or no filtration and uptake of nutrients and sediments within the shoreline zone. Condition of the vegetation as well as the potential source of chemicals from lawn maintenance likely results in little water quality improvement.	Segment A/B: 2
Gravelly Lake	**Vegetation:** Attenuating wave energy **Summary**: Vegetation in marshes or floating mats can diffuse wave energy. **Segment A/B:** Low: There is no shoreline or aquatic vegetation within Gravelly Lake; therefore there is no opportunity for wave attenuation to be provided by emergent marsh or aquatic bed wetland vegetation in the lake.	Segment A/B: 1
Gravelly Lake	**Vegetation:** Sediment removal and bank stabilization **Summary**: As noted above, the condition of the vegetation within the shoreline area of Gravelly Lake is unlikely to influence the input of sediment into the lake. **Segment A/B:** Low: The majority of the shoreline appears to be armored and therefore, vegetation does not provide significant functions to stabilize the lake shore or to remove sediment. As noted previously, the lake is spring-fed, and summer conditions leave more exposed shoreline for sediment production into the waters of the lake.	Segment A/B: 1
Gravelly Lake	**Vegetation:** LWD and organic matter recruitment **Summary:** Recruitment of LWD comes from the upland areas adjacent to the lake shore. There is no distinction between the segments in this function. **Segment A/B:** Low: All shoreline areas adjacent to Gravelly Lake are privately owned and actively managed. It is highly unlikely that any large (or small) woody debris that falls into the shoreline is allowed to remain. There is potential for such recruitment. However, without an educational opportunity for landowners, it is assumed that there is a very low probability of such	Segment A/B: 1

Waterbody	Performance of Function by Segment	Score[1]
	recruitment.	
Gravelly Lake	**Groundwater – Surface Water Connection:** Removing excess nutrients and toxic compounds **Summary:** Gravelly Lake is spring fed, therefore it has little opportunity to have nutrients and toxins enter the lake other than direct sheet flow from surrounding residential areas and from stormwater inputs. **Segment A/B:** Moderate: The spring-fed condition of Gravelly Lake likely results in it having relatively good water quality due to the filtered nature of the majority of the inputs into the Lake. However, it is the stormwater inputs that degrade the lake's water quality by allowing the water to bypass the natural filtering of shallow groundwater functions.	Segment A/B: 3
Gravelly Lake	**Groundwater – Surface Water Connection:** Water storage **Summary:** The lake is recharged from seeps and springs which emanate from the surrounding contributing area: the shallow groundwater has a capacity to 'store' some water; however it is discharged to the lake when hydraulic conditions are appropriate. **Segment A/B:** Moderate: As noted previously the lake has the potential to "store" water based on the seasonal draw-down in the summer-time. However, when the lake draws down in the summer and has the capacity to store stormwater, it is also the time of year when there is less opportunity to store stormwater from the lack of input during the summer. Groundwater discharges to the lake from early winter through spring; there is some potential that the lake discharges to groundwater and therefore to Puget Sound year-round (there is no surface discharge from the lake).	Segment A/B: 3
Gravelly Lake	**Groundwater – Surface Water Connection:** Support of vegetation **Summary:** Shoreline vegetation is predominantly managed as lawn though there are remaining mature native forest trees left in zones around the lake (trees, but not forest habitats). Therefore shallow groundwater does not have the opportunity to support native vegetation within the area of influence near the shoreline. **Segment A/B:** Low: Residential land-use practices have reduced any opportunity for native vegetation to be supported within the shoreline zone.	Segment A/B:1
Gravelly Lake	**Groundwater – Surface Water Connection:** Sediment storage and maintenance of base flows	

Waterbody	Performance of Function by Segment	Score[1]
	Summary: As noted, the Lake has no direct surface inputs; therefore sediment input is likely low. Low summer lake levels may expose the shoreline to erosional forces; therefore the lake may produce sediment in summer conditions. The closed nature of the lake basin means that any sediment created or deposited within the lake is entirely entrapped. No surface flows exit the lake (it discharges to Puget Sound by infiltration and subsurface flow), therefore it does not support base flows. **Segment A/B:** Low: The closed basin of the lake has the potential to store sediment if it is generated or discharged to the lake. Because the lake has no surface outlet, it does not sustain baseflows.	Segment A/B: 1
Gravelly Lake	**Habitat:** Physical space and conditions for life history **Summary:** Life history needs for a variety of wildlife guilds require vegetation community complexity for a variety of nesting/refuge/feeding sources both aquatic and upland based. Gravelly Lake has no obvious aquatic or emergent vegetation communities and the uplands adjacent to the shore are predominantly altered by human uses. **Segment A/B:** Low: The opportunity for habitat for a 'typical' range of wildlife species is quite limited in Gravelly Lake. There are very few sources of food, refuge, breeding, and/or nesting/denning locations in the lake habitats or the adjacent shoreline zone uplands.	Segment A/B: 1
Gravelly Lake	**Habitat:** Food production and delivery **Summary**: See discussion above regarding the lack of physical, vegetation species, or structural complexity in the water or nearshore environments. **Segment A/B**: Low: Gravelly Lake provides limited food productivity for supporting a range of wildlife species. Because the lake has no outlet flows, it does not export organics or primary productivity to downstream systems.	Segment A/B: 1

Waterbody	Performance of Function by Segment	Score[1]
Segment 6—Lake Louise		
Lake Louise:	A 39 acre, spring-fed lake that has no surface water inlets or outlets. Its basin is roughly 0.34 square miles; its mean depth is 22 feet. The lake is surrounded by residential development; many private docks, swimming platforms, and armoring of the upper beach zone. Approximately 72% of the shoreline is armored and 51% of the parcels have boat docks and/or swim platforms. No aquatic bed or emergent wetland vegetation is evident within the lake environs. Little to no native upland forest habitat remains in the shoreline zone, though some mature	

Waterbody	Performance of Function by Segment	Score[1]
Segment 6—Lake Louise		
	native forest trees remain on residential properties. It is inferred from Pierce County water quality documents that Lake Louise likely has stormwater discharges directed into it although there are no natural surface drainages into the lake.	
Lake Louise	**Hydrologic:** Storing water and sediment Moderate: The lake is spring-fed; therefore it has an annual cycle of full-pool in the winter and dropping roughly two feet every summer. It is assumed water infiltrates to discharge in Puget Sound and it is also lost through evapotranspiration. Therefore the lake has the potential to store surface water, but except for some stormwater that is discharged into it, it has very little opportunity to store water. All sediment that reaches the lake is stored in the lake because of the lack of an outlet.	3
Lake Louise	**Hydrologic:** Attenuating wave energy Low/Moderate (seasonally dependent): In general the shoreline of the lake is in residential use, and most of those parcels have some form of armoring at the upper extent (winter levels) of the lake shore. Waves generated in the summer (recreation generated) have an exposed lake-bottom shoreline around the perimeter of the lake, and therefore the opportunity to attenuate wave energy. In the winter, at full pool, the armoring precludes attenuating wave energy.	2
Lake Louise	**Hydrologic:** Removing excess nutrients and toxic compounds Low: Opportunity for removing nutrients or toxins through flushing flows in/out do not exist in this spring-fed lake.	1
Lake Louise	**Hydrologic:** Recruitment of LWD and other organic material Low: Residential uses surrounding the lake have removed nearly all of the native forest stands; though some mature native trees remain. There is the potential for one or more of these larger trees to fall within the shoreline; however there is low probability of residents leaving some or all of the trees remaining within the lake's shore line habitats. Other organic material may reach the lake from adjacent native or non-native vegetation; however there are no vegetated marshes in or on the margins of the lake to provide significant organic inputs.	1
	Vegetation: Temperature regulation Low: The vegetation adjacent to the lake shore is predominantly manicured lawns, some with remnant mature native trees; but not in sufficient density to influence the water temperature in the lake. The lack of vegetated wetlands within or on the margin of the lake also signifies that there is no influence from aquatic vegetation on lake temperatures.	1

Waterbody	Performance of Function by Segment	Score[1]
Segment 6—Lake Louise		
Lake Louise	**Vegetation:** Water quality improvement Low: The maintained lawns likely have little measurable positive influence on water quality within the lake. If the homeowners surrounding the lake are using chemical applications (e.g., herbicides, fertilizers, moss-eliminators, insecticides, etc.) on their lawns, there is high probability that the lawns (vegetation) that predominate along the shoreline zone may be having a harmful effect on lake water quality.	1
Lake Louise	**Vegetation:** Attenuating wave energy Low/Moderate: The lake is spring-fed; therefore it has a seasonal water level fluctuation of several feet driven by the reduction of summer flows into the springs that feed the lake. This seasonally fluctuating water level strongly influences the ability of vegetation to grow within the margins of the lake. Therefore the summer shorelines expose the lake bottom to highly susceptible erosion from waves. In winter when the lake level is higher, the bulk-heading around the lake will not attenuate waves.	2
Lake Louise	**Vegetation:** Sediment removal and bank stabilization Low: The managed vegetation along the shoreline will provide very modest sediment removal from flows across the lawns. However it provides no bank stabilization and the low density of mature trees implies a low degree of bank stabilization from their presence as well.	1
Lake Louise	**Vegetation:** LWD and organic matter recruitment Low: As noted for Gravelly Lake; there is little opportunity for one of the remaining larger native trees to fall within the lake; and probably very low probability that if it fell in, it would be allowed to remain there to provide structural complexity and habitat benefit. Lack of surface flows into the lake reduces the opportunity for appropriate small organic debris to be transported into the lake to support the primary food-web.	1
Lake Louise	**Groundwater – Surface Water Connection:** Removing excess nutrients and toxic compounds Low/Moderate: Lake Louise is fed by springs; the water quality entering the lake from the springs is likely extremely good due to the filtering capacity of the soils. There may be opportunity for impairment based on the very urban condition of the basin surrounding the lake and the potential for inputs from lawn maintenance activities. The highly modified shoreline that includes bulkheads and compacted lawns may impede this function to some degree.	2

Waterbody	Performance of Function by Segment	Score[1]
Segment 6—Lake Louise		
Lake Louise	**Groundwater – Surface Water Connection:** Water storage Low/Moderate: The lake is spring fed; therefore it has an annual water level fluctuation caused by summer evapotranspiration and infiltration. This summer 'low-pool' effect creates the opportunity for storage of water within the lake basin; and come winter, the springs and sheet flow that enter the lake once again 'fill' it. It is assumed this water infiltrates and/or is removed through evapotranspiration. The lake provides storage, but not in the traditional sense of surface flows or storm-water storage to aid downstream conditions.	2
Lake Louise	**Groundwater – Surface Water Connection:** Support of vegetation Low: The majority of the native vegetation surrounding the lake has been removed and replaced with non-native urban landscaping. Some native trees remain in scattered patches, but it is assumed that the condition of the water regime and spring flows do not strongly influence the vegetation near/adjacent to the lake compared to 'yard maintenance' and irrigation practices.	1
Lake Louise	**Groundwater – Surface Water Connection:** Sediment storage and maintenance of base flows Moderate: This spring fed lake has the potential to store all sediments which enter the system because there are no surface outlets from the lake. Sediment may be generated by recreational activities in summer when lake levels are low and shorelines are exposed to wave actions. It is assumed and reported from older Ecology documents that the waters from the lake infiltrate and eventually daylight near or on the shores of Puget Sound. These waters are not supplying baseflows to any surface outlets or streams as documented at this time.	3
Lake Louise	**Habitat:** Physical space and conditions for life history Low/Moderate: Lake Louise is set in a high density residential setting; it has no wetland habitats within the lake or adjacent to the lake; native upland habitats are lacking from the shoreline area of the lake or close proximity. Lack of structural complexity within or near the lake limits the diversity of birds, invertebrates and amphibians which can successfully find all their life-history needs in such a simple habitat. Lack of areas for refuge, breeding, brood-raising, and food gathering limit the habitat benefits of the lake to only the most adaptable urban generalist species.	2

Waterbody	Performance of Function by Segment	Score[1]
Segment 6—Lake Louise		
Lake Louise	**Habitat:** Food production and delivery Low/Moderate: Lake Louise sits amidst a very dense residential setting. Habitats in the basin are fragmented; there are no wetlands associated with the lake or wetland vegetation within the lake. The shoreline of the lake is managed residential lawns with some remnant native trees and perhaps some limited understory in small patches. In-water and adjacent upland habitats are severely limited for a broad range of native species; however urban generalists (e.g., mallard, coot, coyote, raccoon, etc.) may be well established.	2

Waterbody	Performance of Function by Segment	Score[1]
Segment 7—Waughop Lake		
Waughop Lake:	An approximately 33-acre groundwater-fed lake located within Fort Steilacoom Park. It is surrounded by native upland forests, native prairie, and recovering upland grass-lands. The lake has one surface water inlet that discharges stormwater from nearby parking lots; it is assumed to infiltrate into underlying aquifers and eventually to release to Puget Sound. The lake is shallow; it has a mean depth of approximately seven feet. None of the shoreline is armored and there is one fishing pier. Given the presence of good habitat conditions for waterfowl, the lake is well-used and therefore often has an annual cyanobacteria bloom. Stocking of the fish with a variety of native and non-native fish also strongly influences these water quality conditions.	
Waughop Lake	**Hydrologic:** Storing water and sediment Moderate: The lake is spring fed with one surface water inlet and no outflows, therefore any sediment that enters the lake is trapped so it has a good potential for storing sediment. The spring-fed nature of the lake means that it has an annual water-level fluctuation of approximately two feet of draw-down in the summer. Therefore it has the potential to store water in the summer, however the lake is less likely to receive stormwater inputs in the summer when it has the highest capacity to store it.	3
Waughop Lake	**Hydrologic:** Attenuating wave energy High: Summer draw-down exposes lake bottom shorelines, however there is a lack of power-craft recreation vehicles on the lake, therefore wave production is probably limited to only the most significant winter storms when the lake is 'full-pool'. Also the shoreline is ringed with emergent and aquatic bed vegetation which will function to dampen the effects of any waves on the lake surface prior to them reaching shore.	5
Waughop Lake	**Hydrologic:** Removing excess nutrients and toxic compounds Low: Ground water inputs would generally mean good water	1

Waterbody	Performance of Function by Segment	Score[1]
Segment 7—Waughop Lake		
	quality entering the lake. However this lake has high nutrient levels likely influenced by stormwater inputs, use by waterfowl, and by continued and historic stocking with native and non-native fish which in all probability never occurred in the small lake historically, and certainly not at the numbers stocked for a recreational fishery. The system is too small to balance the nutrient inputs and impacted water quality results.	
Waughop Lake	**Hydrologic:** Recruitment of LWD and other organic material High: The lake has some LWD present along the shoreline in existing conditions, and there are stands of native trees along the shore with the potential to provide LWD input in the future. This source of LWD is not influenced by hydrologic processes.	5
Waughop Lake	**Vegetation:** Temperature regulation Moderate: The lake is small and shallow (approximately 7 feet deep on average) which means that it likely cannot form a thermocline (cooler deeper water). Inputs of groundwater would naturally mean cooler water input than surface flows. The presence of marsh and floating leaved aquatics would also serve to shade and cool the water. The shallow depths may counter all these other influences (actual water temperatures are not known but is assumed to be elevated due to frequent cyanobacteria blooms).	3
Waughop Lake	**Vegetation:** Water quality improvement Moderate: The lake has a well established marsh habitat ringing it, which has the potential to uptake and utilize nutrients in the water column. The shoreline surrounding the lake is fully vegetated meaning that sheet flow entering the lake is likely well-filtered. These factors may not be sufficient to counter the high nutrient loading from stormwater inputs, waterfowl, and stocked recreational fish. Therefore the lake has the potential to have good water quality, but it is documented as having frequent cyanobacteria blooms (a sign of high nutrient loading and higher temps).	3
Waughop Lake	**Vegetation:** Attenuating wave energy High: The extent of vegetated wetland surrounding the perimeter of the lake and the shallow condition of the lake both contribute to low potential for wave generation on the lake.	5
Waughop Lake	**Vegetation:** Sediment removal and bank stabilization High: The closed nature of the lake means it has an excellent potential to entrap and hold any sediments generated within the lake. The fully vegetated wetlands surrounding the	5

Waterbody	Performance of Function by Segment	Score[1]
Segment 7—Waughop Lake		
	perimeter of the lake provide excellent bank stabilization and there is little probability of sediment being generated along the lake shore from natural processes.	
Waughop Lake	**Vegetation:** LWD and organic matter recruitment High: The lake has LWD and emergent marsh present on the entire perimeter, therefore recruitment of small and large organic material is likely very high.	5
Waughop Lake	**Groundwater – Surface Water Connection:** Removing excess nutrients and toxic compounds Moderate: The lake, in natural conditions, would have an excellent opportunity to remove nutrients and the potential to store toxins associated with sediments. Sediment that discharges with the stormwater outfall is stored in the lake because the lake does not have an outlet. Nutrient loading in the lake is a well-documented problem with regular cyanobacteria blooms. Nutrient loading from waterfowl and stocked recreational fish is far more than this shallow system can balance.	2
Waughop Lake	**Groundwater – Surface Water Connection:** Water storage Low/Moderate: As a groundwater fed system the lake has a low-summer condition due to infiltration and evapotranspiration. This provides the opportunity for storing winter sheet flow and increased groundwater inputs.	2
Waughop Lake	**Groundwater – Surface Water Connection:** Support of vegetation High: The conditions in the lake support a significant perimeter wetland complex and near-shore upland community.	5
Waughop Lake	**Groundwater – Surface Water Connection:** Sediment storage and maintenance of base flows Low/Moderate: Sediment is likely generated when the lake receives stormwater runoff and the closed lake basin has a high potential for keeping it entrapped. There are no surface outlets from the lake, It is assumed that waters infiltrate into deeper groundwater which discharges near or in Puget Sound.	2
Waughop Lake	**Habitat:** Physical space and conditions for life history Moderate/High: The lake provides excellent habitat for a range of native birds, invertebrates, amphibians, and sources of food/water for terrestrial species present in the surrounding uplands. The presence of native upland forests and prairies and connectivity to large forest patches to the southeast link this	4

Waterbody	Performance of Function by Segment	Score[1]
Segment 7—Waughop Lake		
	aquatic habitat with necessary upland conditions for a wide variety of wildlife species to meet their full life-history needs. Physical complexity within the lake and the margins provides niches for many species uses. Stocking of the lake with native and non-native fish is likely posing a significant impact to water quality conditions as well as the survival and sustainability of native aquatic invertebrates and amphibians. If the water quality issues were resolved, the functions this lake could provide would be very high given the surrounding urbanization.	
Waughop Lake	**Habitat:** Food production and delivery Moderate/High: The lake is a closed system from an aquatic perspective: it does not export organics downstream as there are no surface outlets. However it does provide excellent components to overall habitat complexity within Fort Steilacoom Park and in that regards produces 'food' that can be exported to the surrounding uplands.	4

In Table 6 below, the resulting functions scores are separated by segment and by function.

Table 7—Function Score by Segment

Function	Segment Score			
	Chambers Creek			Clover Creek
Segments	1A	1B	1C	2
Hydrologic				
Transport of water & sediment	4	4	1	2
Attenuating flow energy	2	4	1	2
Removing excess nutrients & toxins	3	5	NA	2
Recruitment of LWD & other organics	3	5	2	2
Vegetation				
Maintain temperature	3	5	1	2
Water quality improvement	3	4	4	2
Attenuating Energy	3	3	4	2
Sediment removal & bank stabilization	3	4	2	2
LWD & organic matter recruitment	4	5	2	2
Hyporheic & Shallow Groundwater Exchange				
Removing excess nutrients & toxic compounds	3	4	4	1
Water storage	2	2	3	1
Support of vegetation	3	4	2	1
Sediment storage & maintenance of base flows	3	4	2	1
Habitat				
Physical space & conditions for life history	4	5	2	1
Food production and delivery	4	5	3	1

Function	Segment Score			
	American Lake			
Segments	3A	3B/C	3D	3E
Hydrologic				
Storing water & sediment	1	2	2	3
Attenuating wave energy	2	1	2	4
Removing excess nutrients & toxins	1	2	1	4
Recruitment of LWD & other organics	2	2	4	4
Vegetation				
Temperature regulation	1	2	2	3
Water quality improvement	1	2	1	4
Attenuating Energy	1	2	2	3
Sediment removal & bank stabilization	1	2	3	4
LWD & organic matter recruitment	2	2	3	4
Hyporheic & Shallow Groundwater Exchange				
Removing excess nutrients & toxic compounds	1	2	2	3
Water storage	1	2	3	5
Support of vegetation	1	1	3	4
Sediment storage & maintenance of base flows	1	1	1	3
Habitat				
Physical space & conditions for life history	1	2	3	4
Food production and delivery	2	2	3	4

Function	Segment Score			
	Lake Steilacoom	Gravelly Lake	Lake Louise	Waughop Lake
Segment	4A/B	5A/B	6	7
Hydrologic				
Storing water & sediment	1	4	1	3
Attenuating wave energy	2	3	2	5
Removing excess nutrients & toxins	1	2	1	1
Recruitment of LWD & organics	2	1	1	5
Vegetation				
Temperature regulation	1	2	1	3
Water quality improvement	1	2	1	3
Attenuating Energy	1	1	2	5
Sediment removal & bank stabilization	2	1	1	5
LWD & organic recruitment	2	1	1	5
Hyporheic & Shallow Groundwater Exchange				
Removing excess nutrients & toxic compounds	1	3	2	2
Water storage	1	3	2	2
Support of vegetation	1	1	1	5
Sediment storage & maintenance of base flows	1	1	3	2
Habitat				
Physical space & life history	1	1	2	4
Food production and delivery	2	1	2	4

5.3 SUMMARY OF SEGMENT RATINGS

In Table 7, the resulting functions scores are separated by segment and by function. As mentioned previously, the qualitative scores range from 1 through 5 (1 being low and 5 being high). Because the scores were qualitatively assigned, no sums or averages were used to conclude the outcome. However, by looking down the columns, it is easy to see that the residential areas generally have a score of 1 or 2 for most functions, while the least impacted segments have the highest scores; the segments with moderate amounts of impact (i.e. parks) generally have scores in the middle range. Even if numbers had not been assigned to the functions, it is a safe assumption that the residential segments would rank the lowest for functions due to the significant land modification, and the natural portions of Chambers Creek and the forested peninsula would rank the highest due to their more natural conditions. For Lake Steilacoom, the park was called out as a separate segment, but due to the overall size of the park in contrast to the large size of the shoreline, the scores were combined under the residential score. For the scores for Gravelly Lake the scores were also combined.

Chambers Creek - Segment 1A - Overall segment rating = Moderate
Segment 1A consists of low density residential housing. Aerial photos indicate that a majority of the riparian buffer has been left intact, providing a largely forested area with some houses/buildings interspersed.

Chambers Creek - Segment 1B - Overall segment rating = Moderate/High
Segment 1B is the most natural condition segment in Lakewood's shoreline jurisdiction and has an intact riparian buffer that protects the stream banks from erosion as well as providing shade, habitat (in stream and on the banks), and water quality improvement.

Chambers Creek - Segment 1C - Overall segment rating = Low/Moderate
Segment 1C is associated with the wetland on the left bank of Chambers Creek, adjacent to Segment 1A. Some of the functions that wetland are able to provide are ranked low simply because the wetland does not have the opportunity to provide the function. This includes organic matter recruitment because the wetland has little vegetation, most of which consists of emergents, this in turn effects the wetlands capability to maintain cool water temperatures. This wetland presents excellent opportunity for restoration.

Clover Creek - Overall segment rating = Low/Moderate
Clover Creek has been greatly compromised by development. Approximately half of this segment in the City of Lakewood is heavily compromised by commercial development, including the section that runs through a long culvert under I-5. The lower half of the segment located in the City has been built out with high density residential housing.

American Lake – Segment 3A - Overall segment rating = Low

The residential segment of American Lake ranks low for overall functions. The shoreline modification has the largest, overarching impact on the functions of the lake and shoreline. The shoreline modifications have impeded wave attenuation, organic matter recruitment, the ability of the shoreline to remove toxins, and the compromised the functions provided by shallow groundwater.

American Lake – Segment 3B/C - Overall segment rating = Low/Moderate
While the parks generally are in a more natural condition than the residential segment, they have still been altered and have moderate amount of impervious surface, some shoreline modification, and compacted soils, all of which compromised the ability to provide necessary shoreline functions.

American Lake – Segment 3D - Overall segment rating = Moderate
Although Silcox Island has been moderately built out with residential structures and has some shoreline modification, the island has mostly retained its forested canopy and has not had as much modification to the soil structure on the island.

American Lake – Segment 3E - Overall segment rating = Moderate/High
The forested peninsula south of Silcox Island appears to have been left in a natural condition for many decades. It has a forested canopy that provides special habitat niches both in the canopy and on the lake edge. Because the lake has such a high amount of development, this parcel provides a high quality area among an otherwise developed area.

Lake Steilacoom – Segment 4A - Overall segment rating = Low/Moderate
The residential area of Lake Steilacoom is similar to that of the other lakes in Lakewood with high density residential housing surrounding the lakeshore. Like American Lake, the shoreline has been extensively armored, reducing the ability of the shoreline to perform many shoreline functions.

Lake Steilacoom – Segment 4B - Overall segment rating = Low/Moderate
Edgewater Park is a small portion of the overall size of Lake Steilacoom and represents the same overall functions and scores. It does have the opportunity to provide organic matter, but again, in relation to the size of the lake, the segments provide similar functions as adjacent residential segments.

Gravelly Lake – Segment 5A/B - Overall segment rating = Moderate
The residential segment of Gravelly Lake is fully developed with residential housing and armored shorelines, reducing the functions the shoreline is able to provide similar to the other constructed shorelines. Segment 5B was included in the functions with 5A because it is also built out, but is managed as a 10-acre garden open to the public. Therefore the functions are the same or similar, but its landuse is different from the rest of the lake.

Lake Louise – Segment 6 - Overall segment rating =Low

Lake Louise is completely surrounded by single family housing, boat docks, and armored shoreline. The functions performed by an intact shoreline have almost completely been modified or heavily compromised on Lake Louise.

Waughop Lake – Segment 7 - Overall segment rating = Moderate/High
Waughop Lake has an intact shoreline and is able to provide nearly all of the functions of a normally functioning shoreline. The lake quality has suffered due to nearby development and land use, which would make this area an excellent candidate for restoration in the way of water quality improvement projects.

6.0 LAND USE ANALYSIS

Land use patterns are an important consideration in SMP analysis because such analysis can identify opportunities for "preferred uses", especially water-dependent, water-related and water-enjoyment uses. Land uses adjacent to the water are also a determinant in assigning environment designations to specific sections of the shoreline. Additionally, an analysis of land use conditions is necessary to determine potential land use changes and their effect on shorelines with respect to SMA objectives. Finally, the existing land uses and proposed environment designation boundaries and provisions must be mutually consistent with the City's comprehensive plan.

6.1 LIKELY CHANGES IN LAND USES

There are few possible changes in the land use in the City's shoreline jurisdiction since the majority of the parcels are already developed. The remaining parcels that could be developed would not drastically change the nature of the waterbodies. Many of the larger tracts of land in the shoreline jurisdiction that have not been developed are zoned or designated as future open space. The likely changes for the City's waterbodies are likely to come as a result of the watershed being further built out upstream of the City. Depending on the type of land uses in the upper watershed and the land use density, waterbodies downstream may experience further water quality degradation; this is particularly true for Clover Creek, Lake Steilacoom, and Chambers Creek as they have a flow through connection from the upper watershed.

6.1.1 Implications for Shoreline Management

Segment	Likely Changes in Land Use	Implications for Shoreline Management
1A (Chambers Creek-south portion)	Parcels within this segment are mostly developed. There are three or four vacant parcels that could potentially be developed, and numerous vacant lots in the northern portion of this segment that are likely not developable due to steep slopes. A new pond project and constructed wetland are planned for the South Puget Sound Urban Wildlife Interpretive Area managed by WDFW (formally called the Lakewood State Game Refuge).	Land use changes in this segment are likely to be modest, and may include the development of vacant developable parcels and additions to existing structures. Such changes may increase imperviousness and result in removal of vegetation. Potential water quality impacts are more likely to come from upstream activity. Habitat enhancement plans at the South Puget Sound Urban Wildlife Interpretive Area will likely result in improved habitat functions within this segment.

1B (Chambers Creek-north portion)	This segment consists largely of Chambers Creek Park, a 195 acre park planned to remain in its natural state with limited improvements in the future for public parking, restrooms, and a trail system. Additional planned shoreline modifications include future pedestrian bridge crossings of the Creek as well as drainage culverts and bank stabilization.	Nature trails would slightly increase imperviousness within the shoreline area if they are paved. Planned parking areas and trailheads would also increase imperviousness in the upland areas beyond the shoreline management area. Drainage improvements could result in very limited increases in run-off volumes and rates to the creek, depending on design. Bank stabilization could reduce erosion and could limit channel migration, depending on design. Mitigation and enhancement should be incorporated into the design and construction of these improvements.
2 (Clover Creek)	Properties within this segment are mostly developed with the exception of four lots that are zoned single-family residential. There are a half dozen parcels in the eastern portion of this segment that currently contain single-family residences that are zoned for higher intensity uses, including Multifamily and Neighborhood Commercial. In addition, there are several parcels in the western portion of the segment that are potentially subdividable given minimum lot and setback standards for the R2 zone. Improvements planned for Springbrook Park, which is located in the eastern portion of the creek, include developing a small parking area, acquiring adjacent land and developing a bridge or water crossing across Clover Creek to connect park with lower Springbrook open space properties.	The development of vacant and subdividable parcels and redevelopment of lower intensity uses into higher intensity uses (particularly within the eastern portion of segment) could result in increases in imperviousness within the shoreline area. Increased imperviousness could negatively impact water quality, increase water temperatures and increase creek flows within the channel, undermining bank stability and habitat functions. Other potential water quality impacts are likely to come from upstream activity. Improvements at Springbrook Park and Open Space may increase upland imperviousness and result in removal of vegetation. These improvements also could be opportunities to enhance functions in an area that is largely developed with high intensity commercial and multi-family uses.

3A (American Lake-Residential)	Properties within this segment are mostly developed with the exception of 16 vacant parcels. In addition, there are potentially 113 parcels that are subdividable based on minimum lot standards only. The actual number of lots that could be subdivided is assumed to be much lower given a number of factors including additional standards within the City's development code, as well as lot shape and configuration. There are two street ends within this segment that have been recommended to be developed as public access points. Additional shoreline modifications could also occur. In particular, 38% of the lots currently do not have significant shoreline armoring and 10% of lots in this segment do not have a dock.	Land use changes in this segment are likely to be modest, and over time, and consist primarily of additions to existing structures and tear-down/rebuilds, as well as possible development of vacant and subdividable parcels. Such activity has the potential to increase imperviousness and removal of vegetation within the shoreline area, which could diminish nutrient and toxin removal and habitat functions. Additional shoreline modifications could also negatively impact shoreline habitat and vegetation, as well as result in additional toxic inputs. Improvement of public street ends to accommodate public access could result in increased imperviousness and removal of vegetation.

3B (American Lake – Park)	This segment consists of three City-owned properties (American Lake Park, Lakeland Park, and Harry Todd Park). The City's Parks and Recreation Plan (2005) contains recommendations for each of these parks: <u>American Lake Park</u> • Explore acquiring adjacent parcels • Convert house on adjacent property to conference/retreat center • Renovate boat launch and dock • Repair retaining wall along beach • Import sand for beach area <u>Harry Todd Park</u> • Construct a perimeter paved pathway system • Develop ADA access route to the dock area • Develop modular skate park area on existing tennis court • Develop additional ballfield on northeast corner of site • Construct ropes course. <u>Lakeland Park (undeveloped)</u> • Dispose of property	Planned park and recreation improvements for parks within American Lake, a Shoreline of Statewide Significance, are intended to meet public demand for such facilities and improve the overall level of public access and recreation, consistent with WAC 173-26-251. Proposed improvements to the park facilities within this segment would likely result in increased imperviousness and vegetation removal. Low impact development techniques should be utilized wherever feasible. In the case of repairing the retaining wall along the beach at American Lake Park more natural shoreline stabilization should be explored. Sale of the Lakeland property could result in removal of vegetation on the property if sold for private recreational use-the property is not large enough for development of a single-family residential structure.
3C (American Lake – Tacoma Country Club and Golf)	This segment consists of a clubhouse and pool facility, as well as dock and beach area associated with the country club. No information was found indicating future improvement or development plans for this portion of the segment. There is also a multifamily development with large surface parking area within this segment.	The country club portion of this segment may see modest changes over time, but the shoreline area would likely not become much more developed given its current highly developed state.

3D (American Lake – Silcox Island)	This segment is completely built with the exception of five vacant parcels. Of these vacant parcels, only two appear large enough to accommodate a residence given minimum setbacks requirements of the R3 zone.	Because access to this segment is limited to boat or seaplane, there are inherent limits to the level of development that can occur here. Land use changes within this segment are likely to be modest over time as existing structures are modified or torn down and rebuilt.
3E (American Lake – Eagle Point.	This segment is undeveloped with fairly undisturbed tree cover and is likely to remain that way for the indefinite future due to it being part of a special open space subdivision tract.	Given the existing native vegetation and current and planned land use, preservation of these conditions through an urban conservancy designation or similar, with management regulations that further these goals, is appropriate.
4A(Lake Steilacoom - Residential)	This segment is largely developed with single-family residential uses with the exception of 11 vacant parcels. In addition, there are 37 parcels that are potentially subdividable given current zoning standards. The actual number of lots that could be subdivided is assumed to be much lower given a number of factors including additional standards within the City's development code, as well as lot shape and configuration. There are two street ends within this segment that have been recommended to be developed as public access points. Additional shoreline modifications could also occur. In particular, 36% of the lots currently do not have significant shoreline armoring and 21% of lots in this segment do not have a dock.	Land use changes in this segment are likely to be modest, and over time, and consist primarily of additions to existing structures and tear-down/rebuilds, as well as possible development of vacant and subdividable parcels. Such activity has the potential to increase imperviousness and removal of vegetation within the shoreline area, which could diminish nutrient and toxin removal and habitat functions. Improvement of public street ends to accommodate public access could result in increased imperviousness and removal of vegetation. Additional shoreline modifications could also negatively impact shoreline habitat and vegetation, as well as result in additional toxic inputs.
4B(Lake Steilacoom – Edgewater Park)	Recommendations for future improvements at Edgewater Park include constructing a boat dock, installing a trail, constructing a picnic facility, developing a parking area, and installing a portable restroom.	Recommended improvements at Edgewater Park would result in increased imperviousness and removal of vegetation. Low impact development techniques and more natural landscape management would help to mitigate these potential impacts.

5A (Gravelly Lake – Residential)	This segment is largely developed with single-family residential uses with the exception of 2 vacant parcels. In addition, there are 14 parcels that are potentially subdividable given current zoning standards. The actual number of lots that could be subdivided is assumed to be much lower given a number of factors including additional standards within the City's development code, as well as lot shape and configuration. Additional shoreline modifications could also occur. In particular, 64% of the lots currently do not have significant shoreline armoring and 14% of lots in this segment do not have a dock	Land use changes in this segment are likely to be modest, and over time, and consist primarily of additions to existing structures and tear-down/rebuilds, as well as possible development of vacant and subdividable parcels. Such activity has the potential to increase imperviousness and removal of vegetation within the shoreline area, which could diminish nutrient and toxin removal and habitat functions. Additional shoreline modifications, such as bulkheads and docks, could also negatively impact shoreline habitat and vegetation, as well as result in additional toxic inputs.
5B (Gravelly Lake – Lakewold Gardens)	No plans for future improvements or development were found for this segment. It is assumed that this segment will continue to function as an open space with manicured gardens and public shoreline access.	Continuation of the current use, i.e. compacted lawns and manicured garderns, may have water quality impacts and limit habitat functions within the shoreline area.

6 (Lake Louise)	This segment is largely developed with single-family residential uses. In addition, there are 67 parcels that are potentially subdividable given current zoning standards. The actual number of lots that could be subdivided is assumed to be much lower given a number of factors including additional standards within the City's development code, as well as lot shape and configuration. There are two street ends within this segment that have been recommended to be developed as public access points. Additional shoreline modifications could also occur. In particular, 28% of the lots currently do not have significant shoreline armoring and 49% of lots in this segment do not have a dock	Land use changes in this segment are likely to be modest, and over time, and consist primarily of additions to existing structures and tear-down/rebuilds, as well as possible development of vacant and subdividable parcels. Such activity has the potential to increase imperviousness and removal of vegetation within the shoreline area, which could diminish nutrient and toxin removal and habitat functions. Improvement of public street ends to accommodate public access could result in increased imperviousness and removal of vegetation. Additional shoreline modifications, such as bulkheads and docks, could also negatively impact shoreline habitat and vegetation, as well as result in additional toxic inputs.
7 (Waughop Lake)	A master plan was recently completed for this park, and improvements are currently underway, including restoring the shoreline, improving specific access areas, and replacing exotic plants with native vegetation along the lake trail, adding fishing piers at various locations, creating an off-leash area, and various other improvements in areas beyond the shoreline management area.	Planned shoreline vegetation improvements will likely improve overall functions within this segment. Other improvements could impact the shoreline by adding imperviousness in the upland areas. Additional piers will create overwater shading and introduce more human activity to the shoreline area. Significant development of this largely natural lake is not anticipated because of its current classification and management as open space. Environment designation and management regulations related to recreation uses in particular should ensure that existing high quality vegetation and habitat are protected.

7.0 SHORELINE MANAGEMENT RECOMMENDATIONS

7.1 SHORELINE MASTER PROGRAM

7.1.1 Environment Designation Provisions

- Areas currently developed with single family uses and designated in the Comprehensive Plan and Zoning Code as residential should be designated as Shoreline Residential.
- Areas developed as parks or designated open space should be designated as Urban Conservancy.
- The north-south portion and part of the east-west portion of Chambers Creek (segment 1A) should be designated as Urban Conservancy while the east-west portion (segment 1B) should be designated as Natural.

7.1.2 General Policies and Regulations

Shorelines of Statewide Significance

- American Lake is a Shoreline of Statewide Significance (SSWS) and the SMP should incorporate the priorities of RCW 90.58.020 in the SMP policies.
- Habitat restoration and water quality improvements on American Lake are broad statewide interests. The City should give priority to these shoreline functions to be consistent with policies for SSWS.
- In managing the shoreline area, City of Lakewood shall develop regulations that:
    - Preserve the natural character of the shoreline to the extent possible;
    - Seek long term over short term benefits to the shoreline area;
    - Protect resources and ecology of the shoreline area; and,
    - Increase public access and recreational opportunities along the shoreline.

Archaeological and Historic Resources

- There are very few areas within Lakewood's shoreline area that have not been previously graded or excavated. The most undisturbed areas are along Chambers Creek, the forested subdivision open space tract known as Eagle Point, south of Silcox Island, and Fort Steilacoom. This does not preclude the possibility of finding artifacts and the Shoreline Master Program should provide clear direction regarding circumstances when a special study may be necessary, and what action to undertake in the event of an unexpected discovery. Per Ecology's SMP guidelines, the following standards shall be incorporated into the City's SMP:
    - Require that developers and property owners immediately stop work and notify the local government, the office of archaeology and historic preservation and affected Indian tribes if archaeological resources are uncovered during excavation
    - Require that permits issued in areas documented to contain archaeological resources require a site inspection or evaluation by a professional archaeologist in coordination with affected Indian tribes.

Critical Areas Regulations

- *"The shoreline master program shall provide a level of protection to critical areas located within shorelines of the state that assures no net loss of shoreline ecological functions necessary to sustain shoreline natural resources"* as defined by Ecology and pursuant to RCW 90.58.060.
- Incorporate or reference the City's critical areas regulations, watershed plans, and state, tribal and federal programs in the Shoreline Master Program.

Flood Hazard Management Regulations

- The City should include policies and regulations that address the protection of properties located along the City's floodplain/floodways.

Parking Regulations

- During the planning stages for new or existing parks or other public access points, policies should be put in place that consider the placement of parking lots. Parking lots should not be placed between a building and a water body. Vegetative planting strips or other vegetated areas should be placed between the shore and the parking area. Specific low impact development techniques should be used and are discussed below.

Public Access

- There are a limited number of public access points, with five public parks on the seven different water bodies. There are also private community access sites and one access point for visitors of the Lakewold Gardens, a private facility.
- In addition, there are a number of undeveloped public street ends that in some cases provide informal public access. The City currently has an ongoing process that is addressing planning for future access improvements at these sites.
- Physical access for swimming and non-motorized boating, passive recreation (such as interpretive trails) and habitat enhancement should be important policy objectives for the management of shoreline public access sites and should address the following identified plans and opportunities:
    - American Lake
        - Planned park improvements, including expansion of American Lake Park, will provide improved and additional facilities for boating, swimming and fishing.
        - Consider the recommendations of the Parks and Recreation Advisory Board (PRAB) regarding potential public access improvements at the street ends of Lake City Boulevard and Wadsworth Street.
    - Lake Steilacoom
        - Planned improvements at Edgewater Park will provide more opportunities for physical access to the shoreline by providing improved and additional facilities for boating, swimming, and fishing.
        - Consider the PRAB recommendations for potential public access improvements at Beach Lane and Westlake Avenue street ends.

        - Public access opportunities should be explored at the Interlaken Drive Bridge.
    - Gravelly Lake
        - The City's Parks and Recreation Plan has identified gaps in shoreline access around Gravelly Lake, and includes an action to explore a partnership opportunity with Lakewold Gardens.
    - Waughop Lake
        - Planned improvements to Fort Steilacoom Park will provide more opportunities for physical access to the shoreline by providing improved and additional facilities for boating, swimming, and fishing.
    - Lake Louise
        - Consider the PRAB recommendations for public access improvements at the 104th St. and Holden St. street ends, which would provide public access to this lake, which is currently lacking.
    - Clover Creek
        - Public access opportunities should be explored where there are public rights-of-way that cross the creek.
        - The City plans to make improvements to Springbrook Park (a small portion of which is within jurisdiction) including acquiring adjacent land and developing a trail and creek crossing to connect to the open space area that is nearby on the northside of the creek.
    - Chambers Creek
        - The *Chambers Creek Master Site Plan* developed by Pierce County identifies several public access points on the Lakewood side of the creek that are to be developed to provide access to trails adjacent to the creek. These planned trailheads are at Zircon Drive SW, Phillips Road SW, and 91st Avenue Court SW.

Water Quality

- General Recommendations
    - Incorporate as appropriate goals, policies or regulations that result from the City's efforts to comply with its NPDES Phase II stormwater permit requirements.
    - Several waterbodies in Lakewood are on the 303(d) list for total phosphorus impairment, fecal coliform, temperature, and dissolved oxygen. Include appropriate goals, policies and regulations in the SMP targeting improvements in these water quality parameters. Continue work with Ecology to create and implement appropriate TMDL parameters.
    - Existing single family residences with septic systems pose a continued source and risk of pollution to the City's waterbodies. Required connection to existing and future sewer facilities will help address this risk. Because the shorelines are already heavily developed, redevelopment should not be allowed without sewer availability and existing development should be required to hook up to sewer when it becomes available to protect water quality.

  - Coordinate water quality monitoring and treatment efforts with JBLM and Pierce County.
  - Implement educational opportunities that focus on the retention of plant material near the shoreline, the restoration of the shoreline using native plants, and limiting the use of fertilizers, pesticides and other nutrients.
  - Discontinue planting the lakes that have water quality issues with trout and other non-native fish.
- Chambers Creek
  - The majority of water quality issues in Chambers Creek are a result of water quality issues in Lake Steilacoom (high copper concentrations). Continual work in the upstream water bodies will help improve water quality in Chambers Creek.
- Clover Creek
  - Clover Creek suffers from poor water quality issues related to upstream agriculture use and dense development, as well as high water temperatures related to removal of vegetation.
  - Restoration projects along the creek that focus on installation of native trees and shrubs would help reduce temperatures, as well as improve water quality through bank stabilization and filtering.
  - The contributing basin for Clover Creek (and thus Lake Steilacoom and Chambers Creek) is very large. The City should coordinate monitoring, treatment, and restoration efforts with jurisdictions located upstream of these water bodies.
- American Lake
  - The remaining neighborhoods surrounding American Lake that are still on septic systems are currently being converted to the City's sanitary sewer system. If there is a high number of failing septic systems, this transition will help improve water quality in American Lake.
  - The houses located on Silcox Island are also presumed to be on septic systems. While it would be ideal for those properties to be on the City's sanitary sewer system, these few houses are not likely making a significant impact on the Lake's water quality, given the size of the waterbody.
  - Because the lake is located in two jurisdictions, the lake's water quality may still be impacted by septic systems or other issues on properties owned and operated by Fort Lewis.
- Lake Steilacoom
  - The City and the residents of Lake Steilacoom should continue to focus their efforts on reducing the copper and phosphorus levels in the lake. Like mentioned previously, the contributing watershed is very large and it may be difficult to coordinate efforts among several jurisdictions.
- Gravelly Lake
  - If warranted, reinstate monitoring and treatment efforts to reduce phosphorus levels and thus limit algal blooms.
- Lake Louise

    - If warranted, reinstate monitoring and treatment efforts to reduce phosphorus levels and thus limit algal blooms.
- Waughop Lake
    - Stormwater from the Pierce College parking areas flows into Waughop Lake. Monitoring and treatment efforts could be coordinated with the College to provide learning opportunities for students.

Vegetation Management

- Conservation of existing native vegetation during land development and ongoing use is critical to maintaining the ecological processes and natural functions of shoreline areas.
- The removal of mature trees and native vegetation should be regulated in a manner that provides increased protection that is equal to or greater than current critical areas regulations.
- Vegetation removal in wetland areas and associated buffers within the shoreline areas should also be restricted to only allow the removal of hazardous trees that could impact an adjacent property, street, or utility. Owners of currently undeveloped parcels should be encouraged to retain as much native vegetation as possible, particularly along areas closest to the shoreline.
- Incentives and education should be provided for the retention and planting of native vegetation, particularly in areas recommended for designation as Shoreline Residential.
- Include provisions for monitoring and control of aquatic invasive species in the lakes and along the stream banks and prevent establishment of other aquatic invasive species.

Low Impact Development and "Green Building" Practices

- Incentives should be provided for the use of low impact development techniques, such as rain gardens, pervious pavements, and filter strips, and green building practices within the Shoreline Management Area. Requirement of green building practices should be required for portions of the home that affect water use and water quality of the lakes and streams.
- Low impact development and green building practices, such as those promoted by the Puget Sound Partnership and Ecology programs should be encouraged, particularly to properties that are replacing a small cabin with a larger home.
- Use LID techniques and green building practices on public projects to set an example for the citizens.

7.1.3 Shoreline Modification Provisions

Shoreline Stabilization

- Explore a range of solutions to reduce the amount of bulkheads and shoreline armoring over time around the four lakes with armoring: American, Steilacoom, Gravelly, and Louise. Alternative methods to typical shoreline armoring using native vegetation and other natural shoreline features should be promoted or required where feasible.
- Implement policies that require new construction on vacant properties to use alternative methods for shoreline armoring where feasible.

- No additional sections of Chambers or Clover Creek should be straightened or ditched. Alternative methods for bank armoring using native vegetation and other natural shoreline features should be considered.

Piers and Docks/Boating Facilities

- Provide clear dimensional standards for new piers and replacement/modified piers. Consider special standards for any public access docks or swim platforms that may be proposed at public access points.
- Pier regulations should be consistent with Washington Department of Fish and Wildlife design standards, and recognize any special local issues or circumstances.
- Piers and other overwater structure regulations should also be consistent with the permitting requirements of the U.S. Army Corps of Engineers.

Fill

- As directed by the SMP Guidelines, provide appropriate limitations on placement of fill in shoreline areas, including areas waterward of the ordinary high water mark. Restoration fills should be encouraged as needed to implement lakeshore restoration. Federal and State laws allow fill under certain permit conditions which apply regardless of the Shoreline Master Program.

Breakwaters, Jetties, Groins and Weirs

- There is a dam located at the outlet of Lake Steilacoom. The City should consider improvements to this structure that could benefit fish access to and from Lake Steilacoom.
- Policies should be put in place to prohibit new construction of these types of structures, and remove them when feasible.

Dredging and Dredge Material Disposal

- As directed by the SMP Guidelines, provide limitations on dredging (excavation) in shoreline areas. Dredging activities are not expected to occur on a frequent basis, but may be conducted as part of certain conveyance maintenance activities or to implement restoration projects. Federal and State laws allow dredging and material disposal under certain permit conditions which apply regardless of the Shoreline Master Program.

Shoreline Habitat and Natural Systems Enhancement Projects

- To the maximum extent feasible, the SMP should include provisions to encourage restoration projects, particularly in areas identified as having low function and high potential. Some of these include the removal of fish passage barriers, water quality improvement projects, shoreline restoration that includes bulkhead removal, and removal or replacement of deteriorating boat docks.

7.1.4 Shoreline Uses

Boating Facilities

- There are two public boating facilities (for motorized boats) located within the City's shoreline jurisdiction; located on American Lake at American Lake Park, and on Steilacoom Lake at Edgewater Park. There is also a WDFW boat launch on American Lake, southwest of the City limits. At Waughop Lake, there is an entry point for access with a non-motorized boat to be carried to the water's edge. Otherwise, boat access to lakes is provided by private docks. If possible, the SMP should include provisions to provide for reasonable development of these facilities (for motorized and non-motorized), while protecting the function of the shoreline.

Industry

- Generally, shoreline master programs must give first preference to water-dependent uses over non-water-dependent uses; and second, give preference to water-oriented industrial uses over non-water-oriented industrial uses. Lands designated for industrial uses should not include shoreline areas with severe environmental limitations, such as critical areas. The City of Lakewood does not have any areas in its shoreline area that are zoned for industrial use, nor does it have any plans to include industrial areas in its future land use within its shoreline jurisdiction (Figures 4 and 5 in Appendix C).

Recreation

- The SMP should give shoreline recreational development priority and assure the activities are primarily related to the public access and enjoyment of the water and shoreline area. In addition to emphasizing water-oriented recreational uses, appropriate limits should be established for non-water oriented activities and facilities, such as the proximity and location of parking areas and ball fields.
- The SMP provisions must protect the ecological functions of the shoreline areas and associated wetlands.

Residential Development

- The SMP must address continued shoreline residential development, particularly redevelopment, replacement, and expansion of existing homes, especially because only 3.5 percent of the parcels remain vacant on the four buildable lakes. The SMP should address the redevelopment to be consistent with control of pollution and prevention of damage to the natural environment.
- The SMP should include provisions which address and educate homeowner regarding shoreline armoring, storm water runoff, septic systems, introduction of pollutants, and vegetation modification and removal. Provisions should be put in place (if not already) to continue converting homes from on-site sewage disposal systems to public sanitary sewer service.

Commercial Development

- Generally, the SMP must give preference to water-dependent commercial uses over non-water dependent commercial uses; and second, give preference to water-related and water-enjoyment commercial uses over non-water oriented commercial uses.

- Incorporate regulations that assure future commercial development will not have an adverse impact on the shoreline and shall result in no net loss of ecological functions.
- As directed by the Shoreline Master Program guidelines, restrict non-water-oriented commercial uses on the shoreline unless they are part of a mixed-use project that includes water dependent uses that provides a public benefit or if navigability is severely limited at the proposed site.

7.2 RESTORATION PLAN

The Restoration Plan should be prepared consistent with 173-26-201(2)(f)(i-vi) by addressing the following six subjects:

(i) Identify degraded areas, impaired ecological functions, and sites with potential for ecological restoration;
(ii) Establish overall goals and priorities for restoration of degraded areas and impaired ecological functions;
(iii) Identify existing and ongoing projects and programs that are currently being implemented, or are reasonably assured of being implemented (based on an evaluation of funding likely in the foreseeable future), which are designed to contribute to local restoration goals;
(iv) Identify additional projects and programs needed to achieve local restoration goals, and implementation strategies including identifying prospective funding sources for those projects and programs;
(v) Identify timelines and benchmarks for implementing restoration projects and programs and achieving local restoration goals; and
(vi) Provide for mechanisms or strategies to ensure that restoration projects and programs will be implemented according to plans and to appropriately review the effectiveness of the projects and programs in meeting the overall restoration goals.

Preliminary recommendations for restoration include:

- Replacement of non-native invasive plants with appropriate native species.
- Educational opportunities for shoreline residents that include topics such as the use of fertilizers and pesticides, the installation of native plant species, and the use LID and green building techniques. Educational opportunities should extend to the public in general because upstream use of fertilizers and pesticides and the removal of shoreline vegetation impacts downstream waterbodies.
- Removal or modification of bulkheads and limiting the number of new or replacement docks to one dock per two parcels.
- Removing shoreline modifications along the streams and creating sinuosity where possible.
- Replacing fish blockage culverts with fish passable culverts.
- The use of LID and green building techniques for the redevelopment of the City parks in shoreline jurisdiction.

- Required conversion of homes with on-site sewage disposal systems to public sanitary sewer service when sewer connection is available within 300 feet and substantial improvements are proposed.
- In areas of natural or semi-natural shoreline condition, education regarding the preservation and maintenance of these features should occur.

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APPENDIX A

Information Request Letter and Distribution List

City of Lakewood

November 18, 2009

RE: City of Lakewood Shoreline Inventory and Assessment, Request for Existing Information: American Lake, Gravelly Lake, Lake Steilacoom, Waughop Lake, Lake Louise, Chambers Creek and Clover Creek

Dear Stakeholders:

The City of Lakewood is in the early stages of examining the shorelines of American Lake, Gravelly Lake, Lake Steilacoom, Waughop Lake, Lake Louise, Chambers Creek, Clover Creek and associated wetlands for the purposes of updating its Shoreline Master Program (SMP) per the requirements of the Washington State Department of Ecology. We have recently hired AHBL, Inc. and OTAK, Inc. to assist with shoreline analysis and characterization, regulatory review and restoration plan development. A shoreline inventory, where we compile all pertinent and reasonably available data, plans, studies, inventories, maps and other applicable information, will be the first step. The inventory will be used to develop a map portfolio and a report characterizing ecological functions and ecosystem-wide processes, among other things.

The City is requesting your help in obtaining all existing physical and biological information regarding these water bodies and associated wetland areas, and other relevant watershed or basin information. We are interested in any and all inventories, assessments, water quality analyses, and/or fish and wildlife distribution and habitat information. A map identifying the City's preliminary shoreline jurisdiction is attached.

We hope to assemble our inventory by December 4, 2009, in order to complete the necessary characterization, analysis, and resultant recommendations in a timely manner. A response would be appreciated by November 30, 2009. If possible, please provide hard copies or electronic files of any studies instead of a list of citations; contact the City if a copy fee is required. If you believe that another individual within your organization would be a more appropriate contact for this solicitation, please forward this letter to that individual, and notify us of the change in contact.

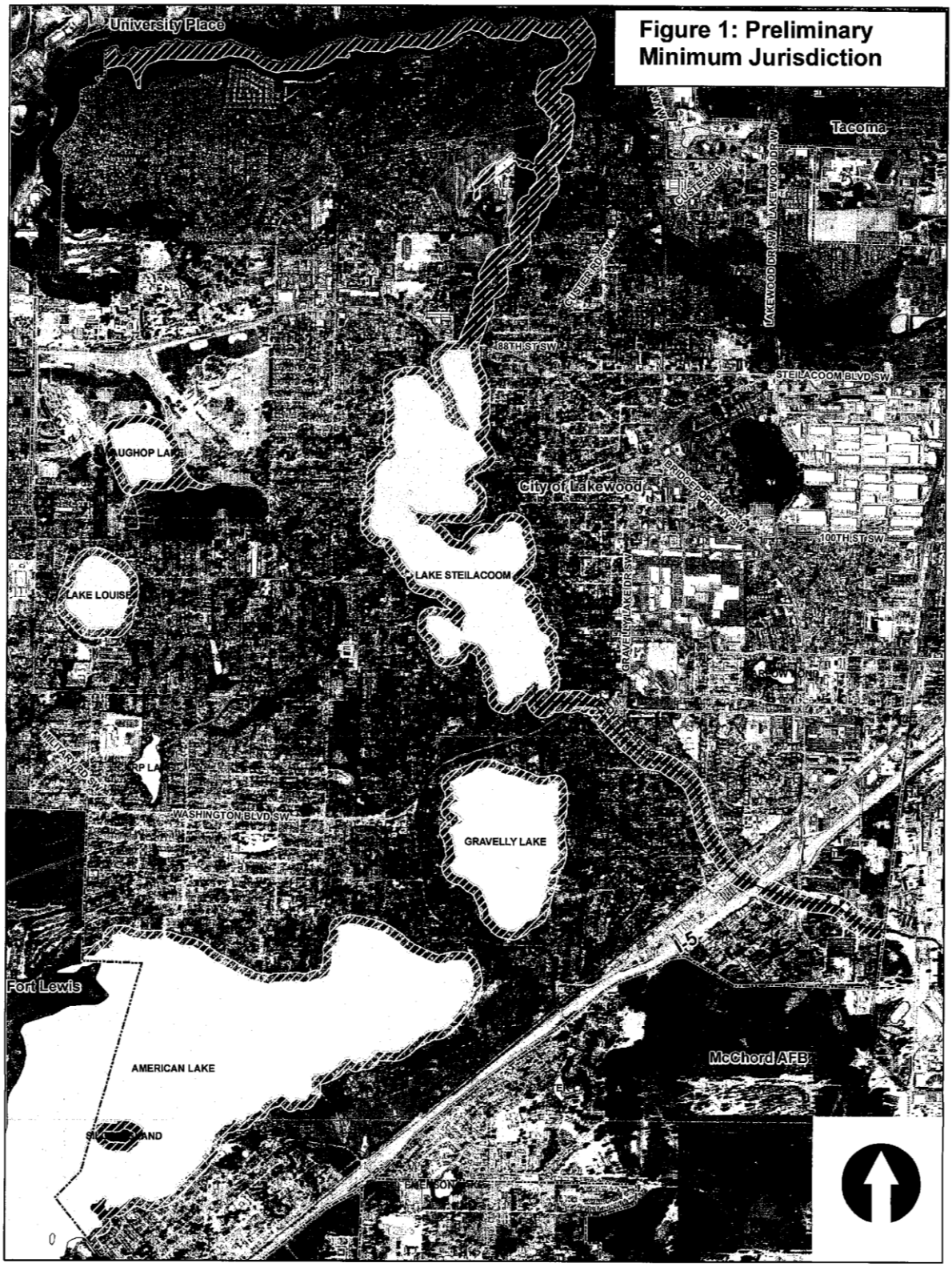
If you have any questions or need additional information, please feel free to contact Marc Amrine, Senior Planner, at (253) 512-2261, or mamrine@cityoflakewood.us.

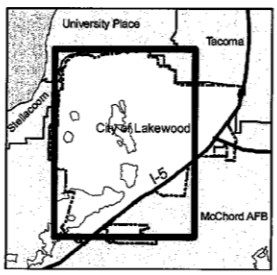
Sincerely,

Marc Amrine
Senior Planner

Encl.

6000 Main Street SW • Lakewood, WA 98499-5027 • (253) 589-2489 • Fax: (253) 589-3774
www.cityoflakewood.us





City of Lakewood Shoreline Master Program

Legend

- Proposed Shoreline Management Area
- Stream
- Water Bodies
- City Boundary

Scale Bar

0 1,000 2,000 3,000 4,000 Feet

City of Lakewood

AHBL

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No warranties of any sort, including but not limited to accuracy, fitness or merchantability, accompany this product.

Source: City of Lakewood, WA

Map Date: November 2009

Puget Sound Partnership
PO Box 40900
Olympia, WA. 98504-0900

Futurewise
Attn: Dean Patterson
814 Second Avenue, Suite 500
Seattle, WA 98104-1530

Kris Kauffman
12228 Nyanza Rd SW
Lakewood, Wa. 98499-1444

McChord Airforce Base
Attn: Vince Bozick
GZ CES/CECP
555 Barnes Blvd
McChord AFB, Wa. 98438

James Taylor
9401 Farwest Dr SW
Lakewood, Wa. 98498-1999

Pierce County Public Works and Utilities
Attn: Lorin Reinelt, Ph.D.
2702 South 42nd Street, Suite 201
Tacoma, WA. 98409-7332

Pierce County Public Works and Utilities
Attn: Melissa Paulson
2702 South 42nd Street, Suite 201
Tacoma, WA. 98409-7322

City of University Place
Attn: David Swindale
Windmill Village
3715 Bridgeport Way W
University Place, WA. 98466

US Army Corp of Engineers
Seattle District Regulatory Branch
CENWS-OD-RG
PO Box 3755
Seattle, Wa. 98124-3755

Edward Brooks
9500 Front Street, Suite 200
Lakewood, WA. 98499

Donald Casad
4924 109th Street SW
Lakewood, WA. 98499-3733

Washington State Department of Fish and Wildlife
Attn: Michelle Tirhi
48 Devonshire Rd.
Montesano, WA. 98563-9618

FEMA
Attn: John Graves
Mitigation Division
FEMA Region X
130 228th ST SW
Bothell, Wa. 98021

Department of Fish and Wildlife
Attn: Gina Piazza
502 High Street, Suite 112
Port Orchard, WA. 98366

Lakewood Water District
Attn: David Hall
11900 Gravelly Lake Drive SW
Lakewood, WA. 98499-0729

Town of Steilacoom
Attn: Doug Fortner
1030 Roe St
Steilacoom, WA. 98388

Washington State Department of Fish and Wildlife
Attn: Jeff Davis
502 High Street, Suite 112
Port Orchard, WA. 98366-4715

City of Dupont
1700 Civic Drive
Dupont, WA. 98327

Nisqually Indian Tribe
4820 She-Nah-Num DR SE
Olympia, WA. 98513

Puyallup Indian Tribe
3009 East Portland Ave
Tacoma, WA. 98404

Department of Ecology
Attn: Kim VanZwalenburg
SEA Program, Southwest Regional Office
PO Box 47775
Olympia, WA. 98504-7775

Department of Ecology
Shorelines Division
PO Box 47775
Olympia, WA. 98504-7775

Washington State Air National Guard
Bldg 1, Camp Murray
Tacoma, WA. 98327-5000

City of Lakewood
Public Works Department
6000 Main St SW
Lakewood, WA. 98499

David Anderson
14916 Washington Ave SW
Lakewood, WA. 98498

Larry Else
9702 Veterans Dr. SW
Lakewood, WA. 98498

Chambers-Clover Creek Watershed Council
c/o Watershed Coordinator
Pierce County Surface Water Management
9850 - 64th Street West
University Place, WA 98467-1078

United States EPA, Region 10
1200 Sixth Avenue, Suite 900
Seattle, WA. 98101

Office of the Attorney General
Ecology Division
PO Box 40100
Olympia, WA. 98504-0100

WA Department of Fish and Wildlife
Priority Habitats and Species
Attn: Lori Guggenmos
600 Capitol Way North
Olympia, WA 98501-1091

Shoreline Property Owners & Contractors Association
1900 N. Northlake Way, Suite 23
Seattle, WA 98103

American Rivers
Northwest Regional Office
150 NICKERSON ST STE 311
SEATTLE, WA 98109-1634

ADOPT-A-STREAM
600 128th ST SE
EVERETT, WA 98208-6353

Recreation Boating Association of Washington
PO Box 23601
Federal Way, WA 98093

Wild Fish Conservancy
PO BOX 402
DUVALL, WA 98019

The Nature Conservancy
Washington Field Office
1917 First Ave
Seattle, WA 98101

US Fish and Wildlife Service
Attn: Roger Tabor
510 Desmond Dr. SE, Suite 102
Lacey, WA 98503-1263

WA Department of Ecology
Water Quality Program
PO Box 47775
Olympia, WA 98504-7775

Cascade Land Conservancy
615 2nd Ave., Suite 525
Seattle, WA 98104-2265

University of Washington
Center for Water and Watershed Studies
Box 352100
Seattle, WA 98195-2100

Pierce Conservation District
Stream Team
1011 East Main, Suite 106
Puyallup, WA 98372

The Trust for Public Lands
Attn: Peter Dykstra
1011 Western Ave., Suite 605
Seattle, WA 98104

Tacoma Chapter of Trout Unlimited
P.O. Box 98044
Lakewood, WA 98496

WA Department of Natural Resources
Aquatic Lands and Resources Program
1111 Washington St. SE, MS 47027
Olympia, WA 98504-0001

South Puget Sound Salmon Enhancement Group
6700 Martin Way E, Suite 112
Olympia, WA 98516

Tahoma Audubon Society
2917 Morrison Rd. West
University Place, WA 98466

WA Department of Natural Resources
Attn: Rex Thompson
PO Box 47001
Olympia, WA 98504-7001

Washington Trails Association
2019 3rd Ave.
Suite 100
Seattle, WA 98121-2430

Washington Water Trails Association
4649 Sunnyside Ave. N
Suite 305
Seattle, WA 98103-6956

Doug Corbin
Municipal Liaison Manager
Puget Sound Energy
6905 S 228th Street
Kent, WA 98032

Puget Sound Clean Air Agency
1904 third Ave.
Seattle, WA 98101-3317

Pierce County
Attn: Debora Hyde, Special Project Coordinator
9850 64th Street West
University Place, WA 98467-1076

Citizens for a Healthy Bay
917 Pacific Avenue, Suite 100
Tacoma, WA 980

APPENDIX B

Photographs

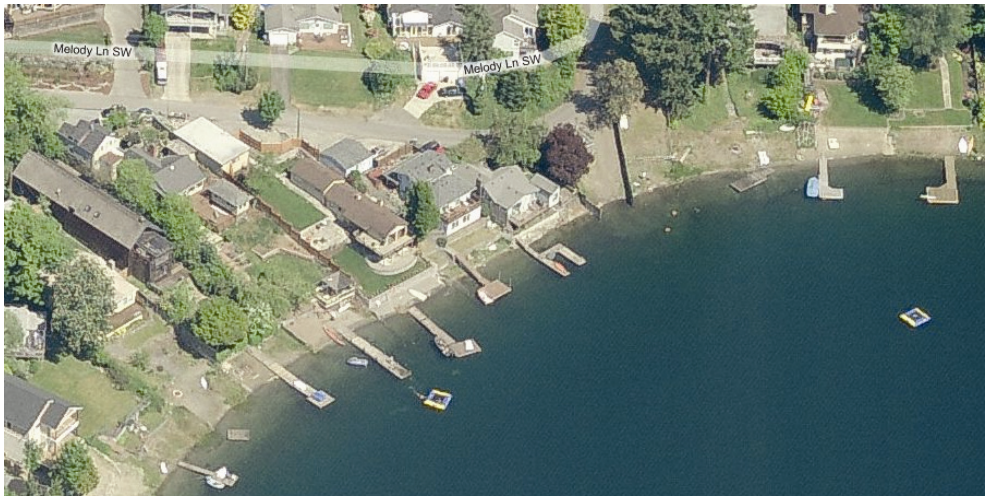
AMERICAN LAKE (PHOTOGRAPH BY OMRAY VIA FLIKR)

LAKE WAUGHOP

CHAMBERS CREEK

LAKE STEILACOOM

GRAVELLY LAKE (PHOTO BY LARBAGE VIA FLIKR



LAKE LOUISE

CLOVER CREEK

APPENDIX C

Map Folio

University Place
Pierce County
Tacoma
Steilacoom
Fort Lewis
McChord AFB
CHAMBERS CREEK
CHAMBERS BAY
GARRISON SPRINGS
WAUGHOP LAKE
LAKE LOUISE
CARP LAKE
LAKE STEILACOOM
GRAVELLY LAKE
SEELEY LAKE
AMERICAN LAKE
PONCE DE LEON CREEK
FLETT CREEK
CLOVER CREEK
ZIRCON DR SW
ONYX DR SW
78TH ST SW
91ST AV SW
87TH AV SW
83RD AV SW
ELWOOD DR SW
HIPKINS RD SW
ANGLE LN SW
PHILLIPS RD SW
BRIDGEPORT WY W
75TH ST W
74TH ST W
CUSTER RD W
CUSTER RD SW
JOHN DOWER RD W
JOHN DOWER RD SW
LAKEWOOD DR W
88TH ST SW
STEILACOOM BLVD SW
WAVERLY DR SW
MEADOW RD SW
WHITMAN AV SW
BRIDGEPORT WY SW
LAKEWOOD DR SW
101ST ST SW
100TH ST SW
ALFARETTA ST SW
59TH AV SW
104TH ST SW
SHORT LN SW
FARWEST DR SW
LAKELOUISE DR SW
GRAVELLY LAKE DR SW
MAIN ST SW
108TH ST SW
LAKEVIEW AV SW
112TH ST SW
111TH ST SW
BUTTE DR SW
IDLEWILD RD SW
HUGGINS MEYERS RD SW
MILITARY RD SW
HOLDEN RD SW
INTERLAAKEN DR SW
WASHINGTON BLVD SW
NORTH GATE RD SW
VERNON AV SW
VETERANS DR SW
NYANZA RD SW
HILLCREST DR SW
PACIFIC HWY SW
15 HWY S
15 HWY N
NEW YORK AV SW
MCCHORD DR SW
NORTH THORNE LN SW
PORTLAND AV SW
UNION AV SW
MURRAY RD SW
EVERGREEN DR

DRAFT

N
W
E
S

University Place
Tacoma
Lakewood
Steilacoom
Pierce County
I-5
McChord AFB
Fort Lewis

City of Lakewood Shoreline Master Program
Figure 1A: Minimum Shoreline Jurisdiction

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Water Body
- Surrounding Jurisdictions
- Proposed Shoreline Management Area

City of Lakewood Washington
AHBL

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Source: City of Lakewood

Map created: March 22, 2010

Figure 1A

University Place
Pierce County
Tacoma
Steilacoom
Fort Lewis
McChord AFB
CHAMBERS CREEK
CHAMBERS BAY
GARRISON SPRINGS
WAUGHOP LAKE
LAKE LOUISE
CARP LAKE
LAKE STEILACOOM
GRAVELLY LAKE
SEELEY LAKE
AMERICAN LAKE
PONCE DE LEON CREEK
FLETT CREEK
CLOVER CREEK
ZIRCON DR SW
ONYX DR SW
78TH ST SW
91ST AV SW
87TH AV SW
83RD AV SW
PHILLIPS RD SW
88TH ST SW
CUSTER RD SW
JOHN DOWER RD W
JOHN DOWER RD SW
BRIDGEPORT WY W
75TH ST W
74TH ST W
LAKEWOOD DR W
CUSTER RD W
STEILACOOM BLVD SW
ELWOOD DR SW
HIPKINS RD SW
ANGLE LN SW
WAVERLY DR SW
MEADOW RD SW
WHITMAN AV SW
BRIDGEPORT WY SW
LAKEWOOD DR SW
101ST ST SW
104TH ST SW
SHORT LN SW
ALFARETTA ST SW
59TH AV SW
100TH ST SW
FARWEST DR SW
LAKE LOUISE DR SW
BUTTE DR SW
IDLEWILD RD SW
GRAVELLY LAKE DR SW
MAIN ST SW
108TH ST SW
LAKEVIEW AV SW
112TH ST SW
111TH ST SW
HOLDEN RD SW
MILITARY RD SW
HUGGINS MEYERS RD SW
83RD AV SW
INTERLAAKEN DR SW
WASHINGTON BLVD SW
NORTH GATE RD SW
VERNON AV SW
VETERANS DR SW
NYANZA RD SW
PACIFIC HWY SW
HILLCREST DR SW
I5 HWY S
I5 HWY N
NEW YORK AV SW
MCCHORD DR SW
NORTH THORNE LN SW
PORTLAND AV SW
UNION AV SW
MURRAY RD SW
EVERGREEN DR

DRAFT

N
W
E
S

University Place
Tacoma
Lakewood
Steilacoom
Pierce County
I-5
McChord AFB
Fort Lewis

City of Lakewood Shoreline Master Program
Figure 2 : Wetlands, Flood Hazard Areas

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Proposed Shoreline Management Area
- Water Body
- Surrounding Jurisdictions

City of Lakewood Washington
AHBL

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Source: City of Lakewood, FEMA

Map created: January 26, 2010

Figure 2

LESCHI RD SW
BRIGGS LN SW
OAKRIDGE DR SW
WELLER RD SW
PHILLIPS RD SW
CHAMBERS CREEK
87TH ST SW
STEILACOOM BLVD SW
88TH ST SW
82ND AV SW
88TH STCT SW
887H STCT SW
81ST AV SW
GRAMERCY PL SW
EDGEWATER DR SW
CHERRY LN SW
FLORA ST SW
WEDGEWOOD CT SW
DALWYN CT SW
CECILE CT SW
NIXON AV SW
CECILE CT SW
SACRAMENTO ST SW
WAVERLY DR SW
FOSTER ST SW
NORTH WY SW
WESTLAKE AV SW
WEST SHORE AV SW
SOUTH WY SW
LAKE STEILACOOM
MT TACOMA DR SW
HOLLY HEDGE LN SW
LAKE STEILACOOM DR SW
CRESCENT LN SW
INTERLAAKEN DR SW

DRAFT

City of Lakewood Shoreline Master Program
Figure 3A: Existing Land Use
Lake Steilacoom - North View

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Water Body
- Proposed Shoreline Management Area
- Surrounding Jurisdictions
- Parcel Boundary
- Single Family Residential
- Multi-Family
- Other Residential
- Commercial
- Recreation
- Retail/Other
- Education
- Hospital
- Parks/Open Space
- Agriculture
- Natural Resources
- Floodway
- Tranportations
- Undeveloped Land
- Utilities
- Water
- Unknown

N W E S

City of Lakewood Washington

AHBL

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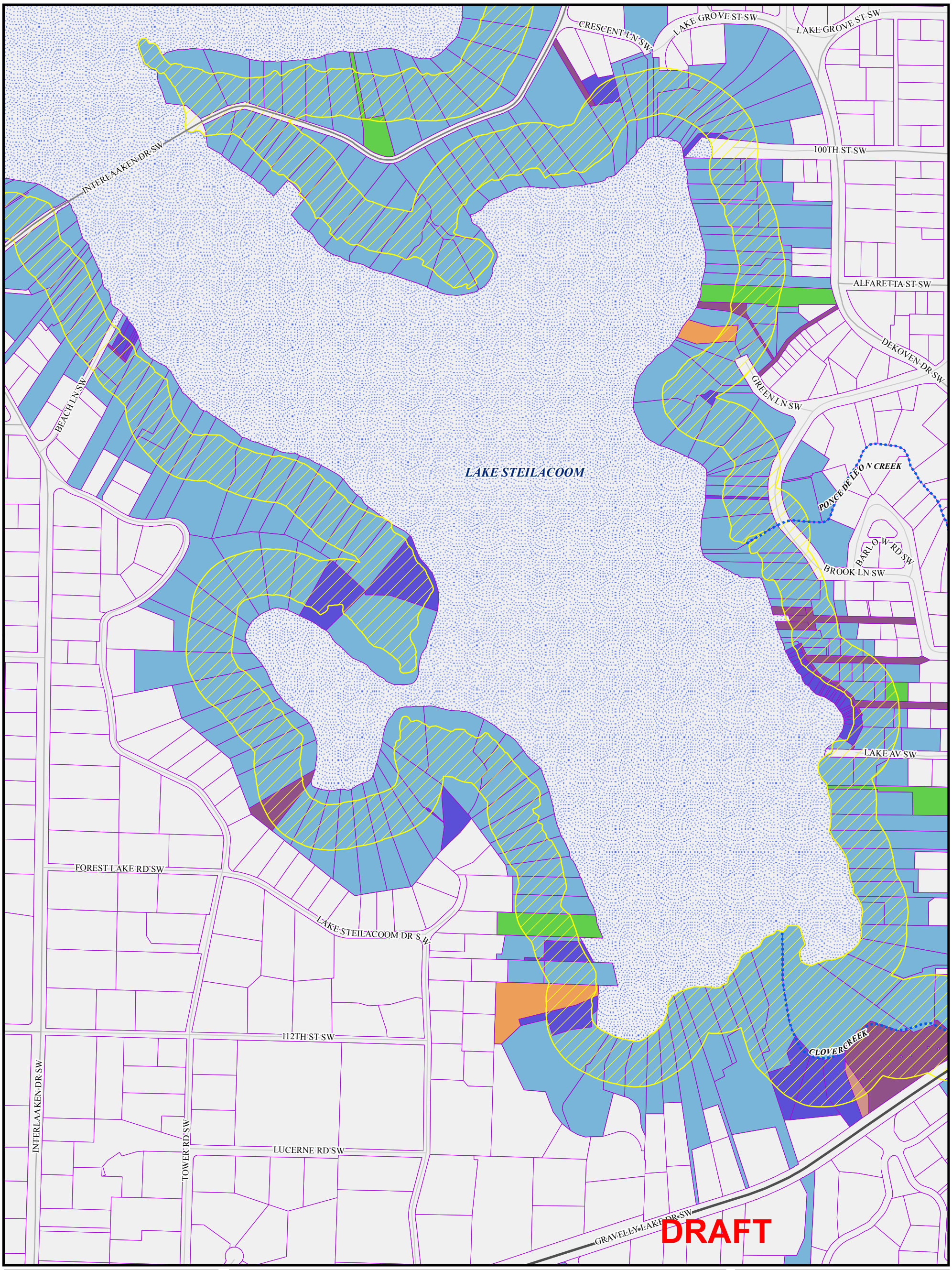
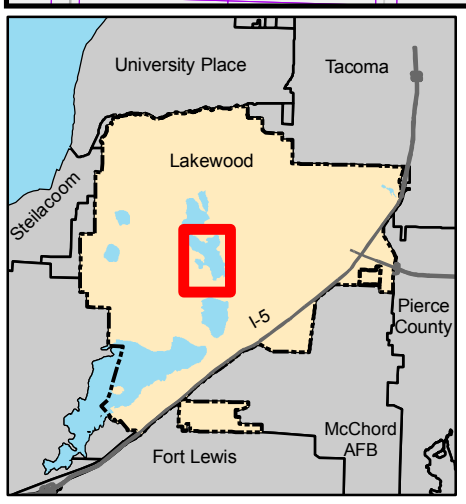
Source: City of Lakewood

Map created: March 22, 2010

1 inch = 362 feet

Figure 3A





City of Lakewood Shoreline Master Program
Figure 3B: Existing Land Use
Lake Steilacoom - South View

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Water Body
- Proposed Shoreline Management Area
- Surrounding Jurisdictions
- Parcel Boundary
- Single Family Residential
- Multi-Family
- Other Residential
- Commercial
- Recreation
- Retail/Other
- Education
- Hospital
- Parks/Open Space
- Agriculture
- Natural Resources
- Floodway
- Tranportations
- Undeveloped Land
- Utilities
- Water
- Unknown

N, W, E, S

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Source: City of Lakewood, WDNR

Map created: March 22, 2010

Figure 3B

100TH STCT SW
100TH AV SW
99TH AVCT SW
101ST ST SW
101ST STCT SW
101ST AVCT SW
103RD ST SW
CLARA BLVD SW
LAKE LOUISE LN SW
MELODY LN SW
104TH ST SW
LAKE LOUISE
LAKE LOUISE DR SW
107TH STCT SW
108TH ST SW
95TH AVCT SW
102ND AV SW
101ST AV SW
HOLDEN RD SW

City of Lakewood Shoreline Master Program
Figure 3C: Existing Land Use
Lake Louise

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Water Body
- Proposed Shoreline Management Area
- Surrounding Jurisdictions
- Parcel Boundary
- Single Family Residential
- Multi-Family
- Other Residential
- Commercial
- Recreation
- Retail/Other
- Education
- Hospital
- Parks/Open Space
- Agriculture
- Natural Resources
- Floodway
- Tranportations
- Undeveloped Land
- Utilities
- Water
- Unknown

N W E S

City of Lakewood Washington

AHBL

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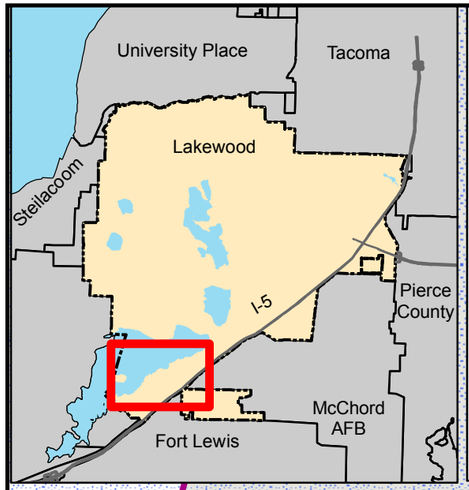
Source: City of Lakewood, WDNR

Map created: March 22, 2010

Figure 3C

City of Lakewood Shoreline Master Program
Figure 3D: Existing Land Use
American Lake - South View



Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Water Body
- Proposed Shoreline Management Area
- Surrounding Jurisdictions
- Parcel Boundary
- Single Family Residential
- Multi-Family
- Other Residential
- Commercial
- Recreation
- Retail/Other
- Education
- Hospital
- Parks/Open Space
- Agriculture
- Natural Resources
- Floodway
- Tranportations
- Undeveloped Land
- Utilities
- Water
- Unknown

AMERICAN LAKE

NORTH THORNE LN SW
WOODLAWN ST SW
PORTLAND AV SW
SPRUCE ST SW
LAKE ST SW
SILCOX DR SW
WADSWORTH ST SW
COMMERCIAL ST SW
WEST THORNE LN SW
FOREST RD SW
ROSE RD SW
GRANT AV SW
WASHINGTON AV SW
MAPLE ST SW
UNION AV SW
ORCHARD ST SW
I5 HWY S
WILLIAMS AVE SW
148TH ST SW

McChord AFB

Fort Lewis

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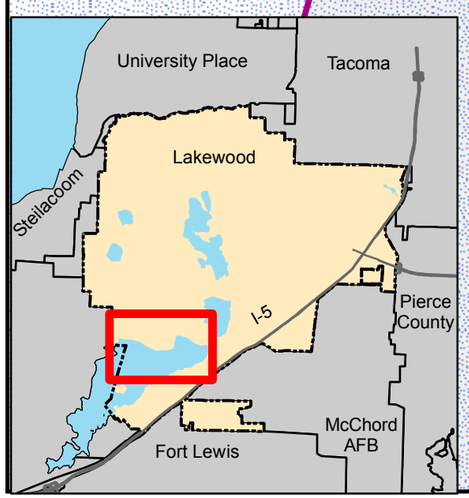
Source: City of Lakewood, WDNR

Map created: March 22, 2010

N
W
E
S

Figure 3D

WINONA ST SW
NORTH GATE RD SW
LAWNDALE AV SW
KENWOOD DR SW
NEWGROVE AV SW
NORTHLAKE DR SW
VETERANS DR SW
AMERICAN AV SW
NOTTINGHAM RD SW
VERNON AV SW
ALAMEDA AV SW
EDGEWOOD AV SW
DE FLOER LN SW
NAOMI LAWN DR SW
HIGHLAND AV SW
DOLLY MADISON ST SW
FRANCES FOLSOM ST SW
LAKE CITY BLVD SW
WOODHOLME RD SW
LAKEHOLME RD SW
AVENUE DE BOIS SW
83RD AV SW
OAK TREE PL SW
INTERLAAKEN DR SW
LAKELAND AV SW
PINE ST SW
WALNUT ST SW
LANGLOW ST SW
NORTH ST SW
GRAVELLY LAKE DR SW
GRAVELLY LAKE
AMERICAN LAKE
Fort Lewis



City of Lakewood Shoreline Master Program
Figure 3E: Existing Land Use
American Lake - South View

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Water Body
- Proposed Shoreline Management Area
- Surrounding Jurisdictions
- Parcel Boundary
- Single Family Residential
- Multi-Family
- Other Residential
- Commercial
- Recreation
- Retail/Other
- Education
- Hospital
- Parks/Open Space
- Agriculture
- Natural Resources
- Floodway
- Tranportations
- Undeveloped Land
- Utilities
- Water
- Unknown

City of Lakewood Washington

AHBL

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Source: City of Lakewood, WDNR

Map created: March 22, 2010

N W E S

Figure 3E

GRAVELLY LAKE DR SW

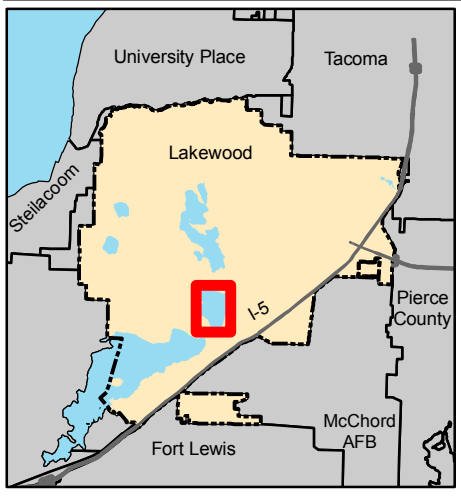
GRAVELLY LAKE

HILLTOP LN SW

LINWOOD LN SW

NYANZA RD SW

GRAVELLY LAKE DR SW



City of Lakewood Shoreline Master Program
Figure 3F: Existing Land Use
Gravelly Lake

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Water Body
- Proposed Shoreline Management Area
- Surrounding Jurisdictions
- Parcel Boundary
- Single Family Residential
- Multi-Family
- Other Residential
- Commercial
- Recreation
- Retail/Other
- Education
- Hospital
- Parks/Open Space
- Agriculture
- Natural Resources
- Floodway
- Tranportations
- Undeveloped Land
- Utilities
- Water
- Unknown

N W E S

City of Lakewood Washington

AHBL

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Source: City of Lakewood, WDNR

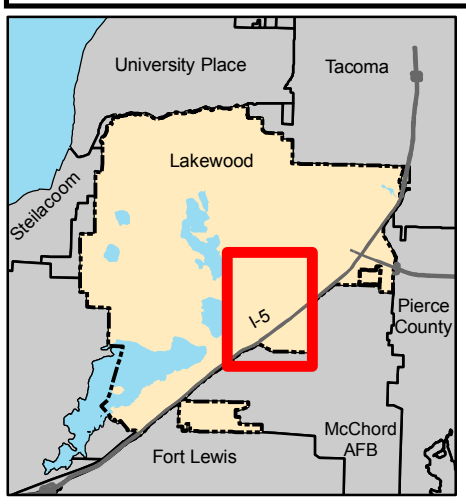
Map created: March 22, 2010

Figure 3F

PONCE DE LEON CREEK
BROOK LN SW
MAIN ST SW
104TH ST SW
PACIFIC ST SW
WILDAIRE RD SW
WILDAIRE RD SW
WILDAIRE RD SW
58TH AV CT SW
DOUGLAS DR SW
WESTWOOD DR SW
RUSSELL RD SW
DOTEN DR SW
OCCIDENT ST SW
CRONINS DR SW
MEADOW RD SW
LAKE AV SW
59TH AV SW
108TH ST CT SW
108TH ST SW
108TH ST CT SW
GRAVELLY LAKE DR SW
SCHOOL ST SW
BRIAR RD SW
DAVISSON RD SW
109TH ST SW
VILLA LN SW
ADDISON ST SW
FREIDAY ST SW
109TH ST SW
47TH AV SW
110TH ST SW
111TH ST SW
60TH AV SW
HIGHLAND AV SW
110TH ST SW
CARAWAY DR SW
OCCIDENT ST SW
111TH ST SW
55TH AV SW
112TH ST SW
KENDRICK ST SW
CLOVER PARK DR SW
ARROWHEAD RD SW
115TH ST SW
115TH ST CT SW
116TH ST SW
PAWNEE DR SW
117TH ST SW
SEMINOLE RD SW
TOMAHAWK RD SW
BRIDGEPORT WAY SW
118TH ST SW
WOODBINE LN SW
MOUNTBROOK LN SW
CLOVER CREEK DR SW
119TH ST SW
119TH ST SW
CLINE RD SW
120TH ST SW
120TH ST SW
CLOVER CREEK
I-5 HWY-N
GRAVELLY LAKE
DRUM LN SW
WOODBINE LN SW
DOCKEN LN SW
NYANZA PARK DR SW
CLOVER CREEK DR SW
121ST ST SW
SEATTLE AV SW
122ND ST SW
NYANZA RD SW
HILLCREST DR SW
HILLCREST DR SW
HILLTOP LN SW
123RD ST SW
47TH AV SW
WHISPER LN SW
SEATTLE AV SW
REBECCA DR SW
EDGEMERE DR SW
BEVERLY DR SW
CHICAGO AV SW
PACIFIC HWY SW
SAN FRANCISCO AV SW
VINE MAPLE DR SW
I-5 HWY-S
LINCOLN AV SW
127TH ST SW
127TH ST SW
NEW YORK AV SW
CHICAGO AV SW
47TH AV SW
BOSTON AV SW
DETROIT AV SW
TRUE LN SW
ADDISON ST SW
GLENWOOD AV SW
MCCHORD DR SW
GRAVELLY LAKE DR SW

McChord AFB

DRAFT



City of Lakewood Shoreline Master Program
Figure 3G: Existing Land Use
Clover Creek

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Water Body
- Proposed Shoreline Management Area
- Surrounding Jurisdictions
- Parcel Boundary
- Single Family Residential
- Multi-Family
- Other Residential
- Commercial
- Recreation
- Retail/Other
- Education
- Hospital
- Parks/Open Space
- Agriculture
- Natural Resources
- Floodway
- Tranportations
- Undeveloped Land
- Utilities
- Water
- Unknown

N W E S

City of Lakewood Washington

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Source: City of Lakewood, WDNR

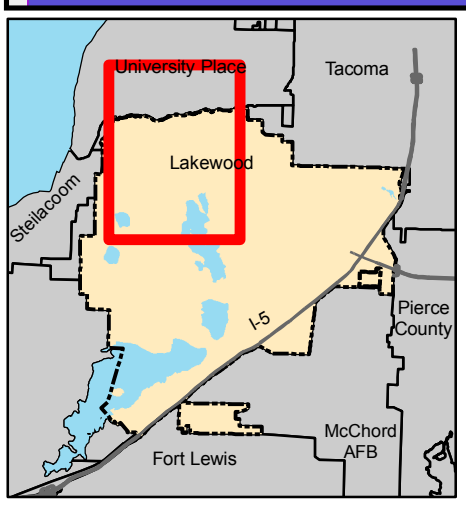
Map created: March 22, 2010

Figure 3G

University Place

CHAMBERS BAY
CHAMBERS CREEK
PEACH CREEK
FLETT CREEK
STEILACOOM CREEK
LAKE STEILACOOM
WAUGHOP LAKE
McChord AFB

CAMEO DR SW
97TH AV SW
70TH ST SW
71ST ST SW
RUBY DR SW
TURQUOISE DR SW
TOPAZ DR SW
ZIRCON DR SW
CITRINE LN SW
SAPPHIRE DR SW
65TH AV W
75TH ST SW
AMBER DR SW
ONYX DR SW
JADE DR SW
75TH ST W
68TH AV W
76TH ST W
73RD ST SW
CORAL DR SW
96TH AV SW
95TH AV SW
93RD AV CT SW
91ST AV CT SW
76TH ST SW
91ST AV SW
90TH AV SW
89TH AV SW
SARDONYX DR SW
GARNET LN SW
EMERALD DR SW
AGATE DR SW
78TH ST SW
87TH AV SW
76TH AV SW
99TH AV SW
79TH ST SW
ONYX CT SW
88TH AV SW
79TH ST SW
80TH ST SW
81ST ST SW
JOHN DOWER RD W
87TH AV SW
83RD AV SW
PHILLIPS RD SW
82ND ST SW
84TH ST SW
LEUZADER LN SW
PAINE ST SW
CUSTER RD SW
FAIRWAY DR SW
LESCHI RD SW
BRIGGS LN SW
86TH ST SW
87TH ST SW
STEILACOOM BLVD SW
TERRACE RD SW
LENOX AV SW
OAKRIDGE DR SW
88TH ST SW
MEADOW RD SW
JOHN DOWER RD SW
DALTON DR SW
88TH ST CT SW
82ND AV SW
CHERRY LN SW
HAVILAND AV SW
GRAMERCY PL SW
EDGEWATER DR SW
FLORA ST SW
ARDMORE DR SW
NIXON AV SW
CECILE CT SW
SACRAMENTO ST SW
92ND ST SW
ELWOOD DR SW
NORTH WY SW
FOSTER ST SW
DALWOOD RD SW
DEKOWEN DR SW
MAPLE AV SW
MEADOW RD SW
94TH ST SW
FIR GLEN RD SW
HIPKINS RD SW
SOUTH WY SW
WAVERLY DR SW
HILLGROVE LN SW
LEXINGTON AV SW
95TH ST SW
MT TACOMA DR SW
MT TACOMA DR SW
97TH ST SW
ANGLE LN SW
LAKE GROVE ST SW
CROSS LN SW
INTERLAAKEN DR SW
100TH ST SW



City of Lakewood Shoreline Master Program
Figure 3H: Existing Land Use
Chambers Creek

DRAFT

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Water Body
- Proposed Shoreline Management Area
- Surrounding Jurisdictions
- Parcel Boundary
- Single Family Residential
- Multi-Family
- Other Residential
- Commercial
- Recreation
- Retail/Other
- Education
- Hospital
- Parks/Open Space
- Agriculture
- Natural Resources
- Floodway
- Tranportations
- Undeveloped Land
- Utilities
- Water
- Unknown

N W E S

City of Lakewood Washington

AHBL

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Source: City of Lakewood, WDNR

Map created: March 22, 2010

Figure 3H

University Place
Pierce County
Tacoma
Steilacoom
Fort Lewis
McChord AFB
CHAMBERS CREEK
CHAMBERS BAY
GARRISON SPRINGS
WAUGHOP LAKE
LAKE LOUISE
LAKE LOUISE DR SW
LAKE STEILACOOM
PONCE DE LEON CREEK
FLETT CREEK
CARP LAKE
GRAVELLY LAKE
SEELEY LAKE
CLOVER CREEK
AMERICAN LAKE
ZIRCON DR SW
ONYX DR SW
91ST AV SW
78TH ST SW
87TH AV SW
83RD AV SW
PHILLIPS RD SW
BRIDGEPORT WY W
JOHN DOWER RD W
JOHN DOWER RD SW
CUSTER RD W
CUSTER RD SW
LAKEWOOD DR W
74TH ST W
75TH ST W
88TH ST SW
STEILACOOM BLVD SW
ELWOOD DR SW
HIPKINS RD SW
ANGLE LN SW
WAVERLY DR SW
MEADOW RD SW
WHITMAN AV SW
BRIDGEPORT WY SW
LAKEWOOD DR SW
101ST ST SW
104TH ST SW
ALFARETTA ST SW
100TH ST SW
59TH AV SW
FARWEST DR SW
SHORT LN SW
IDLEWILD RD SW
GRAVELLY LAKE DR SW
MAIN ST SW
108TH ST SW
LAKEVIEW AV SW
112TH ST SW
111TH ST SW
BUTTE DR SW
HOLDEN RD SW
MILITARY RD SW
HUGGINS MEYERS RD SW
INTERLAAKEN DR SW
WASHINGTON BLVD SW
NORTH GATE RD SW
VERNON AV SW
VETERANS DR SW
NYANZA RD SW
HILLCREST DR SW
PACIFIC HWY SW
I5 HWY S
I5 HWY N
NEW YORK AV SW
MCCHORD DR SW
NORTH THORNE LN SW
PORTLAND AV SW
UNION AV SW
MURRAY RD SW
EVERGREEN DR

DRAFT

City of Lakewood Shoreline Master Program
Figure 4: Zoning

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Proposed Shoreline Management Area
- Water Body
- Surrounding Jurisdictions
- Arterial Residential Commercial
- Commercial One
- Multi Family One
- Multi Family Two
- Multi Family Three
- Mixed Residential Two
- Neighborhood Commercial
- Neighborhood Commercial
- Open Space & Recreation One
- Open Space & Recreation Two
- Public / Institutional
- Residential One
- Residential Two
- Residential Three
- Residential Four
- Water/OSR1

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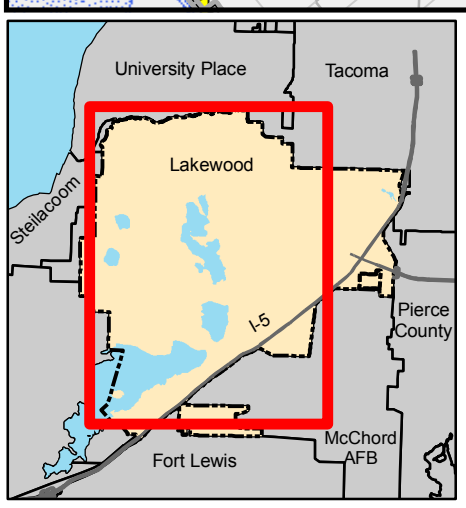
Source: City of Lakewood

Map created: March 22, 2010

Figure 4

University Place
Pierce County
Tacoma
Steilacoom
Fort Lewis
McChord AFB
CHAMBERS CREEK
CHAMBERS BAY
GARRISON SPRINGS
WAUGHOP LAKE
LAKE LOUISE
LAKE STEILACOOM
CARP LAKE
GRAVELLY LAKE
SEELEY LAKE
AMERICAN LAKE
FLETT CREEK
PONCE DE LEON CREEK
CLOVER CREEK
ZIRCON DR SW
ONYX DR SW
78TH ST SW
91ST AV SW
87TH AV SW
83RD AV SW
PHILLIPS RD SW
BRIDGEPORT WY W
JOHN DOWER RD W
JOHN DOWER RD SW
CUSTER RD W
CUSTER RD SW
LAKEWOOD DR W
74TH ST W
75TH ST W
88TH ST SW
STEILACOOM BLVD SW
ELWOOD DR SW
HIPKINS RD SW
ANGLE LN SW
WAVERLY DR SW
MEADOW RD SW
WHITMAN AV SW
BRIDGEPORT WY SW
LAKEWOOD DR SW
101ST ST SW
104TH ST SW
ALFARETTA ST SW
100TH ST SW
59TH AV SW
FARWEST DR SW
LAKE LOUISE DR SW
SHORT LN SW
IDLEWILD RD SW
GRAVELLY LAKE DR SW
MAIN ST SW
108TH ST SW
LAKEVIEW AV SW
112TH ST SW
BUTTE DR SW
HUGGINS MEYERS RD SW
111TH ST SW
MILITARY RD SW
HOLDEN RD SW
83RD AV SW
INTERLAAKEN DR SW
WASHINGTON BLVD SW
NORTH GATE RD SW
VERNON AV SW
VETERANS DR SW
NYANZA RD SW
PACIFIC HWY SW
HILLCREST DR SW
I5 HWY S
NEW YORK AV SW
MCCHORD DR SW
NORTH THORNE LN SW
PORTLAND AV SW
UNION AV SW
MURRAY RD SW
EVERGREEN DR

DRAFT



City of Lakewood Shoreline Master Program
Figure 5: Future Land Use Designation

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Proposed Shoreline Management Area
- Water Body
- Surrounding Jurisdictions

pabshift polygon

FUT_LUSE

- Air Corridor 1
- Air Corridor 2
- Arterial Corridor
- Central Business District
- Corridor Commercial
- High-Density Multi Family
- Industrial
- Public & Semi-Public Institutional
- Multi-Family
- Military Lands
- Mixed Residential
- Neighborhood Business District
- Open Space & Recreation
- Residential Estate
- Single Family

City of Lakewood Washington

AHBL

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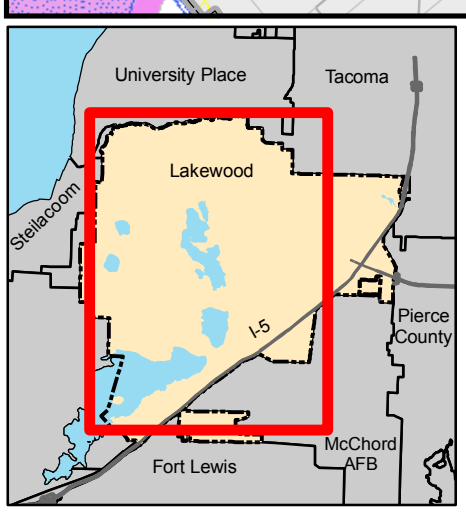
Source: City of Lakewood

Map created: March 22, 2010

Figure 5

University Place
Pierce County
Tacoma
Steilacoom
Fort Lewis
McChord AFB
CHAMBERS CREEK
CHAMBERS BAY
GARRISON SPRINGS
ZIRCON DR SW
ONYX DR SW
91ST AV SW
78TH ST SW
87TH AV SW
83RD AV SW
PHILLIPS RD SW
BRIDGEPORT WY W
JOHN DOWER RD W
CUSTER RD W
74TH ST W
75TH ST W
LAKEWOOD DR W
FLETT CREEK
CUSTER RD SW
JOHN DOWER RD SW
88TH ST SW
STEILACOOM BLVD SW
WAUGHOP LAKE
ELWOOD DR SW
HIPKINS RD SW
ANGLE LN SW
WAVERLY DR SW
MEADOW RD SW
WHITMAN AV SW
BRIDGEPORT WY SW
SEELEY LAKE
LAKEWOOD DR SW
101ST ST SW
100TH ST SW
ALFARETTA ST SW
59TH AV SW
LAKE STEILACOOM
104TH ST SW
SHORT LN SW
LAKE LOUISE
LAKELOUISE DR SW
FARWEST DR SW
PONCE DE LEON CREEK
MAIN ST SW
GRAVELLY LAKE DR SW
LAKEVIEW AV SW
108TH ST SW
112TH ST SW
BUTTE DR SW
IDLEWILD RD SW
HUGGINS MEYERS RD SW
111TH ST SW
MILITARY RD SW
HOLDEN RD SW
CARP LAKE
INTERLAAKEN DR SW
WASHINGTON BLVD SW
NORTH GATE RD SW
VERNON AV SW
VETERANS DR SW
GRAVELLY LAKE
NYANZA RD SW
HILLCREST DR SW
PACIFIC HWY SW
I5 HWY S
I5 HWY N
CLOVER CREEK
NEW YORK AV SW
MCCHORD DR SW
AMERICAN LAKE
NORTH THORNE LN SW
PORTLAND AV SW
UNION AV SW
MURRAY RD SW
EVERGREEN DR
DRAFT
N
S
E
W



City of Lakewood Shoreline Master Program
Figure 6: Wellhead Protection Areas & State Cleanup Sites

Legend

State Cleanup Site
- Active
- Inactive

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Proposed Shoreline Management Area
- Water Body
- Surrounding Jurisdictions
- 1 Year Modeled Wellhead Protection Area
- 5 Year Modeled Wellhead Protection Area
- 10 Year Modeled Wellhead Protection Area

City of Lakewood Washington

AHBL

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Source: City of Lakewood, TPCHD, DOE

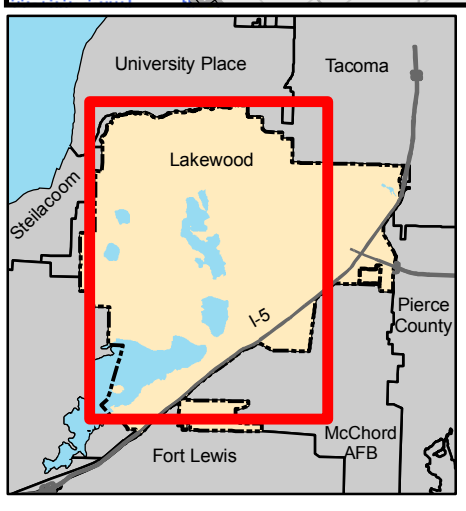
Map created: March 22, 2010

Figure 6

University Place
Pierce County
Tacoma
Steilacoom
Fort Lewis
McChord AFB
CHAMBERS CREEK
CHAMBERS BAY
GARRISON SPRINGS
WAUGHOP LAKE
LAKE LOUISE
LAKE STEILACOOM
CARP LAKE
GRAVELLY LAKE
SEELEY LAKE
AMERICAN LAKE
PONCE DE LEON CREEK
FLETT CREEK
CLOVER CREEK
ZIRCON DR SW
ONYX DR SW
78TH ST SW
91ST AV SW
87TH AV SW
83RD AV SW
PHILLIPS RD SW
88TH ST SW
BRIDGEPORT WY W
JOHN DOWER RD W
CUSTER RD W
CUSTER RD SW
JOHN DOWER RD SW
75TH ST W
74TH ST W
LAKEWOOD DR W
STEILACOOM BLVD SW
ELWOOD DR SW
HIPKINS RD SW
ANGLE LN SW
WAVERLY DR SW
MEADOW RD SW
WHITMAN AV SW
BRIDGEPORT WY SW
LAKEWOOD DR SW
101ST ST SW
104TH ST SW
SHORTLN SW
IDLEWILD RD SW
ALFARETTA ST SW
59TH AV SW
100TH ST SW
FARWEST DR SW
LAKELOUISE DR SW
BUTTE DR SW
GRAVELLY LAKE DR SW
MAIN ST SW
LAKEVIEW AV SW
108TH ST SW
112TH ST SW
111TH ST SW
HOLDEN RD SW
MILITARY RD SW
HUGGINS MEYERS RD SW
INTERLAAKEN DR SW
WASHINGTON BLVD SW
NORTH GATE RD SW
VERNON AV SW
VETERANS DR SW
NYANZA RD SW
PACIFIC HWY SW
I5 HWY S
I5 HWY N
HILLCREST DR SW
NEW YORK AV SW
MCCHORD DR SW
NORTH THORNE LN SW
PORTLAND AV SW
UNION AV SW
MURRAY RD SW
EVERGREEN DR

DRAFT

City of Lakewood Shoreline Master Program
Figure 7: Sanitary Sewer Facilities



Legend

Pierce County Sewer Lines

Pipe Size (Inches)
- 1.25 - 2.5
- 3 - 8
- 9 - 20
- 21 - 30
- 31 - 48
- 49 - 84

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream

- City Boundary
- Proposed Shoreline Management Area
- Water Body
- Surrounding Jurisdictions

City of Lakewood Washington
AHBL

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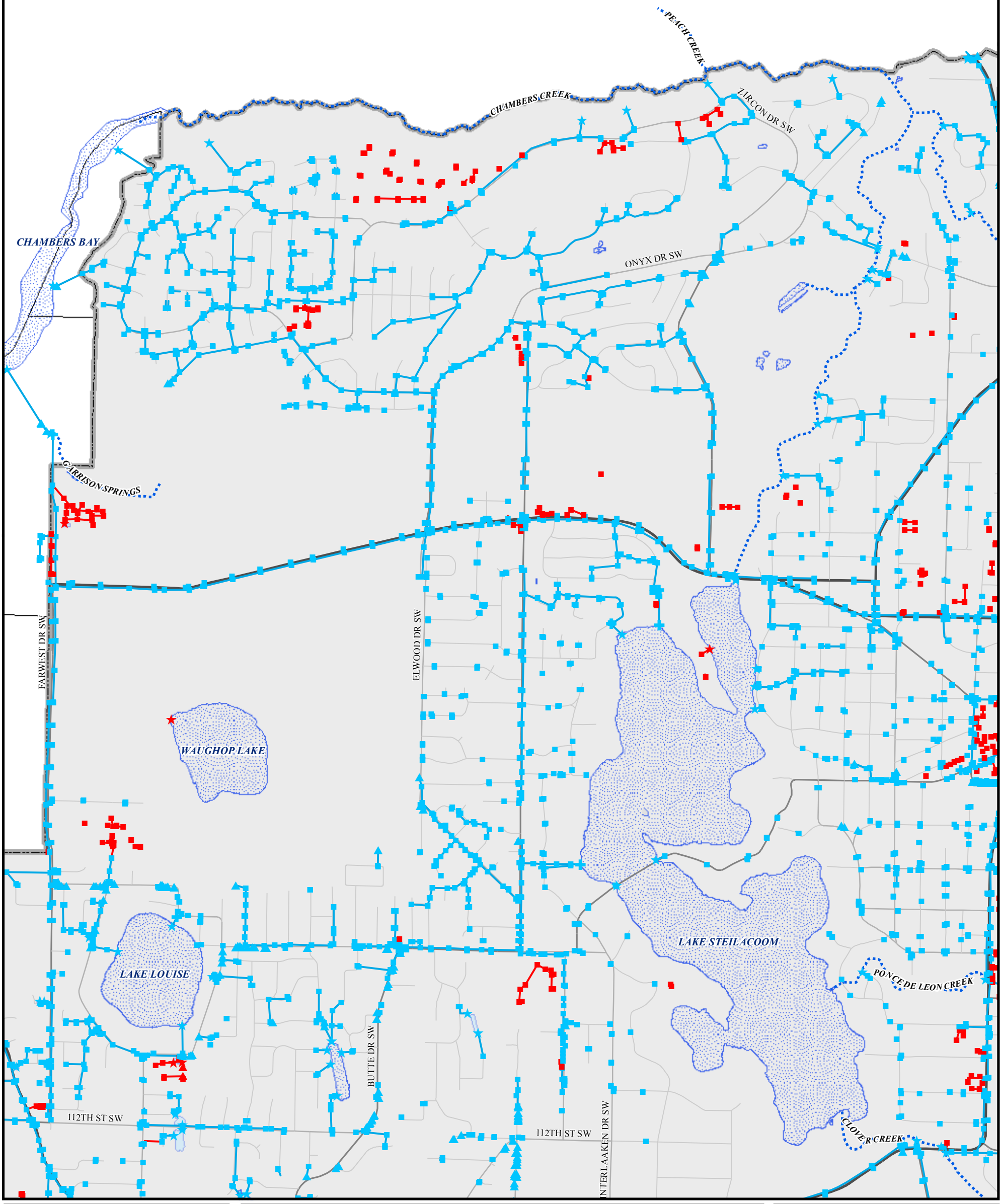
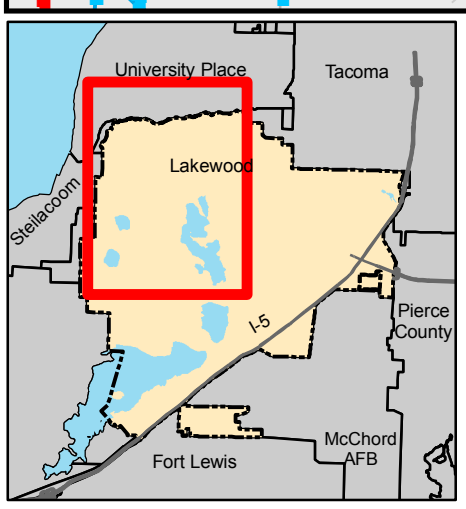
Source: City of Lakewood, Pierce County

Map created: March 22, 2010

Figure 7

DRAFT





City of Lakewood Shoreline Master Program
Figure 8A: Stormwater Facilities

Legend

catchbas point
PUBPRIV
- Catch Basin (Public)
- Catch Basin (Private)

pipepts point
PUBPRIV
- Outfall (Public)
- Outfall (Private)

culverts point
PUBPRIV, OF
- Pipe Endpoint (Public)
- Pipe Endpoint (Private)
- Outfall (Public)
- Outfall (Private)

vaults point
PUBPRIV
- Vault (Public)
- Vault (Private)

sdpipes arc
PUBPRIV
- Storm Line (Public)
- Storm Line (Private)
- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream

- Storm Pond
- City Boundary
- Proposed Shoreline Management Area
- Water Body
- Surrounding Jurisdictions

City of Lakewood Washington

AHBL

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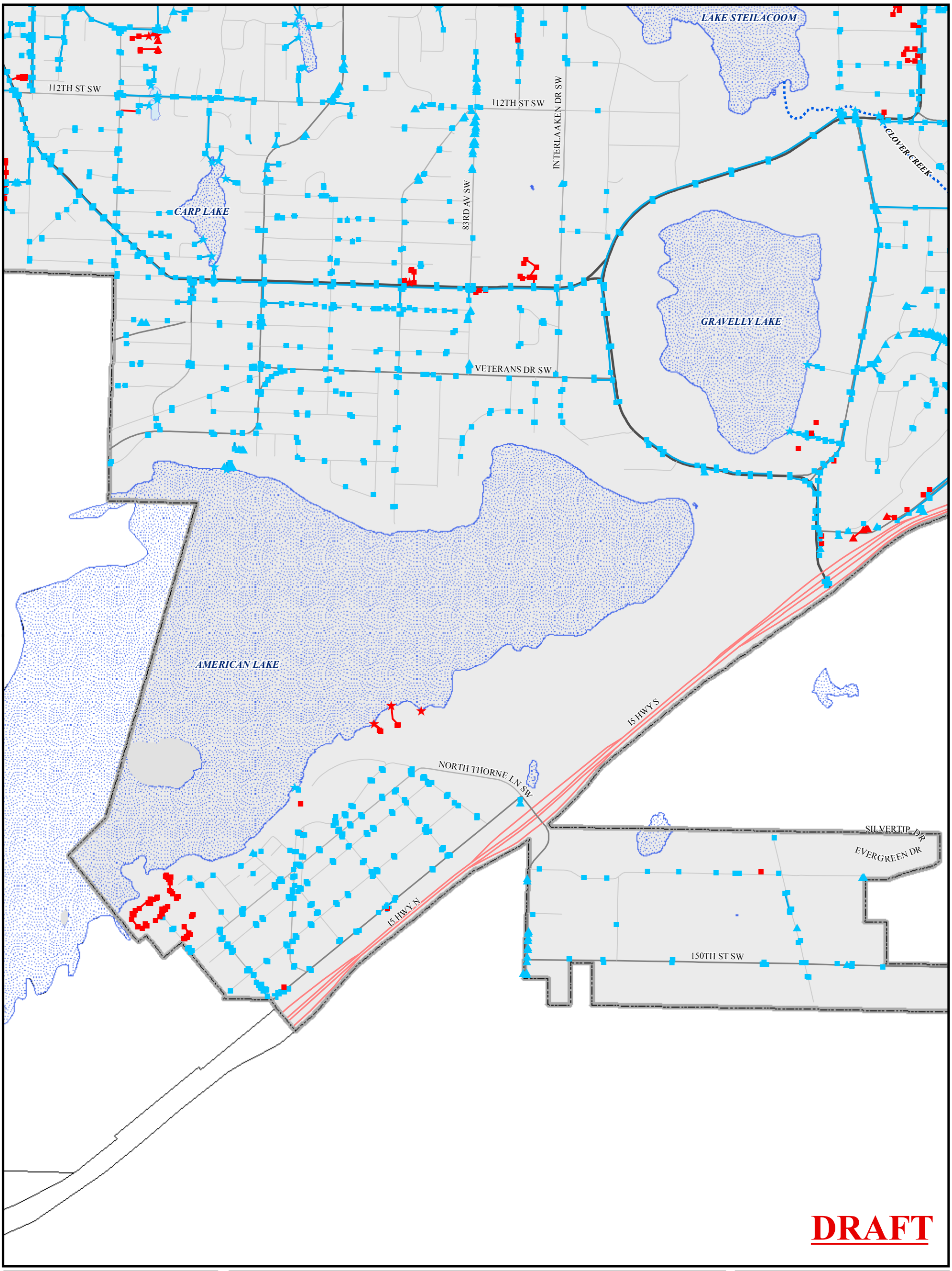
Source: City of Lakewood

Map created: March 22, 2010

Figure 8A



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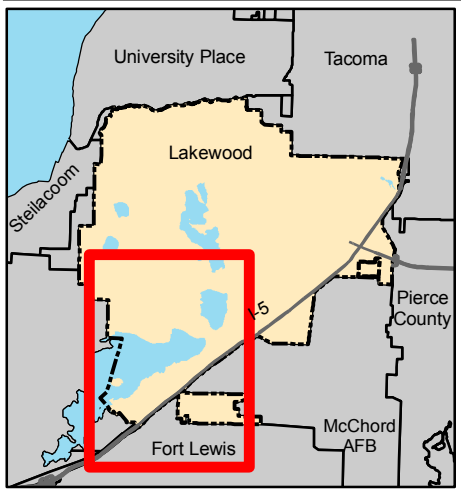

City of Lakewood Shoreline Master Program
Figure 8B: Stormwater Facilities

Legend

catchbas point
PUBPRIV
- Catch Basin (Public)
- Catch Basin (Private)

pipepts point
PUBPRIV
- Outfall (Public)
- Outfall (Private)

culverts point
PUBPRIV, OF
- Pipe Endpoint (Public)
- Pipe Endpoint (Private)
- Outfall (Public)
- Outfall (Private)

vaults point
PUBPRIV
- Vault (Public)
- Vault (Private)

sdpipes arc
PUBPRIV
- Storm Line (Public)
- Storm Line (Private)
- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream

- Storm Pond
- City Boundary
- Proposed Shoreline Management Area
- Water Body
- Surrounding Jurisdictions

N W E S

City of Lakewood Washington

AHBL

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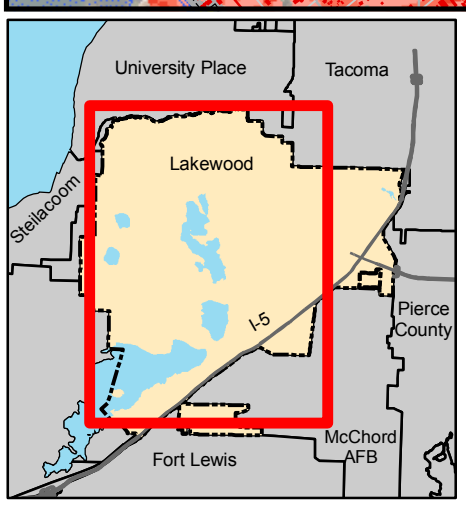
Source: City of Lakewood

Map created: March 22, 2010

Figure 8B

University Place
Pierce County
Tacoma
Stellacoom
Fort Lewis
McChord AFB
CHAMBERS CREEK
CHAMBERS BAY
GARRISON SPRINGS
WAUGHOP LAKE
LAKE LOUISE
LAKE STEILACOOM
CARP LAKE
GRAVELLY LAKE
SEELEY LAKE
AMERICAN LAKE
PONCE DE LEON CREEK
FLETT CREEK
CLOVER CREEK
ZIRCON DR SW
ONYX DR SW
78TH ST SW
87TH AV SW
83RD AV SW
BELL HILL RD SW
JOHN DOWER RD SW
CUSTER RD SW
BRIDGEPORT WY W
75TH ST W
74TH ST W
LAKEWOOD DR W
88TH ST SW
STEILACOOM BLVD SW
ELWOOD DR SW
HIPKINS RD SW
ANGLE LN SW
WAVERLY DR SW
MEADOW RD SW
WHITMAN AV SW
BRIDGEPORT WY SW
LAKEWOOD DR SW
101ST ST SW
104TH ST SW
ALFARETTA ST SW
59TH AV SW
100TH ST SW
FARWEST DR SW
LAKELOUISE DR SW
SHORTLN SW
IDLEWILD RD SW
GRAVELLY LAKE DR SW
MAIN ST SW
LAKEVIEW AV SW
108TH ST SW
112TH ST SW
111TH ST SW
MILITARY RD SW
HOLDEN RD SW
BUTTE DR SW
HUGGINS MEYERS RD SW
83RD AV SW
INTERLAAKEN DR SW
WASHINGTON BLVD SW
NORTH GATE RD SW
VERNON AV SW
VETERANS DR SW
NYANZA RD SW
HILLCREST DR SW
PACIFIC HWY SW
I5 HWY S
I5 HWY N
NEW YORK AV SW
MCCHORD DR SW
NORTH THORNE LN SW
PORTLAND AV SW
UNION AV SW
MURRAY RD SW
EVERGREEN DR

DRAFT



City of Lakewood Shoreline Master Program
Figure 9: Impervious Surface

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- Building Outline
- City Boundary
- Proposed Shoreline Management Area
- Water Body
- Surrounding Jurisdictions

Percent Impervious
- 0
- 9 - 31
- 32 - 62
- 63 - 102
- 103 - 127

City of Lakewood Washington

AHBL

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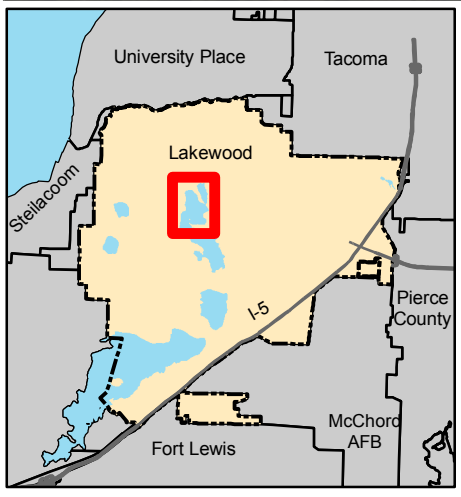
Source: City of Lakewood, DOE NLCID 2006

Map created: March 22, 2010

Figure 9



City of Lakewood Shoreline Master Program
Figure 10A: Shoreline Modifications
Lake Steilacoom - North View

DRAFT

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Proposed Shoreline Management Area
- Parcel Boundary
- Mapped Overwater Structures
- Water Body
- Surrounding Jurisdictions

N W E S

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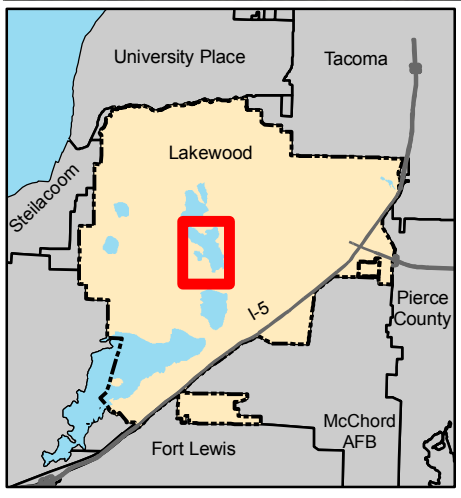
Source: City of Lakewood, WDNR

Map created: March 22, 2010

1 inch = 362 feet

Figure 10A



City of Lakewood Shoreline Master Program
Figure 10B: Shoreline Modifications
Lake Steilacoom - South View

DRAFT

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Proposed Shoreline Management Area
- Parcel Boundary
- Mapped Overwater Structures
- Water Body
- Surrounding Jurisdictions

N W E S

City of Lakewood Washington

AHBL

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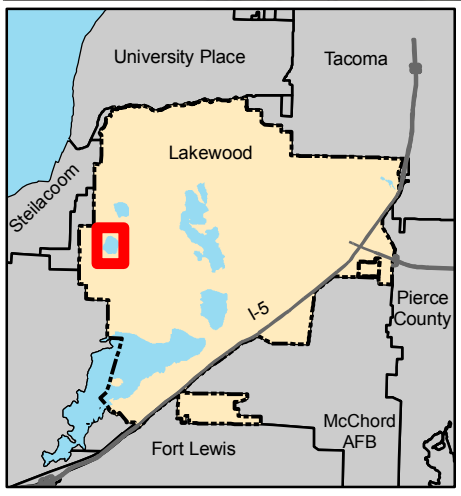
Source: City of Lakewood, WDNR

Map created: March 22, 2010

Figure 10B



City of Lakewood Shoreline Master Program
Figure 10C: Shoreline Modifications
Lake Louise

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Proposed Shoreline Management Area
- Parcel Boundary
- Mapped Overwater Structures
- Water Body
- Surrounding Jurisdictions

N W E S

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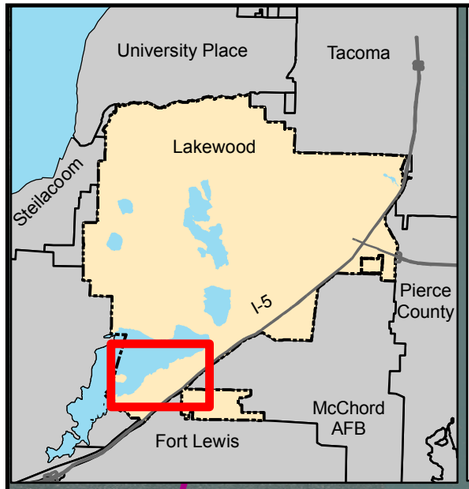
Source: City of Lakewood, WDNR

Map created: March 22, 2010

Figure 10C

City of Lakewood Shoreline Master Program
Figure 10D: Shoreline Modifications
American Lake - South View



Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Proposed Shoreline Management Area
- Parcel Boundary
- Mapped Overwater Structures
- Surrounding Jurisdictions

AMERICAN LAKE

NORTH THORNE LN SW
WOODLAWN ST SW
PORTLAND AV SW
SPRUCE ST SW
LAKE ST SW
15 HWY S
SUL COX DR SW
WADSWORTH ST SW
COMMERCIAL ST SW
WEST THORNE LN SW
FORT ST RD SW
ROSE RD SW
GRANT AV SW
ORCHARD ST SW
WASHINGTON AV SW
MAPLE ST SW
UNION AV SW
MURRAY RD SW
148TH ST SW
McChord AFB
Fort Lewis

City of Lakewood Washington

AHBL

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Source: City of Lakewood, WDNR

Map created: March 22, 2010

N W E S

Figure 10D

WINONA ST SW
NORTH GATE RD SW
LAWNDALE AV SW
KENWOOD DR SW
NEWGROVE AV SW
EDGEWOOD AV SW
NORTHLAKE DR SW
VETERANS DR SW
AMERICAN AV SW
NOTTINGHAM RD SW
VERNON AV SW
DELEGER LA SW
ALAMEDA AV SW
HIGHLAND AV SW
NAOMI LAWN DR SW
LAKE CITY BLVD SW
DOLLY MADISON ST SW
FRANCES FOLSOM ST SW
WOODHOLME RD SW
LAKEHOLME RD SW
AVENUE DUBOIS SW
83RD AV SW
OAK TREE PL SW
INTERLAAKEN DR SW
LAKELAND AV SW
PINE ST SW
WALNUT ST SW
LANGLOW ST SW
NORTH ST SW
GRAVELLY LAKE DR SW
GRAVELLY LAKE
AMERICAN LAKE
Fort Lewis
University Place
Tacoma
Lakewood
Steilacoom
I-5
Pierce County
McChord AFB
Fort Lewis

City of Lakewood Shoreline Master Program
Figure 10E: Shoreline Modifications
American Lake - South View

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Proposed Shoreline Management Area
- Parcel Boundary
- Mapped Overwater Structures
- Water Body
- Surrounding Jurisdictions

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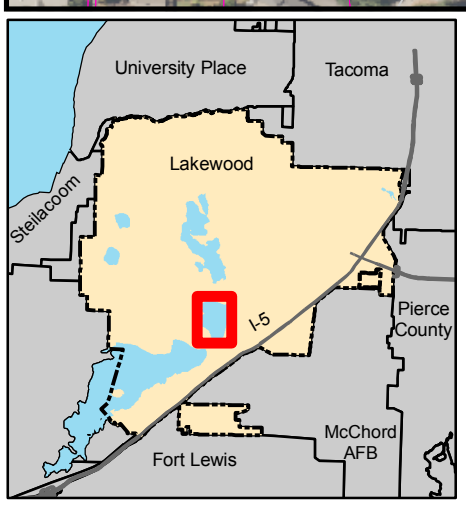
Source: City of Lakewood, WDNR

Map created: March 22, 2010

N
W
E
S

Figure 10E



City of Lakewood Shoreline Master Program
Figure 10F: Shoreline Modifications
Gravelly Lake

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Proposed Shoreline Management Area
- Parcel Boundary
- Mapped Overwater Structures
- Water Body
- Surrounding Jurisdictions

N W E S

City of Lakewood Washington

AHBL

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Source: City of Lakewood, WDNR

Map created: March 22, 2010

Figure 10F

University Place
Pierce County
Tacoma
Steilacoom
Fort Lewis
McChord AFB
CHAMBERS CREEK
CHAMBERS BAY
GARRISON SPRINGS
FLETT CREEK
PONCE DE LEON CREEK
CLOVER CREEK
WAUGHOP LAKE
LAKE LOUISE
LAKE STEILACOOM
CARP LAKE
GRAVELLY LAKE
SEELEY LAKE
AMERICAN LAKE
ZIRCON DR SW
ONYX DR SW
78TH ST SW
91ST AV SW
87TH AV SW
83RD AV SW
PHILLIPS RD SW
BRIDGEPORT WY W
74TH ST W
75TH ST W
CUSTER RD W
LAKEWOOD DR W
JOHN DOWER RD W
CUSTER RD SW
JOHN DOWER RD SW
88TH ST SW
STEILACOOM BLVD SW
WHITMAN AV SW
MEADOW RD SW
WAVERLY DR SW
ELWOOD DR SW
HIPKINS RD SW
ANGLE LN SW
BRIDGEPORT WY SW
LAKEWOOD DR SW
100TH ST SW
101ST ST SW
104TH ST SW
ALFARETTA ST SW
59TH AV SW
SHORTLN SW
IDLEWILD RD SW
GRAVELLY LAKE DR SW
MAIN ST SW
108TH ST SW
LAKEVIEW AV SW
FAIRWEST DR SW
LAKELOUISE DR SW
112TH ST SW
BUTTE DR SW
111TH ST SW
MILITARY RD SW
HOLDEN RD SW
HUGGINS MEYERS RD SW
83RD AV SW
INTERLAAKEN DR SW
WASHINGTON BLVD SW
NORTH GATE RD SW
VERNON AV SW
VETERANS DR SW
NYANZA RD SW
PACIFIC HWY SW
HILLCREST DR SW
15 HWY N
15 HWY S
NEW YORK AV SW
MCCHORD DR SW
NORTH THORNE LN SW
PORTLAND AV SW
UNION AV SW
MURRAY RD SW
EVERGREEN DR

DRAFT

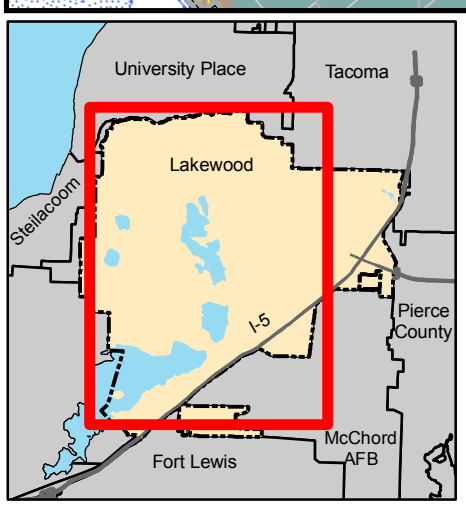
City of Lakewood Shoreline Master Program
Figure 12: Soils and Steep Slopes

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Proposed Shoreline Management Area
- Water Body
- Surrounding Jurisdictions
- Steep Slope (> 40%)
- Potential CMZ Reach

USDA Soil Association

- Alderwood Gravelly
- Aquicxerofluvents
- Dupont Muck
- Everett Gravelly Sandy Loam
- Everett Stony Sandy Loam
- Indianola Sandy Loam
- Nisqually Loamy Sand
- Pits
- Shalcar Muck
- Spana Loam
- Spanaway Gravelly Sandy Loam
- Xerochrepts
- Xerorthents



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Source: City of Lakewood, Pierce County, ECY

Map created: March 22, 2010

Figure 12

University Place

Pierce County

Tacoma

Steilacoom

Fort Lewis

McChord AFB

CHAMBERS CREEK

CHAMBERS BAY

GARRISON SPRINGS

ZIRCON DR SW

ONYX DR SW

78TH ST SW

91ST AV SW

87TH AV SW

83RD AV SW

PHILLIPS RD SW

BRIDGEPORT WY W

JOHN DOWER RD W

JOHN DOWER RD SW

CUSTER RD W

CUSTER RD SW

75TH ST W

74TH ST W

LAKEWOOD DR W

FLETT CREEK

88TH ST SW

STEILACOOM BLVD SW

WAUGHOP LAKE

ELWOOD DR SW

HIPKINS RD SW

ANGLE LN SW

WAVERLY DR SW

MEADOW RD SW

WHITMAN AV SW

BRIDGEPORT WY SW

SEELEY LAKE

LAKEWOOD DR SW

101ST ST SW

LAKE LOUISE

LAKE LOUISE DR SW

104TH ST SW

FARWEST DR SW

SHORT LN SW

LAKE STEILACOOM

ALFARETTA ST SW

59TH AV SW

100TH ST SW

PONCE DE LEON CREEK

GRAVELLY LAKE DR SW

MAIN ST SW

108TH ST SW

LAKEVIEW AV SW

IDLEWILD RD SW

BUTTE DR SW

112TH ST SW

HUGGINS MEYERS RD SW

83RD AV SW

INTERLAAKEN DR SW

111TH ST SW

MILITARY RD SW

HOLDEN RD SW

CARP LAKE

WASHINGTON BLVD SW

NORTH GATE RD SW

VERNON AV SW

VETERANS DR SW

GRAVELLY LAKE

NYANZA RD SW

HILLCREST DR SW

PACIFIC HWY SW

I5 HWY S

I5 HWY N

CLOVER CREEK

NEW YORK AV SW

MCCHORD DR SW

AMERICAN LAKE

NORTH THORNE LN SW

PORTLAND AV SW

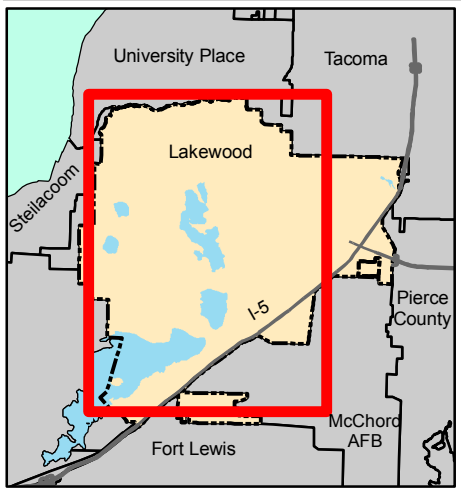
UNION AV SW

MURRAY RD SW

EVERGREEN DR

DRAFT

City of Lakewood Shoreline Master Program
Figure 15: Shoreline Planning Segments



Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Water Body
- Surrounding Jurisdictions

Proposed Shoreline Management Area

- 1A, Moderate
- 1B, Moderate/High
- 1C, Low/Moderate
- 2, Low/Moderate
- 3A, Low
- 3B, Low/Moderate
- 3C, Low/Moderate
- 3D, Moderate
- 3E, Moderate/High
- 4A, Low/Moderate
- 4B, Low/Moderate
- 5A, Moderate
- 5B, Moderate
- 6, Low
- 7, Moderate/High

City of Lakewood Washington

AHBL

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Source: City of Lakewood

Map created: January 26, 2010

1 inch = 2,039 feet

Figure 15

University Place
Pierce County
Steilacoom
Tacoma
Fort Lewis
McChord AFB
CHAMBERS CREEK
CHAMBERS BAY
GARRISON SPRINGS
ZIRCON DR SW
ONYX DR SW
91ST AV SW
78TH ST SW
87TH AV SW
83RD AV SW
PHILLIPS RD SW
BRIDGEPORT WY W
JOHN DOWER RD W
JOHN DOWER RD SW
CUSTER RD W
CUSTER RD SW
74TH ST W
75TH ST W
LAKEWOOD DR W
FLETT CREEK
88TH ST SW
STEILACOOM BLVD SW
WAUGHOP LAKE
ELWOOD DR SW
HIPKINS RD SW
ANGLE LN SW
WAVERLY DR SW
MEADOW RD SW
WHITMAN AV SW
BRIDGEPORT WY SW
SEELEY LAKE
LAKEWOOD DR SW
101ST ST SW
104TH ST SW
LAKE LOUISE
LAKE LOUISE DR SW
FARWEST DR SW
SHORT LN SW
IDLEWILD RD SW
LAKE STEILACOOM
PONCE DE LEON CREEK
ALFARETTA ST SW
59TH AV SW
100TH ST SW
GRAVELLY LAKE DR SW
MAIN ST SW
108TH ST SW
111TH ST SW
112TH ST SW
MILITARY RD SW
HOLDEN RD SW
BUTTE DR SW
HUGGINS MEYERS RD SW
CARP LAKE
INTERLAAKEN DR SW
WASHINGTON BLVD SW
NORTH GATE RD SW
VERNON AV SW
VETERANS DR SW
GRAVELLY LAKE
NYANZA RD SW
PACIFIC HWY SW
I5 HWY N
CLOVER CREEK
NEW YORK AV SW
MCCHORD DR SW
AMERICAN LAKE
I5 HWY S
NORTH THORNE LN SW
PORTLAND AV SW
UNION AV SW
MURRAY RD SW
EVERGREEN DR

DRAFT

City of Lakewood Shoreline Master Program
Figure 16: Structure Setbacks

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- City Boundary
- Proposed Shoreline Management Area
- Water Body
- Surrounding Jurisdictions
- Structures < 30' from water
- Sturctures 30-49' from water
- Structures 50 - 69' from water
- Structures 70 - 99' from water
- Structures > 100' from water

City of Lakewood Washington

AHBL

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Source: City of Lakewood

Map created: March 22, 2010

Figure 16

University Place
Pierce County
Tacoma
Steilacoom
Fort Lewis
McChord AFB
CHAMBERS CREEK
CHAMBERS BAY
GARRISON SPRINGS
ZIRCON DR SW
ONYX DR SW
91ST AV SW
78TH ST SW
87TH AV SW
83RD AV SW
PHILLIPS RD SW
BRIDGEPORT WY W
JOHN DOWER RD W
CUSTER RD W
74TH ST W
75TH ST W
LAKEWOOD DR W
FLETT CREEK
CUSTER RD SW
JOHN DOWER RD SW
88TH ST SW
STEILACOOM BLVD SW
WHITMAN AV SW
MEADOW RD SW
WAVERLY DR SW
HIPKINS RD SW
ELWOOD DR SW
ANGLE LN SW
WAUGHOP LAKE
SEELEY LAKE
BRIDGEPORT WY SW
LAKEWOOD DR SW
100TH ST SW
101ST ST SW
ALFARETTA ST SW
59TH AV SW
LAKE STEILACOOM
SHORT LN SW
104TH ST SW
LAKE LOUISE
LAKELOUISE DR SW
FARWEST DR SW
PONCE DE LEON CREEK
GRAVELLY LAKE DR SW
MAIN ST SW
LAKEVIEW AV SW
108TH ST SW
IDLEWILD RD SW
BUTTE DR SW
112TH ST SW
111TH ST SW
HUGGINS MEYERS RD SW
83RD AV SW
INTERLAAKEN DR SW
HOLDEN RD SW
MILITARY RD SW
CARP LAKE
GRAVELLY LAKE
NYANZA RD SW
WASHINGTON BLVD SW
NORTH GATE RD SW
VERNON AV SW
VETERANS DR SW
HILLCREST DR SW
PACIFIC HWY SW
I5 HWY S
I5 HWY N
CLOVER CREEK
NEW YORK AV SW
MCCHORD DR SW
AMERICAN LAKE
NORTH THORNE LN SW
PORTLAND AV SW
UNION AV SW
MURRAY RD SW
EVERGREEN DR

DRAFT

N
W
E
S

University Place
Tacoma
Lakewood
Steilacoom
Pierce County
I-5
McChord AFB
Fort Lewis

City of Lakewood Shoreline Master Program
Figure 17:
Potentially Vacant And Subdividable Properties

Legend

- Interstate
- Principal Arterial
- Minor Arterial
- Collector
- Local
- Stream
- Proposed Shoreline Management Area
- City Boundary
- Water Body
- Vacant
- Vacant and Potentially Subdividable

Potentially Subdividable

- Determined on a case by case basis

City of Lakewood
AHBL

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Source: City of Lakewood

Map created: March 22, 2010

Figure 17