PLANNING COMMISSION
REGULAR MEETING AGENDA

CALL TO ORDER & ROLL CALL  7:30 PM

APPEARANCES
This is the time set aside for members of the public to speak to the Commission about issues of concern (other than items scheduled for an open record hearing). If you wish to speak, please consider the following points:
  - Speak audibly into the podium microphone
  - State your name and address for the record
  - Limit your comments to three minutes
(Note: The Commission may limit the number of speakers and modify the time allotted. Total time for appearances: 15 minutes)

APPROVAL OF MINUTES  Minutes from April 21, 2010

REGULAR BUSINESS  7:45 PM
Agenda Item #1
Open Record Hearing for a Zoning Text Amendment (file# ZTR10-001) for a proposed amendment to existing regulations related to the City of Mercer Island Shoreline Master Program.

OTHER BUSINESS  Council Liaison Report
  - Staff Comments
  - Planned Absences for Future Meetings
  - Announcements & Communications
  - Next Regular Meeting:  May 19, 2010

ADJOURN

AGENDA TIMES ARE APPROXIMATE
CALL TO ORDER:
Chair Adam Cooper called the meeting to order at 7:36 PM in the Council Chambers, at 9611 SE 36th Street, Mercer Island, Washington.

ROLL CALL:
Chair Adam Cooper, Vice-Chair Eric Laschever, Commissioners Bryan Cairns, Jon Friedman, Steve Marshall, and Craig Olson were present. Commissioner Kristen White was excused. Council Liaison El Jahncke was present. City staff was represented by Shane Moloney, Assistant City Attorney; George Steirer, Principal Planner; and Travis Saunders, Planner.

APPEARANCES:
Robert Thorpe of 5800 West Mercer Way provided comment regarding the Shoreline Master Program update.

Ellie Ziegler, Sound Transit, 401 South Jackson Street, Seattle, WA 98104 provided comment regarding the Shoreline Master Program update.

David Douglas, Integrity Shoreline Permitting, 818 Mill Avenue, Snohomish, WA 98290 provided comment regarding the Shoreline Master Program update.

MINUTES:
Commissioner Laschever motioned to approve the minutes from March 17, 2010. Commissioner Cairns seconded the motion. The Commission unanimously approved the minutes as written.

REGULAR BUSINESS:
Agenda Item #1: Shoreline Master Program Update – Review of requested revisions to shoreline language in MICC 19.07, Shoreline Master Program Cumulative Impacts Analysis, and Restoration Plan.

Travis Saunders, Planner, provided a staff presentation.

The Commission approved the edits to exhibits provided in the Commission packet, directing staff to add I-90 bridges to the definition of Water-Dependent, and to identify additional restoration opportunities within city owned parks to be included in the Shoreline Restoration Plan.

The Commission directed staff to invite Dr. Gilbert Pauley to speak during the public testimony at the Open Record Hearing scheduled for May 5th on the Shoreline Master Program update and to provide the transcript from a recent City of Bellevue meeting, at which Dr. Pauley presented.
COUNCIL LIAISON REPORT:
The Council reviewed the Pedestrian and Bicycles Facility Plan at its April 19, 2010 meeting.

STAFF COMMENTS:
The Shoreline Master Program Public Hearing will be held on May 5, 2010. Code Text Amendments to MICC Chapter 19, Unified Land Code will come before the Commission on May 19, 2010.

PLANNED ABSENCES FOR FUTURE MEETINGS:
Commissioner Cairns will be absent on May 19, 2010

ANNOUNCEMENTS AND COMMUNICATIONS:
None

NEXT REGULAR MEETING:
The next Planning Commission meeting is scheduled for May 5, 2010, which will be an open record meeting on the draft ordinance to update the City’s SMP.

ADJOURNMENT:
The Planning Commission meeting was adjourned at 8:39 PM.

Respectfully submitted by Travis Saunders, Planner
Memorandum

To: City of Mercer Island Planning Commission and Deputy Mayor Jahncke
From: Travis Saunders, Planner
Re: May 5, 2010 Shoreline Master Program (SMP) Update Open Record
    Public Hearing
Date: April 29, 2010

The enclosed Planning Commission packet contains the following agenda items:

Agenda item 1 – Open Record Public Hearing for a Zoning Text Amendment (file #ZTR10-001) for a proposed amendment to existing regulations related to the City of Mercer Island Shoreline Master Program:
This evening’s Hearing is a key step in the process to update the City’s existing Shoreline Master Program (SMP), as mandated by the State Legislature in 2003. The mandate calls for changes in regulations that affect items such as docks, bulkheads, and building setbacks from Lake Washington. In Mercer Island, the draft SMP would apply from the middle of Lake Washington to land that extends 200 feet landward from the edge of the lake.
For the past year, following a public open house, the City of Mercer Island Planning Commission has been conducting public meetings to develop an updated SMP. After a public open house and seventeen Planning Commission meetings to review the State Guidelines, scientific information, and regular comment by the public, the Planning Commission is holding an Open Record Public Hearing to solicit public comments in response to the initial draft SMP ordinance. After the Hearing, and potential changes, the Planning Commission will recommend a draft SMP to the City Council for review and approval. The final review and approval will be by the Washington State Department of Ecology.

Exhibit 1 in the enclosed packet is a copy of the Draft Shoreline Master Program, shown in an ordinance format. (Exhibit 1 contains two exhibits: Exhibit A – Proposed Shoreline Environment Designations Map; Exhibit B – Comprehensive Plan Shoreline Element Goals and Policies.) The draft contains edits requested by the Commission over the course of the past year. (Black text represents existing code. Red text is language approved or deleted by the Commission.)

Exhibit 2 in the packet is a copy of the Draft Cumulative Impacts Analysis, which is required by WAC 173-26-201(3)(d)(iii) as demonstration that the City’s regulation of development will achieve no net loss of ecological functions.
Exhibit 3 in the packet is a copy of the Draft Restoration Plan, which is required by WAC 173-26-201(2)(f) in order to identify existing and ongoing projects and programs that are designed to contribute to local shoreline restoration goals.

Exhibit 4 in the packet is the State Environmental Policy Act Determination of Non-Significance for ZTR10-001, file SEP10-002, issued on March 15, 2010.

Exhibit 5 in the packet contains public comments received during the 14-day comment period for ZTR10-001, which ran from February 22, 2010 through March 10, 2010; and comments received following the Notice of Public Hearing, which was issued on April 21, 2010. (Please note: The packet only contains those comments received by the date of packet production, which was April 29, 2010.)

Should you have questions regarding the materials or the update process, feel free to contact me via email at travis.saunders@mercergov.org or via telephone at 206-275-7717.
CITY OF MERCER ISLAND
ORDINANCE NO. 10C-XX

AN ORDINANCE OF THE CITY OF MERCER ISLAND, WASHINGTON
ADOPTING THE MERCER ISLAND SHORELINE MASTER PROGRAM
UPDATE; AMENDING THE SHORELINE ELEMENT IN THE MERCER
ISLAND COMPREHENSIVE PLAN; AMENDING THE SHORELINE
DESIGNATION MAP; ADOPTING AND AMENDING SHORELINE
DEFINITIONS IN CHAPTER 19.16 OF THE MERCER ISLAND UNIFIED
LAND DEVELOPMENT CODE; AMENDING DEVELOPMENT
REGULATIONS RELATING TO SHORELINES IN TITLES 19.07.100
AND 19.07.110 OF THE MERCER ISLAND UNIFIED LAND
DEVELOPMENT CODE; PROVIDING FOR SEVERABILITY AND
ESTABLISHING AN EFFECTIVE DATE.

WHEREAS, the Washington Shoreline Management Act (RCW 90.58, referred to herein as
“SMA”) recognizes that shorelines are among the most valuable and fragile resources of the
state, and that the state and local government must establish a coordinated planning program to
address the types and effects of development occurring along shorelines of state-wide
significance; and

WHEREAS, the City of Mercer Island (“City”) is required to update its Shoreline Master
Program (“SMP”) pursuant to the SMA and WAC 173-26; and

WHEREAS, on July 20, 2009, the City submitted a Final Shoreline Analysis Report to the
Washington State Department of Ecology (“DOE”), which is an inventory and characterization
of the City’s shorelines to assess ecological functions and ecosystem-wide processes operating
within the City’s shoreline jurisdictions and to serve as a baseline from which future
development actions in the shoreline jurisdiction will be measured; and

WHEREAS, there has been extensive public participation opportunities with respect to the SMP
update, including but not limited to a public open house, and public meetings.

WHEREAS, on March 8, 2010, the City’s Responsible Official reviewed the proposed
amendments to Chapters 19.07.100, 19.07.110, and 19.16 and the Shoreline Element of the
Comprehensive Plan, and under the provisions of the State Environmental Policy Act (SEPA),
issued a Determination of Non-Significance; and

WHEREAS, the Mercer Island Planning Commission, after numerous meetings and a public
hearing, recommended approval of the SMP update at its April 7, 2010 meeting; and

WHEREAS, the Mercer Island City Council considered the SMP at its Regular Meeting of
________ _____, 2010, and Regular Meeting of _________ _____, 2010; and
WHEREAS, the Mercer Island City Council did conclude that the SMP will result in “no net loss” in shoreline ecological function relative to the baseline due to implementation and will ultimately produce a net improvement in shoreline ecological function; and

WHEREAS, on “MONTH DAY YEAR”, the Mercer Island City Council concludes that the SMP is consistent with and meets the guidelines established under WAC Chapter 173.26; and

WHEREAS, the Mercer Island City Council concludes that the SMP is consistent with and implements Shoreline Management Act (RCW 90.58 and the Growth Management Act (RCW 36.70; and

WHEREAS, the Washington State Department of Ecology is authorized under the SMA to approve, deny or propose modifications to the City’s SMP; and

WHEREAS, after considering all public testimony and written comments, the City Council adopts the following Ordinance.

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF MERCER ISLAND, WASHINGTON DOES HEREBY ORDAIN AS FOLLOWS:

Section 1: Amendments to 19.07.100 MICC, Shoreline Areas. MICC 19.07.100  
“Shoreline Areas” is hereby amended as follows:

Shorelands directly impact water quality as surface and subsurface waters are filtered back into the lake. Additionally, shorelines are a valuable fish habitat area characterized by lake bottom conditions, erosion tendencies, and the proximity to watercourse outfalls. These may combine to provide a suitable environment for spawning fish.

A. Critical Areas Delineations.
   1. A survey to determine the line of ordinary high water (OHW) shall be current to within one year of the application for single lots, short subdivisions, long subdivisions, or lot line revisions.
   2. The survey may be included in the site construction plan (see MICC 19.07.060, Reports and Surveys) or waived by city staff if the OHW has been delineated by an existing bulkhead.
   3. Mark the shoreline setback on the site prior to the preconstruction meeting.

B. Site Development.
   1. A 25-foot setback from OHW is required.
   2. If a wetland is adjacent to the shoreline, measure the shoreline setback from the wetland’s boundary.
   3. 25% of the 20 feet closest to the OHW shall contain vegetation coverage. The five feet nearest the OHW shall contain at least 25% native coverage. A shoreline vegetation plan shall be submitted to the City for approval. A variety of ground cover, shrubs, and trees that provides lake shading is encouraged.
C. Site Coverage. The amount of impervious surfaces which will be permitted is as follows:

<table>
<thead>
<tr>
<th>Distance from OHW</th>
<th>Impervious Surface Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 25 feet</td>
<td>10% – No building(s) allowed</td>
</tr>
<tr>
<td>26 – 50 feet</td>
<td>30% – Structure(s) allowed</td>
</tr>
</tbody>
</table>

D. Storm Water and Erosion Control. Erosion control devices shall be installed along the boundaries of the shoreland setback following the preconstruction meeting and prior to clearing or grading.

E. Alteration. Any alteration in this area requires either: (1) a shoreline exemption or (2) a substantial development permit, a building/grading permit, and storm water permit. Some development or alteration may also require a conditional use permit. (Ord. 08C-01 § 3; Ord. 05C-12 § 6; Ord. 02C-09 § 6; Ord. 99C-13 § 1. Formerly 19.07.050).

Section 2: Amendments to 19.07.110 MICC, Shoreline Management Master Program. MICC 19.07.110 “Shoreline Management Master Program” is hereby amended as follows:

A. General Information.
  1. Introduction and Purpose. The Washington State Legislature enacted the Shoreline Management Act (SMA) of 1971 (Chapter 90.58 RCW) to provide a uniform set of rules governing the development and management of shoreline areas. As a basis for the policies of the
SMA, the Legislature incorporated findings that “the shorelines are among the most valuable and fragile” of the state’s resources, that they are under “ever increasing pressure of additional uses” and that “unrestricted construction on the privately or publicly owned shorelines of the state is not in the best public interest.” The Legislature further finds that “coordinated planning is necessary in order to protect the public interest associated with the shorelines of the state, while, at the same time, recognizing and protecting private property rights consistent with the public interest.”

The SMA sets up a process for managing development of the state’s shorelines through state-monitored, locally administered permitting program. Local governments are required to prepare shoreline master programs to manage shoreline development within their jurisdiction. The SMA specifies that each local shoreline master program includes goals and policies that take into account the specific local conditions influencing the shoreline jurisdiction.

The purpose of the shoreline master program is to implement the Shoreline Management Act of 1971 and to establish regulations for development based on the local shoreline goals and policies.

a. The shoreline master program specifies boundaries of a shoreline jurisdiction and shoreline designated environments;

b. The shoreline master program establishes regulations for development within the shoreline jurisdiction;

c. The shoreline master program specifies requirements for public participation in decisions about shoreline development.

2. Shoreline Jurisdiction. The shoreline jurisdiction is geographically defined as:

a. All lands extending landward 200 feet in all directions as measured on a horizontal plane from the ordinary high water mark and all associated shorelands (RCW 90.58.030).

b. All lands under Lake Washington extending waterward to the line of navigability/inner harbor line as established in 1984 by the Board of natural Resources No. 461, middle of Lake Washington, pursuant to RCW 35.21.160

The following illustration shows the applicability of the shoreline master program jurisdiction:
3. Applicability. The regulations and procedures of the shoreline master program apply to all development within the shoreline jurisdiction of the city including the waters and
underlying land of Lake Washington and to the shoreline uses established within the shoreline designated environments.

4. Adoption Authority. The regulations contained in MICC 19.07.080 within the Shoreline Master Program are hereby adopted as the shoreline master program for the City of Mercer Island. These regulations are adopted under the authority of the Chapter 90.58 RCW and Chapter 173-1626 WAC.

5. Relationship to Land Use Code and Other Ordinances.
   a. The shoreline master program regulations are supplemental to the city of Mercer Island comprehensive plan, the Mercer Island development code and various other provisions of city, state and federal laws. Applicants must comply with all applicable laws prior to commencing any use, activity, or development.
   b. The shoreline jurisdiction and the shoreline designated environments are superimposed upon the existing zoning classifications. The zoning regulations specified in the development code and this section are intended to operate together to produce coherent and thorough regulations. All uses, activities and developments must comply with both the Mercer Island development code and shoreline master program. If there is a conflict between the two, the more restrictive regulation applies.

6. Shoreline Master Program Goals and Policies. In 1974 the city of Mercer Island adopted shoreline goals and policies. These goals and policies are consistent with the city’s comprehensive plan adopted in 1993. The goals and policies contained within the City’s Comprehensive Plan Shoreline Chapter shall constitute Mercer Island’s Shoreline Master Program goals and policies.

7. Shoreline Master Program Regulations. The following regulations shall constitute the City of Mercer Island shoreline development regulations:
   a. MICC 19.07.100, Shoreline Areas
   b. MICC 19.07.110, Shoreline Master Program
   c. MICC 19.07, Critical Areas (Ord. No. 05C-12)
   d. MICC 15.09, Storm Water Management Program
   e. Definitions – Those specific to shorelines shall have the meaning ascribed to them below. Terms not defined in this section shall be defined as set forth in MICC 19.16

   **Boat Lift**: A structure or device used to raise a watercraft above the waterline for secure moorage purposes.
   **Boat Ramp**: An inclined structure upon which a watercraft is raised or pulled onto land or a dock.
   **Breakwater**: A protective structure usually built offshore for the purpose of protecting the shoreline or harbor areas from wave action.
   **Bulkhead**: A solid or open pile of rock, concrete, steel, timber or other materials erected parallel to, and normally erected at, the ordinary high water line for the purpose of protecting adjacent property from waves or currents.
   **Covered Moorage**: A pier, dock, boatlift, series of piles, or other structure intended for moorage over which a roof or canopy is erected.
   **Ecological functions or shoreline functions**: means the work performed or role played by the physical, chemical, and biological processes that contribute to the maintenance of the aquatic and terrestrial environments that constitute the shoreline’s natural ecosystem.
Ecosystem-wide processes: means the suite of naturally occurring physical and geologic processes of erosion, transport, and deposition; and specific chemical processes that shape landforms within a specific shoreline ecosystem and determine both the types of habitat and the associated ecological functions.

Feasible: means an action, such as a development project, mitigation, or preservation requirement, meets all of the following conditions: (a) The action can be accomplished with technologies and methods that have been used in the past in similar circumstances, or studies or tests have demonstrated in similar circumstances that such approaches are currently available and likely to achieve the intended results; (b) The action provides a reasonable likelihood of achieving its intended purpose; and (c) The action does not physically preclude achieving the project's primary intended legal use. In cases where these guidelines require certain actions unless they are infeasible, the burden of proving infeasibility is on the applicant. In determining an action's infeasibility, the reviewing agency may weigh the action's relative public costs and public benefits, considered in the short- and long-term time frames.

Fill: means the addition of soil, sand, rock, gravel, sediment, earth retaining structure, or other material to an area waterward of the OHWM, in wetlands, or on shorelands in a manner that raises the elevation or creates dry land.

Finger Pier: An extension from a dock used to create moorage slips.

Floating Platform: A flat structure or device moored or anchored, not permanently secured by piles, which floats upon the water.

Geotechnical report or geotechnical analysis: means a scientific study or evaluation conducted by a qualified expert that includes a description of the ground and surface hydrology and geology, the affected land form and its susceptibility to mass wasting, erosion, and other geologic hazards or processes, conclusions and recommendations regarding the effect of the proposed development on geologic conditions, the adequacy of the site to be developed, the Washington State Shoreline Master Program Guidelines, Chapter 173-26 WAC 96 of 100 Washington State Shoreline Master Program Guidelines, Chapter 173-26 WAC 97 of 100 impacts of the proposed development, alternative approaches to the proposed development, and measures to mitigate potential site-specific and cumulative geological and hydrological impacts of the proposed development, including the potential adverse impacts to adjacent and down-current properties. Geotechnical reports shall conform to accepted technical standards and must be prepared by qualified professional engineers or geologists who have professional expertise about the regional and local shoreline geology and processes.

Groin: A structure used to interrupt sediment movement along the shore.

Jetty: A barrier used to protect areas from accumulations of excess sediment.

Landward: Any point located inland from the ordinary high water mark.

Lateral Line: The extension waterward of a property line into Lake Washington beyond the ordinary high water mark. How property lines extend waterward from the ordinary high water mark is an area of misconception. If the title does not clearly state the location of the property lines waterward from the ordinary high water mark, waterfront owners are not allowed to unilaterally project the upland boundaries out into the shorelands (waterward). There are no statutes defining the direction of the lateral lines waterward from the ordinary high water mark. The Supreme Court has the final word to decide location of lateral line on case-by-case basis.

Light Rail Transit Facilities: A public rail transit line, including all ancillary facilities such as transit power substations, that operates at grade level, above grade level, on a bridge or in a tunnel and that provides high capacity, regional transit service owned or operated by a regional
transit authority authorized under Chapter 81.112 RCW. A regional light rail transit system will be designed to cross I-90 right-of-way.

Marina: A commercial basin providing rental or sale of docks, watercraft, moorage, and/or supplies. Casual single-family renting of moorage is excluded from this definition.

May: means the action is acceptable, provided it conforms to the provisions of this chapter.

Mean Low Water: The level of Lake Washington during the fall and winter when the water level is lowered to minimize winter storm damage to lakeside properties. Mean low water is one and one-half feet lower than ordinary high water.

Moorage Facility: Any device or structure used to secure a boat or a vessel, including piers, docks, piles, lift stations or buoys.

Must: means a mandate; the action is required.

Nonwater-oriented uses: means those uses that are not water-dependent, water-related, or water-enjoyment.

Normal maintenance or repair of existing structures or developments, including damage by accident, fire or elements. "Normal maintenance" includes those usual acts to prevent a decline, lapse, or cessation from a lawfully established condition. "Normal repair" means to restore a development to a state comparable to its original condition, including but not limited to its size, shape, configuration, location and external appearance, within a reasonable period after decay or partial destruction, except where repair causes substantial adverse effects to shoreline resource or environment. Replacement of a structure or development may be authorized as repair where such replacement is the common method of repair for the type of structure or development and the replacement structure or development is comparable to the original structure or development including but not limited to its size, shape, configuration, location and external appearance and the replacement does not cause substantial adverse effects to shoreline resources or environment.

Ordinary High Water (OHW): The point on the shore that will be found by examining the bed and banks and ascertaining where the presence and action of waters are so common and usual, and so long continued in all ordinary years, as to mark upon the soil a character distinct from that of the abutting upland, in respect to vegetation as that condition exists on June 1, 1971, as it may naturally change thereafter in accordance with permits issued by a local government or the department.

Personal Watercraft (PWC) Lift: A structure or device used to raise a personal watercraft such as a jet-ski or wave runner above the water line for secure moorage purposes.

Public Access: A means of physical approach to and along the shoreline, or other area, available to the general public. Public access may also include visual approach.

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.

Shall: means a mandate; the action must be done.

Shoreline areas and shoreline jurisdiction: means all shorelines of the state and shorelands as defined in RCW 90.58.030.

Shoreline master program or master program: means the comprehensive use plan for a described area, and the use regulations together with maps, diagrams, charts, or other descriptive material and text, a statement of desired goals, and standards developed in accordance with the policies enunciated in RCW 90.58.020. As provided in RCW 36.70A.480, the goals and policies
of a shoreline master program for a county or city approved under chapter 90.58 RCW shall be considered an element of the county or city's comprehensive plan. All other portions of the shoreline master program for a county or city adopted under chapter 90.58 RCW, including use regulations, shall be considered a part of the county or city's development regulations.

Shoreline modifications: means those actions that modify the physical configuration or qualities of the shoreline area, usually through the construction of a physical element such as a dike, breakwater, pier, weir, dredged basin, fill, bulkhead, or other shoreline structure. They can include other actions, such as clearing, grading, or application of chemicals.

Should: means that the particular action is required unless there is a demonstrated, compelling reason, based on policy of the Shoreline Management Act and this chapter, against taking the action.

Water-Dependent: A use or a portion of a use which cannot exist in any other location and is dependent on the water by reason of the intrinsic nature of its operations. Examples of water-dependent uses may include ship cargo terminal loading areas, ferry and passenger terminals, the I-90 bridges, barge loading facilities, ship building and dry docking, marinas, aquaculture, float plane facilities and sewer outfalls.

Water-enjoyment use: means a recreational use or other use that facilitates public access to the shoreline as a primary characteristic of the use; or a use that provides for recreational use or aesthetic enjoyment of the shoreline for a substantial number of people as a general characteristic of the use and which through location, design, and operation ensures the public's ability to enjoy the physical and aesthetic qualities of the shoreline. In order to qualify as a water-enjoyment use, the use must be open to the general public and the shoreline-oriented space within the project must be devoted to the specific aspects of the use that fosters shoreline enjoyment.

Water-oriented use: means a use that is water-dependent, water-related, or water-enjoyment, or a combination of such uses.

Water-related use: means a use or portion of a use which is not intrinsically dependent on a waterfront location but whose economic viability is dependent upon a waterfront location because: (a) The use has a functional requirement for a waterfront location such as the arrival or shipment of materials by water or the need for large quantities of water; or (b) The use provides a necessary service supportive of the water-dependent uses and the proximity of the use to its customers makes its services less expensive and/or more convenient. Washington State Shoreline Master Program Guidelines, Chapter 173-26 WAC 100 of 100.

Waterfront Structure: Docks, piers, wharves, floats, mooring piles, anchor buoys, bulkheads, bridges, submerged or overhead wires, pipes, cables, and any other object passing beneath, through or over the water beyond the line of ordinary high water.

Waterward: Any point located in Lake Washington, lakeward from the ordinary high water mark.

B. Shoreline Designated Environments.

1. Designated Environments. Different areas of the city’s shoreline have different natural characteristics and development patterns. As a result, three two shoreline designated environments are established to regulate developments and uses consistent with the specific conditions of the designated environments and to protect resources of the Mercer Island shoreline jurisdiction. They are:

   a. Conservancy Environment. This environment constitutes large undeveloped areas with some natural constraints such as wetland conditions, containing a variety of flora and fauna. The
The purpose of this environment is to protect and manage the existing natural resources in order to achieve sustained resource utilization and provide recreational opportunities.

b. Urban Park. This environment consists of shoreline areas designated for public access and active and passive public recreation. It includes, but is not limited to, street ends, public utilities and other publicly owned rights-of-way. The uses located in this environment should be water-dependent and designed to maintain the natural character of the shorelines.

eb. Urban Residential. The purpose of this environment is to provide for residential and recreational utilization of the shorelines, compatible with the existing residential character in terms of bulk, scale and type of development.

2. Shoreline Environment Map. The map in Appendix F of this development code is the official map of the city designating the various shoreline environments and the shoreline jurisdiction within the city.

3. Permit Requirements for Shoreline Uses and Development within the Designated Environments. All proposed development within the shoreline jurisdiction shall be consistent with the regulations of this Shoreline Master Program, the Shoreline Management Act of 1971 and the Mercer Island development code. In addition all development shall conform to permit requirements of all other agencies having jurisdiction within the designated environments.

The following table specifies the shoreline uses and developments which may take place or be conducted within the designated environments. It also specifies the type of shoreline permit required and further states the necessary reviews under the State Environmental Policy Act (SEPA). The uses and developments listed in the matrix are allowed only if they are not in conflict with more restrictive regulations of the Mercer Island development code and are in compliance with the regulations specified in subsection D of this section.

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE</td>
<td>Categorically Exempt</td>
</tr>
<tr>
<td>SEP</td>
<td>Shoreline Exemption Permit</td>
</tr>
<tr>
<td>SDP</td>
<td>Substantial Development Permit</td>
</tr>
<tr>
<td>SEPA</td>
<td>Required Review under the State Environmental Policy Act</td>
</tr>
<tr>
<td>NP</td>
<td>Not Permitted Use</td>
</tr>
</tbody>
</table>

The regulations of the shoreline master program apply to all shoreline uses and development, whether or not that development is exempt from the permit requirements (CE, SEP, or SDP).

<table>
<thead>
<tr>
<th>Designated Environments</th>
<th>Shoreline Use</th>
<th>Urban Park Environment</th>
<th>Urban Residential Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-family residential and associated appurtenances</td>
<td>NP</td>
<td>NP</td>
<td>CE or SDP if the construction is not by an owner, lessee or contract purchaser for his/her own use or if</td>
</tr>
<tr>
<td>Use</td>
<td>NP</td>
<td>SDP, SEPA</td>
<td>SDP, SEPA</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------</td>
<td>-----------</td>
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</tr>
<tr>
<td>Multifamily residential</td>
<td>NP</td>
<td>NP</td>
<td>SDP, SEPA</td>
</tr>
<tr>
<td>Public and private recreational facilities and parks</td>
<td>SDP, SEPA</td>
<td>SDP, SEPA</td>
<td>SDP, SEPA</td>
</tr>
<tr>
<td>Moorage facilities (including piers, docks, piles, lift stations, or</td>
<td>SDP, SEPA</td>
<td>SDP, SEPA</td>
<td>SDP, SEPA</td>
</tr>
<tr>
<td>buoys)</td>
<td></td>
<td></td>
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<tr>
<td>Commercial marinas, moorage and storage of commercial boats and</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td>ships</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Bulkheads and shoreline protective structures</td>
<td>SDP, SEPA</td>
<td>SDP, SEPA</td>
<td>SEP, SEPA</td>
</tr>
<tr>
<td>Breakwaters and jetties</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td>Utilities</td>
<td>SDP, SEPA</td>
<td>SDP, SEPA</td>
<td>CE, SEP or SDP, SEPA</td>
</tr>
<tr>
<td>Dredging</td>
<td>SDP, SEPA</td>
<td>SDP, SEPA</td>
<td>SDP, SEPA</td>
</tr>
<tr>
<td>Alterations over 250 cubic yards – outside the building footprint</td>
<td>SDP, SEPA</td>
<td>SDP, SEPA</td>
<td>SDP, SEPA</td>
</tr>
<tr>
<td>Boating Facilities</td>
<td>SDP, SEPA</td>
<td>SDP, SEPA</td>
<td></td>
</tr>
<tr>
<td>Transportation and Parking Facilities</td>
<td>SDP, SEPA</td>
<td>SDP, SEPA</td>
<td></td>
</tr>
<tr>
<td>Light Rail Transit Facilities</td>
<td>SDP, SEPA</td>
<td>SDP, SEPA</td>
<td></td>
</tr>
</tbody>
</table>

If a use is not listed in this matrix, it shall be considered as a conditional use, pursuant to WAC 173-26-160.

C. Administration and Procedures.
   1. Administrative Responsibility. Except as otherwise stated in this section, the code official is responsible for:
      a. Administering the shoreline master program.
      b. Approving, approving with conditions or denying shoreline exemption permit, substantial development permits, variances and permit revisions in accordance with the provisions of this shoreline master program.
      c. Determining compliance with Chapter 43.21C RCW, State Environmental Policy Act.
2. Permits and Decisions. No development shall be undertaken within the shoreline jurisdiction without first obtaining a permit in accordance with the procedures established in the shoreline master program. In addition such permit shall be in compliance with permit requirements of all other agencies having jurisdiction within the shoreline designated environment.

a. Shoreline Exemption Permit. A shoreline exemption permit (SEP) may be granted to the following development as long as such development is in compliance with all applicable requirements of this shoreline master program, the city of Mercer Island development code and WAC 173-27-040:

i. Any development of which the total cost or fair market value, whichever is higher, does not exceed $5,718 or as periodically revised by the Washington State Office of Financial Management, if such development does not materially interfere with the normal public use of the water or shorelines of the state;

ii. Normal maintenance or repair of existing structures or developments, including damage by accident, fire or elements. “Normal maintenance” includes those usual acts established to prevent a decline, lapse, or cessation from a lawfully established condition. “Normal repair” means to restore a development to a state comparable to its original condition within a reasonable period after decay or partial destruction except where repair involves total replacement which is not common practice or causes substantial adverse effects to the shoreline resource or environment. Normal maintenance of single-family dwellings is categorically exempt as stated above;

iii. Construction of the normal protective bulkhead common to single-family dwellings. A “normal protective” bulkhead is constructed at or near the ordinary high water mark to protect a single-family dwelling and is for protecting land from erosion, not for the purpose of creating land. Where an existing bulkhead is being replaced, it shall be constructed no further waterward of the existing bulkhead than is necessary for construction of new footings;

iv. Emergency construction necessary to protect property from damage by the elements. An “emergency” is an unanticipated and imminent threat to public health, safety, or the environment which requires immediate action within a time too short to allow full compliance with this section;

v. Construction or modification of navigational aids such as channel markers and anchor buoys;

vi. Construction of a dock, designed for pleasure craft only, for the private noncommercial use of the owners, lessee, or contract purchaser of a single-family dwelling, for which the cost or fair market value, whichever is higher, does not exceed $10,000;

vii. Any project with a certification from the governor pursuant to Chapter 80.50 RCW.

If a development is exempt from the requirements of the substantial development permit, but a deviation or variance from the provisions of the shoreline master program is required, the applicant must request said deviation or variance through the procedures established in this section.

b. Substantial Development Permit. A substantial development permit (SDP) is required for any development within a shoreline jurisdiction not covered under a categorical exemption or shoreline exemption permit. Requirements and procedures for securing a substantial development permit are established below. Compliance with all applicable federal and state regulations is also required.
c. Deviations and Deviation Criteria. The city planning commission shall have the authority to grant deviations from the regulations specified in Table B in subsection D of this section; provided, the proposed deviation:
   i. Will not constitute a hazard to the public health, welfare, and safety, or be injurious to affected shoreline properties in the vicinity;
   ii. Will not compromise a reasonable interest of the adjacent property owners;
   iii. Is necessary to the reasonable enjoyment of property rights of the applicant; and
   iv. Is not in conflict with the general intent and purpose of the SMA, the shoreline master program and the development code.

d. Variances and Variance Criteria. Variances to the shoreline master program requirements are only granted in circumstances where denial of the permit would result in a thwarting of the policy enumerated in RCW 90.58.020. In addition, in all instances the applicant for a variance shall demonstrate strict compliance with all variance criteria set out in MICC 19.15.020(G)(4) and the following additional criteria:
   i. In the granting of all variance permits, consideration shall be given to the cumulative impact of additional request for like actions in the area. For example if variances were granted to other developments in the area where similar circumstances exist the total of the variances shall also remain consistent with the policies of RCW 90.58.020 and shall not produce substantial adverse effects to the shoreline environment.
   ii. Variance permits for development that will be located landward of the ordinary high water mark may be authorized; provided, the applicant can demonstrate all of the following:
      (a) That the strict application of the bulk, dimensional or performance standards set forth in the applicable master program precludes or significantly interferes with reasonable use of the property not otherwise prohibited by the master program;
      (b) That the hardship in subsection (C)(2)(d)(ii)(a) of this section is specifically related to the property, and is the result of unique conditions such as irregular lot shape, size, or natural features and the application of the master program, and not, for example, from deed restrictions or the applicant’s own actions;
      (c) That the design of the project is compatible with other permitted activities in the area and will not cause adverse effects to adjacent properties or the shoreline environment;
      (d) That the requested variance does not constitute a grant of special privilege not enjoyed by the other properties in the area, and is the minimum necessary to afford relief; and
      (e) That the public interest will suffer no substantial detrimental effect.
   iii. Variance permits for development that will be located waterward of the ordinary high water mark may be authorized; provided, the applicant can demonstrate all of the following:
      (a) That the strict application of the bulk, dimensional or performance standards set forth in the applicable master program precludes reasonable use of the property not otherwise prohibited by the master program;
      (b) That the proposal is consistent with the criteria established under subsections (C)(2)(d)(ii)(b) through (e) of this section; and
      (c) That the public rights of navigation and use of the shorelines will not be adversely affected.

   Step 1. Application.
   The applicant shall arrange a preapplication meeting for all substantial development permits, deviations and variances. Upon completion of the preapplication meeting, a complete application including the required processing fees shall be filed with the city on approved forms to ensure
compliance with development codes and standards. A complete application for the shoreline exemption permit (SEP), substantial development permit (SDP), or variance and SEPA checklist, if applicable, shall be filed with the city on required forms.

SEP Review Process: The city shall issue or deny the SEP within 10 calendar days of receiving the request, or after SEPA review. The city shall then send the SEP to the applicant and the Department of Ecology, pursuant to WAC 173-27-130, and to all other applicable local, state, or federal agencies.

Step 2. Public Notice.
Public notice of an application for a substantial development permit shall be made in accordance with the procedures set forth in MICC 19.15.020; provided, such notice shall be given at least 30 days before the date of final local action.

If an application is not exempt from SEPA and no prior SEPA notice has been given, the city shall publish the SEPA determination and a notice that comments on the SEPA documents may be made during the review of the SDP, deviation and variance application.

Within 30 days of the final publication, posting or mailing of the notice, whichever comes last, any interested person may submit written comments on the proposed application. The city will not make a decision on the permit until after the end of the comment period.

Step 3. Review.
The Shoreline Management Act does not require that public hearing be held on SDP and/or variance application. The technical review of SDP and/or variance must ensure that the proposal complies with the criteria of the shoreline master program, Shoreline Management Act policies and all requirements of the city of Mercer Island development code.

An open record hearing before the planning commission, as set out in MICC 19.15.020(F), shall be conducted on all deviation applications and may be conducted on the SDP or variance application when the following factors exist:
(a) The proposed development has broad public significance; or
(b) Within the 30-day comment period, 10 or more interested citizens file a written request for a public hearing; or
(c) The cost of the proposed development, exclusive of land, will exceed $100,000.

Step 4. Decision.
After the 30-day comment period has ended, the city shall decide whether to approve or deny any SDP, deviation and/or variance application, unless the applicant and any adverse parties agree in writing to an extension of time with a certain date.

The city’s action in approving, approving with conditions, or denying SDP, deviation and/or variance shall be given in writing in the form required by WAC 173-27-120 (or its successor) and mailed to the applicant, all persons who submitted written comments, the Department of Ecology, the Washington State Attorney General, and all other applicable local, state, or federal agencies.

The city’s action in approving, approving with conditions, or denying any SDP and/or deviation is final unless an appeal is filed in accordance with applicable law.

The final decision in approving, approving with conditions, or denying variance is rendered by the Department of Ecology in accordance with WAC 173-27-200, and to all other applicable local, state, or federal agencies.

Step 5. Filing.
The city’s final action in approving, approving with conditions, or denying SDP, deviation and/or variance shall be filed with the Department of Ecology and Washington State Attorney General.


If the SDP and/or variance is approved, the applicant shall not begin construction until after the 21-day review period by the Department of Ecology is over and/or any appeals concluded. The applicant shall also comply with all applicable federal, state and city standards for construction.

4. Time Limits of Permits. The following time limits shall apply to all shoreline exemption, substantial development, deviation and variance permits:
   a. Construction or substantial progress toward construction of a development for which a permit has been granted must be undertaken within two years of the effective date of a shoreline permit. The effective date of a shoreline permit shall be the date of the last action required on the shoreline permit and all other government permits and approvals that authorize the development to proceed, including all administrative and legal actions on any such permit or approval.
   b. A single extension before the end of the time limit, with prior notice to parties of record, for up to one year, based on reasonable factors may be granted.

5. Suspension of Permits. The city may suspend any shoreline exemption, substantial development, deviation and variance permit when the permittee has not complied with the conditions of the permit. Such noncompliance may be considered a public nuisance. The enforcement shall be in conformance with the procedures set forth in MICC 19.15.030, Enforcement.

6. Revisions. When an applicant seeks to revise a SDP, deviation and/or variance permit the requirement of WAC 173-27-100, as amended, shall be met.

D. Use Regulations. All development within the shoreline jurisdiction shall be in compliance with all development requirements specified in this section.

1. Table A. Requirements for Development Located Landward from the OHWM

<table>
<thead>
<tr>
<th>Setbacks for All Structures (Including Fences over 48 Inches High) and Parking</th>
<th>A*</th>
<th>25 feet from the OHWM and all required setbacks of the development code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height Limits for All Structures</td>
<td>B</td>
<td>Shall be the same as height limits specified in the development code but shall not exceed a height of 35 feet above average grade level (WAC 173-27-040); provided that the trackway, overhead wires, support poles, and similar features necessary to operate light rail transit facilities on the I-90 bridges are exempt from these height limits</td>
</tr>
<tr>
<td>Maximum Impervious Surface Coverage</td>
<td>C  D</td>
<td>10%: between 0 – 25 feet from OHWM 30%: between 25 – 50 feet from OHWM</td>
</tr>
<tr>
<td>Minimum Land Area Requirements</td>
<td>E</td>
<td>All semi-private, commercial and noncommercial recreational tracts and areas shall have minimum land area: 200 square feet per family, but not less than 600 square feet, exclusive of driveways or parking areas. Screening of the boundaries with abutting properties and a planning commission approval of a site plan is required</td>
</tr>
</tbody>
</table>

*The letters in this column refer to the Plan View(A) and Section(A) diagrams.*
### 1. Table B. Requirements for Moorage Facilities and Development Located Waterward from the OHWM

| Setbacks for All Moorage Facilities, Covered Moorage, Lift Stations, Boatlifts and Floating Platforms | A* | 10 feet from the lateral line  
35 feet from adjoining moorage structures (except where moorage facility is built pursuant to the agreement between adjoining owners as shown in Figure B below)  
50 feet or 50% of the water frontage of the property, whichever is less, from the common boundary of the subject property urban park or conservation environment |
| Setbacks for Boat Ramps and Other Facilities for Launching Boats by Auto or Hand, Including Parking and Maneuvering Space | B | 25 feet from any adjacent private property line |
| Length or Maximum Distance Waterward from the OHWM for Moorage Facilities, Covered Moorage, Lift Stations, Boatlifts and Floating Platforms | C | Maximum 100 feet, but in cases where water depth is less than 10 feet from the mean low water, length may extend up to 150 feet or to the point where water depth is 10 feet at mean low water, whichever is less |
| Width F | 8 feet; does not apply to boat ramps, lift stations, or floating platforms |
| **Square Footage of Piers/Docks** | | Single ** Waterfront Owner- Maximum 1,000 square feet, including floats  
2 **Waterfront Owners- Maximum 1,150 square feet including floats.  
3 or more **Waterfront Owners- Maximum 1,300 square feet including floats  
**-Must meet minimum water frontage standards |
| **Decking requirements for New Piers/Docks** | | For the construction of new piers/docks, decking shall be constructed of material that provides a minimum of 40% open space. |
| **Height Limits for Piers and Docks** | G | 1.5 feet minimum and 5 feet maximum above the elevation of the OHWM |
| **Height Limits for Walls, Handrails and Storage Containers Located on Piers** | H | 3-3.5 feet above the **decking surface** of the moorage facility dock or pier.  
4 feet above the surface of a dock or pier for ramps and gangways designed to clear span within the 30 feet of the nearshore area. |
| **Height Limits for Mooring Piles, Diving Boards and Diving Platforms** | I | 10 feet above the elevation of the OHWM |
| Height Limits for Light Rail Transit Facilities within the Existing I-90 Corridor | The trackway and overhead wires, support poles, and similar features necessary to operate light rail transit facilities may be erected upon and exceed the height of the existing I-90 bridges |

*The letters in this column refer to the Plan View(B) and Section(B) diagrams.*
<table>
<thead>
<tr>
<th>Minimum Water Frontage for Moorage Facility</th>
<th>J*</th>
<th>K</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-family lots: 40 feet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shared – two adjoining lots: 40 feet combined</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-private recreational tracts:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2 families: 40 feet</td>
<td></td>
<td></td>
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<tr>
<td>3 – 5 families: 40 feet plus 10 feet for each family more than 2</td>
<td></td>
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<tr>
<td>6 – 10 families: 70 feet plus 5 feet for each family more than 5</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>11 – 100 families: 95 feet plus 2 feet for each family more than 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>101+ families: 275 feet plus 1 foot for each family more than 100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Covered Moorage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permitted on single-family residential lots subject to the following:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Maximum height above the OHWM: 20 feet; 20 to 25 feet subject to deviation process (*MICC 19.07.080(C)(2)(d)–MICC 19.07.110(C)(2)(c))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Location/area requirements: See Figure A for single-family lots and Figure B for shared moorage. Outside the triangle subject to deviation process (MICC 19.07.080(C)(2)(d)–MICC 19.07.110(C)(2)(c))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) Building area: 600 square feet. Building areas larger than 600 square feet are subject to conditional use permit within the triangle, or variance outside the triangle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) Covered moorage shall have open sides. Prohibited in semi-private recreational tracts, commercial and noncommercial recreational areas. (e) Translucent canopies are required.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boatlifts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permitted subject to the following:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Minimum distance waterward from the OHWM: 30 feet. This does not apply to personal watercraft lifts.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The letters in this column refer to the Plan View(C).
Table 1: Figure A: Area of Permitted Covered Moorage, Individual Lots
The covered portion of a moorage shall be restricted to the area lying within a triangle. The base of the triangle shall be a line drawn between the points of intersection of the property sidelines with the ordinary high water mark. The location of the covered moorage shall not extend more than 100 feet from the center of the base line of such triangle. In cases where water depth is less than 10 feet from the mean low water, the location of the covered moorage may extend up to 150 from the center of the base line or to the point where water depth is 10 feet at mean low water, whichever is less. The required 10 foot setbacks from the side property lines shall be deducted from the triangle area.
Where a covered moorage or moorage facility is built pursuant to the agreement of adjoining owners of single-family lots, the covered moorage area shall be deemed to include, subject to limitations of such joint agreement, all of the combined areas lying within the triangles extended upon each adjoining property and the inverted triangle situated between the aforesaid triangles.

   a. Moorage facilities may be developed and used as an accessory to dwellings on shoreline lots with water frontage meeting or exceeding the minimum lot width requirements specified in Table A.
   b. Piles, floats or other structures in direct contact with water shall not be treated or coated with toxic substances harmful to the aquatic environment. Chemical treatment of structures shall comply with all applicable state and federal regulations.

   a. An existing shoreline stabilization structure may be replaced with a similar structure if there is a demonstrated need to protect principal uses or structures from erosion caused by currents or waves. The following conditions apply:
      i. The replacement structure should be designed, located, sized, and constructed to assure no net loss of ecological functions.
      ii. Replacement walls or bulkheads shall not encroach waterward of the ordinary high water mark or existing structure unless the primary structure was occupied prior to January 1, 1992 and there are overriding safety or environmental concerns. In such cases, the replacement structure shall abut the existing shoreline stabilization structure.
      iii. Soft shoreline stabilization measures that provide restoration of shoreline ecological functions may be permitted waterward of the ordinary high-water mark.
   b. For purposes of this section standards on shoreline stabilization measures, "replacement" means the construction of a new structure to perform a shoreline stabilization function of an existing structure which can no longer adequately serve its purpose. Additions to or increases in size of existing shoreline stabilization measures shall be considered new structures.
   c. Construction and maintenance of normal protective bulkhead common to single-family dwellings requires only a shoreline exemption permit, unless a report is required by the code official to ensure compliance with the above conditions; however, if the construction of the
bulkhead is undertaken wholly or in part on lands covered by water, such construction shall comply with the SEPA Rules, Chapter 197-11 WAC.

b.- New Structures for Existing Primary Structures: New or enlarged structural shoreline stabilization measures for an existing primary structure, including residences, should not be allowed unless there is conclusive evidence, documented by a geotechnical analysis, that the structure is in danger from shoreline erosion caused by currents, or waves. Normal sloughing, erosion of steep bluffs, or shoreline erosion itself, without a scientific or geotechnical analysis, is not demonstration of need. The geotechnical analysis should evaluate on-site drainage issues and address drainage problems away from the shoreline edge before considering structural shoreline stabilization. New or enlarged erosion control structure shall not result in a net loss of shoreline ecological functions.

c.- New development should be located and designed to avoid the need for future shoreline stabilization to the extent feasible. Future shoreline stabilization does not apply to stabilization that occurs pursuant to subsection (a) of this section. New structural stabilization measures in support of new nonwater-dependent development, including single-family residences, shall only be allowed when all of the conditions below apply:

i. The erosion is not being caused by upland conditions, such as the loss of vegetation and drainage.

ii. Nonstructural measures, such as placing the development further from the shoreline, planting vegetation, or installing on-site drainage improvements, are not feasible or not sufficient.

iii. The need to protect primary structures from damage due to erosion is demonstrated through a geotechnical report, in compliance with MICC 19.07.110(D)(4)(k). The damage must be caused by natural processes, such as currents, and waves.

iv. The erosion control structure will not result in a net loss of shoreline ecological functions.

d. New development on steep slopes or bluffs shall be set back sufficiently to ensure that shoreline stabilization is unlikely to be necessary during the life of the structure, as demonstrated by a geotechnical analysis, in compliance with MICC 19.07.110(D)(4)(g). New development that would require shoreline stabilization which causes significant impacts to adjacent or down-current properties and shoreline areas should not be allowed.

e. New structural stabilization measures in support of water-dependent development shall only be allowed when all of the conditions below apply:

i. The erosion is not being caused by upland conditions, such as the loss of vegetation and drainage.

ii. Nonstructural measures, planting vegetation, or installing on-site drainage improvements, are not feasible or not sufficient.

iii. The need to protect primary structures from damage due to erosion is demonstrated through a geotechnical report, in compliance with MICC 19.07.110(D)(4)(k).

iv. The erosion control structure will not result in a net loss of shoreline ecological functions.

f. New structural stabilization measures to protect projects for the restoration of ecological functions or hazardous substance remediation projects pursuant to RCW 70.105D shall only be allowed when all of the conditions below apply:

i. Nonstructural measures, planting vegetation, or installing on-site drainage improvements, are not feasible or not sufficient.
The erosion control structure will not result in a net loss of shoreline ecological functions.

Bulkheads shall be located generally parallel to the natural shoreline. No filling may be allowed waterward of the ordinary high water mark, unless there has been severe and unusual erosion within one year immediately preceding the application for the bulkhead. In this event the city may allow the placement of the bulkhead to recover the dry land area lost by erosion.

Replacement bulkheads may be located immediately in front of and abutting an existing bulkhead, but no filling shall be allowed waterward of the ordinary high water mark.

Geotechnical reports pursuant to this section that address the need to prevent potential damage to a primary structure shall address the necessity for shoreline stabilization by estimating time frames and rates of erosion and report on the urgency associated with the specific situation. As a general matter, hard armoring solutions should not be authorized except when a report confirms that there is a significant possibility that such a structure will be damaged within three years as a result of shoreline erosion in the absence of such hard armoring measures, or where waiting until the need is that immediate, would foreclose the opportunity to use measures that avoid impacts on ecological functions. Thus, where the geotechnical report confirms a need to prevent potential damage to a primary structure, but the need is not as immediate as the three years, that report may still be used to justify more immediate authorization to protect against erosion using soft measures.

When any structural shoreline stabilization measures are demonstrated to be necessary, pursuant to above provisions, the following shall apply:

i. Limit the size of stabilization measures to the minimum necessary. Use measures designed to assure no net loss of shoreline ecological functions. Soft approaches shall be used unless demonstrated not to be sufficient to protect primary structures, dwellings, and businesses.

ii. Ensure that publicly financed or subsidized shoreline erosion control measures do not permanently restrict appropriate public access to the shoreline except where such access is determined to be infeasible because of incompatible uses, safety, security, or harm to ecological functions. See public access provisions; WAC 173-26-221(4). Where feasible, incorporate ecological restoration and public access improvements into the project.

iii. Mitigate new erosion control measures, including replacement structures, on feeder bluffs or other actions that affect beach sediment-producing areas to avoid and, if that is not possible, to minimize adverse impacts to sediment conveyance systems. Where sediment conveyance systems cross jurisdictional boundaries, local governments should coordinate shoreline management efforts. If beach erosion is threatening existing development, local governments should adopt master program provisions for a beach management district or other institutional mechanism to provide comprehensive mitigation for the adverse impacts of erosion control measures.

j. Breakwaters, jetties, groins, and weirs. Breakwaters, jetties, groins, and weirs located waterward of the ordinary high-water mark shall be allowed only where necessary to support water-dependent uses, public access, shoreline stabilization, or other specific public purpose. Breakwaters, jetties, groins, weirs, and similar structures should require a conditional use permit, except for those structures installed to protect or restore ecological functions, such as woody debris installed in streams. Breakwaters, jetties, groins, and weirs shall be designed to protect critical areas and shall provide for mitigation according to the sequence defined in WAC 173-26-201 (2)(e).

5. Utilities.
a. Utilities shall be placed underground and in common rights-of-way wherever economically and technically practical.
b. Shoreline public access shall be encouraged on publicly owned utility rights-of-way, when such access will not unduly interfere with utility operations or endanger public health and safety. Utility easements on private property will not be used for public access, unless otherwise provided for in such easement.
c. Restoration of the site is required upon completion of utility installation.
d. Construction of utility buildings and structures require a conditional use permit.

6. Dredging.
   a. Dredging waterward or landward of the ordinary high water mark shall be permitted only if navigational access has been unduly restricted or other extraordinary conditions in conjunction with water-dependent use; provided, that the use meets all state and federal regulations.
   b. Dredging shall be the minimum necessary to accommodate the proposed use.
   c. Dredging shall utilize techniques that cause the least possible environmental and aesthetic impact.
   d. Dredging is prohibited in the following locations:
      i. Fish spawning areas.
      ii. In unique environments such as lake logging of the underwater forest.
   e. Disposal of dredged material shall comply with Ecology Water Quality Certification process and U.S. Army Corps of Engineers permit requirements. The location and manner of the disposal shall be approved by the city.

7. Transportation and Parking
   a. Shoreline circulation system planning shall include safe, reasonable, and adequate systems for pedestrian, bicycle, and public transportation where appropriate. Circulation planning and projects should support existing and proposed shoreline uses that are consistent with the master program.
   b. Transportation and parking facilities shall be planned, located, and designed where routes will have the least possible adverse effect on unique or fragile shoreline features, and will not result in a net loss of shoreline ecological functions or adversely impact existing or planned water-dependent uses.
   c. Where other options are available and feasible, new roads or road expansions should not be built within shoreline jurisdiction.
   d. Parking facilities in shorelines shall be allowed only as necessary to support an authorized use.
   e. Parking facilities in shorelines shall minimize the environmental and visual impacts.

E. General Provisions

1. Archaeological and Historic Resources
   a. If archaeological resources are uncovered during excavation, the developer and property owner shall immediately stop work and notify the City, the Office of Archaeology and Historic Preservation, and affected Indian tribes.
   b. In areas documented to contain archaeological resources by the Office of Archaeology and Historic Preservation, a site inspection or evaluation is required by a professional archaeologist in coordination with affected Indian tribes.

2. Public Access
a. Development by public entities shall include public access, unless such access is shown to be incompatible due to reasons of safety, security, or impact to the shoreline environment.

b. Public access shall be provided for developments for water-enjoyment, water-related, and non-water-dependent uses; and for new subdivisions of more than four parcels, except:
   
   i. Where the City provides more effective public access
   
   ii. Where it is demonstrated to be infeasible due to reasons of incompatible uses, safety, security, or impact to the shoreline environment, or due to constitutional or other legal limitations that may be applicable

   iii. For individual single-family residences.

c. In determining infeasibility of public access in a given situation, the City may consider alternate methods of providing public access, such as off-site improvements, viewing platforms, separation of uses through site planning and design, and restricting hours of public access.

d. Public access improvements shall not result in a net loss of shoreline ecological functions.

Section 3: Amendments to 19.16 MICC, Definitions. MICC 19.16 “Definitions” is hereby amended as follows:

Words used in the singular include the plural and the plural the singular. For definitions that are specific to the Shoreline, see 19.07.110(A)(7)(e).

B

…

  Boat Ramp: An inclined structure upon which a watercraft is raised or pulled onto land or a dock

  Breakwater: a protective structure usually built offshore for the purpose of protecting the shoreline or harbor areas from wave action.

  …

  Bulkhead: A solid or open pile of rock, concrete, steel, timber or other materials erected parallel to, and normally erected at, the ordinary high water line for the purpose of protecting adjacent property from waves or currents.

C

…

  Covered Moorage: A pier, dock, boatlift, series of piles, or other structure intended for moorage over which a roof or canopy is erected.

  …

F

…

  Finger Pier: An extension from a dock used to create moorage slips.

  …

  Floating Platform: A flat structure or device moored or anchored, not permanently secured by piles, which floats upon the water.

  …
G

...Groin: A structure used to interrupt sediment movement along the shore.

J

Jetty: A barrier used to protect areas from accumulations of excess sediment.

L

Lateral Line: The extension waterward of a property line into Lake Washington beyond the ordinary high water mark. How property lines extend waterward from the ordinary high water mark is an area of misconception. If the title does not clearly state the location of the property lines waterward from the ordinary high water mark, waterfront owners are not allowed to unilaterally project the upland boundaries out into the shorelands (waterward). There are no statutes defining the direction of the lateral lines waterward from the ordinary high water mark. The Supreme Court has the final word to decide location of lateral line on case-by-case basis.

Lift Station (Boat Hoist): A structure or device normally attached to a dock or pier used to raise a watercraft above the waterline for secure moorage purposes.

M

Marina: A commercial basin providing rental or sale of docks, watercraft, moorage, and/or supplies. Casual single-family renting of moorage is excluded from this definition.

Mean Low Water: The level of Lake Washington during the fall and winter when the water level is lowered to minimize winter storm damage to lakeside properties. Mean low water is one and one-half feet lower than ordinary high water.

Moorage Facility: Any device or structure used to secure a boat or a vessel, including piers, docks, piles, lift stations or buoys.

W

Water Dependent: A use or a portion of a use which cannot exist in any other location and is dependent on the water by reason of the intrinsic nature of its operations. Examples of water-dependent uses may include ship cargo terminal loading areas, ferry and passenger terminals, barge loading facilities, ship building and dry docking, marinas, aquaculture, float plane facilities and sewer outfalls.

Waterfront Structure: Docks, piers, wharves, floats, mooring piles, anchor buoys, bulkheads, submerged or overhead wires, pipes, cables, and any other object passing beneath, through or over the water beyond the line of ordinary high water.

Waterward: Any point located in Lake Washington, lakeward from the ordinary high water mark.
Section 4: **Repeal and Replace Appendix F to Title 19 MICC.** Appendix F to MICC Title 19 is hereby repealed and replaced with the attached EXHIBIT A.

Section 5: **Amendments to the Shoreline Element of the Comprehensive Plan.** The City of Mercer Island Comprehensive Plan, Shoreline Element is hereby amended as set forth in the attached EXHIBIT B.

Section 6: **Severability/Validity.** The provisions of this ordinance are declared separate and severable. If any section, paragraph, subsection, clause or phrase of this ordinance is for any reason held to be unconstitutional or invalid, such decision shall not affect the validity of the remaining portions of this ordinance. The City Council hereby declares that they would have passed this ordinance and each section, paragraph, subsection, clause or phrase thereof irrespective of the fact that any one or more sections, paragraphs, clauses or phrases may subsequently be found by a competent authority to be unconstitutional or invalid.

Section 7: **Ratification.** Any act consistent with the authority and prior to the effective date of this ordinance is hereby ratified and affirmed.

Section 8: **Effective Date.** This Ordinance shall take effect and be in force 30 days after its passage and publication.

PASSED by the City Council of the City of Mercer Island, Washington at its regular meeting on the _________ day of ________ 2010 and signed in authentication of its passage.

CITY OF MERCER ISLAND

________________________________
Jim Pearman, Mayor

ATTEST:

______________________________
Allison Spietz, City Clerk

Approved as to Form:

______________________________
Katie Knight, City Attorney

Date of Publication: ________________
Appendix F - Proposed Shoreline Environment Designations

Shoreline Master Program - City of Mercer Island

All areas within shoreline jurisdiction that are not mapped and/or designated are automatically assigned the "Urban Residential" designation until the shoreline can be redesignated through a master program amendment. In the event of a mapping error, the City of Mercer Island shall rely upon common boundary descriptions and the criteria contained in RCW 90.58.030(2) and Chapter 173-22 WAC pertaining to determinations of shorelands, as amended, rather than the incorrect or outdated map.

1. Landward extent of Shoreline Management Area is measured 200 ft landward of the Ordinary High Water Mark.

2. Waterward extent of City jurisdiction is measured to the middle of Lake Washington, pursuant to RCW 35.21.160.

3. Waterward extent of Shoreline Management Area is measured from the Ordinary High Watermark to the middle of Lake Washington.

Produced by the City of Mercer Island, March 2010. All rights reserved. No warranties of any sort, including but not limited to accuracy, fitness or merchantability, accompany this product.
EXHIBIT B to Ordinance No. 10C-XX

INTRODUCTION

The purpose of this document is four-fold:

1. To fulfill the requirements of the Shoreline Management Act (SMA) of 1971, Chapter 286, Laws of 1971, Chapter 90.58. RCW and Chapter 173-46 WAC by developing a Master Program to guide the future use and development of Mercer Island’s shoreline.
2. To recognize the Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook Salmon Conservation Plan.
3. To recognize the Regional Lake Washington Master Program as a basis for Mercer Island’s Master Program.
4. To provide guidelines and recommendations for revising local ordinances and zoning codes and for updating the comprehensive plan.
5. To provide a basis for evaluating applications for shoreline permits on Mercer Island.

The State of Washington Shoreline Management Act of 1971 recognizes that the shorelines of the state are among our most valuable and fragile natural resources and directs all local governments to develop a Master Program for the management of these shorelines. The Law specifies that all lakes over 1,000 acres in surface area are Shorelines of Statewide Significance. Lake Washington is such a shoreline and in our planning we must, as the Shoreline Management Act specifies, provide for uses in the following order of preference: those which

1. Recognize and protect the state-wide 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 shoreline;
6. Increase recreational opportunities for the public in the shoreline;
7. Provide for any other element deemed appropriate or necessary.

PROLOGUE

To the early developers who built metropolitan Seattle, Lake Washington was perceived as a utilitarian resource. During the past hundred years the Lake has been utilized for transportation, agricultural and domestic water supplies, waste disposal, and numerous types of commercial and industrial enterprises. Many of these activities had adverse impacts on the Lake, and the discharge of sewage eventually led to serious problems with respect to water quality. In response to the rapidly declining quality of Lake Washington, the public voted to create the Municipality of Metropolitan Seattle (METRO) for the purpose of treating sanitary sewage and diverting its discharge from the Lake to Puget Sound. Today the lake is once again suitable for swimming and other recreational activities.

Many of the functions previously related to the lake are now met by other means. The region’s water supply is from rivers, one of which feeds into Lake Washington. Sanitary sewers have
been diverted and measures are being taken to minimize further pollutants from entering the Lake. Water-borne transportation has been largely replaced by an extensive road network around and across the Lake. Also, commercial and industrial uses of the Lake have declined in recent years. In contrast, the use of Lake Washington for leisure activities has increased. The vast majority of the Lake is presently used for residential or recreational purposes. Thus, the future of Lake Washington may be quite different from the expectations of its early developers.

Mercer Island was originally utilized as a source of timber, and although proposed as a “regional park” in its entirety at one time, it became a recreational and, later, a prime residential area. Until 1940, boat and ferry travel was the primary means of reaching the Island from Seattle. In 1940 the Lake Washington floating bridge was completed. At this time the population of the Island and, subsequently, the complexion of development changed rapidly. Developers took advantage of the relatively easy access and relatively close proximity to Seattle’s employment centers, and land quickly changed from forest to subdivision.

Planning during this time and up until the early 1960’s was done-conducted by King County. Since accepting the County zoning upon incorporation of the City in 1960, few changes affecting the shoreline uses have occurred, with single-family residential and recreation constituting the primary shoreline uses.

The City developed its first Shoreline Master Program in 1974. Key considerations within this plan included conservation, public access to the shoreline, residential development, and the guidance for recreational uses along the Mercer Island shoreline. These initial policy objectives are reflected in today’s protection of the City’s shoreline, which includes approximately 6,000 lineal feet of publicly owned shoreline, developed as waterfront recreation areas. Included in these publicly owned lands are nineteen street ends; Groveland Beach Park; Clarke Beach Park; and Luther Burbank Park, which was transferred in 2003 from King County to the City of Mercer Island via an Intergovernmental Land Transfer Agreement.

During the 35 years since the City adopted its first SMP, the Mercer Island has matured to the point where it is largely developed with the priority uses planned for in the first SMP. For example, an inventory of the shoreline prepared as part of this SMP update identified only 30 shoreline properties that are currently undeveloped.

Since 1990, when the state enacted the Growth Management Act, state policy has promoted greater density in urban areas, such as the City of Mercer Island and the other cities that surround Lake Washington. In addition, the increased land values on the Island have created pressures for more intense use of lands during redevelopment.

The City’s and region’s development during this time has impacted the shoreline. Docks and bulkheads, impervious surfaces in shoreline area and in adjacent areas have impacted the shoreline environment, including salmonid habitat. In 1999, Chinook salmon and bull trout were listed as “Threatened” under the Federal Endangered Species Act. New scientific data and
research has improved our understanding of shoreline ecological functions and their value in terms of fish and wildlife, water quality, and human health. Scientific information, however, remains incomplete and sometimes inconsistent in some areas important to Mercer Island’s development pattern.

INTENT
To address changes in the shoreline environment, comply with the mandates of the Shoreline Management Act, and enable the City to plan for emerging issues, the City has initiated an extensive update of its Shoreline Master Program. The new program is intended to respond to current conditions and the community’s vision for the future.

The largely built out character of the shoreline, as well as the increasing protections under state and federal law for shoreline habitat are two factors that have strongly influenced the Update’s direction. In updating the program, the City’s primary objectives are to:

- Enable current and future generations to enjoy an attractive, healthy and safe waterfront.
- Protect the quality of water and shoreline natural resources to preserve fish and wildlife and their habitats.
- Protect the City’s investments, as well as those of property owners along and near the shoreline.
- Produce an updated Shoreline Master Program (SMP) that is supported by Mercer Island’s elected and appointed officials, citizens, property owners, the State of Washington, and other key groups with an interest in the shoreline.
- Fairly allocate the responsibilities for increased shoreline protection among new development and redevelopment.

The City of Mercer Island, through adoption of the Shoreline Master Program, intends to implement the Washington State Shoreline Management Act (RCW 90.58) and its policies, including protecting the State’s shorelines and their associated natural resources, planning for and fostering all reasonable and appropriate uses, and providing opportunities for the general public to have access to and enjoy shorelines.

The City of Mercer Island’s Shoreline Master Program represents the City’s participation in a coordinated planning effort to protect the public interest associated with the shorelines of the State while, at the same time, recognizing and protecting private property rights consistent with the public interest. The Program preserves the public’s opportunity to enjoy the physical and aesthetic qualities of shorelines of the State and protects the functions of shorelines so that, at a
minimum, the City achieves a ‘no net loss’ of ecological functions, as evaluated under the Final Shoreline Analysis Report issued in July 2009. The Program also promotes restoration of ecological functions where such functions are found to have been impaired, enabling functions to improve over time.

The goals and policies of the SMA constitute one of the goals for growth management as set forth in RCW 36.70A.020 and, as a result, the goals and policies of this SMP serve as an element of Mercer Island’s Comprehensive Plan and should be consistent with other elements of the Comprehensive Plan. In addition, other portions of the SMP adopted under chapter 90.58 RCW, including use regulations, are considered a part of the city's development regulations.

Most of the shoreline of Mercer Island had been platted previous to incorporation. Some of these areas are zoned R-8.4 which is a higher density than the R-15 which Mercer Island preferred to impose on the unplatted land it had the opportunity to regulate. Changes in zoning to a lower density along the shoreline have been virtually impossible to achieve. However, the City has developed several ordinances such as those relating to waterfront structures, community waterfront tracts, tree clearing, preserving of watercourses and others that directly or indirectly preserve and enhance shoreline areas.

**INTENT**

The Lake Washington Regional Citizens and Technical Committees have recognized that the shoreline of Lake Washington is a valuable and fragile natural resource and that there is a great concern throughout the region relating to its utilization, protection, restoration, and preservation. They further recognized that unrestricted construction on the shoreline of Lake Washington is not in the best public interest, while at the same time recognizing and protecting private property rights consistent with the public interest. In addition, they recognized that the shoreline of Lake Washington is located within a major urbanized area and is subjected to ever increasing pressures of additional uses necessitating increased coordination in the management and development of said shoreline. They stated that there is a clear and urgent demand for a planned, rational and concerted effort to insure coordinated and optimum utilization of the shoreline of Lake Washington.

Although the Regional Program provides a basis for the Mercer Island Master Program, historically, shoreline development and, more recently, the nature of our land use ordinances, zoning codes and comprehensive plan, have established a fairly set land use pattern. Community attitudes have strongly emphasized the desire to retain the residential/recreational uses of the shoreline. Therefore, there appears to be a need to slightly modify the tone of the Regional Program to fit Mercer Island.

The Mercer Island Citizen Advisory Committee has indicated that the order of preference for shoreline development should be evaluated according to the following considerations:

1. Low density single-family residences should continue to be the primary land use of the shoreline of Mercer Island.

2. Conservation of marshes, spawning grounds and other unique or fragile areas is of primary
concern:

3. Importance of the public having ample access to the shoreline.

4. Water-oriented recreation is deemed to be appropriate and desirable.

Planning and usage of the Mercer Island shoreline should reflect these priorities.

This document should be read in its entirety and be considered as a whole. These goals and policies were developed with the above priorities in mind and should be applied accordingly. The goals and policies within the following Elements: Shoreline Uses and Activities, Conservation, Public Access, and Components are intended by the Committees to be applicable in all cases.

LAKE WASHINGTON REGIONAL GOALS

The Regional Goals have provided a basis for the Goals and Policies developed for Mercer Island. The Regional Goals are, therefore, summarized below to provide a reference to the Goals and Policies formulated by the Mercer Island Citizens Committee.

PRIMARY GOAL

The natural amenities and resources of Lake Washington are to be conserved in a predominately recreational/residential environment with adequate access available to the public.

The regional goals established by the Regional Committees are listed below in order of preference:

— The shoreline of Lake Washington is to be planned and coordinated to afford optimal use of the limited water resource.

— The shoreline of Lake Washington is to provide natural amenities within an urban environment.

— The resources and amenities of Lake Washington are to be protected and preserved for use and enjoyment by present and future generations.

— Increase public access to and along the shoreline areas, provided public safety, private property rights, and unique or fragile areas are not adversely affected.

— Water-dependent recreational activities available to the public are to be encouraged and increased on the shoreline of Lake Washington where appropriate and consistent with public interest.

— Existing residential uses are to be recognized and new residential construction will be subject to certain limitations if applicable.
Existing economic uses and activities on the shoreline of Lake Washington are to be recognized, while economic uses of activities that are not dependent on a Lake Washington location are to be discouraged.

A balanced transportation system for moving people and goods is to be encouraged within existing corridors.

**DESIGNATED ENVIRONMENTS**

The Final Guidelines – Shoreline Management Act of 1971 requires that as a part of the Master Program the City is required to do the following:

1. Designated type of environments the Mercer Island shorelines represent.

2. The environmental designations be consistent with the information in the Shoreline Inventory.

3. The designation must be consistent with the provisions of the Guidelines and Mercer Island’s Goals and Policies.

More generally the Guidelines state that:

“In order to plan and effectively manage shoreline resources, a system of categorizing shoreline areas is required for use by local governments in the preparation of the master programs. The system is designated to provide a uniform basis for applying policies and use regulations within distinctively different shoreline areas. To accomplish this, the environmental designation to be given any specific area is to be based on the existing development pattern, the biophysical capabilities and limitations of the shoreline being considered for development and the goals and aspirations of local citizenry.

WAC 173-26-211 states, “Master programs shall contain a system to classify shoreline areas into specific environment designations. This classification system shall be based on the existing use pattern, the biological and physical character of the shoreline, and the goals and aspirations of the community as expressed through comprehensive plans as well as the criteria in this section. Each master program's classification system shall be consistent with that described in WAC 173-26-211 (4) and (5) unless the alternative proposed provides equal or better implementation of the act.”

The recommended system classifies shorelines into four distinct environments (natural, conservancy, rural and urban) which provide the framework for implementing shoreline policies and regulatory measures.

WAC 173-26-211(4)(c) allows for local governments to establish a designation system, provided it is consistent with the purposes and policies of WAC 173-26-211 and WAC 173-26-211(5).

Mercer Island contains two distinct shoreline designations, pursuant to WAC 173-26-
211(4)(c): urban residential, and urban park.

This system is designed to encourage uses in each environment which enhance the character of that environment. The basic intent of this system is to utilize performance standards which regulate use activities in accordance with goals and objectives defined locally rather than to exclude any use from any one environment. Thus, the particular uses or type of developments placed in each environment should be designed and located so that there are no effects detrimental to achieving the objectives of the environment designations and local development criteria. This approach provides an ‘umbrella’ environment class over local planning and zoning on the shorelines. Since every area is endowed with different resources, has different intensity of development and attaches different social values to these physical and economic characteristics, the enforcement designations should not be regarded as a substitute for local planning and land-use regulations.”

Although none of the four categories precisely fit Mercer Island, the most appropriate environment designation is that of Urban as designated in WAC 173-16040(4)(b)(iv).

The objective of the urban environment is to ensure optimum utilization of shorelines within urbanized areas by providing for intensive public use and by managing development so that it enhances and maintains shorelines for a multiplicity of urban uses. Because shorelines suitable for urban uses are a limited resource, emphasis should be given to development within already developed areas. In the master program, priority is also to be given to planning for public visual and physical access to water in the urban environment. Identifying needs and planning for the acquisition of urban land for permanent public access points to the shoreline should be linked to non-motorized transportation routes, such as bicycle and hiking trails.

In some instances, the Conservancy Environment designation may apply. Designation of these areas should be undertaken at the time unique and fragile areas are further inventoried and mapped.

Urban Residential
The purpose of the urban residential environment is to accommodate residential development and appurtenant structures that are consistent with this chapter. An additional purpose is to provide appropriate public access and recreational uses.

Designation Criteria. Areas that are predominantly single-family or multifamily residential development or are planned and platted for residential development.

Management Policies.

1. Standards for density or minimum frontage width, setbacks, lot coverage limitations, buffers, shoreline stabilization, vegetation conservation, critical area protection, and water quality shall be set to assure no net loss of shoreline ecological functions, taking into account the environmental limitations and sensitivity of the shoreline area, the level of infrastructure and services available, and other comprehensive planning considerations.
2. Development of multifamily, recreational and residential subdivisions of five or more lots should provide public access and joint use for community recreational facilities.

3. Access, utilities, and public services should be available and adequate to serve existing needs and/or planned future development.

4. Commercial development should be limited to water-oriented uses.

Urban Park Environment

The purpose of the urban park environment is to protect and restore ecological functions in urban and developed settings, while allowing public access and a variety of park and recreation uses.

Designation Criteria. An urban park environment designation will be assigned to publicly owned shorelands, including all parks, street ends and public access points.

Management policies

1. Uses that preserve the natural character of the area or promote preservation of open space, or sensitive lands either directly or over the long term should be the primary allowed uses. Uses that result in restoration of ecological functions should be allowed if the use is otherwise compatible with the purpose of the environment and the setting.

2. Standards should be established for shoreline stabilization measures, vegetation conservation, water quality, and shoreline modifications within the urban park designation. These standards shall ensure that new development does not result in a net loss of shoreline ecological functions or further degrade other shoreline values.

3. Public access and public recreation objectives should be implemented whenever feasible and significant ecological impacts can be mitigated.

4. Water-oriented uses should be given priority over nonwater-oriented uses. For shoreline areas adjacent to commercially navigable waters, water-dependent uses should be given highest priority.

SHORELINE USES AND ACTIVITIES

The Mercer Island Shoreline Inventory indicates that present usage of the shoreline is primarily residential/recreational in character. As the population of both the Island and the region grows, demands for all forms of shoreline use and activities on Lake Washington are expected to increase. At some future time this demand is likely to exceed the existing supply of the Lake’s shoreline. Several studies related to appropriate uses of the shoreline, particularly those of a residential or recreational nature, have been undertaken on Mercer Island to determine the best
land uses. Most of these studies and plans have only indirectly addressed the question of proliferation of shoreline development on Lake Washington. To date a water use management plan has also been indirectly considered. This document is intended to complement existing studies and to provide criteria to assist in determining the optimal mix of shoreline uses.

The following goals and policies address the general distribution, location, and extent of all uses within shoreline jurisdiction.

**GOALS**

1. Ensure that the land use patterns within shoreline areas are compatible with shoreline environment designations and will be sensitive to and not degrade habitat, ecological systems, and other shoreline resources. The Shoreline of Mercer Island is to be planned and coordinated to afford optimal use of the limited resource.

2. The shoreline of Mercer Island is to provide natural amenities within an urban environment.

**POLICIES**

**POLICY**

1. Plans should be made for reasonable and appropriate shoreline uses and activities:

   a. Short term economic gain or convenience in development should be evaluated in relationship to potential long term effects on the shoreline.

   b. Preference should be given to those uses or activities which enhance the natural amenities of the Lake and which depend on a shoreline location or provide public access to the shoreline.

   c. Planning, zoning, capital improvements and other policy and regulatory standards should not increase the density or intensity of shoreline uses or activities.

   d. Shorelines particularly suited for a specific appropriate water dependent use or activity should be planned for and designated.

   e. Multiple use of shorelines should be planned where location and integration of compatible uses or activities are feasible.

   f. Aesthetic values must be considered when evaluating new development, redevelopment of existing facilities or for general enhancement of shoreline areas.

   g. Shoreline uses and activities should be discouraged if they are objectionable due to noise or odor or if they create offensive or unsafe conditions in relating to reasonable and appropriate uses and activities.
1. All activities, development and redevelopment within the City’s shoreline jurisdiction should be designed to ensure no net loss of shoreline ecological functions.

2. Existing shoreline use or activities identified as being inappropriate should be encouraged to relocate away from the shoreline.

3. Uses and activities in unique or fragile shoreline areas should be discouraged unless measures can be satisfactorily undertaken to mitigate all related adverse impacts.

4. Sufficient amounts of open space should be distributed along the shoreline to provide nearby recreational opportunities for the general public.

5. Shoreline uses or activities not specified in this document should be consistent with the intent of the goals and policies stated herein.

RECOMMENDATIONS:

1. Mercer Island should formulate programs for the relocation of inappropriate uses and activities. The use of public funds, trading of other public lands where feasible, or other incentives should be considered when necessary to accomplish this objective.

2. Unique and fragile shoreline areas should be defined and inventoried on Mercer Island by appropriate City staff members and Boards and Commissions as soon as possible.

CONSERVATION ELEMENT

The following goal and policies address the protection of the resources of the shoreline. According to the Shoreline Management Act, three of the highest priorities for Shorelines of Statewide Significance are to a) preserve the natural character of the shorelines; b) result in long-term over short-term benefit; and c) protect the resources and ecology of the shoreline. Although some natural resources are non-renewable in character, Lake Washington is a unique biological, economic and recreational resource which can be managed in a way to allow its assets to be continually available to the region and the state.

Human activities have either directly or indirectly influenced the Lake’s entire shoreline. Some areas (stream outlets, marshes, embayments, wooded areas and others) have remained in a somewhat natural condition. As the population of the Island increases, the pressures to develop these natural condition. But the costs involved in preparing some of these sites for development may be high due to soil or hydrologic conditions. There may be greater long-term value in preserving these areas for purposes of open space within an urbanizing region. Often these areas are also important habitats for fish and wildlife. Preservation of these remaining areas, during the subdivision or development process, could be accomplished through the use of the open space option of the Subdivision Ordinance.

Conservation efforts are not directed solely toward undeveloped areas. Activities on the shoreline or within the drainage basin may adversely affect water quality, aquatic life or other...
resources of the Lake. Normal single-family residential activities within the shoreline appear to have minimal negative effects on the resources of the Lake. Long Range planning should seek to minimize such adverse impacts.

The concept of conservation should also apply to structures or areas worth preserving for their historical, cultural, educational or scientific value. The use of some areas, either on a temporary basis for special events or festivals, or permanently for facilities reflecting our past or enhancing our future, are considered as reasonable and appropriate.

GOAL

*The resources and amenities of Lake Washington are to be protected and preserved for use and enjoyment by present and future generations.*

POLICIES:

1. Existing natural resources should be conserved, consistent with private property rights.
   
   a. Aquatic habitats, particularly spawning grounds, should be protected, improved and, if feasible, increased.
   
   b. Wildlife habitats should be protected, improved and, if feasible, increased.

   c. Unique and fragile areas should be so designated and have been mapped. Access and use should be restricted if necessary for the conservation of these areas. The type and degree of development to be allowed should be based upon such factors as: slope, soils, vegetation, geology and hydrology.

   d. Water quality should be maintained at a level to permit recreational use (specifically swimming), provide a suitable habitat for desirable forms of aquatic life and satisfy other required human needs.

2. Existing and future activities on Lake Washington and its shoreline should be designed to minimize adverse effects on the natural systems.

3. Uses or activities within all drainage basins related to Lake Washington should be considered as an integral part of shoreline planning.

   a. Developers should be required to bear the cost of providing safeguards to prevent storm drainage damage resulting from their development.

   b. Excessive soil erosion and sedimentation and other polluting elements should be prevented from entering and adversely affecting the Lake and its constituent watercourses.

   c. Restoration of natural systems adversely affected by sedimentation and pollution should
be encouraged.

d. The destruction of watercourses feeding into Lake Washington should be discouraged.

e. The planning and control of surface drainage water from Mercer Island into Lake Washington should be based on such factors as the quality and quantity of water, rate of flow and containment, etc. The latest applicable data should be used in the implementation of a storm drainage system.

4. Shoreline areas having historical, cultural, educational or scientific value should be protected and restored.
   a. Public and private cooperation should be encouraged in site preservation and protection.
   b. Suspected or newly discovered sites should be kept free from intrusion until their value is determined.
   c. Festivals and temporary uses involving public interest and not substantially or permanently impairing water quality or unique and fragile areas should be permitted.

RECOMMENDATIONS

1. Since the shorelines are valuable and fragile resources, Mercer Island should designate use regulations to minimize man-made intrusions on the shoreline. Conservancy environments should be designated and mapped where the natural conditions so indicate.

2. Unique and fragile areas on the Island’s shoreline should be further defined, inventories and mapped by August, 1974.

3. Discharge of sewage (sewage is defined as treated or untreated wastes which do not meet Federal, State, or local standards for discharge in Lake Washington), waste, rubbish and litter from boats on Lake Washington should not be permitted. Pumping and tank facilities for the discharge of sewage, waste, rubbish and litter from boats equipped with marine toilets and/or galleys, should be provided in all new marinas or public moorages.

4. Comment should be solicited from Metro concerning proposed activities affecting water quality in Lake Washington or its tributaries.

5. Mercer Island should consider designating sites of historic value such as the passenger boat and ferry landings and areas of early settlement such as the Proctor, Calkins and Olds homesites.

6. Where appropriate, natural watercourses should be retained.

7. A watercourse ordinance to preserve the systems of natural drainage on the Island should be passed.
8. Information concerning the use of the State Open Space Taxation legislation of 1970, 1971 and 1973 should be made available to encourage preservation of unique and fragile areas.

9. The open-space option of Mercer Island’s Ordinance 59, the Subdivision Ordinance, should be utilized for preserving unique and fragile areas.

**PUBLIC ACCESS ELEMENT**

The waters of Lake Washington are in the public domain and should be readily accessible to the public. As the population around Lake Washington grows, there will be an increasing need for public access to the shoreline. The Shoreline Management Act and the Final Guidelines make repeated reference to the issue of public access to the shoreline. In accordance with the Act, a Public Access Element has been included in this study. However, this situation is not unique to Lake Washington, and other planning efforts have addressed this challenge in a variety of ways.

The intent of the Shoreline Management Act and these goals and policies is not to reduce unlawfully the rights attached to private property to condone trespass, but rather to recognize and protect private property rights consistent with the public interest. The public access requirements of this section are not applicable to single family residences. The following goal and policies address the ability of the public to reach, touch, view, and travel on Lake Washington and to view the water and the shoreline from public places.

**GOAL**

*Increase and enhance public access to and along the Mercer Island Shoreline where appropriate and consistent with public interest, provided public safety, private property rights, and unique or fragile areas are not adversely affected.*

**POLICIES:**

1. Public access to and along the water’s edge should be consistent with the public safety, private property rights, and conservation of unique or fragile areas.

2. Public access to and along the water’s edge should be available in publicly owned shoreline areas.

3. In new substantial shoreline development, developers should be encouraged to provide public access to and along the water’s edge provided that no private property shall be taken involuntarily for public purposes without due compensation.

4. When substantial modifications or additions are proposed to substantial developments, the developer should be encouraged to provide for public access to and along the water’s edge if physically feasible provided that no private property be taken involuntarily without due compensation.

5. In new developments on the shoreline, the water’s edge should be kept free of buildings.
6. Where publicly owned shoreline areas are available for public pedestrian and bicycle pathways, these should be developed as close to the water’s edge as reasonable.

7. Views of the shoreline and water from shoreline and upland areas should be preserved and enhanced. Enhancement of views shall not be construed to mean excessive removal of vegetation.

8. Rights-of-way on the shoreline should be made available for public access where appropriate.

9. Access onto shoreline public street ends should be enhanced.

RECOMMENDATION

10. Consideration should be given to provisions for the handicapped, disabled, and elderly when developing public access to shoreline areas.

RECREATION ELEMENT

Mercer Island has approximately 15 miles of shoreline most of which is devoted to low density single family residences. It could be said that almost 100% of the developed shoreline of Mercer Island is devoted to water-dependent recreation, assuming that the waterfront residents find both active and passive enjoyment from their shoreline location. The remainder of the shoreline is set aside for public or semi-public water-related recreation except for a fraction which is utilized for bridge crossings and utilities. The latter, in some cases, is also available for public access to the water.

The City presently owns approximately 6,000 feet of shoreline which is developed as waterfront parks with facilities for swimming, fishing and car-top boat launching. Beaches at Luther Burbank Park and Groveland Beach Park are staffed with lifeguards during the summer season. Unguarded designated swimming areas also exist at Calkins Landing and Clarke Beach Park. Dock facilities that serve fishing and other activities are located at Luther Burbank Park and Proctor Landing, and seasonally at Clarke and Groveland Beaches. The City manages several summer camps for youth and adult with instruction on sailing and kayaking based at Luther Burbank Park.

Nineteen street ends of widths varying from 30’ to 75’ add an additional 938 lineal feet of shoreline to the public domain and provide the potential for considerable access to the water’s edge in all segments of the Island. Development of some street ends has been undertaken as a cooperative effort between the city and the adjacent neighborhoods. Some provide swimming access, others offer car-top launching access, others provide minimal access solely for passive enjoyment because of the limitation of size or topography, and lack of neighborhood interest and availability of funds. Three street ends were re-developed in 2003, which included eliminating bulkheads and enhancing near shore habitat.
There are two private waterfront clubs owning a combined 1,840 feet of frontage. They provide swimming, moorage, and boat launching facilities to a significant portion of the Island’s families.

**Shorewood Apartments - Covenant Shores**, a continuing care retirement community, owns approximately 650 feet of shoreline which serves as open space, swimming, picnicking, and moorage for its 690 residential units. Numerous private neighborhood waterfront “parks,” with shared access for neighboring residences, offering access to up, and residents exist along the shoreline.

Regarding waterfront recreation, The City of Mercer Island Parks and Recreation Plan, adopted in 2007, calls for Capital improvements at 2 waterfront facilities to enhance recreation opportunities. Shoreline restoration, swim beach enhancements and dock area improvements are anticipated at Luther Burbank Park, and improved boat launching and retrieval is anticipated with planned improvements at the Mercer Island Boat Launch. Future development of Luther Burbank Park is also subject to the Luther Burbank Master Plan.

The Mercer Island Park and Open Space Plan, adopted by the City in 1966, was specific in expressing the desire to acquire and develop waterfront parks and public access to the water’s edge. As of 1973 several of the plans have been implemented. Yet to be accomplished, is the goal to acquire a waterfront park in the East Seattle area, further utilize the street ends and provide public trailer boat launching facilities.

**GOAL**

*Water-dependent recreational activities available to the public are to be encouraged and increased on the shoreline of Mercer Island where appropriate and consistent with the public interest.*

**POLICIES**

1. Provide additional public water-oriented recreation opportunities.

2. Locate public recreational uses in shoreline areas that can support those uses without risks to human health, safety, and/or security, while minimizing effects on shoreline functions, private property rights, and/or neighboring uses.

1. Water-dependent recreational activities should be increased and given priority.

   a. Public shoreline parks should be increased in size and number.
e—b. Additional swimming areas should be developed on the shoreline.

e— Recreational fishing should be maintained or increased.

d— Recreational boating activities should be encouraged as long as they are compatible with other uses. Day moorage should be a permitted use in recreational areas where feasible except in unique and fragile areas.

e— Accommodations should be made for launching small water craft at public shoreline parks and street ends where feasible.

2. Open space and opportunity for passive forms of recreation should be encouraged and increased.

3. Retention of some public shoreline in a nearly natural state is desirable.

4. Based on the Mercer Island Comprehensive Plan, the appropriate governmental agency should avail itself of the earliest opportunity to acquire shoreline when available. See Recommendations.

5. Mercer Island and other appropriate governmental agencies should join in a cooperative effort to expand recreational opportunities through programs of acquisition, development, and maintenance of waterfront areas.

6. Semi-public water-dependent recreational facilities (e.g., private beach clubs, yacht clubs, etc.) should be permitted and recognized as providing access to the water for a segment of the population of Mercer Island and should be recognized as providing a vital part of the island’s recreational facilities.

7. Every opportunity should be taken to acquire private recreational facilities if they are likely to be developed for other than recreational purposes.

8. Recreational shoreline activities adjacent to residential uses are not to constitute a public nuisance.

RECOMMENDATIONS:

1. The Mercer Island Park and Open Space Plan should be coordinated with appropriate, adopted regional plans.

2. Early efforts should be made to suitably develop presently held public shoreline for water-dependent public recreational uses and open space.

3. Cooperation between the City of Mercer Island and neighborhoods should be continued in the
planning and development of small neighborhood parks and street ends.

4. Mercer Island should cooperate with other governmental agencies to undertake studies to determine the optimum level of boating activity on Lake Washington.

5. Rental or provision of small, non-motorized water craft and water-related recreational equipment should be made available at several waterfront parks when feasible.

6. Small non-motorized water craft are nondestructive to the shoreline environment and such boating activity should be shown preference by policies governing waterfront recreation facilities.

7. The designation of underwater areas for skin or scuba diving should be considered.

8. Interest in fishing for bass, perch, crappie, and other under-utilized species should be stimulated through community education.

9. Procedures should be developed for real estate agencies to notify public agencies when waterfront property is available for purchase.

RESIDENTIAL ELEMENT

Residential development presently accounts for over 85% of Mercer Island’s wetland area. Single-family dwellings comprise the majority of this use with Shorewood Apartments being the only multi-family use. The Shoreline Management Act specifically excludes individual homes in the permit process, but the Act does not exclude other types of residential development, such as multi-family structures or residential subdivisions. Inasmuch as the Act encourages the inclusion of elements deemed sufficiently important or necessary, although not specifically named therein, the Residential Element is included herein.

Present residential zoning on Mercer Island’s shoreline is for single family dwellings, residential uses, and conditional uses that are complementary to the single family environment, such as public parks, private recreational areas, retirement homes located on properties used primarily for a place of worship, and noncommercial recreational areas. It should be noted that some of the shoreline is not yet developed as intensely as it could be under existing zoning. Several large shoreline properties now used by one family could be subdivided to allow for one to three additional residences.

GOAL

Existing residential uses are to be recognized, and new residential construction will be subject to certain limitations where applicable.

POLICIES
1. Existing single-family residential uses will be protected. New construction or modifications shall be allowed within the framework of the policies in this document and City Ordinance.

2. New residential uses over water will not be permitted.

3. In single-family development developments within the shoreline, the water’s edge should be kept free of buildings other than components required for boat and equipment storage. Such components should be screened by appropriate landscaping. Single-family uses may include fences or other means to minimize trespassing and provide protection.

4. Public access to and along the water’s edge should be encouraged in the design of multi-family structures, subdivisions of five or more lots, and planned unit developments occurring on the shoreline, provided that no private property shall be taken involuntarily without due compensation.

5. Public access does not include the right to enter upon single-family residential property without the permission of the owner.

RECOMMENDATIONS

1. The Mercer Island Planning Department should have information available for shoreline homeowners regarding the enhancement of fish and wildlife habitats, especially at the water’s edge.

2. Consideration should be given to revising the Mercer Island Zoning Code regarding back yard structures to reflect the intent of Policy No. 2. Boat houses on the water’s edge should be considered as an alternative to, not in addition to, a boat moorage.

3. The Planning Commission should consider actions to clarify the City Zoning Code to provide for a minimum twenty-five (25) foot setback from the water’s edge for all primary residential structures and appropriate accessory structures.

ECONOMIC DEVELOPMENT ELEMENT

Economic development of the shorelines of Mercer Island is essentially non-existent. Such shorelines and associated wetlands, being zoned single-family and multi-family residential, preclude economic development other than that associated with recreation. Thus, zoning and the Comprehensive Plan do not allow for economic development on the shoreline of Mercer Island.

GOAL

Existing economic uses and activities on the shorelines of Mercer Island are to be recognized. Economic uses or activities that are not dependent upon a Mercer Island Shoreline location are to be discouraged.
POLICIES

1. Shoreline economic uses and activities on Lake Washington should locate where commercial or industrial areas exist.

2. Economic uses and activities which do not depend on a Mercer Island shoreline location shall not be permitted.

3. Drilling for oil or gas and deep or surface mining for minerals is prohibited in the shoreline areas of Mercer Island.

CIRCULATION ELEMENT

Lake Washington is a 22,139 acre body of water located in the midst of an urban area. An extensive network of transportation routes exists around and across the Lake. Although transportation facilities were developed in response to projected demands, these facilities have in turn helped generate additional transportation needs. For example, construction of the Lake Washington bridges has permitted the eastern portion of the region to change from a low density, summer home area to a higher density, suburban/commercial area. This increase in activity has resulted in suggestions for third and fourth bridges crossing the Lake. Lake Washington itself is a navigable body of water and is connected to Puget Sound by a system of canals and locks. Although some commercial navigation does occur, most of the boating activities in Lake Washington and recreational in nature. Seaplane activity is also present on the Lake, and three airfields are located on the shoreline. The automobile, however, is the predominant means of transportation to, from, around and across the lake. Our heavy reliance on the automobile has contributed to problems in air quality, fuel supply and traffic congestion. In the long term, urban areas should look toward providing alternatives to the automobile as the primary means of transportation.

Principal transportation routes on Mercer Island include Inter-State 90, a highway that crosses Lake Washington via Mercer Island and two connecting bridges, and a series of arterial roads that follow the shoreline around the Island a short distance inland. Thus, shoreline-related roads form an important element of principal transportation routes on the Island. In addition, numerous lateral roads connect the shoreline following arterials with properties along the water’s edge, and frequently provide public access to the lake through developed and undeveloped street ends as well as visual access to the lake.

A rudimentary system of pedestrian and bicycle ways has gradually developed along portions of the shoreline following arterials; more definitive development of such ways is planned via the City’s Pedestrian and Bicycle Facility Plan. Metro buses provide important modes of on-Island transportation as well as access to neighboring municipalities and employment centers. Other forms of transportation are non-existent, except for privately owned boats and a few seaplanes along the shore.
GOAL

A balanced transportation system for moving people and goods is to be encouraged within existing corridors.

POLICIES

1. Develop efficient circulation systems in a manner that assures the safe movement of people and goods while minimizing adverse effects on shoreline use, developments and shoreline ecological functions.

2. Provide and/or enhance physical and visual public access to shorelines along public roads in accordance with the public access goals.

3. Encourage shoreline circulation systems that provide alternative routes and modes of travel.

1. Roadways serving shoreline areas should be developed principally as scenic avenues rather than major arterials.

2. Public transportation should be provided to facilitate access to recreation areas on the shoreline.

3. Pedestrian and bicycle pathways, including provisions for maintenance, operation and security, should be developed around and across the Lake, consistent with private property rights.

Access points to and along the shoreline should be linked by pedestrian and bicycle pathways developed as close to the water’s edge as reasonable.

Pedestrian and bicycle pathways should be included in new or expanded bridges.

Pedestrian and bicycle pathways should be included in publicly-financed transportation systems or rights-of-way, consistent with public interest and safety.

4. Provisions for METRO Public Transit should be implemented in transportation facilities crossing Mercer Island.

5. No new regional vehicular traffic corridors should be opened across Mercer Island’s shoreline.

   a. The width of the I-90 corridor shall be limited to that approved by the City of Mercer Island as stated in Mercer Island Resolution 595 adopted September 24, 1973.

   b. Future regional requirements for moving people through Mercer Island’s shorelines shall be limited to public mass transit systems constructed within the approved I-90 corridor.

6. Commercial aircraft facilities on the shoreline should not be permitted.
7. Moorage, storage, servicing and operation facilities for ocean-going or commercial ships and barges should not be permitted on the shoreline.

8. Proposals for additional transportation across Lake Washington should consider alternative modes above, on, or below the surface of the Lake.

9. Cross-lake transportation facilities must be designed to minimize the increase in noise, air or water pollution above existing levels and, in addition, must reduce to the maximum extent, similar impacts from existing facilities via upgrading and improvement.

RECOMMENDATIONS

1. Mercer Island should cooperate with Metro to coordinate public transportation routes with public access points along the shoreline.

2. Mercer Island should coordinate with King County and neighboring communities in the implementation of its Trails Plan when feasible.

3. The connection of upland trails on the Island to the shoreline activity nodes and pedestrian and bicycle pathways, along the Mercer Ways, should be encouraged and developed.

4. To assist in developing pedestrian and bicycle pathways, easements along rights-of-way should be obtained and incentives should be offered to property owners for utilizing setback areas.

5. Mercer Island and other governmental agencies should consider using waterborne modes of transporting commuters and sightseers in a manner compatible with environmental quality and recreational activity. Such considerations should include terminals and connections.

COMPONENTS

Lake Washington’s shoreline has been recognized as a “valuable and fragile resource” by the Shoreline Management Act of 1971. The extent and the desirability of man-made modifications to these shorelines has not yet been determined. Although several studies relative to this issue have been made, are being conducted, and are envisioned, it is unlikely that any conclusive evidence will be available in the near future.

In instances where the literal interpretation of the policies in the Components Element create a demonstrated hardship, unique to an individual property, relief may be sought through the variance process as delineated in the Variance and Conditional Uses Section, pages 38 and 39.

POLICIES

Activities, Conservation, Public Access, NOTE: The policies set forth within the following Elements: Shoreline Uses and Components, are to apply to all uses and activities contained within this document. The policies under this heading are to apply to all components.
1. Components in or near the water should not be constructed from materials which have significant adverse physical or chemical effects on water quality, vegetation, fish and/or wildlife.

2. Components should be discouraged in unique or fragile areas, unless it can be shown that measures can be taken to adequately mitigate all related adverse impacts.

3. Components should be designed to permit normal circulation of water, sediments, fish and other aquatic life in and along the shoreline area.

4. High rise structures should be prohibited on the shoreline.

5. Shoreline low-rise development should provide substantial grade level views of the water from public shoreline roads running generally parallel to the water’s edge.

6. Enclosed overwater structures should not be allowed except when overriding considerations of the public interest are served. This would not preclude the use of covered, unenclosed moorage’s.

7. Substantial repairs or alterations to nonconforming structures should be in conformance with the policies contained herein.

8. Non-conforming shoreline structures which receive little use and/or are in a general state of disrepair should be abated within a reasonable period of time.

RECOMMENDATIONS:

1. The Component Section of this document should be reviewed and modified as necessary at the completion of the research program being undertaken by the cooperative Fishery Unit at the University of Washington, and any other relevant studies.

2. Site planning should include setbacks from the shoreline. Landscaping should also be considered as a method of retaining a sense of nature in developed shoreline areas. Retention of trees and other natural vegetation should be encouraged where possible, particularly in those areas in or adjacent to marshes, wetlands, or other areas of ecological and environmental significance. (Note: all site planning, landscaping, and development for non-single family uses is subject to review by the Design Commission under Ordinance No. 297 and the Design Commission Guidelines.)

LANDFILL AND DREDGING

Landfill is usually contemplated in locations where the water is shallow and where rooted vegetation often occurs. In their natural condition these same areas provide suitable habitat for
fish and wildlife feeding, breeding and shelter. Biologically the shallow vegetation areas tend to be highly productive portions of the Lake. For these reasons governmental agencies and scientific experts have generally taken a stand against landfill.

In most cases when dredging is done it also occurs in shallow areas and may disturb the environment in the following ways: 1) temporary reduction of water clarity from suspended sediments, 2) losses in aquatic plants and animals by direct removal or from the sedimentation of suspended materials, 3) alteration in the nutrient and oxygen levels of the water column, and 4) suspension of toxic materials from the sediments into the water column.

Mercer Island has some uneven shorelines due to the historically varying degrees of control over filling and bulkheading beyond the ordinary high water line. In some instances, it may be appropriate to bulkhead and do minor landfill. These instances may include, but not be limited to, provision of protection of slide prone areas where necessary and to add to or repair failing bulkheads. These and other unusual situations in which the literal interpretation of the Shorelines Master Program, Guidelines or Mercer Island Goals and Policies creates a demonstrated hardship can be addressed through variance procedures. (Note: See Variance and Conditional Uses Section)

POLICIES

1. Fills shall be located, designed, and constructed to protect shoreline ecological functions and ecosystem-wide processes, including channel migration.

2. Fills waterward of the ordinary high-water mark shall be allowed only when necessary to support: water-dependent use, public access, cleanup and disposal of contaminated sediments as part of an interagency environmental clean-up plan, disposal of dredged material considered suitable under, and conducted in accordance with the Dredged Material Management Program of the Department of Natural Resources, expansion or alteration of transportation facilities of statewide significance currently located on the shoreline and then only upon a demonstration that alternatives to fill are not feasible, mitigation action, environmental restoration, beach nourishment or enhancement project. Fills waterward of the ordinary high-water mark for any use except ecological restoration should require a conditional use permit.

3. Dredging and dredge material disposal shall be done in a manner which avoids or minimizes significant ecological impacts and impacts which cannot be avoided should be mitigated in a manner that assures no net loss of shoreline ecological functions.

4. New development should be sited and designed to avoid or, if that is not possible, to minimize the need for new and maintenance dredging. Dredging for the purpose of establishing, expanding, or relocating or reconfiguring navigation channels and basins should be allowed where necessary for assuring safe and efficient accommodation of existing navigational uses and then only when significant ecological impacts are minimized and when mitigation is provided. Maintenance dredging of established navigation channels and basins should be restricted to maintaining previously dredged and/or existing authorized location, depth, and width.

5. Dredging waterward of the ordinary high-water mark for the primary purpose of obtaining fill material shall not be allowed, except when the material is necessary for the
restoration of ecological functions. When allowed, the site where the fill is to be placed must be located waterward of the ordinary high-water mark. The project must be either associated with a MTCA or CERCLA habitat restoration project or, if approved through a shoreline conditional use permit, any other significant habitat enhancement project.

Landfill and dredging should be prohibited in unique or fragile areas.

2. Landfill or dredging should not be permitted except in the following cases, and even then should generally be discouraged.

   a. Landfill or dredging may be permitted where necessary for the development and maintenance of public shoreline parks.

   b. Landfill or dredging may be permitted where necessary to improve water quality where no other possible alternatives are available.

   c. Replenishing sand on public and private community beaches should be allowed.

   d. Landfill or dredging may be permitted where additional public access is provided, and/or —where there is anticipated to be a significant improvement to fish or wildlife habitat; —provided there is no major reduction upon the surface waters of the Lake.

3. Dredging spoils should be deposited on approved dumping sites. Dumping sites should not be allowed in the Lake or in unique or fragile areas.

4. Dredging should be permitted to maintain water flow, navigability, and water depth in cases of water course siltation.

5. Dredging for the purpose of obtaining fill or construction material should be prohibited.

RECOMMENDATIONS

1. When reviewing applications for landfill intended to improve water quality, Mercer Island Planning Department should consult with appropriate governmental agencies to determine the necessity and proper location for such fill.

2. Appropriate governmental agencies and local jurisdictions should approve funding and/or personnel to undertake a short term study on the biological impacts of dredging and landfills and to devise suitable criteria or guidelines for such activities.

SHORELINE PROTECTIVE STRUCTURES STABILIZATION

Shoreline protective structures are used to diminish the destructive forces of waves and currents.
on beaches, to protect anchorages, to encourage the deposition of littoral materials or, in some cases, for purposes of convenience of appearance. Although these structures protect the backshore, they may also encourage scouring or erosion on adjacent shoreline or submerged land.

On Mercer Island individual situations and related problems may dictate that the repair of bulkheads or placing of new ones in order to control slides may occur very near to, rather than precisely at, the ordinary high water line. Such minor deviations should remain within the province of the City Planning Department discretion. However, in any other instances where significant changes occur to the water side of the ordinary high water line, these can be addressed through variance procedures.

**BULKHEADS**

The purpose of a bulkhead is to stabilize land at the water’s edge to prevent erosion. When structures reflect rather than absorb wave energy, the destructive forces are largely redirected. In some cases, bulkheads transmit wave energy downward, thereby eroding the beach at the base of the structure. Sloping, permeable structures, on the other hand, absorb wave energy, reduce wave run-up, and minimize scouring action at the base. In cases where bulkheading is permitted, scientific information suggests a rock riprap design should be preferred. The cracks and openings in such a structure afford suitable habitats for certain forms of aquatic life.

At times bulkheads are built out into the water in conjunction with landfill for the purpose of creating new dry land areas. However, this is being discouraged at all levels of jurisdiction concerned with shorelines.

The following policies address shoreline stabilization.

**POLICIES**

1. Construction or repair of bulkheads should not extend into the Lake beyond the existing high water line, except as approved by a variance or in the case of approved land fill.

2. The use of vegetation for stabilizing the water’s edge from erosion should be encouraged with the use of bulkheads.

3. Bulkheads at the water’s edge should be designed to minimize the transmission of wave energy to other properties.

4. Bulkheads and landfill may be permitted to restore lands lost to erosion within one year of the date that erosion occurred. A one year extension for a reasonable cause may be granted by the local jurisdiction. The applicant is responsible for demonstrating the severity and extent of such erosion.

5. Breakwaters should generally be discouraged. In those limited instances where breakwaters are permitted, a floating design is preferred unless such a design is not technically or
ecologically practical.

6. There should be no construction of jetties, groins, or other protective structures unless there is a demonstrated need for such structures and no preferable alternatives are available.

RECOMMENDATIONS

1. Appropriate governmental agencies should be encouraged to undertake a study on the short-term and long-term effects of breakwaters, bulkheads, and other shoreline protective structures in order to develop suitable criteria or guidelines for their construction. It is recommended that bulkheads be of sloping rock riprap design.

3. It is recommended that policy be developed on the issuance of variances for bulkheads to cover such instances as those in which lands are lost to erosion where a suitable building site does not exist. Further, bulkheads or landfills may be permitted out to a line connecting existing immediately adjoining neighboring bulkheads through the variance procedures.

1. Non-structural stabilization measures are preferred over “soft” structural measures. Soft structural measures are preferred over hard structural measures.

PIERS AND MOORAGES

The following policies address piers and moorages. A majority of the single family properties on the shoreline have piers and/or moorages. The only multi-family areas, Shorewood, also has piers along its waterfront area. These waterfront components provide desirable facilities to the property owners but may, at some future date, if totally uncontrolled, result in some undesirable consequences for the Lake and the community. Further, the Shoreline Management Act directs the Local Master Program to address itself to this possibility. Therefore, it is appropriate to consider additional piers and/or moorages in light of future as well as existing uses and patterns and further, to provide general guidelines and controls for issuing permits and reviewing new development proposals.

Existing City zoning codes contain sections on pier length and setbacks as well as moorages. These should be reviewed in light of the recommendations contained in this Master Program. In addition, any relevant data generated from local and regional studies on piers and moorages should be considered in the periodic updating of the Mercer Island Master Program.

POLICIES

1. New piers and docks shall be allowed only for water-dependent uses or public access. Piers and docks associated with single family residences are considered a water-dependent use.

2. Piers and docks shall be designed and constructed to avoid or, if that is not possible, to minimize and mitigate the impacts to ecological functions.
Construction of new or expanded piers should generally be regulated, and the following limitations shall apply:

Piers should be allowed only for moorage of pleasure craft, for water-dependent recreation, for water-dependent economic activities, for utility maintenance, or for required emergency vessels.

Temporary moorages may be permitted for vessels used in the construction of shoreline facilities.

Adjoining waterfront property owners should be encouraged to share a common pier.

The size and extent of a pier should not exceed that which is required for the water-dependent purposes for which it was constructed.

In multi-family or condominium developments the ratio of moorage berths to residential units should be equal to or some fraction less than one.

2. The use of buoys for moorage should be considered as an alternative to the construction of piers for this purpose. Such buoys should be placed as close to shore as possible in order to minimize hazards to navigation.

3. Exterior lighting utilized in conjunction with piers and waterfront structures should be directed away from adjacent property and the water wherever offensive.

RECOMMENDATIONS

1. Mercer Island should establish uniform standards governing the design of piers including criteria for length, width, location, density and floating versus pile construction. It should be noted that floating piers can be rearranged, removed or relocated as needs or regulations change.

2. Consideration should be given to revising Ordinance 15, the Zoning Code, to
reduce setbacks along property lines for piers from ten (10) feet to zero (0) feet.

3. Regulation of spacing between piers and total number of piers in a designated distance should be considered.

4. Study and consideration should be given to revising Ordinance 15, the Zoning Code, as it prescribes dock length at 100 feet. Dock length should be related to intended use and water depth which may be greater or less than that prescribed by the Code.

UTILITIES

The following policies address utilities. Utilities are services which produce or carry electric power, gas, sewage, water, communications or oil products. The potential exists for combining some of these uses with other shoreline uses, including public access.

Although the diversion of sewage away from Lake Washington has substantially improved water quality in the Lake, storm sewers continue to affect water quality. As rain and other waters pass over impervious land surfaces, these waters pick up large quantities of sediments, oil, litter, heat and other contaminants. The impact of surface runoff from construction sites is of particular concern. Excessive quantities of suspended solids and oil are carried away and may significantly affect the quality of the receiving waters and associated aquatic life.

It should be noted that the Federal Water Pollution Control Act of 1972 may apply to surface runoff if there is a recognizable source of contamination (for example, business districts, parking lots, major land developments, and others). But the issue is complicated by the fact that much contamination comes from numerous sources which are small and often very difficult to identify.

POLICIES

1. Utility facilities should be designed and located to assure no net loss of shoreline ecological functions, preserve the natural landscape, and minimize conflicts with present and planned land and shoreline uses while meeting the needs of future populations.

2. Transmission facilities for the conveyance of services, such as power lines, cables, and pipelines, shall be located outside of the shoreline area where feasible, and when necessarily located within the shoreline area, shall assure no net loss of shoreline ecological functions.

3. Utilities should be located in existing rights of way and corridors whenever possible.

4. Whenever possible, consolidation of utilities should be encouraged within rights of way.
2. These facilities should be placed underground, except where it is clearly technically and economically not feasible.

3. After completion of installation or maintenance of these facilities, the shoreline area should be restored to its pre-project condition. If the previous condition is identified as being undesirable, then landscaping and other improvements should be undertaken.

4. In all new developments, the developer should install means to control the entry of contaminants into the Lake within acceptable water quality standards.

5. Prior to construction of major new outfalls, water circulation studies should be conducted to determine the best shoreline location for such facilities.

6. Major shoreline outfalls should be designed and constructed to minimize damage to the lake’s edge and be placed below the surface of the Lake where feasible.

RECOMMENDATIONS

1. The proliferation of impervious surfaces in the drainage basins serving Lake Washington should be kept to a minimum.

2. Whenever possible contaminants should be removed from surface runoff at the source of contamination. Methods of removing contaminants include oil skimmers, sediment traps, and street sweeping.

3. When contemplating the construction of a major new outfall, Metro and other appropriate governmental agencies should be consulted regarding the appropriate location and design for the outfall.

PARKING

The following policies address parking. Whether for work or leisure time, many people reach the shoreline by automobile. The use of shoreline areas for parking, however, precludes other more appropriate uses of the land. Since landfill as a means of increasing dry land areas is to be discouraged, the storage space for automobiles is limited. Thus, the number of required parking spaces for new construction can severely restrict the density in many developments.

The use of the automobiles as the primary mode of transportation is expected to continue. Any reliable public transportation system may take years to develop. The problem of the automobile as a major waterfront land user may increase as the demand for various waterfront uses and activities increases.

POLICIES
Parking facilities for motor vehicles or boat trailers should be minimized in the shoreline area.

a. Parking facilities should not be permitted along the water’s edge.

b. Upland parking facilities for shoreline activities should provide adequate pedestrian access to the shoreline.

c. Upland parking facilities should be designed and landscaped to minimize adverse impacts on the shoreline and adjacent lands.

d. Parking facilities shall be planned, located and designed where they will have the least possible adverse effect on unique or fragile shoreline features, and will not result in a net loss of shoreline ecological functions or adversely impact existing or planned water-dependent uses.

e. Parking facilities in shorelines shall minimize the environmental and visual impacts.

BOAT LAUNCHING FACILITIES

The following policies address boat launching facilities. Boating is a popular form of recreation in the Lake Washington area, and demand for boating is expected to increase as the population in the region grows. The use of boat launching facilities permits dry land storage of vessels and reduces the need for marinas and piers. At present there are 41 public boat launching ramps on Lake Washington; however, none exist on Mercer Island at present. The proposed Comprehensive Plan envisions two areas for boat launching and water-related recreation under the future I-90 bridge approaches.

POLICIES

1. Regional boat launching facilities should be provided which are adequate for the needs and carrying capacity of the Lake subject to other policies herein governing land and water use.

2. Boat launching facilities should not be constructed in unique and fragile areas.

3. Boat launching facilities should be separated from swimming areas wherever possible.

RECOMMENDATIONS

1. Mercer Island should consider the feasibility of developing one or two of their shoreline street ends for car-top boat launching.

2. Mercer Island and appropriate governmental agencies should join together in a
Lake-wide study which would optimize the number of boat-launching facilities on Lake Washington.

3. Boat launching ramps should only be provided after provisions for adequate parking, screening, and landscaping have been made.

SIGNS

Signs are public displays whose purpose is to provide information, direction, identification and advertising. Mercer Island has developed an Ordinance (No., 297) creating a Design Commission. The Ordinance enjoins the Commission to control all signs within the public and private sectors (except traffic control), to assure uniform application to achieve a desirable, balanced environment. Form, proportion, color, material, surface treatment, and position will be considered in each case. The criteria used for Design Commission sign review are the interim sign guidelines developed as a part of the Mercer Island Design Guidelines.

POLICIES

1. Off-premise and non-appurtenant signs are prohibited on the shoreline.

2. Illuminated or free standing signs or any signs extending above roof lines should be prohibited on the shoreline except for required navigational aids.

3. Advertising signs, when permitted, and approved by the Design Commission, should be limited to areas of high-intensity land use, and should be stationary, non-blinking, and a size commensurate with the structure to which it is fixed.

4. Signs advertising the sale of property are not prohibited provided they do not exceed 6 sq. ft. (e.g.: 2’ x 3’), and are limited to one street side and one water side sign.

APPENDIX ‘A’

Mercer Island’s Comprehensive Plan and Zoning Ordinance preclude economic uses of shorelines such as those permitted in Business, Planned Business, or Commercial-Office zones and community values have clearly shown an intent to perpetuate this land use pattern. However, the Regional Master Program, and, in particular, the Economic Element thereof, addresses potential development that may have a significant impact on the waters of Lake Washington and the shoreline. For these reasons the Regional Economic Element is contained herein to indicate Mercer Island’s concern for major developments that may affect the quality of Lake Washington and its tributaries.
SHORELINE CUMULATIVE IMPACTS ANALYSIS

for the City of Mercer Island
Shoreline Master Program

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SHORELINE CUMULATIVE IMPACTS ANALYSIS
FOR CITY OF MERCER ISLAND
SHORELINE MASTER PROGRAM

1 INTRODUCTION

The Shoreline Management Act guidelines require local shoreline master programs to regulate new development to “achieve no net loss of ecological function.” The guidelines (WAC 173-26-186(8)(d)) state that, “To ensure no net loss of ecological functions and protection of other shoreline functions and/or uses, master programs shall contain policies, programs, and regulations that address adverse cumulative impacts and fairly allocate the burden of addressing cumulative impacts.”

The guidelines further elaborate on the concept of net loss as follows:

“When based on the inventory and analysis requirements and completed consistent with the specific provisions of these guidelines, the master program should ensure that development will be protective of ecological functions necessary to sustain existing shoreline natural resources and meet the standard. The concept of “net” as used herein, recognizes that any development has potential or actual, short-term or long-term impacts and that through application of appropriate development standards and employment of mitigation measures in accordance with the mitigation sequence, those impacts will be addressed in a manner necessary to assure that the end result will not diminish the shoreline resources and values as they currently exist. Where uses or development that impact ecological functions are necessary to achieve other objectives of RCW 90.58.020, master program provisions shall, to the greatest extent feasible, protect existing ecological functions and avoid new impacts to habitat and ecological functions before implementing other measures designed to achieve no net loss of ecological functions.” [WAC 173-206-201(2)(c)]

In short, updated SMPs shall contain goals, policies and regulations that prevent degradation of ecological functions relative to the existing conditions as documented in that jurisdiction’s characterization and analysis report. For those projects that result in degradation of ecological functions, the required mitigation must return the resultant ecological function back to the baseline. This is illustrated in Figure 1 below. The jurisdiction must be able to demonstrate that it has accomplished that goal through an
analysis of cumulative impacts that might occur through implementation of the updated SMP. Evaluation of such cumulative impacts should consider:

(i) current circumstances affecting the shorelines and relevant natural processes;
(ii) reasonably foreseeable future development and use of the shoreline; and
(iii) beneficial effects of any established regulatory programs under other local, state, and federal laws.”

SMP Updates: Achieving No Net Loss of Ecological Function

As outlined in the Shoreline Restoration Plan prepared as part of this SMP update, the SMA also seeks to restore ecological functions in degraded shorelines. This cannot be required by the SMP at a project level, but Section 173-26-201(2)(f) of the Guidelines says: “master programs shall include goals and policies that provide for restoration of such impaired ecological functions.” See the Shoreline Restoration Plan for additional discussion of SMP policies and other programs and activities in Mercer Island that
contribute to the long-term restoration of ecological functions relative to the baseline condition.

The following information and analysis provided in this report provides an overview by proposed environment designation of existing conditions, anticipated development, relevant Shoreline Master Program (SMP) and other regulatory provisions, and the expected net impact on ecological function.

2 EXISTING CONDITIONS

The following summary of existing conditions is based on the Shoreline Analysis Report (The Watershed Company 2009a) and additional analysis needed to perform this assessment. As per the Shoreline Analysis Report, this discussion has been divided by proposed shoreline environment designations. As shown in Appendix A, these include Urban Residential, and Urban Park designations. The Shoreline Analysis Report includes an in-depth discussion of the topics below, as well as information about transportation, stormwater and wastewater utilities, impervious surfaces, and historical/archaeological sites, among others.

2.1 Urban Residential Environment

Approximately 90.4 percent of the City’s upland shoreline jurisdiction is in the Urban Residential environment.

2.1.1 Existing Land Use

The entire shoreline within the Urban Residential environment is zoned single-family residential (R-8.4, R-9.6, R-12, or R-15), while Comprehensive Plan designations include single-family residential and multi-family residential (R-8.4, R-9.6, R-12, R-15, and MF-3). Land uses are predominantly single-family residential, with one multi-family use, Covenant Shores (senior retirement facility), located along the north shore of the island. Mercerwood Shore Club and Mercer Island Beach Club, two private swimming, fitness, and tennis clubs, are also included in the Urban Residential environment designation.

In general, the land area designated as Urban Residential is fully developed. Out of 945 existing lots, only 57 (roughly 6% percent) are listed as vacant or undeveloped. Of these lots, only 10 have development potential, based on City G.I.S. analysis. Expansion, redevelopment or alteration to existing single-family units will occur over time, but the majority of this environment will remain unchanged. Since single-family residences are considered to be a preferred use along the shoreline, and thus, very few conflicts are anticipated.
Under the current SMP, the standard residential structure setback is 25 feet from the ordinary high water mark (OHWM). The actual median setback in the Urban Residential environment is 66.4 feet. Table 1 presents data on existing residential structure setbacks on parcels within the Shoreline Residential environment. As Table 1 shows, 44 (6.2%) of the 713 waterfront parcels are listed as vacant. A total of 126 (17.7%) lots have residential structures located less than 25 feet (non-conforming structures) from the OHWM. Of the remaining developed lots, 587 (82.3%) have residential structures greater than 25 feet from OHWM, 413 (58.2%) have residential structures greater than 50 feet from OHWM, 291 (40.8%) have residential structures greater than 75 feet from OHWM, and 206 (28.9%) have residential structures greater than 100 feet from OHWM.

While all areas of the City’s shoreline contain a wide variety of existing setbacks, it is fairly evident that the western shoreline contains a higher percentage of properties with smaller setbacks (those less than 50 feet), including quite a few with non-conforming structures (less than 25 feet). Conversely, areas along the north and eastern shoreline have a higher percentage of lots with structures greater than 50 feet from shore.

Table 1. Existing shoreline residential structure setback data for the Urban Residential environment.

<table>
<thead>
<tr>
<th>Measure of residential structure setback</th>
<th>Number of Waterfront Parcels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Waterfront Parcels</td>
<td>713</td>
</tr>
<tr>
<td>Vacant</td>
<td>44</td>
</tr>
<tr>
<td>Structures &lt; 25 ft from OHWM (non-conforming)</td>
<td>126</td>
</tr>
<tr>
<td>Structures ≥ 25 ft from OHWM</td>
<td>587</td>
</tr>
<tr>
<td>≥ 50 ft. from OHWM</td>
<td>415</td>
</tr>
<tr>
<td>≥ 75 ft. from OHWM</td>
<td>291</td>
</tr>
<tr>
<td>≥ 100 ft. from OHWM</td>
<td>206</td>
</tr>
</tbody>
</table>

2.1.2 Parks and Open Space/Public Access
There are no formal public parks or open spaces within the Shoreline Residential environment.

2.1.3 Shoreline Modifications
The Urban Residential environment is heavily modified with just over 82 percent of the shoreline armored at or near the OHWM (Table 2) (see Figures 7.1-7.14 in the Shoreline Analysis Report) and a pier density of approximately 47 piers per mile (Table 3). This compares to 71 percent armored and 36 piers per mile for the entire Lake Washington shoreline (Toft 2001). Thus, for Mercer Island’s Urban Residential environment, pier
density is much higher and shoreline armoring is slightly higher than the lake-wide figures.

Table 2. Shoreline armoring in the Urban Residential environment.

<table>
<thead>
<tr>
<th>Shoreline Condition (feet / % of shoreline)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Armored&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Natural / Semi-Natural&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>57,934 (82%)</td>
<td>12,444 (18%)</td>
</tr>
</tbody>
</table>

<sup>1</sup> “Armored” shorelines encompass angular or rounded granite or basalt boulder, concrete, and wood armoring types.

<sup>2</sup> “Natural/Semi-Natural” shorelines captures those areas that are not solidly armored at the ordinary high water line; they may include some scattered boulders or woody debris at or near the ordinary high water line.

Table 3. In-water structures in the Urban Residential environment.

<table>
<thead>
<tr>
<th>Total Number of Piers</th>
<th>Average Number of Piers per Mile</th>
<th>Total Overwater Cover (square feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>678</td>
<td>47</td>
<td>532,008</td>
</tr>
</tbody>
</table>

It is not uncommon around Lake Washington for some historic fills to be associated with the original bulkhead construction, usually to create a more level or larger yard. Most of these shoreline fills occurred at the time that the lake elevation was lowered during construction of the Hiram Chittenden Locks.

### 2.2 Urban Park

Approximately 9.6 percent of the City’s shoreline jurisdiction is in the Urban Park environment and includes Luther Burbank Park, which has been re-designated from Conservancy to Urban Park under this update of the Shoreline Master Program. The following data includes Luther Burbank Park in the Urban Park environment.

#### 2.2.1 Existing Land Use

As identified by the City’s Comprehensive Plan, the Urban Park environment is comprised of regional, community, neighborhood, and mini- parks. The entire shoreline within the Urban Park environment is zoned single-family residential (R-8.4, R-9.6, R-12, and R-15), while the Comprehensive Plan zones eight of the parks as “Park”, including Luther Burbank Park.
As with the other environment designations, the standard structure setback under the current SMP is 25 feet from OHWM. The actual median setback in the Urban Park environment is 115 feet, and the mean is 82 feet, based the four park properties that have structures.

### 2.2.2 Parks and Open Space/Public Access

The City parks discussed below provide public access to Lake Washington, as well as provide opportunities for water-dependent, water-related, and water-enjoyment recreational uses.

- **Clarke Beach** is an 8.8-acre grassy park with waterfront access, a swimming area, diving board, public docks, fishing access and picnicking and barbeque areas. It also provides a Lakes-to-Locks Water Trail Launch and Landing Site.
- **Groveland Beach** is a 3.2-acre park with waterfront access, a swimming area, fishing access, public dock, playground, and picnicking and barbeque areas. This park also provides a Lakes-to-Locks Water Trail Launch and Landing Site.
- **Slater Park** is a half-acre park with waterfront access, a swimming area, and a picnic area.
- **Mercer Island Boat Launch** is a public boat launch located at 3600 East Mercer Way. This park provides a Lakes-to-Locks Water Trail Launch and Landing Site.
- **Park on the Lid** is a 20-acre park that provides visual access to the water, as well as a variety of recreational opportunities including: tennis, baseball/softball, soccer, basketball, walking trails, playgrounds, and picnic areas.
- **Calkins Landing** is a waterfront street-end park with a non-guarded public beach and picnicking space. It also provides a Lakes-to-Locks Water Trail Launch and Landing Site.
- **Franklin Landing** is a street-end park with waterfront access and provides a Lakes-to-Locks Water Trail Launch and Landing Site.
- **Forest Landing** is a street-end park with waterfront access.
- **Fruitland Landing** is a street-end park that provides a Lakes-to-Locks Water Trail Launch and Landing Site.
- **Garfield Landing** is a street-end park with waterfront access.
- **Lincoln Landing** is a street-end park with a picnic area that provides a Lakes-to-Locks Water Trail Launch and Landing Site.
- **Luther Burbank Park** is approximately 78 acres in size and provides over three-quarters of a mile of shoreline for public access. A majority of the park has been left undeveloped and contains areas of natural shoreline. The park includes a swimming beach, public boat dock, off-leash dog area, public fishing pier, former...
Luther Burbank School brick dormitory, steam plant and dairy ruins, trails and other groomed areas, wetlands, watercourses, and woodlands. A total of 2 parcels make up the shoreline environment within the park.

- **Miller Landing** is a street-end park with waterfront access.
- **Proctor Landing** is a street-end park with waterfront access, fishing access, and a public dock. It also provides a Lakes-to-Locks Water Trail Launch and Landing Site.
- **Roanoke Landing** is a street-end park with waterfront access.
- **77th Avenue SE Landing** is a street-end park with waterfront access.
- **SE 56th Street Landing** is a street-end park that is primarily undeveloped.
- **SE 72nd Street Landing** is a street-end park with waterfront access.
- **South Point** is a street-end park that provides a Lakes-to-Locks Water Trail Launch and Landing Site.

As funding allows, additional street-ends, other City rights-of-way, and other opportunities may also be formally added to the public access system.

### 2.2.3 Shoreline Modifications

The Mercer Island shoreline in the Urban Park environment has been modified with approximately 35 percent of the shoreline armored (Table 4) (see Figures 7.1-7.14 in the Shoreline Analysis Report) at or near the OHWM and a total of approximately 16 piers per mile (Table 5). As expected, pier density along Mercer Island’s Urban Park environment is significantly lower than the lake-wide figures. Shoreline armoring is also significantly lower than the lake-wide average of 71 percent.

<table>
<thead>
<tr>
<th>Shoreline Condition (feet / % of shoreline)</th>
<th>Armored</th>
<th>Natural / Semi-Natural</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2,539 (35%)</td>
<td>4,716 (65%)</td>
</tr>
</tbody>
</table>

1. “Armored” shorelines encompass angular or rounded granite or basalt boulder, concrete, and wood armoring types.
2. “Natural/Semi-Natural” shorelines captures those areas that are not solidly armored at the ordinary high water line; they may include some scattered boulders or woody debris at or near the ordinary high water line.
Table 5. In-water structures in the Urban Park environment.

<table>
<thead>
<tr>
<th>Total Number of Piers</th>
<th>Average Number of Piers per Mile</th>
<th>Total Overwater Cover (square feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>16.6</td>
<td>15,861</td>
</tr>
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</table>

2.3 Biological Resources and Critical Areas

The shoreline zone itself is generally deficient in high-quality biological resources and critical areas, primarily because of the extensive residential development and its associated shoreline modifications. The highest-functioning shoreline area is within Luther Burbank Park, which has two distinct shoreline associate wetlands and a substantial amount of shoreline vegetation. Many of the parks and street-ends in the Urban Park environment have the potential for the improvement of ecological functions.

Geologically hazardous areas encumber almost the entire island. This is likely due to the steep topography of the island, as well as the crossing of the Seattle Fault along the I-90 corridor. As mentioned above, two wetlands have been inventoried within shoreline jurisdiction, both of which are located in Luther Burbank Park. There are a number of streams in Mercer Island that discharge into Lake Washington. According to a stream inventory completed by Adolfson Associates, Inc. (Adolfson Associates 2005), there are 37 perennial streams, 3 of which have documented fish use and an additional 12 which may have potential for fish use near their mouths at Lake Washington. These streams that are known to support fish use may include chinook (known juvenile use of the mouths of several streams), coho, and sockeye salmon and cutthroat trout. Many of the smaller tributaries to Lake Washington originate as hillside seeps or springs and flow seasonally or during periods of heavy rains. Many of these smaller systems are piped at some point and discharge directly to Lake Washington via a closed system.

3 Anticipated Development and Potential Effect on Function

3.1 Patterns of Shoreline Activity

The City reviewed its shoreline permitting records for the past eight years and found 200 issued Shoreline Exemptions and 86 issued Shoreline Substantial Development Permits. Table 6 presents the shoreline permitting history.

<table>
<thead>
<tr>
<th>Year</th>
<th># of Cases</th>
<th>Pier</th>
<th>Permit Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Modification/Replacement</td>
<td>New</td>
</tr>
<tr>
<td>2000</td>
<td>28</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>2001</td>
<td>42</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>2002</td>
<td>43</td>
<td>26</td>
<td>1</td>
</tr>
<tr>
<td>2003</td>
<td>43</td>
<td>24</td>
<td>4</td>
</tr>
<tr>
<td>2004</td>
<td>24</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>2005</td>
<td>28</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>2006</td>
<td>30</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>2007</td>
<td>49</td>
<td>23</td>
<td>2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>286</td>
<td>159</td>
<td>12</td>
</tr>
</tbody>
</table>

As indicated by the data presented above, new piers are very infrequent, averaging less than two proposals per year. The most commonly proposed shoreline activities are pier modifications/replacements, averaging over 19 proposals per year.

3.2 Residences

With the possible exception of limited additional residential lands being acquired for public open space, land use in the Urban Residential environment is not expected to change over the next 20 years, although some re-builds and substantial remodels are anticipated. As mentioned above, there are only 57 (6%) vacant lots in the Urban Residential environment, 44 of which are listed as vacant waterfront lots. However, only 10 of those lots have any potential for development as the remainder of the vacant lots are either in permanent tracts, easements, public ownership, or simply too small for a single-family use.

Typically, development of vacant lots into residential uses would result in replacement of pervious, vegetated areas with impervious surfaces and a landscape management regime that often includes chemical treatments of lawn and landscaping. These actions can have multiple effects on shoreline ecological functions, including:

1. Increase in surface water runoff due to reduced infiltration area and increased impervious surfaces, which can lead to excessive soil erosion and subsequent in-lake sediment deposition. This can affect the following:
   
   **Hydrologic Functions**
   
   *Storing water and sediment*

2. Reduction in ability of site to improve quality of waters passing through the untreated vegetation and healthy soils. This can affect the following:
Hydrologic Functions
Removing excess nutrients and toxic compounds

Vegetation Functions
Water quality improvement

3. Potential contamination of surface water from chemical and nutrient applications. This can affect the following:
   Vegetation Functions
   Water quality improvement

4. Elimination of upland habitat occupied by wildlife that use riparian areas. This can affect the following:
   Habitat Functions
   Physical space and conditions for life history
   Food production and delivery

Expansions and remodels of existing residences are likely to occur relatively frequently during the future. Many of these activities would not change the baseline condition of ecological function, although expansions that increase impervious surfaces may occur. Runoff from most expanded residences is clean, however, and water quantity is not an issue in the Lake Washington environment. The significance of impervious surfaces on a lake environment where water quantity is not really a factor is very diminished given the residential uses. Single-family or multi-family homes generally have clean roof and sidewalk runoff, and driveways whether 50 square feet or 5,000 square feet are typically pollution-generating surfaces only to the extent that vehicle-related pollutants are deposited on them. Most single-family homes have between two and four vehicles, regardless of the driveway area and thus the correlation between driveway area and amount of pollution is not strong. However, improperly managed runoff during and post construction could increase erosion, and could cause sediments and pollutants to enter the lake.

As mentioned above, the existing median setback in the Urban Residential environment is 66 feet. The SMP proposes a residential setback of 25 feet. Based on the City’s analysis of redevelopment potential, the resultant median setback in the Shoreline Residential environment would be approximately 59 feet. This reduction in the median setback results in a conversion of a maximum of 22 acres of space between the primary structure and the OHWM to a greater level of development. This conversion number is likely an overestimate, both in area and assumed corresponding function, as primary structures are never as wide as the lot. It also does not factor in that much of that “lost” space is already occupied by decks, paved surfaces, lawn or other improvements that have reduced or eliminated the function of that space. Finally, because of the staggered distribution of lot depths and primary structure locations, some of that space landward of a primary structure currently set back far from the water’s edge may be greatly impacted by activities on shallower adjacent lots where the structure is located closer to the water’s edge.
To address the other less direct losses to shoreline function resulting from reduction in the space between primary structures and their attendant activities and the water’s edge, the SMP contains vegetation requirements within 20 feet of Lake Washington’s ordinary high water mark for new development and redevelopment.

### 3.3 Overwater Structures

Piers can adversely affect ecological functions and habitat in the following ways:

1. Alter patterns of light transmission to the water column, affecting macrophyte growth and altering habitat for and behavior of aquatic organisms, including juvenile salmon. This can affect the following:
   - **Habitat Functions**
   - Physical space and conditions for life history
   - Food production and delivery

2. Interfere with long-shore movement of sediments, altering substrate composition and development. This can affect the following:
   - **Hydrologic Functions**
   - Attenuating wave energy

3. Contribute to contamination of surface water from chemical treatments of structural materials. This can affect the following:
   - **Hydrologic Functions**
   - Removing excess nutrients and toxic compounds

4. Pier lighting is known to affect fish movement and predation. This can affect the following:
   - **Habitat Functions**
   - Physical space and conditions for life

Overwater structures encompass a variety of uses, from in-water structures, such as fixed-pile piers and floating docks, to moorage covers, such as canopies and boathouses with associated boatlifts. It is difficult to determine exactly how many waterfront properties do not have a pier or pier access, particularly as many piers are located near property lines and thus it is possible that those may be shared with the adjacent property. In total, it is estimated that out of the 713 waterfront residential properties, approximately 60 (8%) parcels do not have a pier.

Given the current rate of new pier proposals, only about 30 new piers are likely over the next 20 years. If all of those properties add a pier, that would represent a 4.2 percent increase in the total number of piers in the Shoreline Residential environment, with a final density of 49 piers per mile.
Under the proposed SMP, new piers will be smaller than piers approved under the current SMP. New and replacement piers will also include light-transmitting decking material, which will reduce the impact of the overwater cover. Nevertheless, if new piers were the only pier-related activity, ecological function would still decline. The decline would be due to an unavoidable net increase in the number of in-water structures and overwater cover that can be minimized but not entirely mitigated.

However, pier repair and pier maintenance activities are more common, and it is anticipated that pier replacement proposals may become even more common as existing piers degrade or do not meet the property owner’s needs in their current configuration or location. Under the proposed SMP, replacement piers are considered new moorage structures and must meet the dimensional criteria for new private piers or be otherwise approved by State and Federal agencies (Washington Department of Fish and Wildlife and the U.S. Army Corps of Engineers). Any pier repair which involves the replacement of more than 40 percent of the pier support piles must also meet the dimensional criteria of new private piers.

A summary of the quantitative analysis is provided below (Table 7, full analysis provided in Appendix B, based on City trends and assumptions. Based on the trends and assumptions made regarding new piers, pier replacement, pier repairs, and pier additions, the total area of effective overwater cover would decline by 2.8 percent over a 20-year time period.

Table 7. Summary of Pier Analysis

<table>
<thead>
<tr>
<th>Existing Overwater Coverage</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total existing overwater coverage - single-family</td>
<td>683,697</td>
</tr>
<tr>
<td>Total existing overwater coverage - semi-private</td>
<td>15,183</td>
</tr>
<tr>
<td>Total existing overwater coverage - public</td>
<td>15,861</td>
</tr>
<tr>
<td><strong>Total existing overwater coverage (square footage)</strong></td>
<td><strong>714,741</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Effective Overwater Coverage in 20 years</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total overwater cover in 20 years - single-family</td>
<td>664,759</td>
</tr>
<tr>
<td>Total overwater cover in 20 years - semi-private</td>
<td>15,010</td>
</tr>
<tr>
<td>Total overwater cover in 20 years - public</td>
<td>14,858</td>
</tr>
<tr>
<td><strong>Total effective overwater coverage in 20 years (square footage)</strong></td>
<td><strong>694,627</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Change in Effective Overwater Coverage in 20 years</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Net change in overwater cover - single-family</td>
<td>-18,938</td>
</tr>
<tr>
<td>Net change in overwater cover - semi-private</td>
<td>-173</td>
</tr>
<tr>
<td>Net change in overwater cover - public</td>
<td>-1,003</td>
</tr>
<tr>
<td><strong>TOTAL CHANGE IN EFFECTIVE OVERWATER COVER IN 20 YEARS</strong></td>
<td><strong>-20,115</strong></td>
</tr>
<tr>
<td><strong>PERCENTAGE DECREASE IN OVERWATER COVER IN 20 YEARS</strong></td>
<td><strong>-2.8%</strong></td>
</tr>
</tbody>
</table>

Note: “Effective” overwater cover is a measure of the actual solid footprint that shades the water, rather than the structure’s total footprint. Use of grated decking with a minimum of 40% open space reduces the adverse impacts of the overwater structure, even though the traditional structure footprint may increase.
The proposed regulations (MICC 19.07.110) have specifically been crafted to avoid and minimize the following specific potential impacts as outlined below:

1. Growth of aquatic vegetation: Overwater cover is minimized through size and height restrictions for new piers restricting size of replacement structures and requiring grated decking (MICC 19.07.110(D)(1) Table B).

2. Sediment movement. Boatlifts are restricted in the nearshore area (MICC 19.07.110(D)(1) Table B) The use of jetties or breakwaters are prohibited in all environments.

3. Chemical contamination: Piers and other structures shall be constructed of materials that will not adversely affect water quality (MICC 19.07.110(D)(3)b)).

### 3.4 Shoreline Stabilization

Bulkheads typically have the following effects on ecological functions:

1. Reduction in nearshore habitat quality for juvenile salmonids and other aquatic organisms. Specifically, shoreline complexity and emergent vegetation that provides forage and cover may be reduced or eliminated. Elimination of shallow-water habitat may also increase vulnerability of juvenile salmonids to aquatic predators. This can affect the following:
   - **Habitat Functions**
     - Physical space and conditions for life history
     - Food production and delivery

2. Reduction of natural sediment recruitment from the shoreline. This recruitment is necessary to replenish substrate and preserve shallow water conditions. This can affect the following:
   - **Habitat Functions**
     - Physical space and conditions for life history

3. Increase in wave energy at the shoreline if shallow water is eliminated, resulting in increased nearshore turbulence that can be disruptive to juvenile fish and other organisms. This can affect the following:
   - **Hydrologic Functions**
     - Attenuating wave energy
   - **Habitat Functions**
     - Physical space and conditions for life history

Repairs and replacements of existing bulkheads perpetuate those conditions. There have been 55 bulkhead modification proposals in the last eight years, and future proposals are likely to be repairs and replacements (based on trends observed in other Lake Washington jurisdictions with similar shoreline activity). Applications for new
bulkheads are likely to be infrequent as the majority of the shoreline has already been developed with 82 percent armoring in the Urban Residential environment.

The updated SMP states that new shoreline stabilization would only be allowed when “conclusive evidence, documented by a geotechnical analysis, is provided that the structure is in danger from shoreline erosion caused by waves...” It must be demonstrated in a study prepared by a qualified professional that the proposed stabilization is the least harmful method to the environment. Replacement bulkheads must generally be installed in the same location as the existing bulkhead, or farther landward, and must also demonstrate that a loss of ecological functions will not occur. Replacement bulkheads would not be allowed to encroach farther waterward, except that soft shoreline stabilization measures that provide restoration of shoreline ecological functions may be permitted waterward of the ordinary high water mark. Finally, all shoreline stabilization proposals must ensure that there will be no net loss of ecological functions.

Over time, the combined effects of the City’s proposed SMP will likely result in a reduction over time of the net amount of hardened shoreline at the ordinary high water mark and an increase in shallow-water habitat.

4 PROTECTIVE SMP PROVISIONS

4.1 Environment Designations

The first line of protection of the City’s shorelines is the environment designation assignments. Table 8 below identifies the prohibited and allowed uses and modifications in each of the shoreline environments, and clearly shows a hierarchy of higher-impacting uses and modifications being allowed in the already highly altered shoreline environments. This strategy helps to minimize cumulative impacts by concentrating development activity in lower functioning areas that are not likely to experience function degradation with incremental increases in new development.

Table 8. Shoreline Use Matrix

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE</td>
<td>Categorically Exempt</td>
</tr>
<tr>
<td>SEP</td>
<td>Shoreline Exemption Permit</td>
</tr>
<tr>
<td>SDP</td>
<td>Substantial Development Permit</td>
</tr>
<tr>
<td>SEPA</td>
<td>Required Review under the State Environmental Policy Act</td>
</tr>
<tr>
<td>NP</td>
<td>Not Permitted Use</td>
</tr>
</tbody>
</table>
### Designated Environments

<table>
<thead>
<tr>
<th>Shoreline Use</th>
<th>Designated Environments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Park Environment</td>
<td>Urban Residential Environment</td>
</tr>
<tr>
<td>Single-family residential and associated appurtenances</td>
<td>NP</td>
</tr>
<tr>
<td>CE or SDP if the construction is not by an owner, lessee or contract purchaser for his/her own use or if alteration applies.</td>
<td></td>
</tr>
<tr>
<td>Multifamily residential</td>
<td>NP</td>
</tr>
<tr>
<td>SDP, SEPA</td>
<td></td>
</tr>
<tr>
<td>Public and private recreational facilities and parks</td>
<td>SDP, SEPA</td>
</tr>
<tr>
<td>SDP, SEPA</td>
<td></td>
</tr>
<tr>
<td>Moorage facilities (including piers, docks, piles, lift stations, or buoys)</td>
<td>SDP, SEPA</td>
</tr>
<tr>
<td>SDP, SEPA</td>
<td></td>
</tr>
<tr>
<td>Commercial marinas, moorage and storage of commercial boats and ships</td>
<td>NP</td>
</tr>
<tr>
<td>NP</td>
<td></td>
</tr>
<tr>
<td>Bulkheads and shoreline protective structures</td>
<td>SDP, SEPA</td>
</tr>
<tr>
<td>SEP, SEPA</td>
<td></td>
</tr>
<tr>
<td>Breakwaters and jetties</td>
<td>NP</td>
</tr>
<tr>
<td>NP</td>
<td></td>
</tr>
<tr>
<td>Utilities</td>
<td>SDP, SEPA</td>
</tr>
<tr>
<td>CE, SEP or SDP, SEPA</td>
<td></td>
</tr>
<tr>
<td>Dredging</td>
<td>SDP, SEPA</td>
</tr>
<tr>
<td>SDP, SEPA</td>
<td></td>
</tr>
<tr>
<td>Alterations over 250 cubic yards – outside the building footprint</td>
<td>SDP, SEPA</td>
</tr>
<tr>
<td>SDP, SEPA</td>
<td></td>
</tr>
<tr>
<td>Boating Facilities</td>
<td>SDP, SEPA</td>
</tr>
<tr>
<td>SDP, SEPA</td>
<td></td>
</tr>
<tr>
<td>Transportation and Parking</td>
<td>SDP, SEPA</td>
</tr>
<tr>
<td>SDP, SEPA</td>
<td></td>
</tr>
<tr>
<td>Light Rail Transit Facilities</td>
<td>SDP, SEPA</td>
</tr>
<tr>
<td>SDP, SEPA</td>
<td></td>
</tr>
</tbody>
</table>

If a use is not listed in this matrix, it shall be considered as a conditional use, pursuant to WAC 173-26-160.

### 4.2 General Goals, Policies and Regulations

The SMP contains numerous general policies, with supporting regulations (see SMP), intended to protect the ecological functions of the shoreline and prevent adverse cumulative impacts. These policies are summarized below.
• All activities, development and redevelopment within the City’s shoreline jurisdiction should be designed to ensure no net loss of shoreline ecological functions.
• Standards for density or minimum frontage width, setbacks, lot coverage limitations, buffers, shoreline stabilization, vegetation conservation, critical area protection, and water quality shall be set to assure no net loss of shoreline ecological functions, taking into account the environmental limitations and sensitivity of the shoreline area, the level of infrastructure and services available, and other comprehensive planning considerations.
• Standards should be established for shoreline stabilization measures, vegetation conservation, water quality, and shoreline modifications. These standards shall ensure that new development does not result in a net loss of shoreline ecological functions or further degrade other shoreline values.
• Existing natural resources should be conserved, consistent with private property rights.
• Existing and future activities on Lake Washington and its shoreline should be designed to minimize adverse effects on the natural systems.
• Public access to and along the water’s edge should be consistent with the public safety, private property rights, and conservation of unique or fragile areas.
• Develop efficient circulation systems in a manner that assures the safe movement of people and goods while minimizing adverse effects on shoreline use, developments and shoreline ecological functions
• Fills shall be located, designed, and constructed to protect shoreline ecological functions and ecosystem-wide processes, including channel migration.
• Piers and docks shall be designed and constructed to avoid or, if that is not possible, to minimize and mitigate the impacts to ecological functions.

• Utility facilities should be designed and located to assure no net loss of shoreline ecological functions, preserve the natural landscape, and minimize conflicts with present and planned land and shoreline uses while meeting the needs of future populations.
• Critical areas within shoreline jurisdiction will be regulated per MICC 19.07.
5  EFFECT OF OTHER DEVELOPMENT AND
RESTORATION ACTIVITIES/PROGRAMS

5.1 Washington Department of Fish and Wildlife
The Washington Department of Fish and Wildlife has jurisdiction over in- and over-
water activities up to and including the ordinary high water mark, as well as any other
activities that could “use, divert, obstruct, or change the bed or flow of state waters”
(http://www.wdfw.wa.gov/hab/hpapage.htm). Practically speaking, these activities in
the City of Mercer Island include, but are not limited to, installation or modification of
shoreline stabilization measures, piers and accessory structures such as boatlifts,
culverts, and bridges and footbridges. These types of projects must obtain a Hydraulic
Project Approval from WDFW, which will contain conditions intended to prevent
damage to fish and other aquatic life, and their habitats. In some cases, the project may
be denied if significant impacts would occur that could not be adequately mitigated.

5.2 Washington Department of Ecology
The Washington Department of Ecology may review and condition a variety of project
types in Mercer Island, including any project that needs a permit from the U.S. Army
Corps of Engineers (see below), any project that requires a shoreline Conditional Use
Permit or Shoreline Variance, and any project that disturbs more than 1 acre of land.
Project types that may trigger Ecology involvement include pier and shoreline
modification proposals and wetland or stream modification proposals, among others.
Ecology’s three primary goals are to: 1) prevent pollution, 2) clean up pollution, and 3)
support sustainable communities and natural resources
(http://www.ecy.wa.gov/about.html). Their authority comes from the State Shoreline
Management Act, Section 401 of the Federal Clean Water Act, the Federal Water
Pollution Control Act, the Federal Coastal Zone Management Act of 1972, the State
Environmental Policy Act, the Growth Management Act, and various RCWs and WACs
of the State of Washington.

5.3 U.S. Army Corps of Engineers
The U.S. Army Corps of Engineers has jurisdiction over any work in or over navigable
waters (including Lake Washington) under Section 10 of the Federal Rivers and Harbors
Act of 1899, and discharges of dredged or fill material into waters of the United States
(including Lake Washington, streams, and non-isolated wetlands) under Section 404 of

As a federal agency, any activity within Corps jurisdiction that could affect species listed
under the Federal Endangered Species Act must be consulted on with the National
Marine Fisheries Service and the U.S. Fish and Wildlife Service. These agencies ensure that the project includes impact minimization and compensation measures for protection of listed species and their habitats. Since salmon were first listed in Puget Sound, the Corps and the other federal agencies have been working closely to streamline the permitting process, particularly for new pier and pier modification projects. The result of those efforts for Lake Washington has culminated in Regional General Permit (RGP) 3.

6 RESTORATION OPPORTUNITIES

As discussed above, one of the key objectives that the SMP must address is “no net loss of ecological shoreline functions necessary to sustain shoreline natural resources” (Ecology 2004). However, SMP updates seek not only to maintain conditions, but to improve them:

“…[shoreline master programs] 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 (WAC 173-26-201(c)).”

The guidelines state that “master programs shall 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” (WAC 173-26-201(2)(f)). Pursuant to that direction, the City has prepared a Shoreline Restoration Plan (The Watershed Company 2009b).

Practically, it is not always feasible for shoreline developments and redevelopments to achieve no net loss at the site scale, particularly for those developments on currently undeveloped properties or a new pier or bulkhead. The Restoration Plan, therefore, can be an important component in making up that difference in ecological function that would otherwise result just from implementation of the SMP. The Restoration Plan represents a long-term vision for restoration that will be implemented over time, resulting in incremental improvement over the existing conditions.

The Shoreline Restoration Plan identifies a number of project-specific opportunities for restoration on both public and private properties inside and outside of shoreline jurisdiction, and also identifies ongoing City programs and activities, non-governmental organization programs and activities, and other recommended actions consistent with the Final Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook Salmon Conservation Plan.
7 ASSESSMENT OF CUMULATIVE IMPACTS

The following table (Table 9) summarizes for each environment designation the existing conditions (Chapter 2 above), anticipated development (Chapter 3 above), relevant Shoreline Master Program (SMP) and other regulatory provisions, and the expected net impact on ecological function. The complete assessment of overwater structure impacts is presented in Section 3.3, organized by pier type rather than environment designation. The discussion of existing conditions is based on the Final Shoreline Analysis Report (The Watershed Company 2009a), and additional analysis conducted to perform this assessment. The Analysis Report includes a more in-depth discussion of the topics below, as well as information about transportation, stormwater and wastewater utilities, impervious surfaces, and historical/archaeological sites, among others.
### Table 9. Qualitative Assessment of Cumulative Impacts

<table>
<thead>
<tr>
<th>Existing Conditions</th>
<th>Likely Development / Functions or Processes Potentially Impacted</th>
<th>Effect of SMP Provisions</th>
<th>Effect of Other Regulatory Programs and Non-Regulatory Restoration Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Urban Residential</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This segment is dominated by single-family homes and is almost entirely built out. Of the 44 vacant waterfront lots, only 10 have development potential (less than 1% of all lots in shoreline jurisdiction). Nearly the entire shoreline has been altered with a variety of armoring and alteration types, including piers, boatlifts, boathouses, and moorage covers. Approximately 92 percent of all waterfront residences already have a pier and the shoreline is approximately 82 percent armored.</td>
<td>Several facets of the SMP development standards for the Urban Residential environment are aimed at minimizing potential impacts to shoreline ecological functions that are discussed in Sections 3.2, 3.3, and 3.4. Residential setbacks are one of the key components to assess overall impacts to ecological function as they relate to many of the items listed below. Structure setbacks are regulated under MICC 19.07.100(B)(1). Under these scenarios and an anticipated redevelopment of up to 186 lots, the median residential setback would change from 66 feet to 59 feet.</td>
<td>Other Regulatory Programs: Any in- or over-water proposals, primarily piers and shoreline reconstruction, would require review not only by the City of Mercer Island, but also by the WDFW, the U.S. Army Corps of Engineers (Corps), and/or Ecology. Each of these agencies is charged with regulating and/or protecting streams, lakes, and wetlands, and would impose certain design or mitigation requirements on applicants. Due to Endangered Species Act consultation requirements with the U.S. Fish and Wildlife Service and National Marine Fisheries Service, the Corps has developed recommendations to minimize project impacts. These include Regional General Permit 3 (RGP-3) for overwater structures and a Programmatic Biological Evaluation for shoreline stabilization. WDFW also follows similar design standards as the Corps. The City of Mercer Island has included some of these design elements within the proposed SMP. These agencies would also impose certain design and mitigation requirements on a proposed project to minimize adverse impacts.</td>
<td></td>
</tr>
<tr>
<td><strong>FUTURE DEVELOPMENT in the Urban Residential environment</strong> will likely be restricted to remodeled or expanded residences since only ten vacant waterfront lots (&lt;1 percent) have development potential. Based on permit data from 2000 – 2007, the City anticipates that approximately 25 percent of existing developed lots will likely redevelop over the next 20 years. No change in uses is anticipated.</td>
<td>IMPERVIOUS SURFACE INCREASES: As described in Section 3.2, new and re-development may be accompanied by: 1. Impervious surface increases 2. Vegetation removal 3. Chemical contaminant increases 4. Growth of aquatic vegetation 5. Juvenile salmon migration and behavior 6. Sediment movement 7. Chemical contamination 8. Shoreline complexity 9. Wave attenuation</td>
<td>Expansions and remodels of existing residences are likely to occur relatively frequently during the future. Many of these activities would not change the baseline condition of ecological function, although expansions that increase impervious surfaces may occur. The significance of impervious surfaces on a lake environment where water quantity is not really a factor is diminished given the residential uses. Single-family or multi-family homes generally have clean roof and sidewalk runoff. Driveways are typically pollution-generating surfaces only to the extent that vehicle-related pollutants are deposited on them. Most single-family homes typically have between two and four vehicles, regardless of the driveway area and thus the correlation between driveway area and amount of pollution is not strong. However, improperly managed runoff during and post construction could increase erosion, and could cause sediments and pollutants to enter the lake.</td>
<td></td>
</tr>
<tr>
<td>Existing Conditions</td>
<td>Likely Development / Functions or Processes Potentially Impacted</td>
<td>Effect of SMP Provisions</td>
<td>Effect of Other Regulatory Programs and Non-Regulatory Restoration Actions</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------------------------------------------------</td>
<td>--------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>2. Vegetation Removal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mercer Island’s shoreline is largely developed with single family residences, many of which contain lawn areas abutting the shoreline. As redevelopment occurs, on a whole, structures may move closer to the shoreline, which will result in some vegetation removal. Since lawn areas provide little ecological function, and are a source for water polluting fertilizers, reduction of these areas will have little negative effect.</td>
<td></td>
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<tr>
<td></td>
<td>To address any ecological impact that may occur, the SMP requires new development and redevelopment to provide vegetation as follows: 25% of the 20 feet closest to the OHW shall contain vegetation coverage. The five feet nearest the OHW shall contain at least 25% native coverage. A shoreline vegetation plan shall be submitted to the City for approval. A variety of ground cover, shrubs, and trees that provides lake shading is encouraged. This regulation, along with the City’s Restoration Plan, a no-net loss of shoreline functions and values related to vegetation should be met.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Chemical contaminant increases</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>It is anticipated that new development and redevelopment will not likely increase the level of potential chemical applications, such as fertilizers, to the shoreline jurisdiction area. To address storm water discharges, the SMP has included by reference the City’s Storm Water Management Program (MICC 19.15), which utilizes Best Management Practices as set forth by the 2005 Stormwater Management Manual for Western Washington by the Washington State Department of Ecology.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Urban Park**

This segment contains land areas in shoreline jurisdiction generally dominated by City parks, street-ends, and open spaces. The three largest City parks include FUTURE DEVELOPMENT in the Urban Park environment will be limited. There will be a number of park improvements, including restoration work at Groveland and Clarke beach parks, which may Similar to the Shoreline Residential environment described above, SMP development standards for the Urban Park environment are also aimed at minimizing potential impacts to shoreline ecological functions that result from shoreline structures, armoring, and overwater cover. Other Regulatory Programs: Any in- or over-water proposals, primarily piers and shoreline reconstruction, would require review not only by the City of Mercer Island, but also by the WDFW, the Corps, and/or Ecology. Each of these agencies is charged with regulating and/or protecting streams, lakes, and wetlands, and would impose certain design or mitigation requirements on applicants. Due to Endangered Species Act consultation requirements with the U.S. Fish and Wildlife Service and National Marine
<table>
<thead>
<tr>
<th>Existing Conditions</th>
<th>Likely Development / Functions or Processes Potentially Impacted</th>
<th>Effect of SMP Provisions</th>
<th>Effect of Other Regulatory Programs and Non-Regulatory Restoration Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groveland Beach Park, Clarke Beach Park, and Luther Burbank Park.</td>
<td>Include improvements to shoreline armoring and overwater cover. No change in use is anticipated in Clarke Beach Park and Groveland Park. Recent shoreline restoration activities in Luther Burbank Park took place in 2008 as part of mitigation for future sewer lake line repairs expected to occur in 2009/2010. Other restoration activities are expected as part of implementation of the Park Master Plan, including extensive re-vegetation of shoreline areas. No modification to existing shoreline armoring is anticipated. Any future modifications to the three existing pier structures would likely involve installation of grated decking which would improve light transmission. No change in use is anticipated in Luther Burbank Park.</td>
<td>These are regulated under MiCC 19.07.110 As already mentioned, new developments within the parks are not anticipated and redevelopment is not likely to result in structures being located closer to the water’s edge than the current condition, so the existing average setback would not change. Several of the parks, street-ends, and open spaces also include watercourses, which have additional protections under MiCC 19.07.070. Luther Burbank Park also includes watercourses and wetlands, which have additional protections under MiCC 19.07.070 and MiCC 19.07.080. 1. <strong>Impervious surface</strong> It is anticipated that little change in impervious surface in the Urban Park environment will occur. 2. <strong>Vegetation/Habitat</strong> As previously mentioned, many of the activities in the parks are intended to improve ecological functions, and would be conducted voluntarily beyond the SMP requirements for mitigation tied to any development.</td>
<td>Fisheries Service, the Corps has developed recommendations to minimize project impacts. These include Regional General Permit 3 (RGP-3) for overwater structures and a Programmatic Biological Evaluation for shoreline stabilization. While these recommendations are intended for single-family property, many of the same guidelines are also applicable to public and commercial property. WDFW also follows similar design standards as the Corps and the City of Mercer Island has included some of these design elements within the proposed SMP. These agencies would also impose certain design and mitigation requirements on a proposed project to minimize adverse impacts. Outside of the immediate shoreline zone, short- and long-term stormwater management per the latest Ecology Stormwater Manual would minimize/eliminate construction-related stormwater runoff impacts and may slowly improve the quality of any waters reaching the shoreline. <strong>Non-Regulatory Restoration Actions</strong> The City’s Shoreline Restoration Plan (The Watershed Company 2009b) includes goals and objectives with an emphasis on public education and involvement intended to promote voluntary shoreline enhancement and restoration. The Restoration Plan includes two specific projects. One at Groveland Beach Park to remove invasive vegetation, replace worn playground elements, and prepare shoreline improvements. The second at Clarke Beach Park to remove a concrete retaining wall/bulkhead along the shoreline. Other priorities listed in the Restoration Plan include: invasive vegetation species management, reductions in overwater cover and in-water structure, reductions in shoreline armoring, and improvements in stormwater discharges. These measures would improve shoreline processes and ecological functions for fish and wildlife. The City’s Parks Department also has a number of other partnerships or efforts that will likely result in additional improvements to parks that improve ecological function, including Forest Stewardship, Adopt-a-Park, and EarthCorps.</td>
</tr>
<tr>
<td>Existing Conditions</td>
<td>Likely Development / Functions or Processes Potentially Impacted</td>
<td>Effect of SMP Provisions</td>
<td>Effect of Other Regulatory Programs and Non-Regulatory Restoration Actions</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------------------------------------------------</td>
<td>--------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>9. Wave attenuation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
8 NET EFFECT ON ECOLOGICAL FUNCTION

Table 12 above examines development and redevelopment potential by environment designation, except for piers and shoreline armoring which are addressed collectively in Section 3.3 and 3.4. It is clear from Table 9 that the City is already highly developed, and has limited potential for new development on a small number of vacant lots. Most of the ten vacant lots with development potential have a mixture of lawn and vegetation, including some trees. Development of these lots would increase impervious surfaces, and may reduce vegetation and alter existing shoreline functions in those specific areas.

Collectively, the redevelopment potential may shift development closer to the water’s edge, but the condition of the remaining space between the water and structures will be improved overall through vegetation requirements within 20 feet of Lake Washington’s ordinary high water mark for new development and redevelopment, the City-wide tree retention requirements under MICC 19.10, and the City’s Restoration Plan.

In the long term, impervious surfaces currently located in the existing and proposed setbacks may be removed.

The effective overwater coverage (but not the actual footprints) should also decrease over the next 20 years, even with installation of new piers and pier additions due to the required installation of grated decking during redevelopment of existing docks and the relatively small number of new docks.

Because of the increased requirements to demonstrate need for new shoreline armoring and the requirements to consider soft solutions for new and replacement shoreline armoring, the City’s overall shoreline hardening condition will at worst remain the same, and realistically will improve over time.

Potential for improvement of shoreline ecological functions is currently greatest on City park properties, with installation of native vegetation and removal of invasive vegetation and enhancement of currently armored shoreline.

Even without implementation of the Restoration Plan, the proposed Shoreline Master Program should result in maintenance of the current level of ecological function, and possibly even improvements over time. However, when paired with the Restoration Plan, ecological function of the City’s Lake Washington shoreline is certain to improve.

Therefore, no net loss of shoreline ecological functions is anticipated.
9 REFERENCES


City of Mercer Island. 2007. City of Mercer Island Capital Improvement Program.


10 LIST OF ACRONYMS AND ABBREVIATIONS

CIP ............................... Capital Investment Program
Corps ............................... U.S. Army Corps of Engineers
Ecology ............................... Washington Department of Ecology
OHWM ............................... ordinary high water mark
SMP ............................... Shoreline Master Program
WDFW ............................... Washington Department of Fish and Wildlife
APPENDIX A

Shoreline Environment Designation Map
Appendix F - Proposed Shoreline Environment Designations

Shoreline Master Program - City of Mercer Island

All areas within shoreline jurisdiction that are not mapped and/or designated are automatically assigned the "Urban Residential" designation until the shoreline can be redesignated through a master program amendment. In the event of a mapping error, the City of Mercer Island shall rely upon common boundary descriptions and the criteria contained in RCW 90.58.030(2) and Chapter 173-22 WAC pertaining to determinations of shorelands, as amended, rather than the incorrect or outdated map.

Waterward extent of Shoreline Management Area is measured 200 ft landward of the Ordinary High Water Mark.

Waterward extent of City jurisdiction is measured to the middle of Lake Washington, pursuant to RCW 35.21.160.

Waterward extent of Shoreline Management Area is measured from the Ordinary High Watermark to the middle of Lake Washington.

1 Landward extent of Shoreline Management Area is measured 200 ft landward of the Ordinary High Water Mark.

2 Waterward extent of Shoreline Management Area is measured from the Ordinary High Watermark to the middle of Lake Washington.

3 Urban Park Environment

Urban Residential Environment

Watercourse

Major Roads

Minor Roads

 Produced by the City of Mercer Island, March 2010.
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Prepared by: IGS Information & Geographic Services

11131490 Archival Print: Printed on 10/21/2003 at 2:36 PM. No changes since then.
APPENDIX B

PIER ANALYSIS
### New Single-Family Overwater Structures

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total # of new single-family piers possible</td>
<td>30</td>
</tr>
<tr>
<td>Total square footage allowed for a new single-family pier (fully grated)</td>
<td>1,000</td>
</tr>
<tr>
<td>Total # of new joint-use piers possible</td>
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</tr>
<tr>
<td>Total square footage allowed for new joint-use pier (fully grated)</td>
<td>1,000</td>
</tr>
<tr>
<td>Total new square footage for new piers</td>
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<tr>
<td>Total # of new covered moorages possible</td>
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<td>Total square footage allowed for a new covered moorage</td>
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<tr>
<td>Total new square footage for new covered moorage</td>
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</tr>
<tr>
<td>Total new effective overwater square footage (see open space value)</td>
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</tr>
<tr>
<td>Total effective overwater cover (s.f.) for new piers</td>
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### Replacement of Single-Family Overwater Structures

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total # of existing single-family piers</td>
<td>678</td>
</tr>
<tr>
<td>Percentage of piers to be replaced</td>
<td>20%</td>
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<tr>
<td>Total # of piers to be replaced</td>
<td>136</td>
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<tr>
<td>Average replacement pier size (assumes piers to be rebuilt at same size as existing, but fully grated)</td>
<td>828</td>
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<tr>
<td>Total square footage fully grated</td>
<td>828</td>
</tr>
<tr>
<td>Total square footage of replacement piers (same as existing footage)</td>
<td>112,277</td>
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<td>Effective overwater coverage of replacement piers (see open space value)</td>
<td>67,366</td>
</tr>
<tr>
<td>Effective reduction in coverage from replacement</td>
<td>44,911</td>
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</table>

### Repair of Single-Family Overwater Structures

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total # of existing single-family structures</td>
<td>678</td>
</tr>
<tr>
<td>Percentage of existing piers to be replaced with grated decking in nearshore 30 feet (area assumption to right)</td>
<td>30%</td>
</tr>
<tr>
<td>Total # of piers to be repaired</td>
<td>203</td>
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<tr>
<td>Total square footage of decking to be replaced with grating</td>
<td>58,579</td>
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<tr>
<td>Effective overwater coverage of replaced decking (see open space value)</td>
<td>35,148</td>
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<td>Effective reduction in coverage from repair</td>
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### Additions to Single-Family Overwater Structures

<table>
<thead>
<tr>
<th>Description</th>
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<tbody>
<tr>
<td>Total # of existing single-family structures</td>
<td>678</td>
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<tr>
<td>Percent of existing piers expected to propose additions</td>
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<td>Total # of piers with additions</td>
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<td>20,340</td>
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<td>Description</td>
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<td>-----------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Total square footage fully grated</td>
<td>20,340</td>
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<tr>
<td>Total new effective overwater cover (see open space value)</td>
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<tr>
<td><strong>Effective increase in coverage from additions</strong></td>
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<tr>
<td><strong>Total square footage of existing piers</strong></td>
<td>560,236</td>
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<tr>
<td><strong>Total square footage of existing covered moorage</strong></td>
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<tr>
<td><strong>Increase in effective overwater cover based on new piers</strong></td>
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<td><strong>Reduction in effective overwater cover based on replacements</strong></td>
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<tr>
<td><strong>Reduction of effective overwater cover based on repairs</strong></td>
<td>-23,432</td>
</tr>
<tr>
<td><strong>Increase in effective overwater cover based on pier additions</strong></td>
<td>12,204</td>
</tr>
<tr>
<td><strong>TOTAL FINAL EFFECTIVE OVERWATER COVER</strong></td>
<td>664,759</td>
</tr>
<tr>
<td><strong>NET CHANGE IN EFFECTIVE OVERWATER COVER</strong></td>
<td>-18,938</td>
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<tr>
<td></td>
<td>Repair of Semi-private Overwater Structures</td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>4</td>
<td>Total # of existing semi-private structures</td>
</tr>
<tr>
<td>5</td>
<td>Total square footage of structures</td>
</tr>
<tr>
<td>6</td>
<td>Average square footage of semi-private structures</td>
</tr>
<tr>
<td></td>
<td>Percentage of existing piers to be replaced with grated decking in nearshore 30 feet (area assumption to right)</td>
</tr>
<tr>
<td>7</td>
<td>Average pier width in nearshore 30 feet</td>
</tr>
<tr>
<td>8</td>
<td>Total square footage of decking to be replaced with grating</td>
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<tr>
<td>9</td>
<td>Effective overwater coverage of replaced decking (see open space value)</td>
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<td></td>
<td>Effective reduction in coverage from repair</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>Total Cover Calculation for Semi-Private Structures</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>14</td>
<td>Total square footage of existing semi-private piers</td>
<td>15,183</td>
</tr>
<tr>
<td>15</td>
<td>Reduction of effective overwater cover based on repairs</td>
<td>-173</td>
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<td>16</td>
<td>TOTAL FINAL EFFECTIVE OVERWATER COVER</td>
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<tr>
<td>17</td>
<td>NET CHANGE IN EFFECTIVE OVERWATER COVER</td>
<td>-173</td>
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### Repair of Public Overwater Structures

<table>
<thead>
<tr>
<th>Description</th>
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<tbody>
<tr>
<td>Total # of existing public structures</td>
<td>12</td>
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<tr>
<td>Total square footage of structures</td>
<td>15,861</td>
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<tr>
<td>Average square footage of public structures</td>
<td>1,322</td>
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<tr>
<td>Percentage of existing decking to be replaced with grated decking</td>
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<tr>
<td>Total square footage of decking to be replaced</td>
<td>4,758</td>
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<td>Effective overwater coverage of replaced decking (see open space value)</td>
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<td><strong>Effective reduction in coverage from repair</strong></td>
<td>1,903</td>
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### Additions to Public Overwater Structures

<table>
<thead>
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<th>Description</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Total # of additions to piers possible</td>
<td>2</td>
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<tr>
<td>Total square footage estimated for new additions</td>
<td>1,500</td>
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<tr>
<td>Total new effective overwater cover (see open space value)</td>
<td>900</td>
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<tr>
<td><strong>Effective increase in coverage from additions</strong></td>
<td>900</td>
</tr>
</tbody>
</table>

### Total Cover Calculation for Public Structures

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total square footage of existing public piers</td>
<td>15,861</td>
</tr>
<tr>
<td>Reduction of effective overwater cover based on repairs</td>
<td>-1,903</td>
</tr>
<tr>
<td>Increase in effective overwater cover based on additions</td>
<td>900</td>
</tr>
<tr>
<td><strong>TOTAL FINAL EFFECTIVE OVERWATER COVER</strong></td>
<td>14,858</td>
</tr>
<tr>
<td><strong>NET CHANGE IN EFFECTIVE OVERWATER COVER</strong></td>
<td>-1,003</td>
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# Existing Overwater Coverage

<table>
<thead>
<tr>
<th>Description</th>
<th>Square Footage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total existing overwater coverage - single-family</td>
<td>683,697</td>
</tr>
<tr>
<td>Total existing overwater coverage - semi-private</td>
<td>15,183</td>
</tr>
<tr>
<td>Total existing overwater coverage - public</td>
<td>15,861</td>
</tr>
</tbody>
</table>

**Total existing overwater coverage (square footage):** 714,741

# Effective Overwater Coverage in 20 years

<table>
<thead>
<tr>
<th>Description</th>
<th>Square Footage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total overwater cover in 20 years - single-family</td>
<td>664,759</td>
</tr>
<tr>
<td>Total overwater cover in 20 years - semi-private</td>
<td>15,010</td>
</tr>
<tr>
<td>Total overwater cover in 20 years - public</td>
<td>14,858</td>
</tr>
</tbody>
</table>

**Total effective overwater coverage in 20 years (square footage):** 694,627

# Change in Effective Overwater Coverage in 20 years

<table>
<thead>
<tr>
<th>Description</th>
<th>Change (Square Footage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net change in overwater cover - single-family</td>
<td>-18,938</td>
</tr>
<tr>
<td>Net change in overwater cover - semi-private</td>
<td>-173</td>
</tr>
<tr>
<td>Net change in overwater cover - public</td>
<td>-1,003</td>
</tr>
</tbody>
</table>

**TOTAL CHANGE IN EFFECTIVE OVERWATER COVER IN 20 YEARS:** -20,115

**PERCENTAGE DECREASE IN OVERWATER COVER IN 20 YEARS:** -2.8%
SHORELINE RESTORATION PLAN

for the City of Mercer Island
Shoreline Master Program

Prepared by:

City of Mercer Island
Development Services Group
9611 SE 36th Street
Mercer Island, Washington 98040

THE WATERSHED COMPANY

750 Sixth Street South
Kirkland, WA 98033

MAKERS
architecture + urban design
1425 Fourth Avenue, Suite 901
Seattle, WA 98101

This report was funded in part through a grant from the Washington Department of Ecology.
Grant Number: 0800023

April 2010
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SHORELINE RESTORATION PLAN
FOR CITY OF MERCER ISLAND
SHORELINE MASTER PROGRAM

1 INTRODUCTION

A jurisdiction’s Shoreline Master Program applies to activities in the jurisdiction’s shoreline zone. Activities that have adverse affects on the ecological functions and values of the shoreline must provide mitigation for those impacts. By law, the proponent of that activity is not required to return the subject shoreline to a condition that is better than the baseline level at the time the activity takes place. How then can the shoreline be improved over time in areas where the baseline condition is severely, or even marginally, degraded?

Section 173-26-201(2)(f) WAC of the Shoreline Master Program Guidelines\(^1\) says:

“master programs shall include goals and policies that provide for restoration of such impaired ecological functions. These master program provisions shall identify existing policies and programs that contribute to planned restoration goals and identify any additional policies and programs that local government will implement to achieve its goals. These master program elements regarding restoration should make real and meaningful use of established or funded nonregulatory policies and programs that contribute to restoration of ecological functions, and should appropriately consider the direct or indirect effects of other regulatory or nonregulatory programs under other local, state, and federal laws, as well as any restoration effects that may flow indirectly from shoreline development regulations and mitigation standards.”

However, degraded shorelines are not just a result of pre-Shoreline Master Program activities, but also of unregulated activities and exempt development. The new Guidelines also require that “[l]ocal master programs shall include regulations ensuring that exempt development in the aggregate will not cause a net loss of ecological functions of the shoreline.” While some actions within shoreline jurisdiction are exempt from a permit, the Shoreline Master Program should clearly state that those actions are

---

\(^1\) The Shoreline Master Program Guidelines were prepared by the Washington Department of Ecology and codified as WAC 173-26. The Guidelines translate the broad policies of the Shoreline Management Act (RCW 90.58.020) into standards for regulation of shoreline uses. See http://www.ecy.wa.gov/programs/sea/sma/guidelines/index.html for more background.
not exempt from compliance with the Shoreline Management Act or the local Shoreline Master Program. Because the shoreline environment is also affected by activities taking placed outside of a specific local master program’s jurisdiction (e.g., outside of city limits, outside of the shoreline zone within the city), assembly of out-of-jurisdiction actions, programs and policies can be essential for understanding how the City fits into the larger watershed context. The latter is critical when establishing realistic goals and objectives for dynamic and highly inter-connected environments.

As directed by the Guidelines, the following discussions provides a summary of baseline shoreline conditions, lists restoration goals and objectives, and discusses existing or potential programs and projects that positively impact the shoreline environment. Finally, anticipated scheduling, funding, and monitoring of these various comprehensive restoration elements are provided. In total, implementation of the Shoreline Master Program (with mitigation of project-related impacts) in combination with this Restoration Plan (for restoration of lost ecological functions that occurred prior to a specific project) should result in a net improvement in the City of Mercer Island’s shoreline environment in the long term.

In addition to meeting the requirements of the Guidelines, this Restoration Plan is also intended to support the City’s or other non-governmental organizations’ applications for grant funding, and to provide the interested public with contact information for the various entities working within the City to enhance the environment.

## 2 SHORELINE INVENTORY SUMMARY

### 2.1 Introduction

The City conducted a comprehensive inventory of its Lake Washington shoreline in 2008. The purpose of the shoreline inventory was to facilitate the City of Mercer Island’s compliance with the State of Washington’s Shoreline Management Act (SMA) and updated Shoreline Master Program Guidelines. The inventory describes existing physical and biological conditions in the Lake Washington shoreline zone within City limits, including recommendations for restoration of ecological functions where they are degraded. The full Final Shoreline Analysis Report is included as an appendix to the Shoreline Master Program, and is summarized below.

### 2.2 Shoreline Boundary

As defined by the Shoreline Management Act of 1971, shorelines include certain waters of the state plus their associated “shorelands.” 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\(^2\) 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 therefrom (RCW 90.58.030)\(^3\)"

Shorelands in the City of Mercer Island include only areas within 200 feet of the ordinary high water mark, as established by the U.S. Army Corps of Engineers for Lake Washington, and any associated wetlands within shoreline jurisdiction. As part of the shoreline jurisdiction assessment, there were two wetlands identified in Luther Burbank Park that extend the shoreline jurisdiction beyond 200 feet from the Lake Washington ordinary high water mark (Figure 1). Lake Washington does not have a floodway or floodplain.

\[\text{Figure 1: Mercer Island Shoreline Jurisdiction Including Associated Wetlands (inset)}\]

\(^2\) According to RCW 173-220-030, 100-year floodplain is “that land area susceptible to being inundated by stream derived waters 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;”
2.3 Inventory

The shoreline inventory is divided into five main sections: Introduction, Current Regulatory Framework Summary, Shoreline Inventory, Analysis of Ecological Functions and Ecosystem-wide Processes, Land Use Analysis and Shoreline Management Recommendations. The City’s shoreline jurisdiction is divided into two segments: Urban Residential, and Urban Park. These segments are based on existing land use and zoning, as well as the City’s current environment designations.

2.3.1 Land Use and Physical Conditions

Existing Land Use

In general, the City of Mercer Island shoreline area is fully developed. The few areas not occupied by single or multi-family residential uses are either private recreation clubs, vacant lots, City parks or landings. With the possible exception of limited additional residential lands being acquired for public open space, land uses along the shoreline are not expected to change over the next 20 years, although re-builds, substantial remodels and some redevelopment of single-family residential are anticipated. The City’s shoreline is predominately zoned single-family residential (R-8.4, R-9.6, R-12 and R-15). Residential and private club uses (Urban Residential designation) comprise 90.4 percent of the City’s shoreline area, Luther Burbank Park (Urban Park designation) comprises 6 percent, and public recreation and open space (Urban Park designation) comprise the remaining 3.6 percent of the shoreline area. There are five City parks, one City boat launch, two private recreational clubs, and one private retirement facility on the waterfront. There are also 13 City-owned street ends (“landings”) located within the shoreline area. The Mercerwood Shore Club and Mercer Island Beach Club are private waterfront recreation clubs that include clubhouses, picnic areas, swimming beaches, tennis and fitness facilities, boat moorage, and other amenities. Covenant Shores retirement center includes private boat moorage and other similar private recreational opportunities. There are 57 privately owned lots (roughly 6%) within the shoreline jurisdiction that are considered vacant or undeveloped, 44 of which are along the shoreline. Of those 44 properties, only 10 have development potential.

Parks and Open Space/Public Access

There are a number of opportunities to access the Mercer Island waterfront, whether at public parks, landings or the City boat launch. Luther Burbank Park is the City’s largest multi-use park and is considered the crown jewel of the park system (Figure 2). The park is 77 acres and includes a swimming beach, public boat

Figure 2: Luther Burbank Park
dock, public fishing pier, former Luther Burbank School brick dormitory, steam plant and dairy ruins, trails, off-leash dog area, and other groomed and wooded areas. Calkins Point, located on the north end of the park, has been slowly eroding away and has been identified by the City as a high-priority for shoreline restoration.

Other parks located along the shoreline include Clarke Beach (Figure 3), Groveland Beach, Slater Park, and Park on the Lid. These parks provide multiple opportunities for water-related recreational uses, including swimming, fishing, picnicking, and active and passive recreation. Mercer Island Boat Launch is located along the City’s northeast shore and provides a Lakes-to-Locks Water Trail Launch and Landing Site.

There are 13 street-end public rights-of-way into public spaces and parks that provide access to the waterfront. The landings, which vary in the level of development, include swimming and fishing areas, boat launch facilities and docks. A few of the landings remain undeveloped and provide opportunities for future restoration or improvements.

**Figure 3: Clark Beach Park**

**Shoreline Modifications**

The Mercer Island shoreline is heavily modified with close to 78 percent of the shoreline armored at or near the ordinary high water mark and a pier density of approximately 47.5 overwater structures per mile. This compares to 71 percent armored and 36 piers per mile for the entire Lake Washington shoreline. Thus, for Mercer Island, both pier density and shoreline armorning are slightly higher than the lake-wide figures. Many of the piers have one or more boatlifts.

As expected, the Urban Residential segment has the most altered shoreline, with 82 percent armored with either vertical or boulder bulkheads. The Urban Park segment is 35 percent armored. It is not uncommon around Lake Washington for some historic fills to be associated with the original bulkhead construction, usually to create a more level or larger yard. Most of these shoreline fills occurred at the time that the lake elevation was lowered during construction of the Hiram Chittenden Locks.

Also as expected, the highest amount of overwater cover per lineal foot of shoreline can be found in the Urban Residential segment. This can be attributed to the presence of a
number of residential homes within this segment, as well as two beach clubs which have marinas.
The full shoreline inventory includes a more in-depth discussion of the above topics, as well as information about transportation, stormwater and wastewater utilities, impervious surfaces, and historical/archaeological sites, among others.

### 2.3.2 Biological Resources and Critical Areas

With the exception of some portions of the shoreline along Luther Burbank Park (Urban Park), the shoreline zone itself is generally deficient in high-quality biological resources and critical areas, primarily because of the extensive residential development and its associated shoreline modifications. There are a number of City parks along the shoreline, but a majority of these are mostly well manicured and include extensive shoreline armoring or pier and dock structures. The highest-functioning shoreline area is Luther Burbank Park, which contains a majority of the City’s last unaltered shoreline. There are also a few City-owned landings which are undeveloped, but these are surrounded by residential development and do not cover an extensive area of the shoreline area. Virtually all of the Mercer Island shoreline is encumbered by geologically hazard areas, including seismic, erosion and landslide areas. According to City data, there are two wetlands inventoried within shoreline jurisdiction, both of which are located in Luther Burbank Park. There are a number of streams that discharge into Lake Washington, including 39 perennial streams, 13 of which have been identified as having potential for fish use near their mouth to Lake Washington. These streams are used by Chinook, coho, and sockeye salmon, as well as cutthroat trout. Many of the smaller tributaries to Lake Washington originate as hillside seeps or springs and flow seasonally or during periods of heavy rains. Many of these smaller systems are piped at some point and discharge directly to Lake Washington via a closed system. These streams have been impacted extensively by basin development, resulting in increased peak flows, unstable and eroding banks, loss of riparian vegetation, and fish and debris passage barriers. These changes have altered their contributions of sediment, organic debris, and invertebrates into Lake Washington.

WDFW mapping of Priority Habitat and Species (WDFW 2008) also indicates the presence of other Fish and Wildlife Habitat Conservation Areas within and adjacent to the shoreline zone. These include historic and current bald eagle nest locations, wetlands, and urban natural open space (parks and other green spaces). Segments B and C, Urban Park and Urban Residential respectively, generally do not contain any significant fish or other wildlife habitats other than Lake Washington. Extensive residential and park development, which includes landscaping and shoreline modifications, has removed much of the potential for riparian habitat.
3 Restoration Goals and Objectives

According to the Lake Washington/Cedar/Sammamish Watershed (WRIA) Near-Term Action Agenda For Salmon Habitat Conservation, Lake Washington suffers from “Altered trophic interactions (predation, competition), degradation of riparian shoreline conditions, altered hydrology, invasive exotic plants, poor water quality (phosphorus, alkalinity, pH), [and] poor sediment quality” (WRIA 8 Steering Committee 2002). Mercer Island’s Final Shoreline Analysis Report (The Watershed Company 2009) provides supporting information that validates these claims specifically in the City’s shoreline jurisdiction. The WRIA 8 Action Agenda established four “ecosystem objectives,” which are intended to guide development and prioritization of restoration actions and strategies. The objectives are as follows:

- “Maintain, restore, or enhance watershed processes that create habitat characteristics favorable to salmon.
- Maintain or enhance habitat required by salmon during all life stages and maintain functional corridors linking these habitats.
- Maintain a well-dispersed network of high-quality refuge habitats to serve as centers of population expansion.
- Maintain connectivity between high-quality habitats to allow for population expansion into recovered habitat as degraded systems recover.”

The WRIA 8 restoration objectives, in combination with the results of the City’s Final Shoreline Analysis Report, the direction of Ecology’s Shoreline Master Program Guidelines, and the City’s commitment (Appendix A) to support the Final Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook Salmon Conservation Plan, are the foundation for the following goals and objectives of the City of Mercer Island’s restoration strategy. Although the WRIA 8 Action Agenda and the Final Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook Salmon Conservation Plan are salmon-centered, pursuit of ecosystem-wide processes and ecological functions performance that favors salmon generally captures those processes and functions that benefit all fish and wildlife.

**Goal 1** – Maintain, restore or enhance watershed processes, including sediment, water, wood, light and nutrient delivery, movement and loss.

**Goal 2** – Maintain or enhance fish and wildlife habitat during all life stages and maintain functional corridors linking these habitats.

**Goal 3** – Contribute to conservation and recovery of chinook salmon and other anadromous fish, focusing on preserving, protecting and restoring habitat with the intent to recover listed species, including sustainable, genetically diverse, harvestable populations of naturally spawning chinook salmon.
System-wide restoration objectives

- Continue to work collaboratively with other jurisdictions and stakeholders in WRIA 8 to implement the Final Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook Salmon Conservation Plan.
- Use the scientific foundation and the conservation strategy as the basis for local actions recommended in the Chinook Salmon Conservation Plan and as one source of best available science for future projects, ordinances, and other appropriate local government activities.
- Use the comprehensive list of actions, and other actions consistent with the Chinook Salmon Conservation Plan, as a source of potential site-specific projects and land use and public outreach recommendations.
- Use the start-list to guide priorities for regional funding in the first ten years of Chinook Salmon Conservation Plan implementation, and implementing start-list actions through local capital improvement projects, ordinances, and other activities.
- Seek funding for various restoration actions and programs from local sources and by working with other WRIA 8 jurisdictions and stakeholders to seek federal, state, grant and other funding opportunities.
- Develop a public education plan to inform private property owners in the shoreline zone and in the remainder of the City about the effects of land management practices and other unregulated activities (such as vegetation removal, pesticide/herbicide use, car washing) on fish and wildlife habitats.

Lake Washington restoration objectives

- Improve Lake Washington tributary stream health by eliminating man-made barriers to anadromous fish passage, preventing the creation of new barriers, and providing for transport of water, sediment and organic matter at all stream crossings.
- Improve Lake Washington and Lake Washington tributary stream health by identifying hardened and eroding lakeshores and streambanks, and correcting to the extent feasible with bioengineered stabilization solutions.
- Improve Lake Washington and Lake Washington tributary stream health by increasing large woody debris recruitment potential through plantings of
trees in the riparian corridors, particularly conifers. Where feasible, install large woody debris to meet short-term needs.

- Increase quality, width and diversity of native vegetation in protected corridors adjacent to stream and lake habitats to provide safe migration pathways for fish and wildlife, food, nest sites, shade, perches, and organic debris. Strive to control non-indigenous plants or weeds that are proven harmful to native vegetation or habitats.
- Reconnect and enhance small creek mouths as juvenile rearing areas.
- Habitat in small Lake Washington tributaries, such as those in the City of Mercer Island, should be restored for coho so that production of cutthroat trout, which prey on juvenile chinook salmon in Lake Washington, is reduced.
- Decrease the amount and impact of overwater and in-water structures through minimization of structure size and use of innovative materials such as grated decking.
- Participate in lake-wide efforts to reduce populations of non-native aquatic vegetation.

4 List of Existing and Ongoing Projects and Programs

The following series of existing projects and programs are generally organized from the larger watershed scale to the City-scale, including City projects and programs and finally non-profit organizations that are also active in the Mercer Island area.

4.1 Water Resource Inventory Area (WRIA) 8 Participation

Mercer Island has taken advantage of outreach and education offered by WRIA 8 staff on salmon-friendly shoreline landscape design. Mercer Island continues to be involved in the Forum at both the elected official and staff level. The City was one of 27 members of the WRIA 8 Forum, which participated in financing and developing the Final Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook Salmon Conservation Plan. The Chinook Salmon Conservation Plan includes the City of Mercer Island’s implementation commitment in the form of City Council Resolution 1347, approved September 6, 2005 (Appendix A).

The City’s preparation of the Shoreline Analysis Report Including Shoreline Inventory and Characterization of the City of Mercer Island’s Lake Washington Shoreline (The Watershed Company 2009) and this Shoreline Restoration Plan are important steps
toward furthering the goals and objectives of the WRJA 8 Chinook Salmon Conservation Plan. The City’s Shoreline Master Program update products rely heavily on the science included in the WRJA 8 products, and incorporate recommended actions from the WRJA 8 products (Table 1).

To review, the WRJA 8 Steering Committee’s mission and goal statements state that the Plan shall: 1) recognize that local governments are key implementing entities for the plan, because of their responsibilities for land use, 2) direct most future population growth to already urbanized areas, because new development has greater negative effects on hydrology and ecological health of streams in rural than in urban areas, 3) create incentives for behavior that would support Plan goals, and 4) be coordinated with the Growth Management Act, local and regional responses to the Clean Water Act, other environmental laws and past/current planning efforts.

The Plan presents an Action Start-List that attempts to compile the land use, site-specific habitat protection and restoration projects, and public outreach and education recommendations into a single strategy list which focuses watershed priorities yet also provides a manageable number of actions. Conservation priority actions identified for WRJA 8 chinook salmon habitat within Lake Washington included in the Plan are as follows:

- Reduce predation on juvenile migrants in Lake Washington by providing increased rearing and refuge opportunities.
- Restore shallow water habitats and creek mouths for juvenile rearing and migration.

Table 1. The Final Lake Washington/Cedar/Sammamish Watershed (WRJA 8)
Chinook Salmon Conservation Plan Action Start-List for Lake Washington and Status of Implementation in the City of Mercer Island

<table>
<thead>
<tr>
<th>Action Item</th>
<th>Mercer Island Implementation</th>
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<tbody>
<tr>
<td><strong>Reduce predation to outmigrating juvenile chinook by:</strong> reducing bank hardening, restoring overhanging riparian vegetation, replacing bulkhead and rip-rap with sandy beaches with gentle slopes, and use of mesh dock surfaces and/or community docks.</td>
<td>The proposed SMP includes provisions that ensure salmon friendly shoreline design for new construction and redevelopment, including requirements for grated decking and shoreline vegetation…</td>
</tr>
<tr>
<td>Encourage salmon friendly shoreline design during new construction or redevelopment by offering incentives and regulatory flexibility to improve bulkhead and dock design and revegetate shorelines.</td>
<td>The City has done two projects demonstrating these techniques at public Right of Way street ends on the</td>
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<tr>
<td>Action Item</td>
<td>Mercer Island Implementation</td>
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<tr>
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<td>shoreline. The recently completed shoreline restoration at Luther Burbank Park also demonstrates salmon friendly shoreline design.</td>
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<tr>
<td>Increase enforcement and address nonconforming structures over long run by requiring that major redevelopment projects meet current standards.</td>
<td>Code enforcement is responsible for enforcing regulations which address public health and safety issues, including regulations related to rubbish, garbage, specific nuisances, removal of vegetation, zoning, housing, dangerous buildings, and inoperable and unlicensed vehicles on private property. Enforcement actions are taken both proactively and in response to requests for action received from citizens. The City has not recently updated its code enforcement.</td>
</tr>
<tr>
<td>Discourage construction of new bulkheads; offer incentives (e.g., provide expertise, expedite permitting) for voluntary removal of bulkheads, beach improvement, riparian revegetation.</td>
<td>The proposed SMP includes provisions that discourage construction of new bulkheads by limiting new bulkheads to only those properties that can show a demonstrated need through a geotechnical analysis.</td>
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<tr>
<td>Support joint effort by NOAA Fisheries and other agencies to develop dock/pier specifications to streamline federal/state/local permitting; encourage similar effort for bulkhead specifications.</td>
<td>The City has been coordinating on a regular basis with state and federal agencies to help develop consistent pier and bulkhead design standards, including coordination with adjacent jurisdictions.</td>
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<tr>
<td>Promote value of light-permeable docks, smaller piling sizes, and community docks to both salmon and landowners through direct mailings to lakeshore landowners or registered boat owners sent with property tax notice or boat registration tab renewal.</td>
<td>The City has hosted workshops for lakeshore owners which has highlighted the value of eco-friendly pier construction. This includes King County Lakeshore Living and Greenshorelines workshops.</td>
</tr>
<tr>
<td>Develop workshop series specifically for lakeshore property owners on lakeside living: natural yard care, alternatives to vertical wall bulkheads, fish friendly dock design, best management practices for aquatic weed control, porous paving, and environmentally friendly methods of maintaining boats, docks, and decks.</td>
<td>King County has led this effort. As mentioned above, the City has hosted workshops on this topic in the past (Lakeshore Living and Greenshorelines). This work is expected to continue in the near future.</td>
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**Protect and restore water quality in tributaries and along shoreline. Restore coho runs in smaller tributaries as control mechanism to reduce the cutthroat population.**

**Reconnect and enhance small creek mouths as juvenile rearing areas.**
### Action Item

Address water quality and high flow impacts from creeks and shoreline development through NPDES Phase 1 and Phase 2 permit updates, consistent with Washington Department of Ecology’s 2001 Stormwater Management Manual, including low impact development techniques, on-site stormwater detention for new and redeveloped projects, and control of point sources that discharge directly into the lakes.

<table>
<thead>
<tr>
<th>Mercer Island Implementation</th>
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<tr>
<td>The City currently implements Ecology’s 2005 <em>Stormwater Management Manual for Western Washington</em> through its NPDES Phase 2 permit. The NPDES Phase II permit is required to cover the City’s stormwater discharges into regulated lakes and streams. Under the conditions of the permit, the City must protect and improve water quality through public education and outreach, detection and elimination of illicit non-stormwater discharges (e.g., spills, illegal dumping, wastewater), management and regulation of construction site runoff, management and regulation of runoff from new development and redevelopment, and pollution prevention and maintenance for municipal operations.</td>
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Encourage low impact development through regulations, incentives, education/training, and demonstration projects.

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<th>Mercer Island Implementation</th>
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<tr>
<td>The Comprehensive Plan and the proposed SMP contain provisions which promote LID, including allowance of storm water strategies that minimize the creation of impervious surfaces, and measures to minimize the disturbance of native soils and vegetation. The City has already identified a short list of good candidates for LID demonstration projects at City facilities that will be completed in the future.</td>
</tr>
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</table>

Protect and restore water quality and other ecological functions in tributaries to reduce effects of urbanization and reduce conditions which encourage cutthroat. Protect and restore forest cover, riparian buffers, wetlands, and creek mouths by revising and enforcing critical areas ordinances and Shoreline Master Programs, incentives, and flexible development tools.

<table>
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<th>Mercer Island Implementation</th>
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<tr>
<td>The City updated the Critical Areas Ordinance in 2005. Management of the City’s critical areas using these regulations should help insure that ecological functions and values are not degraded, and impacts to critical areas are mitigated. The City also coordinates ongoing Maintenance activities, specifically with drainage basins, with open spaces improvements on adjoining properties. The City currently implements the 2004 Open Space Vegetation Plan (City of Mercer Island 2004) which promotes</td>
</tr>
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</table>
### 4.2 Comprehensive Plan Policies

The City updated its Comprehensive Plan on July 5, 2005. The updated Comprehensive Plan, specifically the Conservation Element of the Shoreline Goals and Policies, contains a number of general and specific goals and policies that direct the City to permit and condition development in such a way that the natural environment is preserved and enhanced. The specific goals and policies include:

**Goal:** The resources and amenities of Lake Washington are to be protected and preserved for use and enjoyment by present and future generations.

- **Policy 1:** Existing natural resources should be conserved, consistent with private property rights.

- **Policy 2:** Existing and future activities on Lake Washington and its shoreline should be designed to minimize adverse effects on the natural systems.

- **Policy 3:** Uses or activities within all drainage basins related to Lake Washington should be considered as an integral part of shoreline planning.

- **Policy 4:** Shoreline areas having historical, cultural, educational or scientific value should be protected and restored.

Techniques suggested by the various policies to protect the natural environment include requiring setbacks from sensitive areas, preserving habitats for sensitive species, preventing adverse alterations to water quality and quantity, promoting low impact development, preserving existing native vegetation, educating the public, and mitigating necessary sensitive area impacts, among others.

### 4.3 Critical Areas Regulations

The City of Mercer Island critical areas regulations are found in Mercer Island City Code Chapter 19.07 Environment. The City completed its last critical areas regulations update
on 2005. The updated regulations are based on best available science, and provide protection to critical areas in the City, particularly for streams and wetlands. All activities which require a substantial development permit, conditional use or variance under the SMP are reviewed under the City’s CAO for consistency. As stated above, if there is a conflict between the CAO and SMP, the regulations that offer the greatest environmental protection apply.

Some of the basic components of the critical areas regulations include a four-tiered watercourse typing system with standard buffers ranging between 25 and 75 feet, and Ecology’s four-tiered wetland rating system with standard buffers ranging from 35 to 100 feet. Management of the City’s critical areas using these regulations should help insure that ecological functions and values are not degraded, and impacts to critical areas are mitigated. These critical areas regulations are one important tool that will help the City meet its restoration goals.

### 4.4 Stormwater Management and Planning

Although much of the City of Mercer Island’s Storm and Surface Water Utility’s jurisdiction is outside of the shoreline zone, all of the regulated surface waters, both natural and piped, are discharged ultimately into Lake Washington and thus affect shoreline conditions. According to the City’s GIS data, there are 208 known stormwater outfalls, 187 of which are located within the shoreline jurisdiction area (see Figures 5.1 - 5.3). The City’s Utilities section of the Comprehensive Plan contains the following stormwater policies:

1. The City shall continue to implement programs and projects designed to meet the goals and requirements of the Puget Sound Water Quality Management Plan.

2. The City shall actively promote and support education efforts focusing on all facets of stormwater management.

3. The City shall maintain and enforce land-use plans and ordinances requiring stormwater controls for new development and re-development. The ordinances shall be based on standards developed by the state Department of Ecology and shall be consistent with the policies in the Land-Use Element of this plan and the goals and policies of the City’s Development Services Group.

The City received its National Pollutant Discharge Elimination System (NPDES) Phase II Municipal Stormwater Permit in January 2007 from Ecology. The NPDES Phase II permit is required to cover the City’s stormwater discharges into regulated lakes and streams. Under the conditions of the permit, the City must protect and improve water quality through public education and outreach, detection and elimination of illicit non-stormwater discharges (e.g., spills, illegal dumping, wastewater), management and regulation of construction site runoff, management and regulation of runoff from new
development and redevelopment, and pollution prevention and maintenance for municipal operations (City of Mercer Island website).

In 2007, the Department of Ecology published information about toxics levels in fish, including fish sampled in Lake Washington (Department of Ecology 2007). Lake Washington ranked second only to the Wenatchee River near Leavenworth for a site contaminant score. Although this report does not identify specific point sources, it represents a clear need to better understand contaminant sources and control.

The City’s 2004 Open Space Vegetation Plan (City of Mercer Island 2004) was prioritized by multiple factors including storm water buffering and erosion control. It directs work to sites where it would most likely improve storm water buffering and erosion control.

4.5 Public Education

The City of Mercer Island’s Comprehensive Plan identifies various policy statements based on the goal of environmental public involvement (excerpted below). These items help guide City staff and local citizen groups in developing mechanisms to educate the public and broaden the interest in protecting and enhancing local environmental resources.

4.5.1 Land Use Element

Natural Environment Policies

Goal 10: The protection of the natural environment will continue to be a priority in all Island development. Protection of the environment and private property rights will be consistent with all state and federal laws.

Policy 10.1 The City of Mercer Island shall protect environmentally sensitive lands such as watercourses, geologic hazard areas, steep slopes, shorelines, wildlife habitat conservation areas, and wetlands. Such protection should continue through the implementation and enforcement of critical areas and shoreline regulations.

Policy 10.2 Land use actions, storm water regulations and basin planning should reflect intent to maintain and improve the ecological health of watercourses and Lake Washington water quality.

Policy 10.3 New development should be designed to avoid increasing risks to people and property associated with natural hazards.
Policy 10.4 The ecological functions of watercourses, wetlands, and habitat conservation areas should be maintained and protected from the potential impacts associated with development.

Policy 10.5 The City shall consider best available science during the development and implementation of critical areas regulations. Regulations will be updated periodically to incorporate new information and, at a minimum, every seven years as required by the Growth Management Act.

4.5.2 Utilities Element

Water Quality Policies

Policy 2.8 The City shall aggressively promote and support water conservation on Mercer Island and shall participate in regional water conservation activities. The goal of the City’s efforts shall be a significant and lasting reduction in Mercer Island’s peak water consumption. In 1999 the City decided to participate in SPU’s 1% Water Conservation Initiative, and continues to receive information and assistance in reducing water consumption in City facilities and in the community.

Stormwater Policies

Policy 4.2 The City shall actively promote and support education efforts focusing on all facets of stormwater management.

4.5.3 Shoreline Goals and Policies

Conservation Element

Policy 4.a. Public and private cooperation should be encouraged in site preservation and protection.

As part of the City of Mercer Island’s efforts to abide by these goals and policies, the City supports several volunteer efforts, such as Mountains to Sound Greenway sponsored events, Open Space Conservancy Trust, Forest Stewardship, Forest Stewardship training, Adopt-a-Park and EarthCorps.

4.6 Open Space Conservancy Trust

The Open Space Conservancy Trust, established by Mercer Island City Council in 1992, “was created for the express purpose of receiving and holding such real property, as transferred for open space purposes; for protecting, maintaining and preserving the
Open Space Properties; and insuring that the development and use of the Open Space Properties are both consistent and compatible with the intent and purpose of the Trust and the guidelines and polices enacted." The trust is led by a seven member volunteer board consisting of six citizens appointed by the Mayor and one City Council member. The trust currently holds Pioneer Park as its sole property.


4.7 Mountains to Sound Greenway Trust

Mountains to Sound (MTS) Greenway Trust, a nonprofit organization founded in 1991, assists local, state, and federal agencies to acquire open space lands for permanent protection in order to create a 100-mile connected green corridor along Interstate 90.

Within the City of Mercer Island, MTS organizes and leads volunteers to improve City parks by removing invasive plants (primarily ivy) and planting native trees and shrubs. Mercer Island Parks and Recreation has teamed up with MTS and a number of other groups and organizations to host several volunteer events throughout the year.


4.8 Forest Stewardship and Adopt-A-Park Programs

Citizens of Mercer Island donate countless hours to maintain the City’s open spaces and parks through picking up litter, cutting ivy, planting and trail maintenance and repair. Forest Stewardship provides opportunities for citizens to be active with City-sponsored projects or work individually with other volunteers. Forest Stewardship training provides the skills to become Forest Stewards who are qualified to run volunteer projects on the island on behalf of the Parks and Recreation Department.

The City’s Adopt-a-Park program allows local schools or services groups to adopt a City park. The program benefits schoolchildren, who learn valuable stewardship skills, and the public who benefit from the restoration efforts.

Contact Information: [miparks@mercergov.org](mailto:miparks@mercergov.org), [http://www.ci.mercer-island.wa.us/Page.asp?NavID=1515](http://www.ci.mercer-island.wa.us/Page.asp?NavID=1515)

4.9 EarthCorps

EarthCorps is a non-profit organization that provides environmental restoration service programs for young adults. These one-year programs provide opportunities to learn conservation and develop skills in leading volunteers. EarthCorps works with Mercer Island Parks and Recreation to organize and lead restoration projects, such as removing invasive plants and planting native species.
5 LIST OF ADDITIONAL PROJECTS AND PROGRAMS TO ACHIEVE LOCAL RESTORATION GOALS

The following series of additional projects and programs are generally organized from the larger watershed scale to the City-scale, including City projects and programs and finally non-profit organizations that are also active in the Mercer Island area.

5.1 Unfunded WRIA 8 Projects

The 2005 Final Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook Salmon Conservation Plan does not identify any specific projects along the Mercer Island shoreline, but does include the following general recommendations to reduce predation on outmigrating juvenile chinook salmon in its “Action Start-List for Migratory Areas”:

- Encourage salmon friendly shoreline design during new construction or redevelopment by offering incentives and regulatory flexibility to improve bulkhead and dock design and revegetate shorelines. Increase enforcement and address nonconforming structures over long run by requiring that major redevelopment projects meet current standards.
- Discourage construction of new bulkheads; offer incentives (e.g., provide expertise, expedite permitting) for voluntary removal of bulkheads, beach improvement, riparian revegetation.
- Support joint effort by NOAA Fisheries and other agencies to develop dock/pier specifications to streamline federal/state/local permitting; encourage similar effort for bulkhead specifications.
- Promote value of light-permeable docks, smaller piling sizes, and community docks to both salmon and landowners through direct mailings to lakeshore landowners or registered boat owners sent with property tax notice or boat registration tab renewal. Offer financial incentives for community docks in terms of reduced permit fees, loan fees/percentage rates, taxes, and permitting time, in addition to construction cost savings.
- Develop workshop series specifically for lakeshore property owners on lakeside living: natural yard care, alternatives to vertical wall bulkheads, fish friendly dock design, best management practices for aquatic weed control, porous paving, and environmentally friendly methods of maintaining boats, docks, and decks. Related efforts include creation of a website to convey workshop material, an awareness campaign, “Build a Beach,” to illuminate impact of bulkheads on development of sandy beaches.
• Restore shoreline in Lake Washington Section 1: work with private property owners to restore shoreline in Section 1. Use interpretive signage where possible to explain restoration efforts.

5.2 Recommended Projects - Public
The following is developed from a list of opportunity areas identified within the Final Shoreline Analysis Report (The Watershed Company 2009) and is intended to contribute to improvement of impaired functions on public property. The list of recommended projects was created after reviewing the City’s CIP list and assessing field conditions during the shoreline inventory and characterization phase.

Luther Burbank Park
Two restoration projects listed in the City’s CIP include:

• Luther Burbank Shoreline Restoration (Summer 2008): removing non-native plant species, replant native vegetation, create recreation access beaches, develop habitat and maintain trail opportunities, stabilize soft banks.

• Luther Burbank Off-Leash Area (OLA) (2008): design and construct minor drainage, surfacing, shoreline, landscaping and fencing improvements in OLA.

Restoration opportunities not included in the City’s CIP include:

• In October 2005, Anchor Environmental, LLC. prepared a Shoreline Habitat Inventory that identified a number of restoration opportunities along the shoreline. Many of these have been completed or are included in the City’s CIP. However, the inventory contains several items not included in the CIP, which represent future opportunities. These include restoration of several stretches (18, 20, 21) along the shoreline. Restoration would include placement of beach nourishment, removal of invasive plants, and planting of native plants to increase overhanging vegetation.

Street-Ends (Landings) and Residential Shoreline Properties
There are two projects listed in the City’s 2007-2008 6-Year Capital Improvement Program. Both projects are currently planned for implementation in 2013.

• Groveland Beach Park: Remove invasive vegetation, replace worn playground elements, and prepare shoreline improvements.

• Clarke Beach Park: Removal of up to 300 linear feet of concrete retaining wall/bulkhead/barrier at Clarke Beaches.

• Many of the parks, street-ends and residential shoreline properties along the shoreline have the potential for improvement of ecological functions through: 1)
reduction or modification of shoreline armoring, 2) reduction of overwater cover and in-water structures (grated pier decking, pier size reduction, pile size and quantity reduction, moorage cover removal), 3) improvements to nearshore native vegetative cover, and/or 4) reductions in impervious surface coverage.

**Open Space – Vegetation Management**

Many parks located on Mercer Island are heavily invaded by non-native invasive species that will eventually damage and destroy forest canopies. Opportunities exist to provide vegetation and property management in existing open space areas. This will improve shoreline and upland habitat areas within the City.

### 5.3 Recommended Projects - Private

Generally, restoration opportunities which have been identified are focused on City property, including parks, open spaces, and street-ends. Many other restoration opportunities exist throughout the City on private property. These opportunities would include many of the same issues as listed above, but would likely occur only through voluntary means or through re-development proposals.

**General:** Many shoreline properties have the potential for improvement of ecological functions through: 1) reduction or modification of shoreline armoring, 2) reduction of overwater cover and in-water structures (grated pier decking, pier size reduction, pile size and quantity reduction, moorage cover removal), 3) improvements to nearshore native vegetative cover, and/or 4) reductions in impervious surface coverage. Similar opportunities would also apply to undeveloped lots which may be used as community lots for upland properties or local street-ends and utility corridors. Other opportunities may exist to improve either fish habitat or fish passage for those properties which have streams discharging to Lake Washington.

An example of how shoreline armoring might be reduced on some lots along the City’s residential areas is depicted below (Figure 4). This example displays before and after images of a lot in which the existing bulkhead is partially pulled back to create a shallow cove beach combined with natural materials. This example combines the effort to improve habitat conditions with improved access and aesthetics.

**Restoration of Multiple Contiguous Properties:** Through grant funding sources, restoration opportunities may be available to multiple contiguous shoreline properties, including residential lots that are interested in improving shoreline function. Restoring shoreline properties that are connected to one another would provide significantly more benefits than a more piecemeal approach. Therefore, priority should be given to restoration projects which involve multiple lots (such as accelerated permit processes).

### 5.4 Public Education/Outreach

The Final Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook Salmon Conservation Plan includes a table outlining 53 “Outreach and Education Actions” with target audiences for each action ranging from the general public, to shoreline property
owners in general, to lakeshore property owners specifically, to businesses, to youth, and others. The complete list of WRIA 8 “Outreach and Education Actions” is included as Appendix B.

Figure 4: Partial bulkhead removal example project
6 PROPOSED IMPLEMENTATION TARGETS AND MONITORING METHODS

As previously noted, the City’s shoreline zone is occupied by single- and multi-family residences, and public recreation/open spaces. Therefore, efforts should be made to improve shoreline ecological function through the promotion of restoration and healthy practices at all levels, from large-scale marina users to single-family property owners. The City of Mercer Island already has a very active environmental community with a restoration and education focus. Continued improvement of shoreline ecological functions on the shoreline requires a more comprehensive watershed approach, which combines upland and shoreline projects and programs.

The following table (Table 2) outlines a possible schedule and funding sources for implementation of a variety of efforts that could improve shoreline ecological function, and are described in previous sections of this report.

Table 2. Implementation Schedule and Funding for Restoration Projects, Programs and Plans.

<table>
<thead>
<tr>
<th>Restoration Project/Program</th>
<th>Schedule</th>
<th>Funding Source or Commitment</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 WRIA 8 Participation</td>
<td>Ongoing</td>
<td>The City is an active member of the WRIA 8 Forum. Membership at this time entails a commitment of staff and elected official time.</td>
</tr>
<tr>
<td>4.2 Comprehensive Plan Policies</td>
<td>Ongoing</td>
<td>The City makes a substantial commitment of staff time in the course of project and program reviews to determine consistency and compliance with the recently updated Comprehensive Plan. The next Comprehensive Plan update will occur in 2010.</td>
</tr>
<tr>
<td>4.3 Critical Areas Regulations</td>
<td>Ongoing</td>
<td>The City makes a substantial commitment of staff time in the course of project and program reviews to determine consistency and compliance with their recently updated Critical Areas Regulations.</td>
</tr>
<tr>
<td>4.4 Stormwater Planning</td>
<td>Ongoing</td>
<td>Currently, staff time and materials are the only City resource commitments. The City currently follows its 2008 Stormwater Management Program which implements the City’s Phase II NPDES permit and reports annually to Ecology. The City is also involved in the implementation of the 2005 Surface Water Master Plan, which goals includes flood reduction, water quality improvements and aquatic habitat improvements. The City also is in full compliance with NPDES permit requirements for Phase II cities.</td>
</tr>
<tr>
<td>4.5 Public Education</td>
<td>Ongoing</td>
<td>Currently, staff time and materials are provided in</td>
</tr>
</tbody>
</table>

22
## Restoration Project/Program

<table>
<thead>
<tr>
<th>Restoration Project/Program</th>
<th>Schedule</th>
<th>Funding Source or Commitment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4.6</strong> Open Space Conservancy Trust</td>
<td>Ongoing</td>
<td>Currently, staff time and materials to support these groups are part of the City’s resource commitments. The Mountains to Sound Greenway Trust also has a contractual agreement with the City for Volunteer Management Services. These groups consist of volunteers appointed by the Mayor.</td>
</tr>
<tr>
<td><strong>4.7</strong> Mountains to Sound Greenway Trust</td>
<td>Ongoing</td>
<td>Currently, staff time and materials to support these groups are the only City resource commitments. These groups consist of volunteers and are supported by the City’s Parks and Recreation Department.</td>
</tr>
<tr>
<td><strong>4.8</strong> Forest Stewardship and Adopt-A-Park</td>
<td>Ongoing</td>
<td>Currently, staff time and materials to support this group is part of the City’s resource commitments. EarthCorps also has a contractual agreement with the City for Volunteer Management Services. These groups consist of volunteers and are supported by the City’s Parks and Recreation Department.</td>
</tr>
<tr>
<td><strong>4.9</strong> EarthCorps</td>
<td>Ongoing</td>
<td></td>
</tr>
<tr>
<td><strong>5.1</strong> Unfunded WRIA 8 Projects</td>
<td>As funds and opportunity allow</td>
<td>The City Council passed a resolution in 2005 expressing its approval and support for the Lake Washington/Cedar/Sammamish Watershed Chinook Salmon Conservation Plan. Projects will be funded by the City, partnering agencies and non-profit organizations, and grants as projects and funding opportunities arise.</td>
</tr>
<tr>
<td><strong>5.2</strong> Recommended Projects - Public</td>
<td>As funds and opportunity allow</td>
<td>Projects identified in this section would likely be implemented either when grant funds are obtained, when partnerships are formed between the City and other agencies or non-profit groups, or as may be required by the critical areas regulations and the Shoreline Master Program during project-level reviews by the City.</td>
</tr>
<tr>
<td><strong>5.3</strong> Recommended Projects - Private</td>
<td>As funds and opportunity allow</td>
<td></td>
</tr>
<tr>
<td><strong>5.4</strong> Public Education/Outreach</td>
<td>As funds and opportunity allow</td>
<td>On-going and future education efforts should be coordinated with the City and partnering agencies, including funding sources (grant funding, monetary donations, volunteer hours)</td>
</tr>
</tbody>
</table>
City planning staff will track all land use and development activity, including exemptions, within shoreline jurisdiction, and will incorporate actions and programs of the Parks and Utilities departments as well. A report will be assembled that provides basic project information, including location, permit type issued, project description, impacts, mitigation (if any), and monitoring outcomes as appropriate. Examples of data categories might include square feet of non-native vegetation removed, square feet of native vegetation planted or maintained, reductions in chemical usage to maintain turf, linear feet of eroding bank stabilized through plantings, linear feet of shoreline armoring removed, or number of fish passage barriers corrected. The report would also update Tables 1 and 4 above, and outline implementation of various programs and restoration actions (by the City or other groups) that relate to watershed health.

The staff report will be assembled to coincide with Comprehensive Plan updates and will be used, in light of the goals and objectives of the Shoreline Master Program, to determine whether implementation of the SMP is meeting the basic goal of no net loss of ecological functions relative to the baseline condition established in the Shoreline Analysis Report (The Watershed Company 2009). In the long term, the City should be able to demonstrate a net improvement in the City of Mercer Island’s shoreline environment.

Based on the results of this assessment, the City may make recommendations for changes to the SMP

7 RESTORATION PRIORITIES

The process of prioritizing actions that are geared toward restoration of Mercer Island’s shoreline areas involves balancing ecological goals with a variety of site-specific constraints. Briefly restated, the City’s environmental protection and restoration goals include 1) protecting watershed processes, 2) protecting fish and wildlife habitat, and 3) contributing to chinook conservation efforts. Constraints that are specific to Mercer Island include a highly developed residential shoreline along Lake Washington with several large areas of public open space/access. While some areas may already offer fairly good ecological functions (e.g. portions of Luther Burbank Park shoreline), they tend to include some additional opportunities to further enhance ecological functions. These goals and constraints were used to develop a hierarchy of restoration actions to rank different types of projects or programs associated with shoreline restoration.

Programmatic actions, like continuing WRIA 8 involvement and conducting outreach programs to local residents, tend to receive relatively high priority opposed to restoration actions involving private landowners. Other factors that influenced the hierarchy are based on scientific recommendations specific to WRIA 8, potential funding sources, and the projected level of public benefit. Restoration projects on public property, such as those identified in Section 5.2, have received a high priority ranking
due to their availability to be funded by a variety of sources, such as CIP program, Parks Department, local grants, and non-profit groups.

Although restoration project/program scheduling is summarized in the previous section (Table 2), the actual order of implementation may not always correspond with the priority level assigned to that project/program. This discrepancy is caused by a variety of obstacles that interfere with efforts to implement projects in the exact order of their perceived priority. Some projects, such as those associated with riparian planting, are relatively inexpensive and easy to permit and should be implemented over the short and intermediate term despite the perception of lower priority than projects involving extensive shoreline restoration or large-scale capital improvement projects. Straightforward projects with available funding should be initiated immediately for the worthwhile benefits they provide and to preserve a sense of momentum while permitting, design, site access authorization, and funding for the larger, more complicated, and more expensive projects are under way.

7.1 Priority 1 – Continue Water Resource Inventory Area (WRIA) 8 Participation

Of basic importance is the continuation of ongoing, programmatic, basin-wide programs and initiatives such as the WRIA 8 Forum. Continue to work collaboratively with other jurisdictions and stakeholders in WRIA 8 to implement the Final Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook Salmon Conservation Plan. This process provides an opportunity for the City to keep in touch with its role on a basin-wide scale and to influence habitat conditions beyond its borders, which, in turn, come back to influence water quality and quantity and habitat issues within the City.

7.2 Priority 2 – Public Education and Involvement

Public education and involvement has a high priority in the City of Mercer Island due to the predominance of residential development along the shoreline. Recent outreach efforts by other jurisdictions, such as the handbook Green Shorelines: Bulkhead Alternatives for a Healthier Lake Washington (City of Seattle 2008), have begun to change the perception of shoreline aesthetics, use, and ecological health. This and other outreach efforts (i.e. workshops, websites, example projects) are clear motivating and contributing factors for restoration activities on private property.

While many opportunities for shoreline restoration exist within City parks (see Section 5.2), multiple other opportunities also exist along community-owned properties and private marinas. Whether the focus is on single-family residential, community-owned, or marina properties, providing education opportunities and involving the public is key to success, and would possibly entail coordinating the development of a long-term Public Education and Outreach Plan (Section 5.2). This could also include focusing on gaining public support for restoration along City parks.
Specific projects from the Action Start List include developing a workshop series and website that is tailored to lakeshore property owners, and that promotes natural yard care, alternatives to vertical bulkheads, fish-friendly dock design, best management practices for aquatic weed control, porous paving, and environmentally friendly methods of maintaining boats, docks, and decks. Collaborative efforts with other jurisdictions (i.e. City of Seattle) could be completed to meet the Action Start List goals. Additionally, design competitions and media coverage could be used to promote the use of “rain gardens” and other low impact development practices that mimic natural hydrology. A home/garden tour or “Street of Dreams” type event might serve to showcase these landscape/engineering treatments.

### 7.3 Priority 3 – Reduce Shoreline Armoring along Lake Washington, Create or Enhance Natural Shoreline Conditions

The preponderance of shoreline armoring and its association with impaired habitat conditions, specifically for juvenile chinook salmon, has been identified as one of the key limiting factors along Lake Washington (Kerwin 2001). Nearly 78 percent of the shoreline within the City of Mercer Island is armored at or below the ordinary high water mark (The Watershed Company 2009). While there are no specifically identified projects in the Final Lake Washington/ Cedar/ Sammamish Watershed (WRIA 8) Chinook Salmon Conservation Plan that are located within Mercer Island, there are many opportunities listed in this Restoration Plan which focus on the potential reduction in shoreline armoring and subsequent restoration and enhancement of shoreline ecological functions.

However, emphasis should also be given to future project proposals that involve or have the potential to restore privately-owned shoreline areas to more natural conditions. The City should explore ways in which to assist local property owners, whether through financial assistance, permit expedition, or guidance, to team together with restoration of multiple contiguous lots.

Recommendations from the Action Start List reflect this focus and encourage salmon friendly shoreline design during new construction or redevelopment by offering incentives and regulatory flexibility to improve bulkhead and dock design and revegetate shorelines. Other recommendations from the List that support this priority include: 1) increasing enforcement that addresses nonconforming structures over the long run by requiring that major redevelopment projects meet current standards; 2) discouraging construction of new bulkheads and offer incentives (e.g., provide expertise, expedite permitting) for voluntary removal of bulkheads, beach improvement, riparian revegetation; 3) utilizing interpretive signage where possible to explain restoration efforts.
7.4 Priority 4 – Reduction of In-water and Over-water Structures

Similar to Priority 3 listed above, in-water and over-water structures, particularly piers, docks, and covered moorages, have been identified as one of the key limiting factors in Lake Washington (Kerwin 2001). Pier density along the City’s shoreline is 48 piers per mile – slightly higher than the lake-wide average of 36 piers per mile (Toft 2001), but inline with other jurisdictions around Lake Washington. The density of residential development along the City’s lakeshore is the main reason for the slightly higher-than-average pier density. While the pier density along residential shorelines is much higher than what is typically found along City-owned park property, the overall footprint of each public pier is generally much greater than is found along single-family residential sites. Opportunities exist for reduction in pier size and overall shading impacts through pier modifications on public sites.

Although no specific privately-owned project sites to reduce in-water and over-water structures within residential areas are identified here, future project proposals involving reductions in the size and/or quantity of such structures should be emphasized. Such future projects may involve joint-use pier proposals or pier reconstruction and may be allowed an expedited permit process.

Action Start List Recommendations in support of Priority 4 include: 1) supporting the joint effort by NOAA Fisheries and other agencies to develop dock/pier specifications that streamline federal/state/local permitting; 2) promoting the value of light-permeable docks, smaller piling sizes, and community docks to both salmon and landowners through direct mailings to lakeshore landowners or registered boat owners sent with property tax notice or boat registration tab renewal; and 3) offering financial incentives for community docks in terms of reduced permit fees, loan fees/percentage rates, taxes, and permitting time, in addition to construction cost savings. Similarly, the WRIA 8 Salmon Conservation Plan identified a future project (C302) to explore opportunities to reduce the number of docks by working with private property owners.

7.5 Priority 5 – Restore Mouths of Tributary Streams, Reduce Sediment and Pollutant Delivery to Lake Washington

Although most of the watercourses and their basins located within the City are outside of shoreline jurisdiction, their impacts to shoreline areas should not be discounted. Several of these streams have the potential to provide fish and wildlife habitat. For juvenile chinook, once they enter Lake Washington, they often congregate near the mouths of tributary streams, and prefer low gradient, shallow-water habitats with small substrates (Tabor and Piaskowski 2002; Tabor et al. 2004; Tabor et al. 2006). Chinook fry entering Lake Washington early in the emigration period (February and March) are still relatively small, typically do not disperse far from the mouth of their natal stream, and are largely dependent upon shallow-water habitats in the littoral zone with overhanging
vegetation and complex cover (Tabor and Piaskowski 2002; Tabor et al. 2004). The mouths of creeks entering Lake Washington (whether they support salmon spawning or not), as well as undeveloped lakeshore riparian habitats associated with these confluence areas, attract juvenile chinook salmon and provide important rearing habitat during this critical life stage (Tabor et al. 2004; Tabor et al. 2006).

Later in the emigration period (May and June), most chinook juveniles have grown to fingerling size and begin utilizing limnetic areas of the Lake more heavily (Koehler et al. 2006). As the juvenile chinook salmon mature to fingerlings and move offshore, their distribution extends throughout Lake Washington. Although early emigrating chinook fry from the Cedar River and North Lake Washington tributaries (primary production areas) initially do not disperse around all of Mercer Island, some salmon fry from the Cedar River are known to depend on nearshore habitats along the southern shore of Mercer Island. Later in the spring (May and June), however, juvenile chinook are known to be well distributed throughout both limnetic and littoral areas of Lake Washington, and certainly utilize the shoreline habitats along Mercer Island.

Action Start List Recommendations in support of Priority 5 include: 1) addressing water quality and high flow impacts from creeks and shoreline development through NPDES Phase 1 and Phase 2 permit updates, consistent with Washington Department of Ecology’s 2001 Stormwater Management Manual, including low impact development techniques, on-site stormwater detention for new and redeveloped projects, and control of point sources that discharge directly into the lakes; and 2) Protecting and restoring water quality and other ecological functions in tributaries to reduce effects of urbanization. This involves protecting and restoring forest cover, riparian buffers, wetlands, and creek mouths by revising and enforcing critical areas ordinances and Shoreline Master Programs, incentives, and flexible development tools.

7.6 Priority 6 – Improve Water Quality and Reduce Sediment and Pollutant Delivery

Although most of the City’s watercourses and their basins are located outside of shoreline jurisdiction, their impacts to shoreline areas should not be discounted. Several of these watercourses have the potential to provide fish habitat in their lower sections and wildlife habitat throughout. They are also a common receiving body for non-point source pollution, which in turn delivers those contaminants ultimately to Lake Washington. Mercer Island started a Water Quality Monitoring effort in 2001 with technical assistance from the King County Water and Land Resources Division that analyzes a variety of water quality factors affecting Lake Washington.

Many actions provided in the WRIA 8 Salmon Conservation Plan focus on addressing water quality and stormwater controls, including:

- Implement Phase 2 NPDES permit requirements
• Address stormwater impacts from transportation projects involving new or expanded roadways

• Encourage low impact development through regulations, incentives, education and training, and demonstration projects

• Improve Enforcement of Existing Land Use and Other Regulations

These recommendations emphasize the use of low impact development techniques, on-site stormwater detention for new and redeveloped projects, and control of point sources that discharge directly into surface waters. They involve protecting and restoring vegetative cover, riparian buffers, wetlands, and creek mouths by revising and enforcing critical areas ordinances and Shoreline Master Programs, incentives, and flexible development tools.

7.7 Priority 7 – Improve Riparian Vegetation, Reduce Impervious Coverage

Similar to the priority listed above to improve water quality and reduce sediment and pollutant delivery, improved riparian vegetation and reduction in impervious surfaces are emphasized throughout the WRIA 8 Salmon Conservation Plan. These factors correspond directly to the emphasis to increase use of Low Impact Development techniques. Actions which involve improvements to riparian vegetation and reductions in impervious surface coverage are likely to take place on both public and private development. The City’s Parks and Recreation Department is committed to providing improved shoreline landscapes by incorporating areas of native riparian vegetation. Private development should be encouraged to utilize low impact development techniques such as the planting of native trees and use of porous paving.

7.8 Priority 8 – Reduce Aquatic Non-Native Invasive Weeds

While not specifically listed in the WRIA 8 Salmon Conservation Plan, reduction of aquatic invasive weeds from Lake Washington, particularly Eurasian watermilfoil and white water lily, is of particular concern across many jurisdictions with Lake Washington shoreline. Not only are aquatic weeds a problem for boats and swimmers, but they also tend to reduce dissolved oxygen to lethal levels for fish, hampering foraging opportunities. Long-term control of aquatic non-native invasive plants in Lake Washington will be very difficult to achieve without coordinated inter-jurisdictional collaboration.

7.9 Priority 9 – Acquisition of Shoreline Property for Preservation, Restoration, or Enhancement Purposes

The City should explore opportunities to protect natural areas or other areas with high ecological value or restoration potential via property acquisition. Mechanisms to purchase property would likely include collaboration with other stakeholder groups.
including representatives from local government, businesses and the general public in order to develop a prioritized list of actions. Properties throughout the more developed shoreline areas within the City may be available for acquisition both for preservation but also to act as a showcase for restoration potential.

### 7.10 Priority 10 – City Zoning, Regulatory, and Planning Policies

City Zoning, Regulatory, and Planning Policies are listed as being of lower priority in this case simply because they have been the subject of a thorough review and have recently been updated accordingly. Notably, the City’s Critical Areas Ordinance was updated (November 2005) consistent with the Best Available Science for critical areas, including those within the shoreline area. However, as noted in the WRIA Implementation Monitoring Report (WRIA 8 2008a), both Shoreline Master Programs and Critical Areas Ordinances are highly linked to the implementation of plan recommendations. For the time being, it is considered more important to capitalize on this Restoration Plan by focusing on implementing projects consistent with the updated SMP policies. Unimplemented or unused policies, by themselves, will not improve habitat. As time goes by, further review and potential updating of these policies may increase in priority. Policy-related items in this category as listed in previous sections include Comprehensive Plan Policies (Section 4.2), Critical Areas Regulations (Section 4.3), and Stormwater Planning (Section 4.4).

The City received its final NPDES Phase II permit in February 2007 from Ecology. The NPDES Phase II permit is required to cover the City’s stormwater discharges into regulated lakes and streams. Under the conditions of the permit, the City must protect and improve water quality through public education and outreach, detection and elimination of illicit non-stormwater discharges (e.g., spills, illegal dumping, wastewater), management and regulation of construction site runoff, management and regulation of runoff from new development and redevelopment, and pollution prevention and maintenance for municipal operations.

The City conducts all of the above at some level already, but significant additional effort may be needed to document activities and to alter or upgrade programs. The City has various programs to control stormwater pollution through maintenance of public facilities, inspection of private facilities, water quality treatment requirements for new development, source control work with businesses and residents, and spill control and response. Monitoring may be required as part of an illicit discharge detection and elimination program, for certain construction sites, or in waterbodies with a Total Maximum Daily Load (TMDL) Plan for particular pollutants. General water quality monitoring concerns include: a) stormwater quality; b) effectiveness of best management practices; and c) effectiveness of the stormwater management program.
8 REFERENCES

Anchor Environmental LLC. 2005. Draft Shoreline Habitat Inventory Memorandum

City of Mercer Island. 2007. City of Mercer Island Capital Improvement Program.


9 LIST OF ACRONYMS AND ABBREVIATIONS

AASF……………………Adopt-A-Stream Foundation

cfs……………………cubic feet per second

CIP ............................ Capital Investment Program

GMA ............................ Growth Management Act

NGPA .......................... Native Growth Protection Area

NGPE ........................ Native Growth Protection Easement

OHWM ......................... ordinary high water mark

WDFW ........................ Washington Department of Fish and Wildlife
APPENDIX A

CITY OF MERCER ISLAND
RESOLUTION 1347
RATIFYING THE WRIA 8 CHINOOK SALMON CONSERVATION PLAN
CITY OF MERCER ISLAND
RESOLUTION NO. 1347

A RESOLUTION RATIFYING THE WATER RESOURCE INVENTORY AREA (WRIA) 8 CHINOOK SALMON CONSERVATION PLAN

WHEREAS, in March 1999, the National Oceanic and Atmospheric Administration (NOAA) Fisheries listed the Puget Sound Chinook salmon evolutionary significant unit as a threatened species under the Endangered Species Act (ESA); and

WHEREAS, in November 1999, the United States Fish and Wildlife Service (USFWS) listed the Puget Sound bull trout distinct population segment as a threatened species under the ESA; and

WHEREAS, under the ESA, it is illegal to take a listed species, and the ESA defines the term “take” to include actions that could harm listed species or their habitat; and

WHEREAS, under the ESA, Section 4(f), NOAA Fisheries (for Chinook salmon) and USFWS (for bull trout) are required to develop and implement recovery plans to address the recovery of the species; and

WHEREAS, an essential ingredient for the development and implementation of an effective recovery program is coordination and cooperation among federal, state, and local agencies, tribes, businesses, researchers, non-governmental organizations, landowners, citizens, and other stakeholders as required; and

WHEREAS, Shared Strategy for Puget Sound, a regional non-profit organization, has assumed a lead role in the Puget Sound response to developing a recovery plan for submittal to NOAA Fisheries and the USFWS; and

WHEREAS, local jurisdictions have authority over some habitat-based aspects of Chinook survival through land use and other policies and programs; and the state and tribes, who are the legal co-managers of the fishery resource, are responsible for addressing harvest and hatchery management in WRIA 8; and

WHEREAS, in WRIA 8, habitat actions to significantly increase Chinook productivity trends will be helpful, in conjunction with other recovery efforts, to avoid extinction in the near term and restore WRIA 8 Chinook to viability in the long term; and

WHEREAS, Mercer Island supports cooperation at the WRIA level to set common priorities for actions among partners, efficient use of resources and investments, and distribution of responsibility for actions and expenditures;

WHEREAS, 27 local governments in WRIA 8 jointly funded development of The WRIA 8 Steering Committee Proposed Lake Washington/Cedar/Sammanish Watershed Chinook

Resolution No. 1347
Salmon Conservation Plan (the Plan), published February 25, 2005 following public input and review; and

WHEREAS, while the Plan recognizes that salmon recovery is a long-term effort, it focuses on the next 10 years and includes a scientific framework, a start-list of priority actions and comprehensive action lists, an adaptive management approach, and a funding strategy; and

WHEREAS, Mercer Island has consistently implemented habitat restoration and protection projects, and addressed salmon habitat through its land use and public outreach policies and programs over the past five years; and

WHEREAS, it is important to provide jurisdictions, the private sector and the public with certainty and predictability regarding the course of salmon recovery actions that the region will be taking in the Lake Washington/Cedar/Sammamish Watershed, including the Puget Sound nearshore; and

WHEREAS, if insufficient action is taken at the local and regional level, it is possible that the federal government could list Puget Sound Chinook salmon as an endangered species, thereby decreasing local flexibility.

NOW, THEREFORE, BE IT RESOLVED BY THE MERCER ISLAND CITY COUNCIL AS FOLLOWS:

Section A: The Mercer Island City Council hereby ratifies The WRIA 8 Steering Committee Proposed Lake Washington/Cedar/Sammamish Watershed Chinook Salmon Conservation Plan, dated February 25, 2005, a copy of which is on file with the Mercer Island City Clerk (the Plan). Ratification is intended to convey the city's approval of the Plan.

Section B: Mercer Island recognizes that negotiation of commitments and assurances/conditions with appropriate federal and state agencies will be an iterative process. Full implementation of this Plan is dependent on the following:

1. NOAA Fisheries will adopt the Plan, as an operative element of its ESA Section 4(f) recovery plan for Puget Sound Chinook salmon.

2. NOAA Fisheries and USFWS will:
   a) take no direct enforcement actions against Mercer Island under the ESA for implementation of actions recommended in or consistent with the Plan,
   b) endorse the Plan and its actions, and defend Mercer Island against legal challenges by third parties, and
   c) reduce the regulatory burden for Mercer Island activities recommended in or consistent with the Plan that require an ESA Section 7 consultation.
3. Federal and state governments will:
   a) provide funding and other monetary incentives to support Plan actions and
      monitoring activities,
   b) streamline permitting for projects implemented primarily to restore salmonid habitat
      or where the actions are mitigation that further Plan implementation,
   c) offer programmatic permitting for local jurisdiction actions that are consistent with
      the Plan,
   d) accept the science that is the foundation of the Plan and support the monitoring and
      evaluation framework,
   e) incorporate actions and guidance from the Plan in future federal and state
      transportation and infrastructure planning and improvement projects, and
   f) direct mitigation resources toward Plan priorities.

Section C: This resolution does not obligate the Mercer Island City Council to future
appropriations beyond current authority set forth in its 2005-2006 biennial budget. All future
appropriations are subject to review and approval by the then seated City Council.

ADOPTED BY THE CITY COUNCIL OF THE CITY OF MERCER ISLAND,
WASHINGTON AT ITS REGULAR MEETING ON THE 6TH DAY OF SEPTEMBER 2005.

[Signature]
Bryan Cairns, Deputy Mayor

ATTEST:

[Signature]
Allison Spietz, City Clerk
APPENDIX B

PROPOSED OUTREACH AND EDUCATION ACTIONS
# Draft Proposed Outreach & Education Actions for the Cedar Population (Tier 1 and 2 Subareas)
(by WRIA 8 Public Outreach Committee)

<table>
<thead>
<tr>
<th>Project #</th>
<th>Habitat Condition</th>
<th>Desired Outcome</th>
<th>Target Audience</th>
<th>Proposed Action</th>
<th>Priority</th>
<th>Proven Track Record/Model</th>
<th>Level of Financial Commit.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C701</td>
<td>Riparian vegetation displaced by lawn, invasives, or exotics; water quality compromised by garden chemicals, metals, sediment; higher water use at times when flows lowest.</td>
<td>Protect &amp; restore riparian vegetation to provide sources of large woody debris/pools/riffles; protect &amp; restore water quality, maintain instream flows.</td>
<td>Shoreline property owners and general public.</td>
<td>Update and distribute streamside living materials such as <em>Streamside Savvy</em>, <em>Salmon Friendly Gardening Practices</em>, or <em>Going Native</em>. Distribute to all shoreline property owners and make available at City Hall, libraries, and retail establishments such as home &amp; garden centers.</td>
<td>High</td>
<td>Ongoing or have been distributed in past.</td>
<td>Low-Medium</td>
</tr>
<tr>
<td>C702</td>
<td>Riparian vegetation displaced by lawn, invasives, or exotics; water quality compromised by landscape practices; higher water use at times when flows lowest.</td>
<td>Protect &amp; restore riparian vegetation to provide sources of large woody debris/pools; protect &amp; restore water quality, maintain instream flows.</td>
<td>Shoreline property owners.</td>
<td>Offer shoreline property owners a workshop in streamside living. Include tips on landscape design/maintenance appropriate for riverside properties and shoreline stabilization (alternatives to vertical wall bulkhead design). Feature designers and contractors who have both experience and recognition in salmon friendly design.</td>
<td>High</td>
<td>Seattle Public Utilities and Snohomish County Streamside Stewardship Courses, Issaquah’s Creekside Living workshops</td>
<td>Low</td>
</tr>
<tr>
<td>C703</td>
<td>Smaller parcels lost to development or possible habitat degradation without financial incentives to conserve that are offered to owners of larger parcels.</td>
<td>Protect good salmon habitat that could provide source of shelter, pools, riffles, food</td>
<td>Shoreline property owners.</td>
<td>Expand use tax credit incentives to encourage protection of smaller properties not currently eligible for existing programs.</td>
<td>High</td>
<td>Public Benefits Rating System, Open Space Current Use Tax (CUT)</td>
<td>Variable (Low budget)</td>
</tr>
<tr>
<td>C704</td>
<td>Channel confinement from bulkheads, levees, and armoring; loss of riparian vegetation.</td>
<td>Soften shorelines, restore floodplain connectivity and channel complexity.</td>
<td>Shoreline property owners.</td>
<td>Reduce permit fees for shoreline stabilization if design is salmon friendly (employing alternatives to dikes, levees, revetments, and vertical wall bulkheads). Also reduce permit fees (where applicable) for streamside restoration and removal &amp; replacement of non-native vegetation.</td>
<td>High</td>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Proj #</td>
<td>Habitat Condition</td>
<td>Desired Outcome</td>
<td>Target Audience</td>
<td>Proposed Action</td>
<td>Priority</td>
<td>Proven Track Record/ Model</td>
<td>Level of Financial Commit.</td>
</tr>
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</tr>
<tr>
<td>C705</td>
<td>Riparian vegetation displaced by lawn, invasives, or exotics; water quality compromised by garden chemicals, metals, sediment. Higher water use at times when flows lowest.</td>
<td>Protect &amp; restore riparian vegetation; protect &amp; restore water quality, maintain instream flows, stabilize slopes with native riparian vegetation. Increase likelihood of achieving these goals by bringing on board industry with a large influence over the landscapes within watershed.</td>
<td>Landscape Contractors</td>
<td>Offer educational opportunities to landscape designers/contractors on riparian design/naturescaping, local plant sourcing, proper installation techniques, invasive species, efficient watering techniques and use of compost to build healthy soils, control erosion and reduce need for supplemental irrigation. Augment training to accommodate English as Second Language participants.</td>
<td>High</td>
<td>Washington Assoc. of Landscape Professionals (WALP) trainings</td>
<td>Low - Medium (industry supported)</td>
</tr>
<tr>
<td>C706</td>
<td>Reduced forest cover; increased impervious areas/lack of infiltration/ground water recharge</td>
<td>Protect forest cover, reduce impervious surface area, increase infiltration back into soil and ground water recharge, decrease water use.</td>
<td>Design &amp; Building Professionals</td>
<td>Provide education to architects, landscape architects, engineers, and developers on sustainable building/design practices. Work with professional associations to highlight building practices that maintain watershed health. Include Low Impact Development, importance of maintaining canopy cover and limiting impervious surfaces.</td>
<td>High</td>
<td>City of Seattle Business &amp; Industry Venture, King County Green Building, LEEDS, Construction Works and other Solid Waste Division outreach programs</td>
<td>Low – Medium</td>
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<tr>
<td>C707</td>
<td>Reduced forest cover; increased impervious areas/lack of infiltration/ground water recharge</td>
<td>Control stormwater runoff to more closely mimic natural hydrology, reduce paving and impervious areas, increase infiltration, protect forest cover</td>
<td>Design &amp; Building Professionals</td>
<td>Use recognition as a means to encourage more salmon sustainable designs and construction. In addition to professional association awards, expand recognition to include merit awards celebrated by popular magazines read by a broader sector of the general public. Promote through design competitions and media coverage the use of “rain gardens” and other low impact development practices that mimic natural hydrology. Combine a home/garden tour or “Street of Dreams” type event featuring these landscape</td>
<td>High</td>
<td>AIA, ASLA, Sunset Magazine, and Seattle Times Home and Garden awards, King County EnviroStars</td>
<td>Low – Medium</td>
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<td>Level of Financial Commit.</td>
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<tr>
<td>C708</td>
<td>Insufficient flow</td>
<td>Maintain instream flows</td>
<td>High-end water users, general public</td>
<td>Extend availability of water conservation incentive programs (such as rebates for efficient toilets, appliances, free indoor conservation kits, or free landscape irrigation audits) to decrease household and commercial water consumption.</td>
<td>High</td>
<td>Smart &amp; Healthy Landscapes, Water Cents</td>
<td>Low</td>
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<tr>
<td>C709</td>
<td>Water quality compromised by garden chemicals, metals, sediment. Higher water use at times when flows lowest.</td>
<td>Protect water quality from degradation by pesticides and soil erosion, maintain instream flows by reducing water used for irrigation, increase organic content in soils to increase water holding capacity</td>
<td>General public</td>
<td>Target Natural Yardcare Neighborhoods Program to include more communities in the Cedar sub-basin. Expand curricula to offer more landscaping guidelines specific to shoreline residences.</td>
<td>High</td>
<td>Ongoing program</td>
<td>Medium - High</td>
</tr>
<tr>
<td>C710</td>
<td>Water quality degraded by cleaners, oils, grit, and paint; stream flows reduced by excessive water use</td>
<td>Protect and restore water quality and maintain flows</td>
<td>General Public</td>
<td>Coordinate with local business community to encourage the use of commercial car washes. (Water quality and salmon conservation could provide a new marketing angle; car dealerships could offer car wash coupons as bonus with car purchase.). Require that car kits be used for all parking lot fund raiser car washes, or offer carwash coupons or as more eco-friendly alternative funding source.</td>
<td>High</td>
<td>Puget Sound CarWash Association Coupon Program.</td>
<td>Variable - Low</td>
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<tr>
<td>C711</td>
<td>All conditions listed above</td>
<td>Increase public watershed literacy awareness of effects on water quality and habitat conditions. General Public, but in particular, residents of Cedar sub-basin who may not be aware of existence of salmon right within urban area</td>
<td>Support and encourage efforts of Cedar River Naturalist Program to promote voluntary stewardship by focusing on education, monitoring, and maintenance of restoration sites (e.g. Cavanaugh Pond). Continue and expand messaging about how everyday personal actions affect salmon, the Cedar River, and entire watershed.</td>
<td>High</td>
<td>Ongoing program with successful track record since 1998</td>
<td>Low-Medium</td>
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<tr>
<td>C712</td>
<td>Water quality degraded by toxics</td>
<td>Keep toxics out of water by providing safer alternative</td>
<td>General Public</td>
<td>Increase outreach about availability and locations of Hazardous Waste Collection sites and special collection events.</td>
<td>High</td>
<td>King County Local Hazardous Waste Management Program</td>
<td>Low (cheaper than dealing with illegal dumping)</td>
</tr>
<tr>
<td>C713</td>
<td>Water quality degraded by toxics, pesticides, metals, increased nutrient loads, sediments, loss of riparian buffer</td>
<td>Protect and restore water quality</td>
<td>General Public</td>
<td>Publicize emergency call numbers for public to report water quality and quantity problems, non-permitted vegetation clearing, non-permitted in-stream grading, and wood removal incidents.</td>
<td>High</td>
<td>Seattle Public Utilities Surface Water Pollution Prevention Hotline and website</td>
<td>Low</td>
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<tr>
<td>C714</td>
<td>Riparian vegetation displaced by lawn, invasives, and exotics, providing little food value, no source of LWD, or soil stability (sedimentation of gravel beds), Increased water use when flows lowest; increased use of pesticides on less resistant exotics</td>
<td>Restore native riparian vegetation to provide cover and terrestrial food source, reduce soil erosion and sedimentation in gravel beds, protect and restore water quality, maintain instream flows</td>
<td>Shoreline Property Owners and Community</td>
<td>Increase number of native plant salvages. Integrate these salvage opportunities into naturscaping classes; class participants can take home native plants for immediate use both within and surrounding sensitive areas.</td>
<td>High</td>
<td>King and Snohomish County Native Plant Salvage Programs, WSU Cooperative Extension Native Plant Salvage Project partnership with Puget Sound Action Team, Thruston &amp; Mason Counties.</td>
<td>Low</td>
</tr>
<tr>
<td>C715</td>
<td>Channel confinement and loss of channel complexity from bulkheads, levees, and armoring; loss of riparian vegetation</td>
<td>Reduce channel confinement, restore riparian vegetation, and floodplain connectivity and channel complexity</td>
<td>Shoreline property owners, general Public</td>
<td>Demonstration Project. Locate property owner in publicly accessible (or viewable) area willing to remove bulkhead, levee, or stream bank armoring and replace it with more ecologically friendly design. Publicize efforts through various means. Demonstration project should contain elements that can be done by average shoreline property owner. Provide information on costs and advantages of alternate treatments.</td>
<td>High – Medium-</td>
<td>Variable</td>
<td>Variable</td>
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<tr>
<td>C716</td>
<td>Lack of large woody debris</td>
<td>Overcome public fear and resistance to providing and</td>
<td>Shoreline property owners,</td>
<td>Increase public awareness about the value of large woody debris and native vegetation for flood protection, salmon habitat, and healthy streams. Convey through</td>
<td>High-Medium</td>
<td>Existing King County and US Forest</td>
<td>Low</td>
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<td>maintaining woody debris along shorelines and subsequent source of cover, pools, riffles</td>
<td>general public</td>
<td>media (local newspapers, community newsletters); signage along publicly accessible “model” shoreline; and brochures such as King County’s Large Woody Debris and River Safety and US Forest Service Large Woody Material: The Backbone of a Stream. Distribute to all shoreline property owners and to more of general public, especially recreational boaters. Brochures on LWD and boater safety could be made available at appropriate locations such as: the Renton Community Center (where some tubers put in or pull out), the Henry Moses Pool and Water Park, the Renton Public Library (also on the river), and retail locations where inner-tubes, canoes, and kayaks are sold or rented. Where there is right-of-way or permission from private owners, consider installing kid-friendly signage which addresses the potential dangers that LWD can pose to boaters – along with the value it provides to salmon and the health of the river.. Where possible, locate signs at popular “put-in” and “take-out” spots along the river.</td>
<td>Service brochures</td>
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<tr>
<td>C717</td>
<td>All conditions listed above.</td>
<td>Reduce channel confinement, restore riparian vegetation, and floodplain connectivity and channel complexity</td>
<td>Shoreline property owners</td>
<td>Explore possibility of adding a disclosure to Real Estate Sales Agreement describing shorelines as sensitive areas, subject to rules and regulations of City and County. Look to model set by King County.</td>
<td>High – Medium</td>
<td>King County Dept. of Development and Environmental Services</td>
<td>Medium</td>
</tr>
<tr>
<td>C718</td>
<td>Water quality compromised by toxics, pesticides, metal fines, and nutrient overloads</td>
<td>Protect and restore water quality.</td>
<td>General Public</td>
<td>Work with auto parts retailers and gas stations to increase potential for collection of used motor oil/transmission fluids. Distribute Water Quality poster series which depicts impacts of everyday practices: washing car, driving car without maintenance, leaving pet wastes unattended, and improperly using lawn chemicals. Promote</td>
<td>High-Medium</td>
<td>Yes, King County Local Hazardous Waste Management EnviroStars program</td>
<td>Medium</td>
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<tr>
<td>C719</td>
<td>Channel confinement reduced channel complexity, loss of riparian vegetation</td>
<td>Increase public watershed literacy awareness of effects on water quality and habitat conditions,</td>
<td>Community</td>
<td>Increase citizen involvement in voluntary stewardship programs, focusing on restoration projects to meet the needs of the conservation plan through restoration, education, monitoring and restoration site maintenance</td>
<td>High – Medium</td>
<td>Various: Cedar River Naturalists, Sammamish ReLeaf, Stream Team; Water Tenders</td>
<td>Medium</td>
</tr>
<tr>
<td>C720</td>
<td>Water quality degraded by sediment, diminished ground water recharge, flashiness of floods and resultant bed scour</td>
<td>Protect and restore forest cover, increase infiltration, decrease intensity of flood conditions, protect water quality from sediment</td>
<td>General public</td>
<td>Increase outreach efforts about the benefits of trees and basin-wide forest coverage to protect water quality. Clarify issues about hazard trees. Offer seedlings (perhaps provided by a timber company) to replant after potentially hazardous trees are removed. Enlist the help of nurseries/home &amp; garden centers on this education campaign. (Potential new Fathers’ Day gift idea: Buy and plant a tree each year for a dad who loves salmon).</td>
<td>High in rural areas; Medium in urban/suburban areas.</td>
<td>Yes, Sammamish ReLeaf; Mountains-to-Sound Greenway; City tree ordinances.</td>
<td>Variable - Medium</td>
</tr>
<tr>
<td>C721</td>
<td>All conditions listed.</td>
<td>Protect forest cover, wetlands, headwaters, critical salmon habitat; increase public support for land acquisition and restoration projects, as well as landuse policies.</td>
<td>Shoreline property owners, general public</td>
<td>Identify and encourage shoreline neighborhood and community stewardship associations to foster the ethic of voluntary stewardship. Use these groups to build a bridge between property owners, agencies, and locals governments. Promote watershed health through grassroots messaging. Increased potential for media coverage when efforts initiated at community level.</td>
<td>Medium</td>
<td>Friends of Rock Creek Valley; Friends of Cedar River Watershed, Cedar River Council, Lake Forest Park Stewardship Foundation,</td>
<td>Low</td>
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<tr>
<td>C722</td>
<td>Loss of forest cover, organic content in soils, increase in impervious areas and increased run-off, degraded water quality flashiness during flood conditions.</td>
<td>Protect forest cover , reduce impervious area and runoff, increase infiltration, protect and restore water quality, maintain instream flows</td>
<td>Design/Build Industry</td>
<td>Create a campaign that tracks demand among community residents for purchasing green homes and remodeling with green building strategies.</td>
<td>Medium</td>
<td>Green Car Program</td>
<td>Low</td>
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<tr>
<td>C723</td>
<td>Degraded water</td>
<td>Cultivate ethic of</td>
<td>Youth</td>
<td>Link education and community service stewardship</td>
<td>Medium</td>
<td>Environmental</td>
<td>Low</td>
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<tr>
<td>C724</td>
<td>quality, instream flows, habitat quality</td>
<td>environmental stewardship; increase watershed awareness and links between manmade habitat and environmental health.</td>
<td>General Public</td>
<td>projects. Expand to community outreach to community/technical colleges &amp; universities.</td>
<td>Medium</td>
<td>Portal Seattle, Mercer Slough Interns, N. Shore Utility Tour, Water Tenders.</td>
<td>Low</td>
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<td>Riparian vegetation displaced by lawn, invasives, or exotics, providing little food value, source of large woody debris, or soil stability. Water quality compromised by garden chemicals, metals, sediment. Higher water use at times when flows lowest.</td>
<td>Replace lawn and other lower ecological value plantings with riparian buffers and native plants</td>
<td>General Public</td>
<td>Encourage neighborhood garden tours of salmon friendly gardens. Help residents visualize alternatives to traditional (and often less eco-friendly) landscape treatments. Offer neighbors assistance with publicity, signage, and volunteer docents. Coordinate with neighborhood garden clubs.</td>
<td>Medium</td>
<td>Existing neighborhood garden tours. Volunteer docents by King County Master Recycler Composters and WSU Master Gardeners.</td>
<td>Low</td>
</tr>
<tr>
<td>C725</td>
<td>All conditions discussed above.</td>
<td>Increase awareness about effects of habitat on salmon and watershed health; increase support for land acquisition and restoration efforts as well as landuse policies; inspire shoreline property owners to make changes on their own property.</td>
<td>General Public, but in particular Shoreline property owners</td>
<td>Create local informational TV spots that could run on the government cable channels. Focus on those habitat conditions threatening salmon that are affected by our daily personal practices, landscape design and management practices. Showcase good designs to provide models to emulate.</td>
<td>Medium – Low</td>
<td>Salmon Information TV, C-TV,</td>
<td>Variable</td>
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<tr>
<td>C726</td>
<td>All conditions discussed above.</td>
<td>Encourage Design/Build industry professionals to offer more salmon friendly/eco-friendly</td>
<td>Design &amp; Building Professionals</td>
<td>Use recognition as a means to encourage more salmon sustainable designs and construction. Coordinate with professional association awards in addition to popular magazine merit awards. Continue to recognize businesses that carry out procedures or use products</td>
<td>Medium – Low</td>
<td>American Institute of Architects, American Society of</td>
<td>Low</td>
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<tr>
<td>C727</td>
<td>All conditions discussed above</td>
<td>Increase watershed literacy and understanding of effects of habitat on salmon</td>
<td>Business Community and General Public</td>
<td>Coordinate with businesses along Cedar that can help with outreach goals. For example, Ivar’s Seafoods could promote key messages about salmon conservation on their menus or though game cards. This seafood chain also has other restaurants located within WRIA 8 so it could be cost effective for them to do such a promotion.</td>
<td>Medium</td>
<td>Yes</td>
<td>Low</td>
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<tr>
<td>C728</td>
<td>Water quality degraded by toxics and metal fines.</td>
<td>Reinforce to students and the community the relationship between what goes down storm drain and watershed health via an affordable and easily implemented program.</td>
<td>General Public</td>
<td>Expand storm-drain stenciling program locally and basin-wide. Track locations and dates in a Cedar Basin database.</td>
<td>Medium - Low</td>
<td>Yes</td>
<td>Low</td>
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<tr>
<td>C729</td>
<td>Channel confinement, loss of riparian buffer: sources of large woody debris, pools, riffles; reduced channel complexity,</td>
<td>Inspire shoreline property owners to make changes on their own property by providing good examples; increase public support for land acquisition and restoration efforts as well as landuse policies.</td>
<td>Shoreline property owners and general public</td>
<td>Use government cable channels to follow progress of the site specific restoration projects. Use of video to document projects before, during, and after restoration. Distribute resulting programs to libraries, schools, and communities groups.</td>
<td>Low</td>
<td>Salmon Information TV</td>
<td>Variable</td>
</tr>
<tr>
<td>C730</td>
<td>All conditions discussed above.</td>
<td>Improve watershed awareness and</td>
<td>Youth</td>
<td>Focus environmental/science curricula on local watershed issues, with particular emphasis on key</td>
<td>Low-Future</td>
<td>Yes</td>
<td>Medium</td>
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<td>possibly prevent future habitat degradation by instilling a better understanding of interrelationship between habitat, daily actions, and watershed health.</td>
<td>factors limiting the Cedar Chinook population.</td>
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## Draft Proposed Outreach & Education Actions for Lake Washington
(by WRIA 8 Public Outreach Committee)

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<thead>
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<tbody>
<tr>
<td>C729</td>
<td>Shoreline hardening, riparian vegetation displaced by lawn, invasives, or exotics with low ecological value, overwater structures creating sharp light contrast, water quality degraded by effects of landscape practices</td>
<td>Increase awareness that the lakeshore is also a nursery for juvenile salmon. It’s possible to make “home improvements” that can benefit both property owner and salmon. [people pets, and planet]</td>
<td>Lakeshore property owners</td>
<td>Promote concept of living with the lake, instead of just on it through public messaging. Foster idea of sharing the shoreline with other species that inhabit the lakeshore. Carry out through workshops, literature, and development of education and marketing campaigns</td>
<td>High</td>
<td>Lakeside Living Workshop Series; King County Lake Stewardship Program</td>
<td>Variable</td>
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<tr>
<td>C730</td>
<td>Shoreline hardening, riparian vegetation displaced by lawn, invasives, or exotics with low ecological value, overwater structures creating sharp light contrast, water quality degraded by effects of landscape practices</td>
<td>Reduce conditions favored by predator species; protect &amp; restore water quality.</td>
<td>Lakeshore property owners</td>
<td>Offer lakeshore property owners a series of workshops on lakeshore living: natural yard care; reduction of lawn size, shoreline buffer planting design/noxious weed management; alternatives to vertical wall bulkheads; salmon friendly dock design; aquatic weed management; environmentally friendly methods of maintaining boats, docks, decks; porous paving options</td>
<td>High</td>
<td>WRIA 8/KCD Lakeside Living Lakeshore Property Owner Workshops, Seattle Public Utilities and Snohomish County Creek Stewardship Programs, City of Issaquah’s Creekside Living Program, Natural Yard Care Neighborhoods</td>
<td>Medium-High</td>
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<td>C731</td>
<td>Forested parcels threatened by development, (even though difficult to build on); creek mouths degraded or unrecognizable (culverted); riparian vegetation replaced by invasives infested along shoreline</td>
<td>Protect and/or restore forest land, critical areas such as wetlands and shallow water rearing habitat. Promote watershed health through grassroots messaging.</td>
<td>Community, but especially lakeshore property owners.</td>
<td>Identify and encourage shoreline neighborhood and community stewardship associations. Use to foster the ethic of voluntary stewardship, set examples for other neighbors to follow, enlist community support to acquire and restore habitat, and to build a bridge between property owners, agencies, and local governments. Increase potential for media coverage when efforts initiated at community level.</td>
<td>High</td>
<td>Lake Forest Park Stewardship Foundation, Save Lake Sammamish, Denny Creek Neighborhood Association</td>
<td>Low</td>
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<td>C732</td>
<td>Riparian vegetation displaced by lawn, invasives, or exotics; water quality compromised by garden chemicals, metals, sediment; elevated water temperatures due to increased water use at times when flows lowest.</td>
<td>Protect and improve rearing and migratory habitat; protect and restore water quality</td>
<td>Lakeshore property owners, general public</td>
<td>Update where necessary salmon-friendly educational materials such as <em>Salmon Friendly Gardening Practices, Going Native, Watershed Waltz and Sammamish Swing</em> booklets. Print and distribute to the following prioritized audiences: 1) lakeshore property owners 2) Public places such as libraries, city halls, community centers and where permitted, at home improvement centers and other major retail establishments.</td>
<td>Medium - High</td>
<td>Yes</td>
<td>Low-Medium</td>
</tr>
<tr>
<td>C733</td>
<td>Riparian vegetation displaced by lawn, invasives, or exotics; water quality compromised by garden chemicals, metals, sediment; elevated water temperatures due to increased water use at times when flows lowest.</td>
<td>Protect &amp; restore shoreline buffer plantings to provide source of food &amp; shelter; protect &amp; restore water quality, maintain baseflows of feeder streams in order to provide source of cooler water</td>
<td>Lakeshore property owners</td>
<td>Modify more for “lakeshore living” the existing “Streamside Living Welcome Wagon” program in which residents welcome new homeowners to the neighborhood and provide information concerning “salmon friendly” yard care, lakeshore planting tips, water-wise gardening.</td>
<td>Medium</td>
<td>WaterTenders Streamside Living Welcome Wagon</td>
<td>Low-Medium</td>
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<tr>
<td>C734</td>
<td>Solid overwater surfaces that create sharp light contrast and dark shadows,</td>
<td>Reduce severity of predation on juveniles</td>
<td>Lakeshore property owners</td>
<td>Explain about mutual value of mesh docks, smaller piling sizes, and community docks to salmon and property owners: Reduced predation for fish; reduced maintenance for homeowners, opportunity to watch small</td>
<td>High</td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td>Proj #</td>
<td>Habitat Condition</td>
<td>Desired Outcome</td>
<td>Target Audience</td>
<td>Proposed Action</td>
<td>Priority</td>
<td>Proven Track Record/Model</td>
<td>Level of Financial Commit.</td>
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<tr>
<td>C735</td>
<td>Sharp light contrast and dark hiding spots created by overwater structures, conditions favored by predators.</td>
<td>Reduce severity of predation on juveniles by reducing number of docks.</td>
<td>Lakeshore property owners</td>
<td>Offer financial incentives for community docks in terms of reduced: permit fees, loan fees/percentage rates, taxes and permitting time, in addition to reduced construction costs</td>
<td>High</td>
<td>Pro Bono advertising campaign development – The Coalition for Drug Free America ad campaign.</td>
<td>low</td>
</tr>
<tr>
<td>C736</td>
<td>Steep shoreline gradient with coarse aggregate caused by wave action on vertical wall bulkheads</td>
<td>Create sandy, shallow water habitat needed by juveniles.</td>
<td>Lakeshore property owners</td>
<td>Utilize niche marketing to promote a “Build a Beach” campaign. Clarify how hardened shorelines prevent the development of shallow, sandy beaches and how alternative treatments can provide these amenities. Of benefit to salmon and to homeowners desiring more easily accessible shallow beach and aesthetics of a cove. Work with media (including design and lifestyle magazines) and real estate community (articles in real estate sections of papers) as well as construction, and design industry professionals</td>
<td>High</td>
<td>Various Bert the Salmon ads</td>
<td>Variable, but low able to get Pro Bono assistance.</td>
</tr>
<tr>
<td>C737</td>
<td>Lack of shelter provided by large and small woody debris due to lack of shoreline vegetation; steep dropoffs from shoreline hardening</td>
<td>Reduce conditions favored by predator species.; increase shoreline buffer vegetation and sources for large and small woody debris</td>
<td>Lakeshore property owners</td>
<td>Alternative marketing campaign: work with advertising industry and media. Do a play on “Child Haven” promotion. <em>Fry Haven?</em> Contrast picture of a sandy shallow shoreline containing woody debris hiding Chinook juveniles with that of a deep gravelly shoreline with evil looking predator species lurking, gobbling up young Chinook. [A “Chinook need safe places too” idea]. Possibly graphics in style of <em>Finding Nemo</em>. Create a marketing niche with landscape related industries to inform property owners about feeding requirements of out-migrating salmon off their beach. Validate need for native vegetation along the shoreline</td>
<td>High</td>
<td>Various Bert the Salmon Ad campaigns</td>
<td></td>
</tr>
<tr>
<td>Proj #</td>
<td>Habitat Condition</td>
<td>Desired Outcome</td>
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<tr>
<td>C738</td>
<td>Lack of appropriate shoreline vegetation, shoreline hardening by vertical wall bulkheads and rip rap walls; docks that create stark light contrast and hiding spots for predators</td>
<td>Reduce conditions favored by predator species by “softening” shoreline; increase shoreline buffer vegetation and sources for large and small woody debris, replace the many docks with more salmon friendly designs</td>
<td>Lakeshore property owners</td>
<td>Demonstration Project. Locate property owner in publicly accessible (or viewable) area willing to remove bulkhead, or shoreline armoring and replace it with more ecologically friendly design. Similarly, renovate existing dock with more salmon-friendly design. Publicize efforts through various means. Demonstration project should contain elements that can be done by average shoreline property owner. Provide information on costs and advantages of alternate treatments.</td>
<td>Medium – High</td>
<td>Redmond River Walk, Juanita Beach, Classic Nursery, Lark Forest Park Stewardship projects</td>
<td>Medium</td>
</tr>
<tr>
<td>C739</td>
<td>Coarse substrate, steep slope, dark hiding spots for predators caused by bulkheads and solid surface docks.</td>
<td>Reduce conditions favored by predator species; increase shoreline buffer vegetation and sources for large and small woody debris</td>
<td>Lakeshore property owners, general public</td>
<td>Document video progress on a range of restoration projects from planning to post-construction. Air on government cable channels, in shoreline property owner classes and for libraries, schools, communities groups.</td>
<td>Medium</td>
<td></td>
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</tr>
<tr>
<td>C740</td>
<td>Coarse substrate, steep slope, dark hiding spots for</td>
<td>Overcome resistance of shoreline property</td>
<td>Lakeshore property owners,</td>
<td>Combine recreation and education. Organize a Bulkhead Alternatives and Salmon Friendly Dock Design tour to see good examples of design on a residential scale.</td>
<td>Low</td>
<td>King County and People for Puget Sound</td>
<td>Variable</td>
</tr>
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<tr>
<td>C741</td>
<td>Shoreline hardening, riparian vegetation displaced by lawn, ivasives, or exotics with low ecological value, overwater structures creating sharp light contrast, water quality degraded by effects of landscape practices</td>
<td>Protect and improve water quality; habitat quality - or- Protect &amp; restore riparian vegetation to provide terrestrial food source and shelter; protect &amp; restore water quality, maintain instream flows upstream to provide source of cooler water</td>
<td>Landscape Contractors</td>
<td>Offer professional workshops to landscape designers &amp; contractors on environmentally-friendly lakeshore landscaping. Include topics such as shoreline buffer function and design, native plant selection, installation techniques, use of compost to build healthy soils, and noxious weed control. Determine need for training for non-English speaking participants</td>
<td>Medium – High</td>
<td>Washington Assoc of Landscape Professionals (WALP) Trainings by King County Local Hazardous Waste Management Program</td>
<td>Low</td>
</tr>
<tr>
<td>C742</td>
<td>Riparian vegetation displaced by lawn. Water quality compromised by garden chemicals, metals, sediment.</td>
<td>Increase shoreline planting; reduce lawn size to at least have buffer between lawn and shore.</td>
<td>Lakeshore property owners</td>
<td>Work with landscape, design, and real estate industries to sell benefit of “privacy” to homeowners. With restoration of shoreline buffer planting homeowners can increase privacy without sacrificing views. Promote idea of “framed views” as a more sophisticated landscape aesthetic.</td>
<td>Medium - High</td>
<td>1998 Lake Sammamish Shoreline Prop owners workshop Pilot Program</td>
<td></td>
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<tr>
<td>C743</td>
<td>Lack of shoreline buffer vegetation, increased water use when levels lowest;</td>
<td>Increase native vegetation and source of shelter and food for fish;</td>
<td>Lakeshore property owners, Community</td>
<td>Increase number of native plant salvages where landowners can take plants back to their yards. Publicize opportunity to drop off unwanted native plants at various parks surrounding the lake.</td>
<td>Low – Lake Washington</td>
<td>King County Native Plant Salvage Program</td>
<td></td>
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<td>C744</td>
<td>increased perceived need for pesticides</td>
<td>reduce erosion and need for supplemental irrigation (once established)</td>
<td>Lakeshore property owners</td>
<td>Reduce permit fees (where applicable) for shoreline restoration, removal &amp; replacement of non-native vegetation</td>
<td>Low-Med</td>
<td>Sammamish</td>
<td>Low</td>
</tr>
<tr>
<td>C745</td>
<td>Lack of appropriate shoreline vegetation</td>
<td>Increase shoreline vegetation and reduce non-native vegetation &amp; spread of invasives</td>
<td>General Public</td>
<td>Publicize emergency call numbers for public to report water quality problems, water diversion from lake for irrigation, non-permitted vegetation clearing, or tree overspray (pesticide) related incidents.</td>
<td>High</td>
<td>King County Water &amp; Land Division, Seattle Public Utilities Hotlines</td>
<td>Low</td>
</tr>
<tr>
<td>C746</td>
<td>Water quality degraded by toxics, pesticides, increased nutrient loads, sediment from construction sites; loss of riparian vegetation</td>
<td>Protect and improve water quality</td>
<td>General public, but property owners in particular</td>
<td>Increase outreach concerning the benefits of trees and basin-wide forest coverage to protect water quality. Include such actions as significant tree ordinance and information that links canopy cover to storm water issues. Provide clarification on hazardous tree issues. Offer seedlings to replant after hazard trees are removed. Coordinate with commercial nurseries to expand outreach about benefits of trees to salmon.</td>
<td>Medium-High</td>
<td>Sammamish ReLeaf; Mountains-to-Sound Greenway; City tree ordinances, King County Forestry Program</td>
<td>Low</td>
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<tr>
<td>C747</td>
<td>Elevated lake temperatures, lack of cool water sources from feeder streams, insufficient flows in feeder streams to provide source of cooler water, lack of ground water recharge, water</td>
<td>Protect forest cover, reduce paving and impervious areas, infiltration and conditions that mimic natural hydrology, protect water quality</td>
<td>Design, engineering, and construction industries</td>
<td>Provide education to architects, landscape architects, engineers, and developers on sustainable building/design practices. Work with professional associations to highlight building practices that maintain watershed health, importance of maintaining canopy cover and limiting impervious surfaces. Provide incentives to builders that demonstrate a use ecologically sensitive designs and/or techniques. Provide professional workshop and tours focusing on</td>
<td>Medium-High</td>
<td>WALP Trainings by King County Local Hazardous Waste Management Program</td>
<td>Variable</td>
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<td>quality, habitat quality</td>
<td>Protect and improve water quality and quantity to more closely mimic natural hydrology</td>
<td>Developers, Architects, Engineers Building Professionals</td>
<td>sustainable building/design practices to architects, landscape architects, engineers and developers. Build partnerships with professional associations to highlight the benefits of practices that maintain watershed health. Promote through design competitions and media coverage the use of “rain gardens” and other low impact development practices that mimic natural hydrology. Combine a home &amp; garden tour or “Street of Dreams” type event featuring these landscape and engineering treatments.</td>
<td>Medium</td>
<td>Concrete Council for Sustainable Development outreach on pervious pavement. Port Blakely Communities, Issaquah partnerships, Built Green, Sustainable Seattle, LEEDS</td>
<td>Low</td>
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<tr>
<td>Reduced forest cover, increased impervious area, decreased infiltration and ground water recharge, water quality degraded by runoff</td>
<td>Protect and improve water quality and quantity to more closely mimic natural hydrology</td>
<td>Developers, Architects, Engineers Building Professionals</td>
<td>Use recognition as a means to encourage more salmon sustainable designs and construction. Coordinate with professional association awards, in addition to popular magazine merit awards. Continue to recognize businesses that carry out procedures or use products that protect watershed health. Promote through design competitions and media coverage the use of “rain gardens” and other low impact development practices that mimic natural hydrology. Combine a home/garden tour or “Street of Dreams” type event featuring these landscape /engineering treatments</td>
<td>Medium</td>
<td>AIA, ASLA, Sunset Magazine, and Seattle Times Home and Garden awards, King County Enviro Stars.</td>
<td>Low</td>
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<tr>
<td>Water quality degraded by metals, toxins, pesticides, and nutrient overloads</td>
<td>Protect and improve water quality</td>
<td>General Public</td>
<td>Create a program that addresses impact of car maintenance and offers alternatives that help protect watershed health and water quality. More actively distribute – poster series developed by multi-jurisdictional Water Quality Consortium. Series depict water quality implications of everyday activities such as car washing, ignoring car maintenance, pet wastes. Work with auto parts retailers and gas stations to increase potential for collection of used motor oil/transmission fluids.</td>
<td>Medium</td>
<td>King County Local Hazardous Waste Mgmt Program Water Quality Consortium, Businesses for Clean Water</td>
<td>variable</td>
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<td>C750</td>
<td>Water Quality degraded by toxics and metal fines</td>
<td>Protect and restore water quality</td>
<td>General Public</td>
<td>Make outreach materials available to non-English speakers.</td>
<td>Medium</td>
<td>Commute Trip Reduction Programs</td>
<td>Low - Medium</td>
</tr>
<tr>
<td>C751</td>
<td>Water Quality degraded by toxics and metal fines degraded by metals and toxins</td>
<td>Protect and restore water quality</td>
<td>General Public, schools/non-profits and Charity groups – and business that offer to host a carwash.</td>
<td>Coordinate with local business community to encourage the use of commercial car washes over washing at home on street or in parking lots. Encourage alternatives to charity cash washes via commercial car wash coupon books or extend car wash kits throughout entire watershed. Make requirement that all charity car washes use coupons or car wash storm drain kit. Distribute “alternative community fundraising idea” brochure to volunteer fundraisers.</td>
<td>Medium - High</td>
<td>Yes, various cities’ car wash kit programs. Puget Sound Carwash Association</td>
<td>Low</td>
</tr>
<tr>
<td>C752</td>
<td>Water quality degraded by metals and toxins</td>
<td>Protect and restore water quality</td>
<td>Businesses, property management companies, homeowners associations.</td>
<td>Educate and support retail business and homeowner associations on stormwater best management practices specifically related to parking lot cleaning, storm drain maintenance, and boat cleaning.</td>
<td>Medium</td>
<td>Ongoing programs by various jurisdictions within WIRA, e.g. Issaquah, Redmond</td>
<td>Low</td>
</tr>
<tr>
<td>C753</td>
<td>Reduced baseflows from streams that feed into lake and subsequent elevated water temperatures in lake</td>
<td>Protect and restore sources of cool water</td>
<td>High end water users and general public</td>
<td>Extend availability of water conservation incentive programs such as rebates for efficient toilets, appliances, soaker hoses, free indoor conservation kits, or free landscape irrigation audits to decrease household and commercial water consumption.</td>
<td>High</td>
<td>Smart &amp; Healthy Landscapes, Water Cents, and other utility incentive programs</td>
<td>Low</td>
</tr>
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</table>
SEPA THRESHOLD DETERMINATION OF NON-SIGNIFICANCE (DNS)

Application No.: SEP10-002 (ZTR10-001)

Description of Proposal: A proposed amendment to existing regulations related to the City of Mercer Island Shoreline Master Program.

Applicant: Travis Saunders, Planner
City of Mercer Island
Development Services Group

Location of Proposal: The proposal is a nonproject action that affects all lands within the City of Mercer Island

Lead Agency: City of Mercer Island

The lead agency for this proposal has determined that this proposal will not have a probable significant adverse impact on the environment. An Environmental Impact Statement (EIS) or mitigation was not required under RCW 43.21C.030. This decision was made after review of a completed environmental checklist and other information on file with the lead agency. This information is available to public on request.

There is no comment period on this DNS.

X This Optional DNS is issued under WAC 197-11-355. The lead agency is acting on this proposal following the termination of the comment period, using the optional process. Deadline for comments was March 10, 2010 at 5:00 PM.

This DNS is issued under WAC 197-11-340(2); the lead agency will not act on this proposal for 14 days from the date below. Comments must be submitted by

SEPA Responsible Official: George Steirer, Principal Planner
City of Mercer Island
Development Services Group
9611 SE 36th Street
Mercer Island, WA 98040-3732
Tel: (206) 275-7719
Fax: (206) 275-7726
Email: george.steirer@mercergov.org

Signature: [Signature]
Date: March 15, 2010
APPEAL INFORMATION

This decision to issue a Determination of Nonsignificance (DNS) rather than to require an EIS may be appealed pursuant to Section 19.07 of the Mercer Island Unified Land Development Code, Environmental Procedures Code. Only those persons who submitted written comments within the designated comment period become parties of record and are eligible to file an appeal. Appeals shall be filed with the City Clerk on or before Monday, March 29, 2010 at 5:00 p.m. either in person or mailed to the City of Mercer Island, 9611 SE 36th Street, Mercer Island, WA 98040-3732. The required appeal fee of $611 must accompany the appeal letter being filed. Please contact the City Clerk for further information.
EXHIBIT 5 – PUBLIC COMMENTS
Muckelshoott Comments

From: Karen Walter [Karen.Walter@muckelshoott.nsn.us]
Sent: Wednesday, March 10, 2010 4:46 PM
To: Travis Saunders
Cc: jobu461@ecy.wa.gov
Subject: RE: Shoreline Master Program Zoning code text amendment, ZTR10-001, SEP10-002

Travis,
We are going to need more time to review these materials than the standard 14 day SEPA comment period. I apologize but I didn't not realize that the City was using this environmental review process to revise its entire SMP materials. At this time, we'll need a couple of weeks to review the material and provide any comments that we may have. To start, we'll need a copy of the shoreline inventory. Is the shoreline inventory available online or somewhere? We haven't seen a copy of it.

Thanks,
Karen Walter
MITFD
RE Mercer Island SMP Draft Language

From: Dean Patterson [Dean@futurewise.org]
Sent: Wednesday, February 24, 2010 4:03 PM
To: Travis Saunders
Subject: RE: Mercer Island SMP Draft Language

Three questions:

1. This appears to be just the comment period for SEPA. Is this right? Typically I see the comment period extending through the hearing process – usually after the PC hearing and before the Council hearing – in order to implement the SEPA WACs without the hearing creating a new set of SEPA comments:

WAC 197-11-535 Public hearings and meetings. (1) If a public hearing on the proposal is held under some other requirement of law, such hearing shall be open to consideration of the environmental impact of the proposal, together with any environmental document that is available. This does not require extension of the comment periods for environmental documents.

2. If this is just for SEPA, then will there be a separate comment period for public comment on the Draft SMP?

3. Is there a hearing set already?

Dean Patterson - Shoreline Planner
futurewise
Celebrating 20 years of protecting Washington's future.

email: dean@futurewise.org
web: www.futurewise.org
814 Second Avenue, Suite 500, Seattle, WA 98104-1530
Direct Cell 509-823-5481 / HQ office 206-343-0681 / Fax 206-709-8218
March 9, 2010

Re: Comments on #ZTR10-001/SEP 00-002, SEPA for a proposed amendment to existing regulations related to the City of Mercer Island Shoreline Master Program.

Travis Saunders
Development Services Group
City of Mercer Island
9611 SE 36th Street
Mercer Island, Washington 98040

Dear Mr. Saunders,

Thank you for requesting comments on the Shoreline Master Plan process. Our organization in conjunction with Friends of Luther Burbank Park worked on the Luther Burbank Park Master Plan which was completed in April of 2006. During that citizen driven process it was clear the community supports an urban oasis park that remains natural. Friends and Citizens presented a position paper which stated we do not want the park commercialized or privatized.

This Shoreline Master Plan SEPA filing states this is a non-project related filing. Although at this date the document is not completed and approved by the Planning Commission, they seem to be adhering to the elements of importance: that the park remain public and free of restricted or pay for play areas, or that it become privatized or commercialized. We trust the mention of docks, moorage and such is not intended for Luther Burbank Park. We feel no sewer upgrades or new lake lines should be necessary near the park and that a full EIS be required if dock areas are replaced or upgraded or new
construction projects considered. Immediate notice by planning staff will be appreciated over time with regard to the future of Luther Burbank Park.

Outside the park our organization feels the natural buffers required by waterfront homeowners should be widened to 50 feet or more and that “streams” should be added to the description of wetlands and natural habitats. Lake Washington is known to be a valuable and fragile body of water. We feel a naturally buffered shoreline is critical to clean water and healthy habitat for salmon and should be a priority of our waterfront homeowners.

Sincerely,

Sue Stewart
Chairperson,
Citizens to Preserve Upper Luther Burbank Park
3205 84th Avenue SE
Mercer Island, WA 98040
Hi Travis,

I would like to put "on record" that the Mercerwood Shore Club, 4150 East Mercer Way, Mercer Island, WA 98040, would like for the current existing shoreline uses to remain in place.

Would it behoove us to send a letter to you and/or the commission to reflect this?

Thanks again for keeping us all informed!

Paul

Paul T Von Destinon
General Manager
206-232-1622
paul@mercerwood.com

----- Original Message ----- 
From: Travis Saunders
To: smp
Sent: Thursday, February 25, 2010 12:48 PM
Subject: Mercer Island Planning Commission SMP Workshop 3/3/10

Shoreline Master Program update interested parties:

Attached is the agenda for the March 3, 2010 Mercer Island Planning Commission workshop for the Shoreline Master Program update.

The Commission packet materials related to the Shoreline Master Plan update will be online at: www.mercergov.org/smp as they become available.

Travis Saunders | Planner
City of Mercer Island, WA
T: 206.275.7717
F: 206.275.7726

NOTICE OF PUBLIC DISCLOSURE: This e-mail account is public domain. Any correspondence from or to this e-mail account may be a public record. Accordingly, this e-mail, in whole or in part, may be subject to disclosure pursuant to RCW 42.56, regardless of any claim of confidentiality or privilege asserted by an external party.
March 9, 2010

Travis Saunders,
Planner
Development Services
Building & Planning

Mr. Saunders:

The purpose of this letter is to express interest of the Board of Friends of Luther Burbank (FofLBP) in the development of regulations for the Shoreline Master Program presently under development. Members of the FofLBP Board have appeared before the Planning Commission numerous times during the development of the regulations for the Shoreline Master Program.

In addition, members of the FofLBP have been active in improvement of the shoreline of the park along with other improvements such as the wetlands in the park.

It is significant in development and adoption of policy for the shorelines that the shoreline of LBP is the longest shoreline of any park in the city. That is a most important basis for member’s interest. Many of the members of FofLBP were active in the development of the Luther Burbank Park Master Plan adopted by the City Council.

Based on the information noted above, this letter is a request that Friends of Luther Burbank Park be considered and treated as one of the “parties of record” for future public hearings concerning the Shoreline Master Program.

Please call me at 206-232-1283 if you have questions concerning this matter.

Sincerely,

Joe Wallis
Co-President

Marguerite Sullivan
Co-President
Mr. Saunders,

Please enter the comments below and the attachments as written comments to the Zoning Code Text Amendment Notice of Application filed February 22, 2010 for file number ZTR10-001, SEP10-002

Comments:

Our own current city code from http://www.codepublishing.com/wa/mercerisland/ section 19.07.110 Shoreline management master program states: “the shorelines are among the most valuable and fragile” of the state’s resources...

I have three problems with the SMP as proposed:

- The vegetated buffers as proposed in the SMP are inadequate and not based on the current science.

  The WAC 173-26-231 on shoreline modification reads: "Master programs should include provisions fostering habitat and natural system enhancement projects.

  Page 10-11 (PDF page 14-15) of the proposed SMP reads:

  **19.07.100 Shoreline areas. 3.B Site Development**

  1. A 25-foot setback from OHW is required.

  2. If a wetland is adjacent to the shoreline, measure the shoreline setback from the wetland’s boundary.

    established, measured landward from the OHW. 25% of the buffer area shall contain

    vegetation coverage. The five feet nearest the OHW shall contain at least 25% native coverage. A shoreline vegetation plan shall be submitted to the City for approval. A variety of ground cover, shrubs, and trees that provides lake shading is encouraged.

1. The above does not mention anything about what happens when there is a stream flowing through the shoreline property to the lake. The Mercer Island riparian vegetative buffer requirements should apply to the area where the stream passes through the lake property. There is no mention of this in the draft SMP.
Currently riparian areas in Mercer Island require 50' native vegetated buffers. The stricter riparian buffer requirements should supersede the shoreline requirements unless the SMP become equivalent to riparian requirements or the shorelines vegetation requirements are stricter.

2. The 20 foot vegetation buffer definition is inadequate and not based on current science. Vegetation is measured in three overlapping layers:

- ground cover
- shrub
- canopy (trees)

When you state a percent cover you need to specify by layer. For example 90% ground cover, 25% canopy cover and 30% shrub cover. You also need to take into account at what point in time to address the size of plants;

- at installation
- 5 year expected size
- 10 year expected size
- maturity

The sizes for most plants, in gardening books, are usually size at 10 years.

I have attached a document, Objections to shoreline buffers and adding conditioning to shoreline permits, that you may find useful.

From the City of Seattle, Department of Planning and Development, CAM 326:

**Riparian Corridors (see SMC 25.09.200)**

All areas within 100 feet of a stream or small lake are designated as riparian management areas and receive special protection. For new lots created on or after May 9, 2006, no new development will be allowed within the entire 100 foot riparian management area. For lots created before that date, the first 75 feet from Type II and III waters with anadromous fish present for any part of the year and the first 50 feet from all other riparian corridors are a no build area (anadromous fish are known to be present in the Thornton, Piper's, Longfellow, Taylor, and Fauntleroy creek systems). These distances are measured from the top of the stream bank. No new development is allowed in this area except in cases where it is found to be necessary for access. For lots created before May 9, 2006, the remainder of the 100 foot riparian management area outside of the no build area is a limited development area. Within this area, new development is allowed as long as it meets the following conditions or institutes an alternative restoration plan that meets or exceeds this level of protection.

From SMC 25.09.200

1. Riparian Management Area Vegetation.

1) If the vegetation in the riparian management area protects the fish habitat and wildlife habitat as they exist on the site at the time development is proposed, including preventing erosion and protecting water quality, the existing vegetation shall remain undisturbed, except as allowed under Section 25.09.320.

2) If the riparian management area is not functioning in the manner set out in subsection 25.09.200.A.3.c.1 above, the applicant shall prepare and carry out a tree and vegetation plan that augments the existing vegetation with
native vegetation to the extent commensurate with the impact of the development on the riparian management area. The plan shall be prepared and executed consistent with Section 25.09.320. Vegetation in the riparian management area shall not be removed or otherwise disturbed until the applicant is ready to immediately replant according to the approved plan. A monitoring plan shall be prepared to monitor the establishment of the vegetation. The plan shall cover five growing seasons or the period needed to successfully carry out the plan, whichever is earlier.


a. Shoreline habitat has a 100 foot buffer from the ordinary high water mark.
b. Bioengineered solutions, such as using plants or other approved natural material, to stabilize the shoreline are allowed in the buffer, provided they are allowed under Title 23, including Chapter 23.60, the Shoreline Master Program.

These restriction are much stricter than those proposed for Mercer Island.

I propose Mercer Island implement code similar to the above the above.

- **Add "streams" to marshes and wetlands as areas of ecological and environmental significance.**

  Reiterated from above, the Mercer Island riparian vegetative buffer requirements should apply to the area where the stream joins the lake. There is no mention of this in the draft SMP. Currently riparian areas in Mercer Island require 50' native vegetated buffers. The stricter riparian buffer requirements should supersede the shoreline requirements unless the SMP become equivalent to riparian requirements or the shorelines vegetation requirements are stricter.

Page 20 of Exhibit 5 (PDF page 90 )

Add streams so it reads "adjacent to streams, marshes, wetlands, or other areas of ecological and environmental significance."

"2. Site planning should include setbacks from the shoreline. Landscaping should also be considered as a method of retaining a sense of nature in developed shoreline areas. Retention of trees and other natural vegetation should be encouraged where possible, particularly in those areas in or adjacent to streams, marshes, wetlands, or other areas of ecological and environmental significance."

- **Nothing addresses adding buffers and native vegetation on a major remodel or reconstruction.**

  Since most of Mercer Island's shoreline is built out except for a few thousand feet, more focus should be added to require a natural, native vegetated buffer be installed if an existing residence or building undergoes a rebuild, major reconstruction or major remodelling. The same buffer rules as in new construction should apply.

"No net change" is not appropriate for the Mercer Island shoreline since it is almost completely built out. Instead, Mercer Island needs to move forward to increase shoreline habitat for our endangered salmon and other
wildlife. Naturally vegetated shorelines need not restrict views and will enhance properties. The changes proposed in the draft SMP do not do enough to improve and protect EPA listed salmon in Lake Washington.

Please consider making changes to the draft SMP based on my comments above.

Thank you,
Rita Moore
4509 Ferncroft Rd
Mercer Island, WA 98040
206 275-3883

""
Objections to shoreline buffers and adding conditioning to shoreline permits


Q: Aren’t requirements for shoreline vegetation buffers a “taking” of private property rights?

A:
No. The U.S. Constitution allows state and local governments to limit private property activities provided it’s for a legitimate public benefit and they do not deprive the landowner of all reasonable use of the property. For example, state and local governments can adopt regulations that prevent sediment from running off private property and entering a salmon-spawning stream. These regulations protect salmon, a public resource. In most cases, buffers do not deprive landowners of all reasonable use of their property and, in fact, all property tends to benefit from reasonable setbacks and buffers. In those limited instances where the buffer precludes or significantly interferes with a reasonable use, the property owner may obtain a variance.

Q: Won’t buffers and other shoreline regulations decrease my property values?

A:
Property values are relatively unaffected by buffers. Waterfront property has skyrocketed in value in the past 30 years despite shoreline buffers of 25 to 125 feet being in place for the same period. Protecting native vegetation along the shoreline actually enhances property values by:

- Stabilizing slopes.
- Screening adjacent development from view.
- Providing attractive landscaping and habitat.
- Blocking noise and glare from adjacent properties.

Q: Do the new guidelines require restoration?

A:
Local governments must plan for restoration in their shoreline master programs. Restoration is not a direct requirement for private development. Local government must consider its restoration needs, identify resources available to conduct restoration, prioritize restoration actions, and make sure development activities don’t interfere with planned restoration efforts in the community and vice versa. A shoreline master program may include incentives for developers to invest in shoreline restoration.

Q: Why are critical areas ordinances often incorporated into local shoreline program updates?
A recent state Supreme Court decision (Futurewise v. Anacortes) decided that the shoreline master program solely regulates the shorelines and critical areas covered by the program, once Ecology approves it. Many existing master programs contain buffer requirements but are based on outdated conditions and science. Rather than repeat the work local governments have already done developing their critical areas ordinances under the state Growth Management Act, relevant portions of existing critical areas ordinances may be placed in updated shoreline master programs under the Shoreline Management Act.

Q: Do the rules surrounding “best available science” apply to shoreline master programs?

A:

No. Current science is the basis for shoreline master programs while “best available science” is a term from the state Growth Management Act, and does not apply to shoreline master programs. Shoreline management requires use of the “most current, accurate and complete scientific and technical information” as the basis for decision making.

Conditioning shoreline permits

From

Many permits are issued with conditions attached. Shoreline permit approvals must include any conditions that are needed to ensure that the project is consistent with the SMA and the shoreline master program. Local jurisdictions often apply conditions under powers granted by SEPA in order to mitigate the environmental impacts of a proposal. See WAC 197-11-660. Conditions that are necessary to mitigate impacts to shoreline resources are authorized by the SMA directly [RCW 90.58.020].

When permit approval is based on conditions, the conditions must be satisfied prior to occupancy or use of a structure or prior to commencement of a non-structural activity, unless an alternative compliance schedule is a condition of approval [WAC 173-27-090 (4)].

Conditions imposed on shoreline permits run with the property even if ownership changes, i.e. conditions must be complied with even after the permit expires for the life of the development or beyond if the circumstances warrant such an interpretation. Ecology recommends that certain conditions be recorded on the title, particularly those that commit a property owner to maintain habitat or public access. Recording conditions such as vegetation buffers, habitat mitigation areas (including submerged sites), public access points, trails, or parks, and flood control measures will alert future property owners of the commitment for maintenance of such areas in perpetuity. (Note: As a general practice many local governments avoid incorporating non-shoreline related
permits or conditions into shoreline permit conditions. Keeping issues separate may help appeals and processing.

Typical conditions issued under a shoreline permit might include:

- landscaping,
- screening and berms,
- hooded lighting,
- limited operating hours,
- provisions for public access,
- monitoring of water quality or other environmental parameters, or
- modifications of proposed structures to limit obstruction of shoreline views.

Under WAC 197-11-660 (SEPA), conditions or mitigating measures must be "reasonable and capable of being accomplished." The Shoreline Hearings Board has determined that the test for "reasonableness" of the conditions imposed by a local government for a permit is whether the conditions further the policy of the SMA or aid the implementation of the master program. See SHB Case No. 81-37.
Attention Travis Saunders. Comments and questions about the SMP.

From: Arye Gittelman [aryeg@comcast.net]
Sent: Monday, April 26, 2010 9:05 PM
To: smp
Cc: egittelman@comcast.net; tonyw@seanet.com
Subject: Attention: Travis Saunders. Comments and questions about the SMP.

Hello,

I read with interest the document at: http://www.mercergov.org/files/Ord%2010C-XX.pdf. I don’t believe that I have digested it all, and have mostly looked at the changes.

I have a few questions and concerns about the new plan. I will attend the hearing on May 5th, and hope you can answer the questions before or at the hearing.

1. It is difficult to discern what rules concern new construction and landscaping, and which are for existing construction. Is landscaping considered an “existing structure” for purposes of this document?
2. For instance, there is a rule that 25% of the nearest 5 ft. to the shore (ordinary high water mark) must be covered by native vegetation and 25% of the nearest 20ft. must be covered by vegetation. Does this mean that I must change the landscaping if I am not in compliance? Or is existing landscaping grandfathered in?
3. Does bare soil between shrubs or trees count as vegetation? Does grass count?
4. Will the city publish a list of “native” vegetation? Where can I obtain such a list?
5. It is my impression that existing structures within the 25ft. limit are allowed to remain. However, the document is somewhat ambiguous about this and I would like clarification.
6. There are several comments about dock maintenance that I consider disturbing, to say the least.

“For piers and docks, if more than 40% of the pilings that make up a dock are replaced, the activity is not considered ordinary repair and maintenance and the dock shall be brought into compliance with regulations in place at the time of the action …”

And

“For pier and dock decking, if more than 50% of the decking is replaced, the replacement is not considered ordinary repair and maintenance and it shall be brought into compliance with”
Attention Travis Saunders. Comments and questions about the SMP.

I can tell you that it is very “ordinary” to replace all decking and pilings at one time. Visits by dock maintenance crews are difficult and expensive to schedule and the ordinary mode of operation is to do all the work that is necessary (or soon to be necessary) at one time. These regulations will force me and others to repair our docks in pieces over a period of time, incurring extra expense and leaving potentially dangerous structures in place longer than necessary. Given that everyone on Mercer Island who owns a dock will now need to do this, you will have to define what period of time needs to elapse between repairs in order to avoid running into these percentages.

6. Another regulation with respect to decking:

For the construction of new piers/docks, decking shall be constructed of material that provides a minimum of 40% open space.

This leads me to imagine some sort of grating or grid, or wide spaces between planks. This is pretty close to useless for a swimming dock; uncomfortable to walk on in bare feet, prone to dropping and losing items into the lake, and dangerous for small children who will catch toes and feet in the gaps, possibly spraining or breaking them. It seems as if it might be acceptable for commercial docks whose purpose is to moor boats, but not for multi-use, private structures. If the purpose is to allow sunlight to get through to the water, could I propose that some clear material be used instead of open space?

7. Do I have any obligations with respect to milfoil. Milfoil is, of course, an invasive species. Do I have obligations under the SMP to control it?

8. I have carefully read the regulations for placement of covered moorings. I would like to know if any existing structures will be allowed to remain in place or if these rules only apply to new construction. I would also like to lengthen my dock. It only sticks 50ft. into the lake and the water is only 7ft. deep at high water at the end of the dock. Do I have the right to build the dock out to 150ft? Or just to 10ft. of depth? I’m also curious about the reason for the triangular shape of the legal space. It would seem to me that encouraging covered moorings to be further out from the shoreline would be more ecologically sound.

9. The first entry in the moorage regulation table reads:

(Moorage shall be) 10 feet from the lateral line (and) 35 feet from adjoining moorage structures …

and another that reads (under Minimum Water Frontage for Moorage Facility):

Single-family lots: 40 feet

This implies that neighboring lots of 40 feet each can only be in compliance if they have very thin (five foot wide) docks evenly spaced down their properties and that covered moorage is
Attention Travis Saunders. Comments and questions about the SMP.

nearly impossible for 40 foot lots. Is this the intent? It means that the majority of docks on Mercer Island are not in compliance. Again, I would like clarification that existing docks are not going to be forced into compliance.

10. Given the statements in eight (8) and four (4) above, it would seem that if I need to repair more than 50% of my planking, then I will need to bring the rest of my dock into compliance (“and it shall be brought into compliance with regulations in place at the time of the replacement.”).

This seems quite draconian. Is my interpretation correct? Or does the statement, “in compliance with regulations” only refer to the planking regulations? I would like clarification.

11. Another paragraph that requires some clarification:

No filling may be allowed waterward of the ordinary high water mark, unless there has been severe and unusual erosion within one year immediately preceding the application for the bulkhead. In this event the city may allow the placement of the bulkhead to recover the dry land area lost by erosion.

What is the precise definition of severe and unusual? Does an earthquake count? A severe storm? Anything different that happened the preceding year? Does this imply that in the event of a severe earthquake all Mercer Island bulkheads must be repaired within a year or the city must give special dispensation for each repair?

Thank you very much for your attention.

Arye Gittelman
Sirs,

Please put me on the list for email distribution of items related to the SMP process. Thank you.

Question: I read through the draft SMP but frankly found its complexity a little much to understand a basic question: Will this draft plan impose any requirements on residential land owners to make changes to existing conditions, and permit maintenance thereof?

Thank you,
D. M. Perozek
Mercer Island
Please send notices throughout the SMP process to bschwartz@schwartzbros.com.
April 28, 2010

Mr. Travis Saunders
Planner
City of Mercer Island
9611 SE 36th Street
Mercer Island, WA 98040

RE: City of Mercer Island Draft Shoreline Master Program Update

Dear Mr. Saunders:

The Muckleshoot Indian Tribe Fisheries Division has reviewed the City of Mercer Island’s Draft Shoreline Master Program (SMP), Shoreline Inventory, Restoration Plan, Cumulative Impacts Plan, and associated maps. You will find our attached comments in the interest of protecting and restoring the Tribe’s treaty protected fisheries resources.

In general, we appreciate the City’s commitment and ongoing efforts to protect and restore salmon habitat. The Shoreline Master Program is one tool that City can use for this purpose. Lake Washington and its tributaries contribute salmon resources that are important for the Muckleshoot Tribe’s ceremonial, commercial and substance fisheries. The City needs to ensure that the SMP and its implementation do not continue the degradation of these treaty protected fisheries resources. Our attached comments note several areas within the draft SMP that have a potential to have impact fisheries resources and include recommendations to address these concerns.

We appreciate the opportunity to review and comment on the SMP. We are available to meet to discuss these comments and answer any questions that the City may have. Please call me at 253-876-3116 to set up this meeting.

Sincerely,

Karen Walter
Watersheds and Land Use Team Leader

Cc: Barbara Nightingale, WDOE, NW Region
Mercer Island Shoreline Master Program Update Comments

I. General Comments
1. The Muckleshoot Indian Tribe Fisheries Division (MITFD) requests to receive all notices of application for projects seeking approval under the City’s Shoreline Master Program regardless if these projects are seeking shoreline deviations, variances, exemptions, or Substantial Development Permits so that we may review these proposals for potential impacts to treaty protected fisheries resources and provide the City and Ecology with any comments that we may have.

II. Page Specific Comments for Individual SMP documents
The following are specific comments from the Muckleshoot Indian Tribe Fisheries Division (MITFD) in response to the City of Mercer Island’s Draft Shoreline Master Program documents. Each comment is shown by Chapter, Section, Page Number, and Specific item as described in the specific draft SMP document to assist with identification of the comments

Shoreline Master Program Regulation (M.I.C.C. Title 19) Comments
2. Page 2, Section 1, 19.07.100(B)(1)
A 25 foot setback from the shoreline is inadequate to protect existing vegetation and shoreline vegetation restoration opportunities necessary to provide shoreline functions and habitat for salmon. The shoreline setback needs to be wide enough to protect existing functional shoreline areas and provide for restoration opportunities that will also create functional shoreline areas. Shoreline functions should include shading of nearshore areas, leaf litter input, and recruitment of wood to provide fish habitat. Wood recruitment is the function that will likely result in the greatest setback need and should be based upon the site potential to grow the tallest mature conifer or deciduous tree based on soil conditions. The Washington Department of Natural Resources has maps showing the site index which may include areas on Mercer Island, to assist with this assessment.

3. Pages 2-3, Section 1, 19.07.100(B)(3)
The proposed 20 foot buffer with 25% vegetation and only 25% native vegetation in the first five feet from the Ordinary High Water Mark of Lake Washington is inadequate to provide sufficient shoreline functions. It is doubtful that this approach will result in a restored shoreline along Lake Washington and the associated wetlands designated as shoreline in the draft SMP. There is no technical basis for these setback numbers in any of the documents we reviewed. The City should provide the technical basis to demonstrate that the 25 foot setback in combination with a 5’ vegetated buffer will allow the protection and restoration of riparian functions necessary to support salmon, including juvenile chinook salmon, in Lake Washington.

4. Page 3, Section 1, 19.07.100(C)
This code will allow up to 40% impervious surfaces within the first 50 feet from the OHWM of Lake Washington (i.e. 10% in first 25 feet and 30% in next 25 feet). These percentages are too high and will
allow too much impervious surfaces within what should be riparian corridor functional habitat. Per the Shoreline Inventory, the majority of the regulated shoreline in Mercer Island lacks functional riparian areas in Segments B and C which represents 90% of the shoreline per the Restoration Plan and Figure 13 in the Shoreline Inventory. The combination of a narrow vegetated buffer and impervious surfaces within 50 feet of the shoreline means additional impacts will occur as a result of new and potentially redevelopment and given limited restoration opportunities on existing properties, it is unlikely that shoreline riparian functions will be restored in any meaningful manner. The shoreline setback and impervious surface values need to protect existing functional shoreline areas and provide for restoration opportunities that will also create functional shoreline riparian habitats. Shoreline functions should include, but not be limited to, shading of nearshore areas, leaf litter input, and recruitment of wood to provide fish habitat. Wood recruitment is the function that will likely result in the greatest setback need and should be based upon the site potential to grow the tallest mature conifer or deciduous tree based on soil conditions. The Washington Department of Natural Resources has maps showing the site index which may include areas on Mercer Island, to assist with this assessment.

5. Page 9-10, Section 2, 19.07.110(B)(1)
There should be a designation for the aquatic environment and regulations that protect this environment, including the removal of non-native aquatic invasive plant species following the Washington Departments of Fish and Wildlife and Ecology’s regulations.

6. Page 12, Section 2, 19.07.110(C)(2)(a)(iii)
This code should require new bulkheads to have to demonstrate that non-bulkhead (e.g., vegetation and/or bioengineering) measures cannot be used to protect private property from erosion. If bulkheads are used, they must fully mitigate their impacts to shoreline functions and processes.

7. Page 12, Section 2, 19.07.110(C)(2)(a)(vi)
There may be a conflict. Per the Table on pages 10-11, all moorage facilities are required to get a shoreline substantial development permit. However, the code language on page 12 allows the construction of docks less than $10,000 to be exempt from a shoreline permit.

A 25 foot setback from the shoreline is inadequate to protect existing vegetation and will limit shoreline vegetation restoration opportunities necessary to provide shoreline functions. See previous comments regarding shoreline functions.

This maximum impervious surface limits in this table will allow up to 40% impervious surfaces within the first 50 feet from the OHWM of Lake Washington (i.e. 10% in first 25 feet and 30% in next 25 feet). These percentages are too high and will allow too much impervious surfaces within what should be riparian corridor functional habitat. Per the Shoreline Inventory, the majority of the regulated shoreline in Mercer Island lacks functional riparian areas in Segments B and C which represents 90% of the shoreline per the Restoration Plan and Figure 13 in the Shoreline Inventory. The combination of a narrow vegetated
buffer and impervious surfaces within 50 feet of the shoreline means additional impacts will occur as a result of new and potentially redevelopment and given limited restoration opportunities on existing properties, it is unlikely that shoreline riparian functions will be restored in any meaningful manner. The shoreline setback and impervious surface values need to protect existing functional shoreline areas and provide for restoration opportunities that will also create functional shoreline riparian habitats. Shoreline functions should include, but not be limited to, shading of nearshore areas, leaf litter input, and recruitment of wood to provide fish habitat. Wood recruitment is the function that will likely result in the greatest setback need and should be based upon the site potential to grow the tallest mature conifer or deciduous tree based on soil conditions. The Washington Department of Natural Resources has maps showing the site index which may include areas on Mercer Island, to assist with this assessment.

10. Page 17, 19.07.110.D, Table B, Square Footage of Piers and Docks
The maximum square footage values for piers and docks in this table for 1, 2, and 3 or more waterfront owners is too high and will result in additional cumulative adverse impacts to juvenile chinook salmon and their habitats, particularly if bulkheads are not modified and the maximum area of native vegetation is a 5 foot wide swath along the shoreline. The values should be modified to a maximum of 480 square feet for a single property owner; 700 square feet for two or more property owners; and 1000 square feet for three or more property owners consistent with the U.S. Army Corps of Engineers’ Regional General Permit 3 for new or modified existing overwater structures in Lake Washington, Lake Sammamish, the Sammamish River and Lake Union, including the Lake Washington Ship Canal.

11. Decking, when requiring repair or replacement, should include light transmission materials to the fullest extent.

12. Personal watercrafts should also be located as far waterward as possible to avoid the nearshore area and areas where the inlake sewer line is located.

13. Pier and dock lighting should be minimized to the fullest extent possible; avoid reflecting and/or spilling over onto and illuminating the water and creating hunting advantages for juvenile salmon predators.

14. Page 22, Section 2, 19.07.110.D(4)(a), Bulkheads and Shoreline Stabilization
Existing shoreline stabilization structures that are proposed to be replaced should also be required to meet the geotechnical reporting requirements that new structures must meet in subsections 4(c) and (h).

Utilities located within the regulated shoreline area should be required to fully mitigate for unavoidable impacts to shorelines, rivers, streams, lakes, wetlands, etc. Utilities that need water crossings should be deep enough to avoid bank stabilization and stream/riverbed filling over time to protect utilities from erosion. Boring should be the preferred method of crossing waterbodies over trenching. Finally, new and expanded pipelines and cables within shorelines, where no other feasible option exists, should be required to fully mitigate their impacts including the permanent loss of potential habitat restoration areas and
opportunities due to vegetation standards (i.e. no trees allowed over these structures).

Dredging can eliminate shallow water habitat preferred by juvenile salmon. It should be used in very limited instances and not for uses that result in regular maintenance dredging activities to maintain that use. Furthermore, the control of upland erosion and sedimentation should be implemented prior to dredging in order to avoid or decrease the need for dredging.

**Exhibit B to Ordinance 10C-XX (Shoreline Management Policies)**
17. Pages 6-7, Environmental Designations
An aquatic environment should be added to the two environmental designations proposed and include policies to protect this environment.

18. Page 8, Urban Residential Designation, Management Policies, Policy 4
Commercial uses in the regulated shoreline area should be water dependent uses only.

Trails should be located as far away from shoreline as possible to avoid impacting shoreline/lakeshore restoration opportunities and introducing more human and pet disturbance to salmon utilizing these areas.

20. Page 11, Conservation Element, Policies
There should be a policy that seeks to restore lakeshore functions by removing or setting back bulkheads, reducing the number and overwater coverage/footprint of piers and docks, and restores riparian functions. All of these factors were identified in the Shoreline Analysis Report as contributing to the degradation of salmon habitat.

Trails should be located as far away from shoreline as possible to avoid impacting shoreline/lakeshore restoration opportunities and introducing more human and pet disturbance to salmon utilizing these areas.

22. Page 23, Landfill and Dredging, Policies, Policy 4
Maintenance dredging activities should also be required to fully mitigate their impacts.

23. Page 26, Shoreline Stabilization Policies, Policy 1
This policy should include additional language that requires that soft stabilization methods be analyzed and used often. Hard stabilization methods should be limited and used only when demonstrated that soft methods will not work and threaten public safety and built structures. Hard stabilization methods should also be required to fully mitigate their impacts as part of permit requirements.

**Shoreline Restoration Plan**
24. Page 5, Additional information is needed to support the statement that most of the shoreline filling occurred when the lake was lowered due to the construction of the Chittenden Locks in 1917. Elsewhere, the plan indicates that the island’s population did not increase substantially until 1940 when the first Lake
Washington bridge was constructed.

25. Page 6, The fish use information should include citations to support the documentation of specific salmon use in Mercer Island streams.

26. Page 10, Table 1  
Two bulkhead projects at street ends and shoreline restoration work at Luther Burbank Park is a good start, but since 90% of the City’s shoreline is privately held, more work will be needed to restore the shoreline within Mercer Island. A meaningful plan which involves private property restoration actions that is funded and implemented is needed.

27. Page 11, Table 1  
The City’s pier and dock standards are not consistent with the U.S. Army Corps Regional General Permit 3.

28. Page 12, Table 1  
The restoration plan should discuss how the City intends to address Low Impact Development requirements. The policies and regulations regarding impervious surfaces and vegetation do not reflect Low Impact Development guidelines and principals.

29. Pages 12-13, Table 1  
The restoration plan should discuss if the City has tree retention requirements in its code and if so, what these requirements are.

30. Page 13, Table 1  
Educating people about LID techniques and rain gardens is not the same as constructing these facilities on public property or requiring that they are constructed as part of new private development where appropriate soils exist.

31. The restoration plan action items should include educating citizens about pre-spawning mortality of coho, likely a result of pesticides and metals in stormwater and implement effective measures to reduce these pollution sources. (See http://www.seattlepi.com/local/107460_coho06.shtml  
http://www.nwfsc.noaa.gov/research/divisions/ec/ecotox/fishneurobiology/acutedieoffs.cfm  

32. Any water quality monitoring data collected to demonstrate compliance with the City’s NPDES permit should be made readily available and used to assess potential project impacts for projects undergoing environmental review, as well as, the next update to the SMP.

33. Page 13  
The restoration plan should also discuss how the City will work with property owners to control or otherwise control non-native invasive terrestrial and aquatic plant species. We agree that to be truly
effective, there needs to be a coordinated effort and plan with all local governments along Lake Washington.

34. Page 24
We applaud the city’s commitment to track all development activities within regulated shorelines and document this information as part of Comprehensive Plan updates. This is essential information to determine if no net loss of ecological functions and restoration actions are being achieved.

**Shoreline Inventory Analysis (June 2009)**

35. Section 1.4.2, Page 4

36. Section 1.4.2, Page 5
Not all populations of salmon in the Cedar River and Lake Washington are healthy. For example, there are less than 100 steelhead surviving to return as adults annually since 2000 (see http://wdfw.wa.gov/webmaps/salmonscape/sasi/full_stock_rpts/6154.pdf). Cedar River Chinook salmon are also not a healthy population; hence their listed under the ESA. Cedar River sockeye are also not considered a healthy population. See http://wdfw.wa.gov/cgi-bin/database/sasi_search_new_db.cgi?keyword=08&field=4&search_sort=sort&srchtype=within&job=search&wria=wria for more stock status information.

37. Section 1.4.3, Pages 7-9
See previous comment regarding water temperature in Lake Washington.

38. Section 1.4.3, Page 9
The Chittenden Locks are not the only problem for salmon migration. The Ship Canal is too warm and has low dissolved oxygen for most of its length, requiring returning Chinook and sockeye adults to concentrate in the few holding areas, waiting for favorable conditions to continue upstream migration.

39. Section 1.4.3, Page 9
40. Section 1.4.3, Page 9
Shoreline hardening has likely reduced fine sediment inputs and reduced the amount and location of shallow water habitat preferred by juvenile salmon such as Chinook.

41. Section 1.4.3, Page 10
Lake Union is undergoing a cleanup project for inwater sediments at Gasworks Park.

42. Section 1.4.3, Page 10
Chinook salmon are not a complete proxy for all salmon species in Lake Washington. While similar in some ways, sockeye, coho, and steelhead have distinct life histories and may use different habitat areas than Chinook.

43. Also on page 10, there should also be some discussion on this page regarding potential culvert and other human created barriers on Mercer Island that limit salmon access to Mercer Island streams. Section 3.7.4 notes that there are streams piped that discharge directly to Lake Washington.

44. Section 1.4.4, Page 11
The “Anadromous Fish” section is Chinook salmon centric and does not discuss the other salmon species, their status, and their potential to be affected by activities within the Mercer Island’s shoreline.

45. Section 1.4.6, Pages 12-13
The statements regarding bass populations should have citations.

46. Section 2.1.1, Page 15
This section should also discuss the existence of the inwater sewer line around much of Mercer Island and the existing float plane and boat ramps.

47. Table 2 should include the shoreline substantial development permit for the sewer repair work in 2009.

48. Section 2.1.1, Page 16
The number of shoreline permits is not a useful metric. A better metric would be to quantify the length of bulkhead and overwater coverage due to piers and docks for the permit years surveyed to determine if there are increases in bulkhead and piers/docks metrics.

49. Section 3.10.3, Page 37
It may also be desirable to remove non-native aquatic plants if they are used by salmon predators or have increased predation rates as a result of warmer water created by the wave reduction effects as a result of these plants.
April 28, 2010

Mr. Adam Cooper, Chair
City of Mercer Island Planning Commission
c/o Travis Saunders, Planner
Mercer Island Development Services – Planning
9611 S.E. 36th Street
Mercer Island, Washington  98040

Sent by email to: travis.saunders@mercergov.org

Subject: Comments on Mercer Island Shoreline Master Program – May 2010 Draft

Dear Chair Cooper and Mercer Island Planning Commissioners:

Futurewise is a statewide citizens group that promotes healthy communities and cities while protecting working farms, working forests, and shorelines for this and future generations. We have members in the City of Mercer Island, as we do throughout Washington State. We appreciate the hard work of the City of Mercer Island staff, the consultant team, the Planning Commission, and Mercer Island residents and property owners. We also appreciate the opportunity to comment on the draft shoreline master program update.

The Mercer Island Shoreline Master Program (SMP) is important because it encompasses approximately 15 miles of the Lake Washington shore. We are very concerned that the proposed shoreline master program is inadequate to protect the shoreline functions of Lake Washington and the other resources within shoreline jurisdiction. Lake Washington and its tributaries are home to three threatened species: the Puget Sound Chinook salmon, the Puget Sound Steelhead, and the Bull Trout.¹ Business-as-usual has resulted in the loss of habitat that has contributed to the listing of these threatened species. We cannot afford a business-as-usual shoreline master program. Unfortunately, that is what is largely proposed. What the City of Mercer Island needs is a sustainable shoreline master program. That is what we urge you to adopt.

Due to the short timeframe for providing our comments in time for the hearing packets, we are providing two comment letters – this letter which is limited to a few major issues, and another letter on remaining issues prior to the hearing. This comment letter addresses the major issues

of shoreline environment, inventory, and buffers. With this letter, we have attached the following:

- Our guidance document on using smaller buffers for existing developed areas while still meeting the SMA and SMP Guidelines requirements for using science and no-net-loss of ecological functions. This guidance document explains why small buffers don’t work to protect ecological functions unless they are accompanied by built-in mitigation in the form of enhancement requirements to offset the built-in impacts that come with small buffers. We must caution you however, that the small buffers in this guidance document are not consistent with the buffers in the National Marine Fisheries Service - Northwest Region’s *Endangered Species Act Section 7 Consultation Final Biological Opinion for Implementation of the National Flood Insurance Program in the State of Washington, Phase One Document – Puget Sound Region*. So you should carefully consider the potential consequences of using such small buffers.

- Our guidance document on meeting the restoration requirements of the SMP Guidelines and the SMA requirement to protect ecological functions.

**Use Environment Designations to Build Mitigation Sequencing into the SMP**

The Shoreline Management Act (SMA) policy statement in RCW 90.58.020 lists the primary policy objective of the act [with added emphasis]: “This policy contemplates protecting against adverse effects to the public health, the land and its vegetation and wildlife, and the waters of the state and their aquatic life; while protecting generally public rights of navigation and corollary rights incidental thereto.” In addition, the SMA policy provides that “[p]ermitted uses in the shorelines of the state shall be designed and conducted in a manner to minimize, insofar as practical, any resultant damage to the ecology and environment of the shoreline area and any interference with the public’s use of the water.”

To implement these policies to protect the ecology and minimize damage (as well as other policies), the SMP Guidelines require **no-net-loss of ecological functions**, stating specifically: “Local master programs shall include policies and regulations designed to achieve no net loss of those ecological functions.” This is accomplished in part through **mitigation sequencing**, whereby the first task of mitigation is avoidance of impacts, the second task is minimization of impacts, and the third is compensation for remaining impacts. Stated another way, allowing development to impact the shoreline is supposed to be the last option, not the first option.

Since the entire SMP must be designed to accomplish no-net-loss of ecological functions, this includes the shoreline environments, which are one of the fundamental components of the SMP. Designing the shoreline environments is particularly important because the environments control the corresponding use limits within those environments.

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2 WAC 173-26-186(8)(b) under Governing Principles of the Guidelines relating to ecological functions; and implemented in WAC 173-26-201(2)(c) under Basic Concepts. Despite being called ‘Guidelines,’ the SMA, in RCW 90.58.080(1), requires that shoreline master programs shall be consistent with the SMP Guidelines.

3 WAC 173-26-201(2)(c) under Basic Concepts and Protection of Ecological Functions; and implemented in WAC 173-26-201(2)(c) under Basic Concepts, Environmental Impact Mitigation.
Since most jurisdictions have extensive areas of developed shorelines, it is critical to design the shoreline environments to protect the remaining ecological functions in the jurisdiction. This is accomplished by identifying the well functioning areas and designating them with the Natural and Conservancy environments (or an equivalent), and equally importantly, by limiting uses in the Management Policies and use limits so these areas are not converted to higher intensity uses. **By protecting the remaining areas of higher functions with protective environments, the SMP accomplishes the avoidance and minimization steps in mitigation sequencing.**

If the higher functioning areas are planned for conversion to higher intensity uses, they will experience a loss of ecological functions that site-specific project mitigation almost certainly cannot mitigate due to increases in impervious surface, loss of vegetation both inside and outside the buffer, elimination of wildlife habitat, and increased disturbances that drive off wildlife. This greatly complicates the Restoration Planning and Cumulative Impacts Analysis for the jurisdiction, making it extremely difficult to replace the ecological functions that will be lost to development.

Our concern is that the city has applied only one environment (Urban Residential) to the private lands of the entire island, even though there is variation across the approximately 13 miles of this environment. Yet, there are several segments of shoreline where homes are constructed at an almost rural density, where homes are set back well away from the water, where intact vegetation still exists between the homes and the water, or where homes are spaced apart with good vegetation existing between them. As stated before, allowing the conversion of these higher functioning areas has repercussion in the Restoration Planning and Cumulative Impacts Analysis elements of the SMP and will fail to protect shoreline functions and values. Our recommendations for shoreline environments are provided with our comments and recommendations for the Inventory and Assessment.

**Inventory and Assessment Does Not Distinguish Upland Conditions**

One of the reasons that all of the private lands are in one environment may be that the inventory and assessment of did not seem to identify the upland vegetation and existing setbacks from the lake for different geographic locations, but rather only discussed them generally.

The assessment of shore lengths is done for only three shore “segments” corresponding to the existing SMP shoreline environments. Two of the segments account for approximately 2 miles of the 15 miles of the island’s shoreline, and are the park properties or street ends. This leaves the remaining “segment” (Shoreline Residential) with the approximately 13 remaining miles of shoreline. Thus the “segments” (excluding the environment for Luther Burbank Park) aren’t even intended to describe contiguous shorelines, and thus are not specific to geographic locations.

There are inventory maps and tables for many development related facilities. However, there is no similar assessment of the different geographic locations for vegetation character, and setback of structures (the Cumulative Impact Assessment does have an overview assessment of setbacks, but it is not geographically based), both of which would be easy to do using air photos. Using Google Earth we were able to do cursory assessment of vegetation and setbacks
in a short period of time, although the city’s aerial photographs would likely yield better results. We found that there is a wide diversity of conditions in the areas to be designated Urban Residential, which matched the overview found in the Cumulative Impacts Assessment. Some areas are developed nearly to the water. Some areas have nearly intact vegetation and setbacks of over 100 feet on fairly large lots. We summarized these to the Planning Commission at the commission’s October 21, 2009 meeting:

- About ¼ of the shoreline appears to have setbacks less than 40 feet from the water.
- About ½ of the shoreline appears to have setbacks between 40-80 feet from the water.
- About ¼ of the shoreline appears to have setbacks 80 feet or more from the water.
  Some of these areas still have intact vegetation.

Another missing element is an assessment of subdivision potential. This is particularly important for the remaining areas with larger lots, and areas with higher levels of ecological function and intact vegetation. Neither the inventory document nor the Cumulative Impacts Analysis considers that the larger lots with higher function levels may be subdivided as allowed under current zoning codes. Since most of these lots are developed with houses set well back from the water, new subdivided lots will result in the new development very close to the water using the very small buffers currently proposed. Thus higher function lots will be converted to intensively developed lots, with the loss of ecological functions that entails. **We recommend** that this assessment be performed.

Since all private lands are lumped into one assessment unit, the general assessment of ecological functions that is provided is incapable of differentiating upland shoreline areas with higher levels of ecological function and intact vegetation. **We recommend** that an effort be made to identify the higher functioning upland areas so steps can be taken to ensure they are not further degraded with additional development. **We recommend** that this be done by either establishing a separate environment (for example Low Density Residential), or using some other means of designation to identify them. **We recommend** applying specific buffers and development standards to the identified areas. Of particular interest is that increases in residential density in shoreline areas that increase the development footprint need to stop – specifically the subdivision of shoreline lots. In the next section, will provide more detail on our buffer recommendations.

**Setbacks and Vegetation Protection Measures are Inadequate to Protect Shoreline Functions**

As described in our guidance document, the use of small buffers alone will not adequately protect the ecological functions of shorelines. Over time, urban shorelines will continue to be developed and redeveloped, and existing uses will be expanded and intensified. Shoreline areas will be subject to more and more adverse impacts. The scientific evidence shows that full-sized intact buffers are needed to adequately mitigate the impacts of adjacent development on water features. For example, the National Marine Fisheries Services calls for
100 foot wide buffers on lakes in the Puget Sound region. Small buffers, even of intact native vegetation, are incapable of protecting shoreline function. And degraded buffers or setbacks are unable to perform their buffering function. If existing developed and degraded areas are to have small buffers applied to them, the only justification for doing so is that it will result in enhancement of the buffers ecological functions to the extent possible.

**Thus,** small buffers **may be** acceptable if done right, as described in the guidance document. Using such a system will help reduce the impacts of new development and redevelopment on shoreline resources. It will also result in a gradual increase in vegetation and habitat for fish and small animals over time. This will meet the requirement for no-let-loss of shoreline functions, the requirement to plan for restoration of the jurisdiction’s degraded shorelines, and meet the requirement to achieve overall improvements in shoreline ecological functions. It will also help improve the water quality of the Puget Sound.

The draft SMP includes the following buffer strategy (in MICC 19.07.100).

**B. Site Development.**

1. A 25-foot setback from OHW is required.
2. If a wetland is adjacent to the shoreline, measure the shoreline setback from the wetland’s boundary.
3. 25% of the 20 feet closest to the OHW shall contain vegetation coverage. The five feet nearest the OHW shall contain at least 25% native coverage. A shoreline vegetation plan shall be submitted to the City for approval. A variety of ground cover, shrubs, and trees that provides lake shading is encouraged.

Thus for the Lake Washington vegetation characteristics, only 25% of the setback has to have any vegetation. In areas with currently intact native vegetation, it may be eliminated using these requirements. Even the five feet nearest to the water need only have 25% vegetation. The remaining 75% may be developed.

This strategy effectively results in no vegetation protection in the SMP, even for extensive new development, and for development on areas with intact vegetation. This violates the Shoreline Management Act and the Shoreline Master Program Guidelines. For example, WAC 173-26-211(5)(f)(ii)(A) provides that the shoreline residential environment, which is the residential environment the SMP Guidelines call for being included in the urban growth area such as Mercer Island, is to include “[s]tandards for density or minimum frontage width, setbacks, lot coverage limitations, buffers, shoreline stabilization, vegetation conservation, critical area protection, and water quality [that] shall be set to assure no net loss of shoreline ecological functions, taking into account the environmental limitations and sensitivity of the shoreline

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5 WAC 173-26-186(8)(d).

6 WAC 173-26-186(8)(c).

7 WAC 173-26-201(2)(f).

area, the level of infrastructure and services available, and other comprehensive planning
considerations." *Crafting a Lake Protection Ordinance* documents that “[n]atural shoreline
vegetation has a direct influence on the ecological integrity of a lake, as it provides shade, leaf
litter, woody debris, protection from erosion, and littoral habitat.” Since the natural shoreline
vegetation will not be protected, the proposed regulations do not “assure no net loss of
shoreline ecological functions” as the SMP Guidelines require. They also will not protect the
threatened salmon, steelhead, and trout that call Lake Washington home.

With the wide diversity of developed shoreline character existing on the island, as described in
comments on the inventory, a different strategy is needed to protect the shorelines with higher
levels of function from further degradation, while also dealing with the highly developed areas.
We recommend a strategy similar to the one described in our attached guidance document on
using small buffers, whereby enhancement is used to offset the built-in impacts of using small
buffers. The following recommendations add specific details to Mercer Island’s situation:

- The vegetation condition and setback character needs to be mapped for use in the
  buffer system.
- For your highly developed areas (those developed at 40 feet or less), allow very small
  setbacks consistent with the common existing width. Require at least 20 feet of
  revegetation next to the water when new development takes place as built-in
  mitigation for allowing additional development close to the water. Establish a trigger
  for the replanting requirement, such as expansions of structure or impervious surface of
  100 sq. feet or more.
- For your modest setback areas (40-80 feet), establish 35’ of revegetation and a 15’
  setback from the vegetation area when new development takes place as built-in
  mitigation for allowing additional development close to the water. Establish a trigger
  for the replanting requirement, such as expansions of structure or impervious surface of
  100 sq. feet or more.
- For areas where development is set well back (80 feet or more), and where development
  is widely spaced with vegetation in-between residences, and for the park areas,
  establish a 100 foot buffer.
- Add an umbrella statement that existing vegetation native within the setbacks may not
  be eliminated or disturbed. Water-dependent facilities and limited facilities to access
  the water should not be subject to the vegetation requirement.

In summary, Mercer Island has such a diversity of shoreline conditions (even though most have
some form of development) that the proposed buffer system will cause further degradation to
ecological functions by allowing additional development very close to the water as a default
position. In those areas where small buffers are to be used, enhancement strategies need to be
developed and built into the system. As described in our guidance document, this is the only
thing that makes the small buffers workable in the face of the SMA and SMP Guideline
requirements for using science and ensuring no-net-loss of ecological functions. At a

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Karen Cappiella and Tom Schueler, *Crafting a Lake Protection Ordinance*, Urban Lake Management, Watershed
http://www.cwp.org/Resource_Library/Center_Docs/special/lakes/ulm_lakeprotectionord.pdf and enclosed with
this letter.
minimum, it should include vegetation enhancement, but it should also include removal of shore armoring, where possible.

**Critical Areas Buffers are Inadequate to Protect Streams and Wetlands**

The SMP incorporates the critical areas protection measures of MICC 19.07 by reference for protection of shoreline wetlands and streams. We note that the critical areas protection measures for wetlands and streams are almost exclusively buffers. There are little or no other protection measures. These buffers are highly deficient from the buffers that the scientific literature indicates is needed to protect their ecological functions.

For wetlands Ecology has comprehensively reviewed the scientific literature on the measures necessary to protect wetlands. Ecology summarized the results of the study’s conclusions for buffer widths:

> Effective buffer widths should be based on the above factors. They generally should range from:

- 75 to 150 feet (15 to 46 m) for wetlands with moderate habitat functions and moderate or high-intensity land uses adjacent to the wetland
- 150 to 300+ feet (46 to 92+ m) for wetlands with high habitat functions, regardless of the intensity of the land uses adjacent to the wetland

All of the land uses in Mercer Island would be classified as moderate or high intensity land uses. Based on the analysis of the science, the Washington State Department of Ecology’s *Wetlands in Washington State Volume 2: Guidance for Protecting and Managing Wetlands* recommends wetland buffer widths for Western Washington in cases where a local government chooses only use wetland category (as Mercer Island does) of 300 feet for Category I wetlands, 300 feet for Category II wetlands, 150 feet for Category III wetlands, and 50 feet for Category IV wetlands. In contrast, Mercer Island’s wetland buffers are 100 feet reducible to 50 feet for Category I wetlands, 75 feet reducible to 37 feet for Category II wetlands, 50 feet reducible to 25 feet for Category III wetlands, and 35 feet reducible to 25 feet for Category IV wetlands. These are only one third to one half of the widths recommended by science. We urge the city to adopt one of the three wetland buffer alternatives recommended by the Washington State

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12 MICC 19.07.080(C)(1).
Department of Ecology in *Wetlands in Washington State - Volume 2: Guidance for Protecting and Managing Wetlands* Appendix 8-C as part of the city’s shoreline master program.

The critical areas ordinance stream buffers vary from 25-75 feet, which is only one half of the widths recommended by science. The National Marine Fisheries Service requires, and we recommend, 150 foot wide buffers for S (shorelines of the state not including lakes) and F (fish-bearing) streams, 100 foot wide buffers N (non-salmonid-bearing) streams, and 50 feet for all other streams.

Like the Growth Management Act requirement for using Best Available Science, the Shoreline Management Act also has a requirement to use the current science. Given buffer deficiencies noted above, one of two things needs to be done to correct them: (1) the SMP can separately establish buffers for streams and wetlands within shoreline jurisdiction that reflect the current science, or (2) the critical area ordinance buffers can be revised to reflect the current science.

Thank you for considering our comments. If you require additional information please contact me at dean@futurewise.org or 509-823-5481.

Sincerely,

Dean Patterson  
Shoreline Planner  
Futurewise

Enclosures

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13 MICC 19.07.070(B)(1).
Introduction
In the course of reviewing Shoreline Master Programs (SMPs), Futurewise has seen several proposals for small buffers in areas of existing development. Some of these proposals seem to be based on the belief that, if a small buffer is established based on existing development patterns, unlimited new development (including redevelopment, expansion, and more intensified uses) outside that small buffer will have no additional impacts to shoreline ecological functions, and thus no mitigation is necessary. This paper shows that there is no scientific basis for such a strategy, and provides a recommended strategy for the acceptable use of small buffers in existing intensely developed areas which we believe allows for reasonable development while also having a reasonable chance of protecting the existing shoreline functions, as the Shoreline Management Act and the Shoreline Master Program Guidelines require.

Purpose of Regulatory Buffers – Avoiding & Minimizing Impacts
The Shoreline Management Act (SMA) policy statement in RCW 90.58.020 lists the primary policy objective of the act [with emphasis]: “This policy contemplates protecting against adverse effects to the public health, the land and its vegetation and wildlife, and the waters of the state and their aquatic life, while protecting generally public rights of navigation and corollary rights incidental thereto.” In addition, the SMA policy provides that “[p]ermitted uses in the shorelines of the state shall be designed and conducted in a manner to minimize, insofar as practical, any resultant damage to the ecology and environment of the shoreline area and any interference with the public’s use of the water.”

To implement these policies to protect the ecology and to minimize damage, as well as other policies of the SMA, the SMP Guidelines require no-net-loss of ecological functions, stating specifically: “Local master programs shall include policies and regulations designed to achieve no net loss of those ecological functions.”¹

This is accomplished through mitigation sequencing,² whereby the first task of mitigation is avoidance of impacts, the second task is minimization of impacts, and the third is compensation for remaining impacts. Stated another way, allowing development to impact the shoreline is supposed to be the last option, not the first option. Impacts should only be allowed to the extent that it is not practical to avoid damage to the environment and the

¹ WAC 173-26-186(8)(b) under Governing Principles of the Guidelines relating to ecological functions; and implemented in WAC 173-26-201(2)(c) under Basic Concepts. Despite being called ‘Guidelines,’ the SMA, in RCW 90.58.080(1), requires that shoreline master programs shall be consistent with the SMP Guidelines.

² WAC 173-26-201(2)(c) under Basic Concepts and Protection of Ecological Functions; and implemented in WAC 173-26-201(2)(e) under Basic Concepts, Environmental Impact Mitigation.
public’s use of the water, and then the development should minimize and compensate for those impacts.

Designing an SMP to achieve no-net-loss of ecological functions is largely a scientific exercise, and the SMA is specific in its requirements to use science in developing the SMP. It requires using “a systematic interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts.” This science requirement is similar to the Growth Management Act’s “Best Available Science” requirement. While each has its own terminology, these two science requirements are functionally the same in that they require the use of current up-to-date science.

The science literature on the impacts of development near water bodies provides the basis for jurisdictions to accomplish mitigation sequencing for shoreline waters (streams, lakes, wetlands, marine waters, etc.) and adjacent shorelands. One essential strategy for protecting the functions and values provided by intact riparian vegetation is using a regulatory buffer (or a setback and vegetation retention area) of a width supported by science. An adequate buffer can provide many important functions and help protect water quality and water resources. While an adequate buffer can accomplish much, it cannot mitigate everything, especially impacts from degraded upland areas and the broader watershed – for example stormwater, erosion, habitat loss, etc. Other regulations are needed to deal with such impacts, including those areas outside shoreline jurisdiction.

An adequate regulatory buffer can do much to provide mitigation sequencing:

1. It helps accomplish the first task of mitigation sequencing – avoidance. But this is only the case if the buffer is intact. An adequate buffer will help protect a large percentage of the functions that riparian vegetation provides, and will encompass the most important riparian habitat areas.

2. While an adequate buffer can do much, it can’t accomplish everything. Thus, an intact buffer can be a first step in minimizing the adverse impacts of development to functions that extend outside the buffer. It also reduces or helps minimize those repeating or ongoing impacts from adjacent development, such as water quality, glare, and noise impacts, by filtering pollutants, screening glare, and reducing noise transmission.

3. For both degraded and intact areas, a science-based regulatory buffer also identifies an area within which new development will cause impacts that need compensation. In addition, when buffers are degraded, they provide a location where any impacts of the development can be compensated for by enhancing the degraded functions.

Even when science-based buffers are degraded, they can still perform functions at a dampened level, depending on the amount of degradation. Even heavily degraded shorelines will perform

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3 RCW 90.58.100, with emphasis added.
4 For example, to maintain the health of streams and salmon habitats, rivers basins should limit effective impervious surfaces to no more than ten percent and forest cover to no less than 65 percent.
functions at a very low level. This is specifically stated in the SMP Guidelines, and
documented in the science literature (including those footnoted below) that compares
developed and undeveloped sites. For example, even lawns can provide better animal feeding,
runoff treatment, and other functions than paved surfaces and structures. New impervious
surfaces and more intensive use will degrade these even further. Thus, if the regulatory buffer
is not of adequate width to avoid and mitigate impacts, as is the case when using small
buffers, new development outside the small buffer will still cause new impacts.

Vegetative Buffer Areas Perform Many Functions
The peer-reviewed scientific evidence has been reviewed and synthesized in several documents
that show that intact buffers of adequate width are needed to mitigate the impacts of adjacent
development on lakes, rivers, streams, marine waters, and wetlands. An item of particular

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5 WAC 173-26-201(2)(c) under Basic Concepts and Protection of Ecological Functions.

NOTE: If some links do not operate, removing the last item on the link may provide an alternate access path. Otherwise perform a search on that website or the internet in general.
note is that some studies\textsuperscript{7} found that riparian vegetation performed similar functions for all types of water environments. Indeed, many of the science articles seeking numerical values for buffer widths are not based on any particular type of water feature (stream v. wetland, etc.). The buffer widths recommended to protect the wide variety of ecological functions in these synthesis studies are summarized in the following table. Specific functions are described in more detail below the table.

<table>
<thead>
<tr>
<th>Science Review Source</th>
<th>Recommended Vegetated Buffer Width</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stream</td>
</tr>
<tr>
<td>Cappiella and Schueler, <em>Crafting a Lake Protection Ordinance</em> (Review of Lake Ordinances)</td>
<td>Range from 50-150'; Septic 100'+</td>
</tr>
<tr>
<td>Engel and Pederson, <em>The construction, aesthetics, and effects of lakeshore development</em></td>
<td>Only functions listed</td>
</tr>
<tr>
<td>National Marine Fisheries Service, <em>ESA Consultation Biological Opinion for NFIP in Wa. State</em></td>
<td>Greater of: Lg. rivers - 150'; or CMZ +50'; or floodway</td>
</tr>
<tr>
<td>Spence et al., <em>An Ecosystem Approach to Salmonid Conservation</em>. (ManTech Report for NOAA)</td>
<td>1 site pot. tree height (up to 150')</td>
</tr>
<tr>
<td>EnviroVision et al., <em>Protecting Nearshore Habitat and Functions in Puget Sound: An Interim Guide</em> (Aquatic Habitat Guideline Working Group)</td>
<td>150-200'</td>
</tr>
<tr>
<td>Brennan and Culverwell, <em>Marine Riparian: An assessment of riparian functions</em> (SeaGrant)</td>
<td>&gt;30m (&gt;100')</td>
</tr>
</tbody>
</table>

\textbf{NOTE:} See footnote 6 for full citations and links to the studies.

These science reviews document that: (1) small buffers, even with intact vegetation, are incapable of fully mitigating development impacts; and (2) degraded buffers are unable to fully perform their buffering function.\textsuperscript{8} The science of intact buffer areas of adequate width shows that they perform many functions - some of which are provided below and grouped by similarity.


Water Quality and Infiltration
- Inhibiting surface erosion from surface runoff and flood flows.
- Filtering sediment from surface runoff and flood flows.
- Removing and transforming nutrients and harmful substances from surface runoff and flood flows.
- Infiltrating and storing surface runoff and flood flows into groundwater for later release to water bodies.
- Removing and transforming nutrients and harmful substances from groundwater passing through root zones.

Stabilization
- Providing stabilization to streambanks, lake shores, and marine waters against erosive water forces through root mats and root-strength.
- Contributing in-water woody debris which reduces and slows erosive water forces against streambanks and lake shores through barriers and increased roughness.
- Protects uplands from surface erosion caused by storms and rising sea levels.

In-Water Habitat Contributions
- Providing fish with over-water hanging cover from predators.
- Providing shade to help cool the water, especially for shallow margins.
- Contributing in-water woody debris needed for creation of fish habitat.
- Contributing in-water organic matter to support fish food species (insects and invertebrates), and other aquatic life.
- Screening or dampening noise, glare, and human activity from the water.

Land Habitat
- Providing refuge for fish from fast flows during floods, as well as access to new food sources.
- Contributing large woody debris needed for amphibian, small mammal, bird, and insect habitat.
- Providing wildlife habitat areas (for feeding, reproducing, resting, etc.) for riparian species, and for upland species that use riparian areas.
- Providing a wildlife dispersal and migration corridor along the water to other areas.
- Generating organic matter needed for foundation of food web.
- Providing natural processes and food web functions to support wildlife.
- Altering the microclimate near the water to be more suitable for aquatic and riparian species by sheltering from wind, holding humidity, etc.
- Screening or dampening noise, glare, and human activity.
- Providing separation from human activity for sensitive aquatic and upland species.

While full-sized, intact buffers perform or protect almost the full level of the functions above, degraded buffers still perform low levels of functions, and additional development continues to impact these. It is not the case that degraded buffers have no functions; thus mitigation is needed for new development outside any buffer area which is too small to fully perform or protect the full range of shoreline functions.
Small Degraded Buffers Cannot Protect Shoreline Functions

The currently available science shows that using the science-based buffer for avoidance and minimization in mitigation sequencing has several *policy implications* that bear on the use of small buffer regulations for existing development:

1. If the science-based buffers are intact, they can provide functions and protect the resource from many impacts from nearby development.
2. If the buffers are not intact, they cannot provide the functions nor protect the resource from adjacent development - even if it meets the science-based width - and there will be impacts.
3. If development takes place within the buffer area, there will be impacts.
4. In the case of existing development within the science-based buffer width, the vegetation is both degraded and there is not enough width. The presence of existing development does not mean that new development will not have impacts or even that existing development does not have ongoing impacts. Just as in #3 above, additional development in the science-based buffer area will increase the impacts. Simply making the regulatory buffer width smaller to match the existing development does not change the presence of impacts.
5. Using small regulatory buffer widths to accommodate existing development establishes *built-in impacts* in the SMP review system.
6. Since the normal path of development in urban areas over time is expansion and intensification, there will be a continual increase in impacts and degradation across shoreline jurisdiction in these areas. This creates additional impacts that must be addressed in both the Cumulative Impacts Analysis and the Restoration Plan.

This information shows that just because the science-based buffer area is degraded, *it is not the case* that unlimited additional development has no additional impacts as long as it meets a small regulatory buffer or setback. It also shows that small buffers cannot be applied to areas that may still have intact functions, especially if it is possible to maintain or establish a scientific buffer width, as those areas need to be protected from loss.

Some small buffer systems proposed in some SMPs seem to assume that the smaller degraded buffer works the same as an intact science-based buffer, i.e. adequately providing functions and buffering against impacts as long as development is outside the buffer line. But the peer-reviewed scientific literature shows that a smaller degraded buffer is incapable of performing functions adequately and incapable of protecting the resource it is intended to protect.

New Development and Existing Development Impact Shoreline Functions

Expansion of existing development, redevelopment, and new development on vacant land all adversely affect shoreline resources and functions. In fact, even existing development can continue to cause impacts to ecological functions. As described above, this is the case even for development outside a small regulatory setback. Consider the following adverse impacts of development on the shoreline resources.
• New structures and impervious surfaces increase runoff volumes, remove vegetation, remove native soils that absorb water, and reduce the area available to infiltrate those volumes. Note that these impacts are partially mitigated through stormwater ordinances. However, stormwater regulations generally only address increased peak runoff volumes, not the other impacts. In addition, small developments are only required to comply with some of the stormwater requirements, thus reducing the ability of those regulations to address these impacts.

  a. The increased runoff is focused into smaller receiving areas, thus increasing the erosive power and sediment carrying ability of the surface runoff in those areas.

  b. Where infiltration can still occur, the focused runoff drives infiltrated water to the groundwater table more rapidly with less opportunity for soil treatment.

  c. Less vegetation area is available to filter sediment and nutrients from flood waters and the larger volumes of surface runoff passing over the site.

  d. Less native soils and vegetation root structure is available to treat groundwater.

  e. The trend of decreased infiltration in a drainage basin changes the hydrology of the basin by increasing winter flows and decreasing summer and fall flows adversely affecting water quality and aquatic habitats.

• Adding new structures, additions, or impervious surfaces, and removing or simplifying vegetation (cutting trees, replacing shrubs with lawn, paving, etc.) also adversely affect habitat:

  a. Higher value habitat areas and migration pathways are eliminated or replaced with lower value areas, until the most simplified areas (open impervious surfaces) have only limited value for migration pathways and separation areas.

     More complex areas for nesting and refuge are most susceptible to loss.

  b. Substituting native vegetation with non-native species, or their total removal, results in a loss of food sources for the entire food web. For example, many native insect species cannot effectively use non-native vegetation for food. The reductions in insect populations then affect the fish that feed on them.

  c. Natural processes, insect food sources, and food web functions are reduced or eliminated with the progressive removal of complex vegetation elements.

  d. Species (large and small) capable of using degraded areas are greatly reduced with greater degradation.

  e. Microclimate is altered for species currently using site.

  f. Reduces the organic matter input to the water from drifting and blowing wind that supports the aquatic food web and aquatic life.

  g. Reduces the large woody debris input from trees and branches falling into the water that is needed to form and diversify fish and aquatic life habitat.

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10 Id. at p. 2-9.
• In addition removing or simplifying the vegetation near water also:
  a. Reduces the root strength and root mats that provide bank stabilization.
  b. Increases sun exposure on shallow water areas and heats them.

• Residential uses have additional impacts, not directly related to construction, that increase with enlargement or expansion of the use. Aside from lighting, very little can be done to mitigate these impacts – they are a function of the existence of the development. Non-residential uses can have impacts similar to residential uses that vary depending on the activities and the level of use.
  a. Human presence and activity that impacts or drives off fish and wildlife. Bigger residences usually mean more people on the property, whether family members or guests.
  b. Pets that prey on or drive off fish and wildlife. More family members increase the likelihood of having more pets.
  c. Machinery and vehicular noise that impacts or drives off fish and wildlife. More people on the property increase the likelihood of having more machines and vehicles – including automobiles, watercraft, yard machinery, and recreational vehicles.
  d. Use of chemicals and fertilizers for house and yard. Larger structures and grounds increase the use of chemicals.
  e. Use of night lighting that impacts or drives off fish and wildlife. Larger structures and grounds typically increase the use of night lighting.

• Existing development that has inadequate buffers can also have ongoing impacts or impacts that increase over time. While shoreline master programs do not apply to most existing uses, these impacts show that allowing an expanded, redeveloped, or new use that continues to rely on existing, degraded buffers or non-existent buffers will result in an increased loss of shoreline functions, contrary to the requirements of the SMA. Further, shoreline master programs do apply to ongoing activities that require five year permit renewals. The SMP should require measures to protect shoreline functions when those permits are renewed.
  a. Inadequate buffers allow larger pollutant loads to pass than intact buffers. Thus the receiving waters become more and more contaminated as pollutants build up in aquatic sediments and the water body year after year. Some pollutants are removed or transformed by flushing and biological processes, but others build up over time.
  b. Inadequate buffers allow larger sediment loads to pass than intact buffers. Thus aquatic life and habitat areas continue to be smothered by sediment, and water turbidity continues to impact organisms.
  c. Buffers degrade over time, so existing uses increase their pollution loads as the buffers degrade. The degraded buffers also provide fewer functions and mitigate fewer impacts.
Recommendations for Using Small Buffers, or Setbacks with Plantings

Based on the discussion above, regulatory systems that use small buffers alone are ineffective and fail to comply with the SMA. While a science-based regulatory buffer can provide a means of avoidance and minimization, small degraded regulatory buffers and setbacks do not, and result in a system with built-in adverse impacts to ecological functions.

Since a system that uses small buffers or setbacks alone cannot accomplish avoidance, or otherwise mitigate the impacts of a development, the only other acceptable strategy for their use is if the built-in impacts are offset by built-in mitigation measures, including mitigation for habitat impacts. This is best accomplished by an improvement of the existing degraded buffer or habitat conditions. While this approach can be used with validity, it must be only one part of a system that addresses the range of different shoreline conditions in a logical and systematic manner. Below is our recommended strategy for jurisdictions to use small buffers or setbacks for existing developed areas.

1. The shoreline area should be carefully mapped, and the existing level of development should be characterized. This should be part of the inventory and characterization step of the SMP update. When broad variations exist in setback and vegetation, the areas should be categorized based on the character so the protection measures can consider such variations.

2. Science-based regulatory buffer widths need to be adopted for areas with intact functions or with consistently large setbacks. These areas need to be protected from further degradation.

3. Small regulatory buffers widths or setbacks, along with built-in mitigation (as described below), can be used for areas of existing development, and should be based on the vegetation and setback categories identified during mapping. These areas need to be wide enough to function, and function over time. For example, the narrowest high quality buffer that can filter nutrients is 13 feet, and for filtering pollutants you need 33 to 52 feet. And buffers degrade over time as they filter out nutrients and pollutants. The area needs to be at least 20 feet wide (enough for a fully grown tree) to provide minimum functions. Wider buffers are needed to protect other important shoreline functions.

4. Built-in mitigation requirements need to be included when an intact science-based buffer cannot be used to mitigate impacts of new development. This should include various means of enhancing the degraded shoreline areas where doing so is possible – such as planting native shoreline vegetation, removal or reduction of unnecessary shore armoring or other near-water structures, etc. Where native vegetation is planted, it needs to include native groundcover, shrub, and tree planting; and needs to extend across the shoreline with allowances for water access.

5. Even if a science-based buffer can be used in some places, it will be ineffective if it is degraded or non-vegetated. In such cases, the buffer or setback must be planted and maintained in order to buffer the impacts of the new development. This must include native understory, shrub, and tree planting and extend across the shoreline with allowances for water access.

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In addition to built-in mitigation in the form of enhancement, the use of small buffers means other impacts need to be carefully controlled, which means the use of additional standards.

1. Only very limited uses should be allowed in the setback and no uses can be allowed within the planted areas if they are to function. Encroachments into a buffer or setback vegetation should be limited to those that are water-dependent and water-related. Water-enjoyment and non-water-oriented uses and facilities can function without being in the buffer area.

2. Low impact development (LID) techniques should be required to minimize storm water runoff and help maintain a more natural hydrologic system. This is needed to help reduce the polluted storm water that would otherwise overwhelm the narrow planting strip.

3. Major redevelopments and changes in use, which usually result in great intensification, must established scientific based buffers to ensure no net loss of shoreline functions.

4. When permits for activities are renewed every five years, buffers or setbacks and vegetation plantings should be required.

While small buffers can be made acceptable for highly developed urban areas and rural areas, there needs to be policy support for not basing the buffer width on the available scientific information - of course science-based buffers should be used for intact areas. Such justification can be provided in the jurisdiction’s policy that supports the use of shoreline buffers. We recommend a policy similar to the following:

**BUFFER POLICY:** While buffers widths based on science are necessary to protect ecological functions, using them is not possible in existing heavily developed areas, such as along some parts of [FILL IN THE BLANK]. In such areas, an alternative strategy is established using smaller buffers [OR setbacks] that are based on the existing development pattern, in combination with mitigation requirements for new development that provide enhancement of the smaller buffer and other degraded features to address impacts of the new development outside the small buffer areas.

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Recommendations for Incorporating Restoration Planning into Shoreline Master Programs (SMPs)

The Restoration Plan is one of several important documents that support the shoreline master program (SMP). However, it is not a stand-alone document. It is also important in the context of the other SMP documents, because they are all interdependent on each other.

- **Inventory and Characterization** – This is the foundation of the SMP by establishing baseline conditions that are used in the other documents.
- **Restoration Plan** – Uses the baseline conditions to identify opportunities for restoration, and identifies regulatory and non-regulatory programs that exist or are needed to accomplish shoreline restoration.
- **Land Use Analysis** – Based on the inventory, assesses the existing and future demand for water-dependent, water-related, and water-enjoyment shoreline uses against the available shoreline lands.
- **Goals, Policies, and Regulations** – Uses and influences the other documents in an iterative manner to establish regulatory standards for new shoreline development and non-regulatory courses of action for the jurisdiction (such as transportation planning).
- **Cumulative Impact Analysis** – Assesses the ability of the regulatory program and restoration program to result in “no-net-loss of ecological functions” at full build out.¹

Restoration plans sometimes only address large stand-alone restoration projects. Yet this is not the limit of the requirement for restoration planning.

One of the primary functions of the Shoreline Management Act (SMA) is to protect the natural character of the state’s shorelines. This is stated in the SMA policy statement in 90.58.020:

“This policy contemplates protecting against adverse effects to the public health, the land and its vegetation and wildlife, and the waters of the state and their aquatic life, while protecting generally public rights of navigation and corollary rights incidental thereto.”

In the history of shoreline development under the SMA, this protection hasn’t been done very well because people did not fully understand, or did not care about the impacts of development on aquatic and riparian areas, floodplains, and wetlands. As a result, extensive shoreline areas have been degraded over the last 30 years. The current SMP Guidelines try to address this problem in two ways: protecting existing shorelines with a requirement of no-net-loss of ecological function, and improving the condition of degraded shorelines with a requirement for restoration planning. These three subjects - SMA policy, no-net-loss of ecological function, and restoration planning - are intimately tied together, as described in

more detail below. A SMP and its supporting documents need to implement these requirements.

No-net-loss is typically thought of in terms of avoiding and mitigating the impacts of permitted uses and activities. However, not all project impacts can be mitigated, since developments and activities convert habitat into human use areas or converts land to more intensive uses. Nor does site specific mitigation address the continual creep of existing human development that gradually encroaches on native vegetation and wildlife habitat. Without a method of offsetting this effect, shoreline wildlife will get displaced or driven off, habitat and native vegetation slowly disappear, and shoreline waters get slowly degraded - even with project specific mitigation. In addition to the one time impacts of the conversion of native vegetation to development, development can also cause continuing adverse impacts on shorelines. For example, development located along a river with narrow or non-existent buffers will continue to adversely impact the shorelines due to unfiltered water pollution, noise, glare, and other ongoing adverse impacts. Restoration offsets these lost functions and the creeping degradation caused by new development, and helps maintain the condition of no-net-loss of ecological functions. It also addresses the 30 plus years of historic unmitigated degradation since establishment of the SMA. This is why restoration planning is needed.

The restoration plan “should be designed to achieve overall improvements in shoreline ecological functions over time, when compared to the status upon adoption of the master program.” One of the important functions of the shoreline master program restoration plan is to determine how the jurisdiction will accomplish the restoration of ecological functions over time in the face of historic and future degradation. This is indicated in the Restoration Planning requirements of WAC 173-26-186(8)(c), which states [emphasis added]:

For counties and cities containing any shorelines with impaired ecological functions, master programs shall include goals and policies that provide for restoration of such impaired ecological functions. These master program provisions shall identify existing policies and programs that contribute to planned restoration goals and identify any additional policies and programs that local government will implement to achieve its goals. These master program elements regarding restoration should make real and meaningful use of established or funded nonregulatory policies and programs that contribute to restoration of ecological functions, and should appropriately consider the direct or indirect effects of other regulatory or nonregulatory programs under other local, state, and federal laws, as well as any restoration effects that may flow indirectly from shoreline development regulations and mitigation standards.

As indicated in the WAC above, a restoration plan needs to focus both on opportunities for restoration projects and on the regulatory programs.

Restoration Plans that have come out recently have been thorough in assessing shoreline conditions and opportunities for future restoration projects. Such an assessment can be used

\(^2\) WAC 173-26-201(2)(f).
by future restoration project proponents in targeting locations and improving conditions that have been degraded in those locations. Thus they do well in addressing restoration in the context of nonregulatory restoration projects. However, they typically do not address the regulatory programs.

Most jurisdictions have vast areas of degraded shorelines; yet stand-alone nonregulatory restoration programs can only address a small fraction of those areas, and are thus incapable of achieving overall improvements in shoreline ecological functions over time. The most effective method of addressing these large degraded areas in a programmatic way is through the regulatory program, which works jurisdiction-wide in the course of redeveloping land, expanding existing uses, infill development, and urbanizing undeveloped land on a project-by-project basis. Such everyday development review will encounter degraded areas on a scale that is hundreds of times larger and more common than normal restoration projects, and it is these degraded areas that is the very reason for the restoration planning requirement.

To be clear, requirements for restoration should not be applied retroactively to the continued operation, maintenance, and repair of existing development – just to new development in degraded areas.

In short, the SMP plays a critical role in development review, and restoration needs to be incorporated into development review. Whether the word “restoration,” “enhancement,” or some other term is used is immaterial, as long as the intent is to improve degraded areas and thereby offset the adverse impacts of development and redevelopment.

The commonly understood first priority of shoreline regulation has been “protect what you have”. This is traditionally done during the permit review process. Restoration needs to be incorporated into the permit process so that the priority becomes “protect what you have and improve what you can.” Such a no-net-loss and restoration strategy would use the line of logic provided below, which integrates restoration efforts at the common smaller-scale permit level and the uncommon larger-scale restoration project level into a comprehensive strategy. Note that the first five bullets are about mitigation sequencing, and that it is only the last three bullets that are the focus of a typical Restoration Plan.

- Set the shoreline environments and the uses allowed within them to limit uses appropriately.\(^1\)
- Avoid impacts for allowed uses when possible – meeting buffers goes a long way toward accomplishing avoidance, though not entirely.\(^4\)
- Minimize impacts when avoidance is not possible.
- Determine the impacts that are being caused – it can be difficult and very expensive to determine the exact impacts, especially for homeowners and smaller project proponents, since a report is required. The restoration plan and other technical studies can help by establishing a natural resource baseline.

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\(^1\) See WAC 173-26-191(1)(d).
\(^4\) See WAC 173-26-201(2)(e).
• Mitigate for impacts caused.
• Use restoration of degraded conditions to mitigate impacts – for example: removing structures or fill, removing sources of pollution, removing lawn at the waterline, etc. Judicious application of restoration also avoids the need to determine exact impacts and exact amounts of mitigation, which may be a basis for waiving a difficult and costly report.
• Require that degraded buffers be restored and given long term protection, so they are capable of protecting Puget Sound and marine waters, rivers, streams, lakes, and wetlands they are meant to protect.
• Where structures and uses already exist, and the critical areas or shorelines are degraded, provide restoration as much as possible to reduce the continuing and ongoing impacts of existing development, in addition to mitigating new development.
• As required by law, the mitigation must be tied to the impacts of the proposed development and the extent of required restoration would have to be roughly proportional to the extent of development being undertaken and its impacts.
• Make stand-alone restoration projects easier to approve and review by providing properly limited exemptions, etc. Note: Structural elements (such as hard stabilization, etc.) should not normally be considered restoration for an exemption, and should obtain a permit.
• Incorporate existing restoration efforts, programs, planned projects, and ongoing projects into the Restoration Plan.
• Make Restoration Plan opportunities and Inventory documents available to guide future proponents of restoration projects, and required mitigation.

Summary

In both the Restoration Plan and the SMP, the restoration goals and policies need to address restoration comprehensively - in both the regulatory program and in non-regulatory programs. The goals and policies then need to be translated into the SMP regulations.

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FINAL REPORT

A Summary of the Effects of Bulkheads, Piers, and Other Artificial Structures and Shorezone Development on ESA-listed Salmonids in Lakes

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Introduction

Purpose

This report is a product of a literature review initiated to determine our state-of-knowledge about the impacts of lakeshore development on salmonids, in the context of the Endangered Species Act (ESA). There is much uncertainty surrounding the impacts of various shorezone structures and activities on salmonids within lakes in the Tri-County area (King, Pierce and Snohomish Counties, WA). Identifying the level of current knowledge, areas of uncertainty, and future research needs could provide a more consistent review and evaluation of shoreline development proposals, and decrease potential impacts to threatened salmon populations if the information is utilized in the course of permit review and assimilated into regulations.

This review was initiated by the City of Bellevue, WA, to provide a digest, a library of pertinent literature, and an annotated bibliography in the form of a Microsoft Access database, detailing the potential impacts of lakeshore development on ESA-listed species. The review is primarily focused on Lake Washington and Lake Sammamish, but most of the information should be applicable for other lakes within the Tri-County area that have threatened salmonid species. Review products will be utilized by decision-makers at the local through federal levels of government to assist in the creation of guidelines and policies related to lakeshore development. It should be emphasized that, due to time constraints, this “review” is not an exhaustive compendium of all available resources, but rather a measured digest of what was readily accessible in the time allowed. Collection was directed at literature that related directly to shorezone structures and activities in cold, freshwater lakes, but pertinent literature on warmwater, riverine, and marine systems was also included. Despite time constraints, over 350 literature sources were collected and examined, and the salient points from those sources were incorporated into this digest. Primary searches targeted all relevant electronic databases, followed by secondary searches of the references sections of pertinent literature collected during primary searches. Literature collected includes peer-reviewed journal articles, theses/dissertations, books, and technical documents. The literature collected for the review constitutes the majority of available relevant documents, with only the most inaccessible documents omitted. In addition, personal communications with respected local scientists were included where pertinent, current research was not yet published.

Potential Impacts

Shoreline development may seem innocuous to most people. The average property owner on Lakes Washington and Sammamish has no intention of harming salmonids when they propose to build a pier or bulkhead or otherwise modify their shoreline. The property owner’s intention is often to reduce erosion, to develop a tidy shoreline, and/or to improve water access. Thus, it is initially important to define which structures and activities are being analyzed for impacts, and to identify how they may affect ESA-listed species. In Lakes Washington and Sammamish, shoreline development activities and structures that have a federal nexus (i.e., if a federal agency funds, constructs, or
permits the proposed project) and are thus subjected to review under the ESA, include those activities/structures that require a U.S. Army Corps of Engineers (USACE) permit. Specifically, USACE permits are required for the construction, replacement, or repair of piers, docks, boat canopies, boathouses, and shoreline armoring structures (i.e., bulkheads). Adverse impacts on listed species can result from construction or maintenance activities, or from the existence of the structure.

Proposed projects having a federal nexus are analyzed for potential impacts at a variety of levels. Under the ESA, “take,” means any potential adverse effects to a listed species that can occur as a direct result of a proposed project, or as an indirect or interrelated result. Direct impacts to a listed species could occur from water quality impacts during construction, or result from increased opportunities for predation from the presence of a new pier. Such a take would be a direct effect. Indirect effects are less obvious. The reduction in water quality that might occur from a fuel spillage during boat fueling at a new residential pier would be an indirect effect. If the pier had not been constructed, the fuel spill would not have occurred.

The following are some specific potential impacts of shorezone structures and activities that have been identified through discussions between The Watershed Company and the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) (collectively called the Services) during 1999 and 2000 as part of the Biological Assessment (BA) process of Section 7 of the ESA. The Services are concerned about potential adverse impacts of shorezone development on juvenile and adult chinook and coho salmon, and bull trout. Despite the Services concern for these ongoing impacts, they can only act on those concerns when an application for a project requiring a federal permit (or with some other federal nexus) is proposed.

1) Piers, piles, boatlifts, and moored boats may provide cover, shade, and focal points for exotic predators of juvenile chinook (*Oncorhynchus tshawytscha*) and coho (*O. kisutch*) salmon such as smallmouth bass (*Micropterus dolomieui*) and largemouth bass (*M. salmoides*). Note: native predators such as cutthroat trout (*O. clarki*) and piscivorous birds may also benefit from shorezone structures, but they have yet to be considered in BAs for proposed shorezone development in the Lake Washington system.

2) Shading from piers, boat canopies, boathouses, and moored boats may reduce the abundance of prey organisms available to juvenile chinook and coho salmon, and to forage fish of bull trout (*Salvelinus confluentus*) by reducing aquatic vegetation and phytoplankton abundance. Any reduction in aquatic vegetation may also reduce complex refuge habitat. To date, the Services have made no distinction between native and non-native aquatic vegetation.

3) The temporary turbidity associated with construction may reduce water quality to the detriment of chinook and coho salmon, bull trout, and forage fish of bull trout.

4) Pile driving may disrupt the distribution and behavior of, or injure, chinook and coho salmon, bull trout, and forage fish of bull trout.
5) Piers and/or bulkheads may disrupt the migratory and rearing behavior of juvenile chinook and coho salmon.

6) The boating activity that accompanies piers could disturb rearing or migrating chinook and coho salmon.

7) Chemicals used to preserve or clean wood structures, and hydrocarbons from boats and personal watercraft could be acutely or chronically toxic to chinook and coho salmon, bull trout, or prey items of those species.

8) Pier lighting may facilitate nocturnal predation on juvenile chinook and coho salmon by visual predators like smallmouth bass, cutthroat trout, and piscivorous birds.

9) The removal of vegetation during bulkhead construction or replacement could eliminate a potential source of cover and food (allochthonous input of terrestrial insects and detritus for foraging aquatic insects) for juvenile chinook and coho salmon, and forage fish of bull trout. Vegetation removed is typically not replaced with native woody species that could provide a future source of woody debris to the lake (see impact # 13, below). Instead, shoreline property owners generally favor lawn or ornamental shrubby species that preserve lake views.

10) Bulkheads prevent the recruitment of native sediment to the lake, resulting in a loss of heterogeneous substrate, and resulting in shoreline erosion at the toe or along the shore downwind of the bulkhead. This could affect the availability of spawning and rearing habitat, and the forage base for a variety of fish species.

11) Bulkheads eliminate shallow-water habitat, which is critical as refuge and foraging habitat for juvenile salmonids and other small fish.

12) Bulkheads reflect wave energy at the shoreline, resulting in the scour of sediment at the bulkhead toe, and creating an inhospitable high-energy environment for juvenile fish.

13) The permanent removal of woody debris during bulkhead and/or pier construction reduces the availability of complex refuge habitat for small fish, and attachment surfaces for periphyton.

While the above list of identified potential impacts of shorezone structures and activity on ESA listed species is not exhaustive, it does illustrate the intricacy of the problem. There are potentially many ways that the existing and future development of lakeshores could adversely affect ESA-listed salmonids. A significant shortcoming of the above list is the exclusion of non-ESA-listed salmonids such as sockeye salmon, kokanee (O. nerka), and steelhead (O. mykiss). While the focus of this report is on salmonid species that are listed or considered for listing under the ESA, shorezone development could have the same potential impacts on many other native fish within Tri-County-area lakes. The listing or proposed listing of chinook and coho salmon, and bull trout under the ESA indicates that these species face serious threats to their perpetuation within the region.
Such threats are likely being faced by other salmonids as well. Thus, in most cases it would be appropriate to consider all salmonids, and perhaps native non-salmonids, as the subjects of the following discussion of impacts.

The potential impacts identified above of docks and bulkheads provided the focus for the review. For discussion purposes, the above list of impacts has been condensed into six categories: chemical contaminants associated with piers, docks, and bulkheads; disruption of natural physical processes; effects on predation and prey refuge habitat; effects on productivity; effects on migration; and recreation and construction activities. The following is a summary of the information contained within the collected literature. The summary will begin with a discussion of the salmonid species that are present in the lakes of the Tri-County area, and are listed, or candidates for listing under the ESA. Second will be a discussion of pertinent research regarding the potential impacts. Finally, the summary will conclude with recommendations for best management practices (BMPs), mitigation options, and further study.

**Fish Ecology**

*Federally Listed Salmonid Species*

In order to analyze how an activity or structure could adversely affect any species, it is necessary to understand the ecology and biology of that species, particularly within the subject area. The subject area includes Lakes Washington and Sammamish, but the information should be applicable to other lakes within the Tri-County area that are utilized by ESA-listed or Candidate species. Chinook salmon stocks occurring in the Puget Sound Evolutionary Significant Unit (ESU), which includes tributaries of Lakes Washington and Sammamish, are listed as Threatened by NMFS under the ESA (U.S. Federal Register, 24 March 1999). NMFS has also designated coho salmon stocks in the Puget Sound-Strait of Georgia ESU as Candidates, which are eligible for listing under the ESA (U.S. Federal Register, 25 July 1995), but NMFS has not chosen to list them at this time. In addition, the USFWS has designated bull trout in the Coastal-Puget Sound Distinct Population Segment (DPS) as Threatened (U.S. Federal Register, 1 November 1999) (Table 1). A petition was submitted to the USFWS on 16 March 2000 for an emergency listing of the early run Issaquah Creek kokanee as Endangered. The petition occurred following both the scope development, and the literature collection phases of this review. Thus, kokanee-specific data could not be incorporated into this report.
Table 1. Listed and Candidate Fish Species in the Lake Washington Watershed.

<table>
<thead>
<tr>
<th>Species</th>
<th>Federal Status</th>
<th>State Status</th>
<th>ESU/DPS¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinook salmon</td>
<td>Threatened March 1999</td>
<td>Candidate</td>
<td>Puget Sound ESU</td>
</tr>
<tr>
<td><em>Oncorhynchus tshawytscha</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coho salmon</td>
<td>Candidate July 1995</td>
<td>None</td>
<td>Puget Sound - Strait of Georgia ESU</td>
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<tr>
<td><em>Oncorhynchus kisutch</em></td>
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<td></td>
</tr>
<tr>
<td>Bull trout</td>
<td>Threatened November 1999</td>
<td>None</td>
<td>Coastal-Puget Sound DPS</td>
</tr>
<tr>
<td><em>Salvelinus confluentus</em></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

¹ ESU = Evolutionarily Significant Unit, the species definition used by the National Marine Fisheries Service  
DPS = Distinct Population Segment, the species definition used by the U.S. Fish and Wildlife Service

**Chinook Salmon**

Chinook salmon are found along the Pacific Coast from the Ventura River in southern California to Point Hope, Alaska (Wydoski and Whitney 1979). In Washington, chinook salmon spawn in streams in the Columbia River Basin, Puget Sound, and coastal drainages (Wydoski and Whitney 1979). In the Lake Washington watershed, fall-run chinook salmon migrate through Lake Washington to reach spawning grounds in the Cedar and Sammamish River systems and in other Lake Washington tributaries. Washington Department of Fish and Wildlife (WDFW) hatchery staff allow returning progeny of the Issaquah Hatchery to migrate beyond the hatchery weir only if egg-take goals have been achieved. Occasional beach spawning within Lake Washington has been observed (Roberson 1967; Fresh, pers. comm., 28 March 2000). Adults begin migrating into fresh water in June, peaking in August, and spawn from mid-August to mid-December (Myers et al. 1998). After spawning, females guard redds for up to three weeks before dying; males attempt to fertilize other redds before dying (U.S. Federal Register, 9 March 1998). Chinook salmon eggs hatch after 90 to 150 days, depending on water temperature (Wydoski and Whitney 1979).

**Life History Strategies**

The Puget Sound ESU exhibits an “ocean-type” life history (Myers et al. 1998). In general, ocean-type fish move relatively rapidly through fresh water into coastal or estuarine rearing areas, compared to their stream-type counterparts (U.S. Federal Register, 9 March 1998; Wydoski and Whitney 1979). The ocean-type chinook in the Lake Washington basin typically begin their downstream migration as sub-yearlings (Myers et al. 1998). Most chinook emigrate as fry after emerging from the gravel (Myers et al. 1998), reaching Lake Washington in early January to March (Fresh, pers. comm., 2 August 1999). A second wave of juvenile fingerlings enters Lake Washington in May and June (Fresh, pers. comm., 2 August 1999). Chinook fry are an average of 40 mm (1.6 in.) in length when they enter Lake Washington; chinook fingerlings are an average of 100 mm (4 in.) in length when they enter Lake Washington (Fresh, pers. comm., 2 August 1999). In addition to the contribution of natural spawners, WDFW’s Issaquah
Creek hatchery has an annual production goal of releasing 2 million age-0+ chinook each May into Issaquah Creek, many of which enter Lake Washington via the Sammamish River. On average, that goal has been met over the last five years (Mahovlich, pers. comm., 7 June 2000). The University of Washington hatchery has an annual production goal, which is consistently met, of releasing 180,000 chinook smolts each May (Tetrick, pers. comm., 10 July 2000). The majority of chinook smolts leave Lake Washington in May and June (Fresh, pers. comm., 9 September 1999).

A study by Reimers (1971) in Sixes River, Oregon, demonstrated that juvenile migration timing within the “ocean-type” designation occurs as a continuum rather than a discreet event. Evidence that most juvenile chinook begin entering the lake in early January and are leaving Lake Washington as smolts by early July, suggests that juvenile chinook in the lake are exhibiting a “type-2” life history (as per Reimers 1971). However, the WDFW Cedar River fry trap that has provided most of the data on migration timing is typically operational only through the end of June or early July. Sampling at the mouth of the Cedar River has found that small numbers of juvenile chinook continue entering Lake Washington as late as 29 July (Fresh, pers. comm., 9 September 1999). Outmigrating chinook smolts have been observed at the Ballard locks in late August (Fresh, pers. comm., 7 June 2000).

Yearling and older chinook (monthly mean fork lengths ranging from 256-323 mm) were captured in littoral gill nets (2-8 m deep) in all regions of Lake Washington from January through October in 1984-1985 (Beauchamp, Univ. of Washington, unpubl. data). Tabor and Chan (1996) captured two juvenile chinook yearlings (234 and 280 mm fork length) in south Lake Washington in March 1995. Although it is not known whether these yearlings reared in the lake or in a tributary, their large size is typical of lake-rearing fish. The appearance of small numbers of age-1+ and age-2+ chinook juveniles in Lake Washington provides additional evidence that extended freshwater rearing occurs in the Lake Washington system (Fresh, pers. comm., 9 September 1999). Haw and Buckley (1962) reported extended freshwater rearing of juvenile chinook in Lakes Washington and Sammamish, with age-I+, and -2+ smolts representing 21 percent and 12 percent respectively of sampled returning adults. The majority of age-0+ chinook juveniles in the Lake Washington watershed leave the lake by mid-summer; 66 percent of the returning adults sampled by Haw and Buckley (1962) had been age-0+ smolts. Reimers (1971) found relatively few juvenile fall chinook migrating as yearlings in Sixes River, Oregon, where yearling migrants represented only 3.1 percent of returning adults. Data from the Lake Washington Ecological Studies indicate that resident chinook up to adult size are in the lake at all times of the year; it is not clear whether these fish go to sea eventually or continue rearing in the lake until spawning (Warner, pers. comm., 7 July 2000).

**Diet and Distribution**

In Lake Washington, juvenile chinook are distributed along shorelines (Fresh, pers. comm., 18 November 1999). Sampling of both the limnetic and littoral zones of Lake Washington has shown that from early February through late May, young-of-the-year chinook occupy the littoral zone exclusively (Warner and Fresh 1999). They feed
primarily on aquatic insects (chironomid pupae) (Fresh, pers. comm., 18 November 2000) and terrestrial insects (Wydoski and Whitney 1979; Tabor and Chan 1996). Rondorf et al. (1990) found that in a Columbia River reservoir, the diet of juvenile chinook salmon consisted primarily of zooplankton and terrestrial insects; in free-flowing river sections the diet consisted mostly of aquatic insects. Juvenile chinook adapt to local prey abundance by modifying their selection of prey items (Rondorf et al. 1990).

Chinook juveniles, predominantly large individuals, begin appearing in limnetic sampling gear in late May and June in Lake Washington (Fresh, pers. comm., 9 September 1999). Increasing use of the limnetic zone may be an ontogenetic response, a response to increasing temperatures in the littoral zone, or merely represent the capture of outmigrating smolts (Fresh, pers. comm., 9 September 1999). Hamilton et al. (1970) observed an ontogenetic shift with increasing fish body size from littoral foraging on aquatic and terrestrial insects, to limnetic foraging on zooplankton, by coho salmon in a reservoir (see below).

Reimers (1971) found that in the Sixes River, chinook fry (~40 mm) occupied shallow water and were closely associated with shoreline features such as logs and debris, but larger fish (~55 mm) occupied the entire channel. Others have noted a similar transition from an affinity for shoreline structure and cover for newly emerged chinook fry, to a progressively offshore distribution as fish size increases (Lister and Genoe 1970; Weitkamp and Campbell 1980; Roper et al. 1994). In the lower Willamette River, Ward et al. (1994) reported that young-of-the-year chinook caught in vertical gill nets were a mean distance of 31 meters from shore. However, all of these studies were in rivers or riverine portions of estuaries, where current velocity and channel width influenced habitat selection. Even though the fish in Reimers’ (1971) study were utilizing the entire estuary, they were still occupying habitat that did not exceed 5 meters in depth.

Temperature

The distribution and residence time of juvenile chinook in Lake Washington may be influenced by temperature. Bjornn and Reiser (1991) reported the preferred temperature for chinook as 12 to 14°C, and temperatures from 23 to 25°C could be lethal and were actively avoided. Offshore temperatures at a depth of 1 meter in Lake Washington typically exceed 15°C from mid-May through mid-October, and exceed 20°C from mid-July into September, with maxima generally near 25°C in early August (http://dnr.metrokc.gov/wlr/waterres/lakes/wash.htm). Nearshore summer surface-temperatures may exceed those offshore. Despite high temperatures, chinook can be found in the littoral zone during summer. During 1984, chinook were captured throughout the summer in littoral gill nets (3-10 m deep) and in offshore vertical gill nets from mid-July to mid-August at depths of 12 to 18 meters, which corresponded with the thermocline (Beauchamp, Univ. of Washington, unpubl. data). Chinook smolts (and adults) are often found near the surface in water above 18°C (Warner, pers. comm., 7 July 2000).

Behavioral thermoregulation by salmonids is common. Roper et al. (1994) suggested that high temperature (20°C) in the lower reaches of Jackson Creek, Oregon, caused
the emigration of age-0+ chinook. Biro (1998) reported that some young-of-year brook trout (*Salvelinus fontinalis*) in an Ontario lake remained in the littoral zone during periods of high water temperature (23-27°C), but they held and defended positions at cold groundwater seeps. Given the propensity for littoral foraging by juvenile chinook, and that summer temperatures in the littoral zone may be undesirable or potentially lethal, chinook may either leave Lake Washington in mid-summer, limit the timing of their activity, or limit their distribution to cooler areas of the lake. The energetic consequences of such avoidance behavior could reduce the growth rate of juvenile chinook, potentially reducing marine survival. Smolt size has been found to positively correlate with marine survival (Quinn and Peterson 1996). Observations of juvenile chinook in the littoral zone of Lake Washington decline in early to mid-July; this phenomenon could possibly be a behavioral response to high temperatures, but could also be due to smolts leaving the lake (Fresh, pers. comm. 18 November 1999). An avoidance of the littoral zone by chinook during summer would segregate them from shore-based sampling efforts.

Both returning adult and juvenile chinook in Lake Sammamish and Lake Union must also contend with anoxic conditions in the hypolimnion from July through October (http://dnr.metrokc.gov/wlr/waterres/lakes/thermo.htm). High temperatures in the epilimnion restrict chinook to depths below 5 to 10 meters, while anoxic conditions below depths of 15 to 20 meters prevent chinook use, thus concentrating them in the relatively narrow (5-10 m) metalimnion (http://dnr.metrokc.gov/wlr/waterres/lakes/thermo.htm). These physical restrictions of chinook distribution limit juvenile foraging opportunities, and expose juvenile fish to predators occupying habitat in the metalimnion. In addition, these physical conditions are a stress to holding adults that could cause pre-spawning mortality and reduced egg survival for those adults that survive to spawn.

**Coho Salmon**

Coho salmon are found along the Pacific Coast from Monterey Bay in central California to Point Hope, Alaska (Wydoski and Whitney 1979). In Washington, coho salmon spawn in streams in the Columbia River Basin, Puget Sound, and coastal drainages (Wydoski and Whitney 1979). In the Lake Washington system, coho salmon stocks have been divided into the Lake Washington/Sammamish Tributary stock and the Cedar River stock (Washington Department of Fisheries [WDF] et al. 1993). Adult coho salmon migrate through Lake Washington and Lake Sammamish to reach spawning grounds in the Cedar and Sammamish River systems, and in small tributaries to the lakes. Adults begin migrating into fresh water in August, and spawn from late October through December in most systems, and through mid-March in the Cedar River (WDF et al. 1993). Coho salmon eggs hatch after 45 to 60 days, depending on water temperature (Wydoski and Whitney 1979).

**Life History Strategies**

Coho juveniles typically rear in fresh water for one year, but may spend two years in fresh water or migrate to sea as fry during their first spring (Groot and Margolis 1991;
Hartman et al. 1982). While in fresh water, juveniles utilize all accessible reaches of their natal stream systems for rearing, including lakes, seasonally wetted areas, off-channel ponds, sloughs, swamps, and their tributaries (Pollard et al. 1997; Bryant et al. 1996; Swales et al. 1988; Hartman and Brown 1987; Cederholm and Scarlett 1981; Skeesick 1970). Some physical characteristics of habitat typically selected by coho fry and parr include depths greater than 8 centimeters, low current velocity, and availability of cover (Fransen et al. 1993; Fausch 1993; Shirvell 1990; Bugert et al. 1991). Coho juveniles overwintering in two small Vancouver Island lakes were closely associated with the shoreline, with the highest CPUEs from traps set as close as possible to the shore (Swales et al. 1988).

Migration

Juvenile coho generally begin migrating to sea as smolts during their second spring, although Irvine and Ward (1989) found that 10 percent of the smolts migrating from the Keogh River watershed were age-2+ fish. In general, peak outmigration is in May and average smolt size is 90 to 115 mm (Weitkamp et al. 1995).

Studies at the mouth of the Cedar River have shown that most coho enter Lake Washington in May and June, and are 100 mm or greater (Fresh, pers. comm., 2 August 1999). Beyond the contribution of natural spawners, WDFW’s Issaquah Creek hatchery has an annual production goal of releasing 1 million age-0+ coho and 450,000 yearlings into Issaquah Creek each spring, many of which enter Lake Washington via the Sammamish River. Additionally, 90,000 coho smolts are also released each May from the University of Washington hatchery (Tetrick, pers. comm., 10 July 2000).

Emigrating coho smolts in a Lewis River reservoir traveled in schools of a few to several hundred fish, and generally remained in the upper 3 meters (Hamilton et al. 1970). Allen (1968) tested whether coho smolts migrating 56 km to saltwater from the Issaquah Creek hatchery through a lake system populated with piscivorous fish would experience higher mortality than coho from the same cohort released from the University of Washington hatchery (8 km from saltwater). Allen (1968) found that the fish migrating from the Issaquah Creek hatchery had an approximately 22 percent higher mortality rate than those from the University of Washington hatchery.

McMahon and Holtby (1992) found that coho smolts in a river and estuary aggregated and sought cover near large woody debris, overhanging banks, and riparian vegetation. Moser et al. (1991) reported that progress of the smolt migration in the Chehalis River was saltatory, with periods of movement with the current interspersed with periods of holding in low-velocity areas that also provided cover.

The distribution of juvenile coho salmon in Lakes Washington and Sammamish is poorly understood. There is evidence that juvenile coho are migrating and feeding along the Lake Washington shoreline (Fresh, pers. comm., 2 August 1999). Gill net sampling in all zones of Lake Washington by Bartoo (1972) indicated that coho juveniles were present during May, June, and July. Beauchamp (Univ. of Washington, unpubl. data) captured juvenile coho in all sampled littoral areas except during July and August. Beak
Consultants Incorporated (1998) reported that peak smolt migration from the Sammamish River was April through mid-May, although their sampling ended in mid-June. Tabor and Chan (1996) found coho smolts in south Lake Washington from April to early June, with peak abundance in early May. Coho juveniles are relatively rare compared to chinook and sockeye juveniles (Walter, pers. comm., 7 July 2000).

**Temperature**

Water temperature affects the distribution of coho salmon in lakes and reservoirs. Bjornn and Reiser (1991) reported the preferred temperature for coho as 12 to 14°C, and that temperatures from 23 to 25°C could be lethal and were actively avoided by most salmonids. In a stocked Wisconsin lake and in a Washington reservoir, coho inhabited nearshore areas in the spring and fall, and moved below the thermocline into the metalimnion in the summer where temperatures remained below 17°C (Engel and Magnuson 1976; Hamilton et al. 1970). However, coho fry remained in the littoral zone throughout the summer in Margaret Lake in southeast Alaska, especially near the cooler tributary mouths (Bryant et al. 1996). Summer afternoon surface temperatures occasionally exceeded 18°C in Margaret Lake, but most coho were caught while beach seining at dawn and dusk when temperatures were lower, and at the mouths of cool tributaries (Wright, pers. comm., 13 August 1999). This preference for lower water temperatures may be a factor in selection of migration corridors, at least in the latter part of coho migration into and through Lakes Washington and Sammamish. Juvenile coho may avoid the high temperatures in the littoral zone during the summer, segregating themselves from shore-based sampling efforts. The late summer distribution of coho would also be restricted to the narrow metalimnion in Lake Sammamish, in a similar manner as chinook (see above). Like chinook, the result of this restricted distribution would be increased stress on holding adult fish, reduced juvenile foraging opportunities, and potentially higher predation mortality.

**Diet**

Diet may also be a factor in the distribution of juvenile coho in lakes. Hamilton et al. (1970) found that large coho juveniles were limnetic, with zooplankton as their primary prey. In Chignik Lake, Alaska, yearling coho fed heavily on newly emerged sockeye salmon fry around shoreline spawning and incubation areas (Ruggerone and Rogers 1992). Coho in the littoral zone of Margaret Lake, Alaska, fed entirely on insects (Cartwright and Beauchamp 1995). Aquatic insects comprised 75 percent of the diet of coho smolts in south Lake Washington during spring (February-June) 1995, and juvenile fish another 15 percent (Tabor and Chan 1996). Smolt-sized coho in a Wisconsin lake fed at the surface in the littoral zone during April, and ate aquatic and terrestrial insects (Engel and Magnuson 1971). In late spring and early summer, coho occupied both the littoral and epilimnetic zones, and continued to feed at the surface on terrestrial insects and some aquatic insects (Engel and Magnuson 1971). In late summer (mid-July to October), when water temperature in the epilimnion exceeded 16°C, coho avoided the littoral and epilimnetic zones, and fed on aquatic insects and zooplankton in the metalimnion (Engel and Magnuson 1971). Coho appear to adapt to existence in either the littoral or limnetic zones, exploiting available prey items.
Because of this adaptability, temperature may be the most important determinant of coho distribution in lakes.

**Bull Trout**

Several thorough reviews of bull trout literature were surveyed in preparation for this species description. Rather than repeat their work here, the following is a summary of the salient points from those reviews cited collectively, with information from other sources cited separately. The collective citation for the bulk of this description follows: Brown (1992), Rieman and McIntyre (1993), Sanborn et al. (1998), and U.S. Federal Register (1 November 1999).

The historical range of bull trout extended from the McCloud River in California to the Yukon River in Alaska, west of the Continental Divide within the contiguous United States except in tributaries of the Saskatchewan River, but east of the Continental Divide in the Saskatchewan and MacKenzie river systems in Canada. In Washington, bull trout occur within the Columbia River system, in rivers of Puget Sound, and in coastal rivers from Grays Harbor north. Two subpopulations of bull trout are considered within the Lake Washington basin: the Chester Morse Reservoir subpopulation and the Issaquah Creek-Sammamish River subpopulation (U.S. Federal Register, 1 November 1999; Washington Department of Fish and Wildlife [WDFW] 1998). In the mid- to late 1990s, less than 10 spawning sites were found, and fry abundance was low in the Chester Morse Reservoir; however, the population in the reservoir was estimated at approximately 3,000 adults based on hydroacoustic surveys, and did not include estimates of juveniles in the tributaries (Seattle Public Utilities, unpubl. data). In the past 10 years, only two “native char” [either bull trout or Dolly Varden (*Salvelinus malma*)] have been reported in Issaquah Creek and none have been reported in the Sammamish River (U.S. Federal Register, 1 November 1999; WDFW 1998). The USFWS is not certain that the latter subpopulation is “viable.” There is no known spawning subpopulation resident in Lake Washington or Lake Sammamish. However, subadult and adult native char are occasionally found in the lakes (USFWS 1999). Two subadult native char (300-400 mm fork length) were captured in horizontal gill nets (3-10 m deep) off the Cedar River delta in March 1985, and an adult (635 mm fork length) in the same location in April 1985; a subadult native char (300 mm fork length) was also captured in August 1984 at a depth of 60 meters (Beauchamp, Univ. of Washington, unpubl. data). Other native char have been caught or observed in Lake Washington, as well as in the Cedar River, Lake Sammamish, Carey Creek (Issaquah Creek tributary), and at the Ballard Locks (KCDNR 2000).

**Life History**

Several life history forms of bull trout occur, and all may be present within the same population. Fish exhibiting the resident life history strategy are non-migratory, spending their entire lives within their spawning stream. Migratory life history strategies include fluvial, adfluvial, and anadromous. Migratory bull trout reside as adults and subadults in larger rivers (fluvial), lakes or reservoirs (adfluvial), or marine waters (anadromous), and spawn and rear as juveniles in headwater tributaries. Due to differences in productivity
between small headwater streams and larger rivers, lakes, and marine environments, resident fish are typically smaller than migratory fish. Resident fish seldom exceed 300 mm, while migratory forms can exceed 900 mm. Anadromous forms are common in Puget Sound drainages from the Snohomish River north (Kraemer in prep.).

The majority of bull trout spawning occurs between late August and early November. Spawning migrations occur during the summer, but may start as early as April in some systems (Ratliff et al. 1996). In river systems of north Puget Sound, spawners typically arrive in holding areas near spawning grounds from several weeks, to up to four months before spawning (Kraemer in prep.). Characteristics of holding areas are: depth of at least one meter; cover in the form of turbulent water, undercut banks, woody debris, or overhanging vegetation; and cool temperatures, often provided by groundwater input. Spawning typically does not commence until stream temperatures drop to 8°C. In the North Puget Sound region, “the downstream limit of successful spawning is always upstream of the winter snow line (that elevation at which snow is present on the ground for much of the winter)” (WDFW 1999). In Montana, no spawning occurred in 1st order streams, only limited spawning by non-migratory bull trout occurred in 2nd order streams, and the majority of spawning by migratory fish occurred in 4th order streams. Bull trout spawning habitat typically consists of gravel/cobble substrates, although spawning has been observed in sand, and also in cobbles too large to be dislodged by female digging attempts (Kraemer in prep.). Close proximity to cover, low gradient (even within a high-gradient reach), and depths greater than 10 cm appear to be important spawning site-selection criteria. Once sexually mature, resident, fluvial and anadromous bull trout in north Puget Sound spawn annually (Kraemer in prep.). Following spawning, adult bull trout move downstream quickly, remaining in deep pools in larger rivers, or in lakes for the winter. Spawned-out bull trout have been observed in November feeding on loose eggs in salmon spawning grounds (Kraemer in prep.). Beach spawning of native char in Lake Washington and Lake Sammamish is improbable. Confirmed observations of beach spawning bull trout are limited to extreme downwelling conditions in cold, high-elevation lakes (WDFW 1998); water temperatures in Lake Washington and Lake Sammamish are too high for successful incubation.

Temperature

Successful egg incubation requires temperatures less than 5°C (WDFW 1999), with maximum survival between 2 and 4°C. Incubation usually takes from 100 to 145 days, depending on temperature. Egg-to-fry survival declines with increasing percentages of fine particles in the substrate (particles smaller than 6.35 mm). Fine sediments decrease egg-to-fry survival by impeding the flow of water to the eggs or by physically preventing fry emergence (entombment). Maintaining water flow to the developing eggs is necessary to remove metabolic wastes and deliver dissolved oxygen.

Juvenile bull trout are rarely found in streams with summer temperatures that exceed 15°C. Cold groundwater seeps can provide temperature refuge for bull trout in streams with summer temperatures that exceed 15°C. Fry are closely associated with the substrate while foraging, and rely on interstitial spaces for cover. This strong association with the substrate decreases with body size and is substituted by an
association with woody debris and large boulders. Juveniles are benthic foragers, feeding on aquatic invertebrates until they are large enough to become piscivores (> 100 mm). In allopatry, bull trout forage throughout the water column. Bull trout juveniles show a preference for low-velocity habitat; fry are often found in backwater areas, stream margins, and side channels, while larger juveniles occupy pools. There is some evidence for a diel habitat shift between concealment during the day and foraging in deep, fast water at night. Juveniles disperse widely from the spawning area, and should be expected even in tributaries that do not support spawning unless access is obstructed by a passage barrier. Juveniles that adopt a migratory life history strategy usually move downstream to a mainstem river, lake, or ocean following two or three years of rearing in headwater streams. Migration is possibly related to the need for a larger prey base that arises with the onset of piscivory. The timing of this migration varies between and within systems, and is not confined to spring.

Like juveniles, adult and subadult bull trout are typically found only in streams with summer temperatures that do not exceed 15°C. Pools with groundwater seeps may function as thermal refuges where stream temperatures exceed 15°C. Adults and subadults select low-velocity habitats, typically large pools, with abundant cover and large substrate. The diet of adults and subadults in streams consists primarily of fish, including juvenile salmon and trout, and whitefish (Prosopium spp.). A diel habitat shift similar to that of juveniles has been observed in adults and subadults in streams. Non-spawning movements are generally associated with thermal requirements, either seeking warmer water in winter (non-coastal populations) or colder water in summer.

The distribution of subadults and adults in lakes and reservoirs appears to be temperature mediated, with fish generally avoiding temperatures greater than 15°C, and preferring temperatures less than 10°C. Following stratification of lakes in the spring, bull trout are mostly found below the thermocline, and generally near the lake bottom. The diet of bull trout in lakes consists almost entirely of fish, and the species composition within the diet varies with the relative abundance of prey species in the lake. Cyprinids, catostomids, cottids, and salmonids [ kokanee, cutthroat trout, smaller bull trout, whitefish] represent a substantial portion of the diet of lake-dwelling bull trout in various studies. The presence of warm-water prey species, such as yellow perch (Perca flavescens), in the diet of bull trout indicates that they either make occasional forays into warmer (17–20 °C) nearshore waters or exploit these prey during winter and spring. Bull trout have also been observed aggregating to take advantage of localized prey abundance such as concentrations of spawning prey fish.

Anadromous Form

The anadromous life history strategy in bull trout is not well understood. Historically, anadromous char were all considered Dolly Varden. The separation of Dolly Varden and bull trout into distinct species, and recent investigations of native char populations in Puget Sound, have suggested that Dolly Varden and bull trout in north Puget Sound are sympatric and equally anadromous. Anadromous bull trout spend two to three years in fresh water before migrating in the spring to the estuary or nearshore marine environment (Kraemer in prep.). While in the marine environment, they feed on smaller
fish such as surf smelt (*Hypomesus pretiosus*), Pacific herring (*Clupea harengus pallasii*), Pacific sand lance (*Ammodytes hexapterus*), and pink (*O. gorbuscha*) and chum (*O. keta*) salmon smolts, closely following the distribution of the prey fish (Kraemer in prep.). Subadults usually spend two summers in the marine environment before they mature (Kraemer in prep.). Anadromous bull trout return to fresh water to overwinter, and immature and non-spawning adult fish migrate upstream with the spawners in late summer (Kraemer in prep.).

**Local Lake Washington/Sammamish Sub-Populations**

The only likely viable bull trout subpopulation in the Lake Washington watershed is the Chester Morse Reservoir subpopulation. Spawners have not been confirmed within the Sammamish River-Issaquah Creek subpopulation (WDFW 1998), and only two bull trout have been observed in the system within the last 10 years. The thermal requirements for spawning and successful egg incubation may prevent bull trout reproduction in the Sammamish River-Issaquah Creek system. Only a few streams within the Issaquah Creek system approach the winter snow line (see above), and they may be too small to be used by migratory spawners. Vestigial pockets of resident spawners could reside within thermal refugia in the upper reaches of Issaquah Creek (i.e., Holder Creek). Successful spawning by these remnants could produce migratory offspring that may never successfully reproduce. Adfluvial or anadromous offspring of remnant resident spawners could be present within the system. High summer water temperatures and an anoxic hypolimnion (http://dnr.metrokc.gov/wlr/waterres/lakes/thermo.htm) would likely deter bull trout from residing in Lake Sammamish.

The Chester Morse Reservoir subpopulation is above an anadromous barrier and is a glacial relic population (WDFW 1998). The population exhibits an adfluvial life history strategy, although residents could exist in the upper watershed (WDFW 1998). Because all life history strategies can arise from the same population, it is possible that some fish emigrate from the Chester Morse Reservoir to exhibit anadromy or to reside in Lake Washington. Water temperatures in the lower Cedar River are probably too high to support a fluvial population (WDFW 1998). Cedar River tributaries below Chester Morse Reservoir likely do not meet the thermal requirements for spawning and successful egg incubation; thus, bull trout that emigrate from Chester Morse Reservoir would not represent a viable spawning population. However, these fish may spawn in a non-natal system. Char are known to exhibit “pioneering” behavior, spawning in areas other than their native stream (WDFW 1999). Anadromous bull trout and Dolly Varden overwinter in freshwater, and may overwinter in systems other than their natal system.

Bull trout that occupy Lake Washington or Lake Sammamish should exhibit similar distribution and behavior to that of bull trout observed in other lakes. Juveniles (length 150-300 mm) would migrate to the lake after rearing one to three years in headwater streams. Spawners would begin upstream migrations from April through July, including anadromous fish migrating through the lake. Adults would likely spawn annually as observed in other North Puget Sound populations (Kraemer in prep.). Immature fish residing in the lake would be likely to migrate upstream with the spawners. Those immature fish and any non-spawning adults remaining in the lake during the summer...
would avoid temperatures above 15°C. High temperature avoidance would likely confine bull trout below the thermocline (> 15 m) from mid-June through mid-October, with some annual variation due to climatic differences. The presence of a large prey base in limnetic [e.g., sockeye salmon and longfin smelt (Spirinchus thaleichthys)] and deep benthic (e.g., Neomysis mercedis and prickly sculpin [Cottus asper]) regions would reduce the need for summer forays into nearshore areas. Native char that were captured at the mouth of the Cedar River in March and April were eating spawning longfin smelt and outmigrating sockeye fry (Beauchamp, Univ. of Washington, unpubl. data).

**Other Species**

Ajwani (1956) reported 20 native and 15 introduced fish species in the Lake Washington watershed. Of those species, 14 are considered common or abundant in Lake Washington, including prickly sculpin, longfin smelt, juvenile sockeye salmon, threespine stickleback (Gasterosteus aculeatus), peamouth (Mylocheilus caurinus), yellow perch, rainbow trout (O. mykiss), northern pikeminnow (Ptychocheilus oregonensis), largescale sucker (Catostomus macrocheilus), brown bullhead (Ictalurus nebulosus), cutthroat trout, smallmouth bass, largemouth bass, and common carp (Cyprinus carpio) (Beauchamp 1990). The relationships of any of the common fish species to ESA-listed salmonids would be related to the timing and duration of distributional overlaps among species. The primary zone of overlap for juvenile chinook and coho with other fish species would be the littoral zone. The expected timing of littoral zone occupation for each species is shown in Table 2.

**Bass**

Bass have been studied extensively throughout their range, including in Lakes Washington and Sammamish. Direct studies on the relationship between piers and other shorezone structures, and bass predation on salmonids are currently underway (Roger Tabor, USFWS; Kurt Fresh, WDFW; Rod Malcom and Eric Warner, Muckleshoot Tribal Fisheries). Conjecture about that relationship can be supported with information from other studies and personal communications from local scientists. Both largemouth and smallmouth bass demonstrate an affinity for structural elements, and both are piscivorous, preying on salmonids when available.

Stein (1970) found that largemouth bass in Lake Washington preferred heavy log and brush cover to all other available habitat (including docks), and considered the lack of this habitat to be a limiting factor. Largemouth bass were often found under docks in early spring in Lake Washington (Stein 1970). One third of the largemouth bass in Lake Baldwin, Florida showed a significant preference for piers in the absence of aquatic vegetation (Colle et al. 1989). Largemouth bass preferred moderate to dense vegetation and silt or sand substrate in Lake Sammamish (Pflug 1981). Nests were constructed at depths from 0.6 to 1.5 meters, in vegetated areas with soft-sediment to gravel substrates, on moderate to steep slopes (Pflug 1981). Others have noted preferences for nest locations adjacent to a structural feature such as a rock, stump, or a slope (Heidinger 1975; Allan and Romero 1975), and locations that provide cover...
(Vogele and Rainwater 1975). In general, largemouth bass select soft substrates; cover in the form of logs, brush, aquatic vegetation, or other structures; and utilize a variety of prey-capture tactics.

Both smallmouth and largemouth bass utilize docks and piles in addition to natural cover. However, smallmouth bass generally select hard substrates without aquatic vegetation, drop-offs or outcroppings, and cover in the form of logs or rocks, whereas largemouth bass generally prefer softer-bottom substrates and aquatic macrophytes (Coble 1975). Smallmouth bass in Lake Sammamish often selected residence areas with overhead cover such as docks, submerged logs, or overhanging vegetation, and preferred areas with cobble/gravel substrate and drop-offs, without aquatic vegetation (Pflug 1981; Pflug and Pauley 1984). Smallmouth bass were the only species that Bryan and Scarnecchia (1992) consistently found in equal or greater abundance in developed sites than in undeveloped sites in Spirit Lake, Iowa. Smallmouth bass in a Texas reservoir selected rock outcroppings more than other habitat types (Kraai et al. 1991). Male smallmouth bass in Lake Sammamish generally located nests within 7 to 20 meters of shore, on gently sloping gravel/cobble substrates, devoid of vegetation, at depths of 1 to 3 meters, and associated with a structural element such as a log, boulder, pile, or other artificial structure (Pflug and Pauley 1984; Malcom, pers. comm., 13 April 2000).

Largemouth and smallmouth bass spawned beside fallen trees in water as shallow as 80 cm in lakes of the Eastern Region national forests (Bassett 1994). Danehy and Ringler (1991) reported that smallmouth bass displayed two different foraging and habitat selection strategies: those occupying cobble/rubble shoals were strongly associated with the substrate and fed primarily on benthos (mostly crayfish), and those found over sandy substrates were piscivorous and exhibited an active hunting behavior, feeding pelagically without an association with the substrate (Danehy and Ringler 1991). Haines and Butler (1969) showed that structures that provided darkness were selected most frequently by yearling smallmouth bass. Fallen trees in less than 1.5 meters of water were generally used by juvenile smallmouth bass, but not by adults in Eastern Region national forest lakes (Bassett 1994). Bassett (1994) reported that artificial structures placed at depths of 3 to 6 meters were most effective at attracting centrarchids during summer. In Lake Joseph, Ontario, young-of-the-year smallmouth bass were the only fish group whose density was not significantly related to coarse woody debris (CWD); instead, their density was highest in areas with high concentrations of shorezone structures (Brown 1998). Helfman (1979) experimented with fish attraction to shade-producing, floating objects in Cazenovia Lake, New York, and found that smallmouth bass were not attracted to the floats (sized from 1.1-3.6 m²); largemouth bass occasionally hovered below the experimental floats, but were more common under larger swimming floats at similar depths. Helfman (1979) speculated that the response of largemouth bass might be indicative of an attraction to “more massive structure” than the experimental floats provided.
Key Predators

Table 2 illustrates that the distributions of all of the common fish species in Lake Washington overlap the distribution of juvenile chinook salmon at some point. Of primary interest is the distribution of potential predators on juvenile chinook. Information provided at a recent workshop convened to present a report on the progress of the ongoing Lake Washington Ecological Studies provided an updated perspective on the predators of juvenile salmonids. The primary native fish species identified as potential predators in the Lake Washington system were: river lamprey, cutthroat trout, rainbow trout, coho salmon, and five species of sculpin; other native species were: mountain whitefish, bull trout, longfin smelt, chinook salmon, and sockeye salmon (Lake Washington Sockeye Studies Interim Workshop 2000). The primary introduced fish species identified as potential predators in the Lake Washington system were: smallmouth bass, largemouth bass, and yellow perch; other species include: brown bullhead, black crappie, white crappie, pumpkinseed, Atlantic salmon, bluegill, and warmouth (Lake Washington Sockeye Studies Interim Workshop 2000). The most important nearshore predator of sockeye fry in Lake Washington was identified as cutthroat trout less than 250 mm; other predators noted were juvenile coho salmon, and rainbow trout (Lake Washington Sockeye Studies Interim Workshop 2000). The most important limnetic predator of juvenile salmonids was identified as cutthroat trout over 250 mm, whose diet consists of approximately 50 percent salmonids (Lake Washington Sockeye Studies Interim Workshop 2000). Prickly sculpin larger than 125 mm were also identified as the most important benthic predator (Lake Washington Sockeye Studies Interim Workshop 2000). Although the focus of the Lake Washington Sockeye Studies was on sockeye salmon, identified predators also prey on other juvenile salmonids, including chinook.

The primary predator of juvenile chinook occupying the littoral zone from January through June, and the limnetic zone for the remainder of the year, would be cutthroat trout (Warner, pers. comm., 7 July 2000). A small proportion of northern pikeminnow, yellow perch, and smallmouth bass reside in nearshore regions during winter, but the majority move inshore in the spring as temperatures in nearshore areas warm (Bartoo 1972; Olney 1975; Coutant 1975). The distributions of these fishes overlap primarily with the peak out-migration of chinook through the littoral zone, whereas the overlap of cutthroat and chinook distributions is continuous. Sculpins are present in the littoral zone year-round and are known to eat chinook (Tabor et al. 1998). In mid-summer, temperatures in the littoral zone become undesirable for juvenile chinook and coho salmon, and the majority leave the lake or seek cooler temperatures away from the littoral zone, thus segregating themselves from littoral predators, but remaining vulnerable to cutthroat trout and potentially prickly sculpin.

The magnitude of avian predation on salmonids in Lake Washington is unknown. Studies from other systems indicate that consumption rates can be substantial. Double-crested cormorants (Phalacrocorax auritus) and western grebes (Aechmophorus occidentalis) consumed more than 31 percent of the spring plant of trout fry in a Utah reservoir over a two-week period, and nearly 33,000 larger subadult trout over eight months (Modde et al. 1996). Wood (1987a) estimated that common mergansers
(Mergus merganser) consumed as much as 39 percent of the potential coho smolt production from the Big Qualicum River, BC. Suter (1995) estimated that cormorants (P. carbo) consumed from 5 to 22 percent of the annual standing crop of grayling (Thymallus thymallus) in two Swiss rivers. Salmonids comprised the major dietary component of both red-breasted mergansers (M. serrator) (Feltham 1990) and common mergansers (Wood 1987b) in their respective studies. Wood (1987b) stated that “mergansers rank among the largest (in terms of appetite) and most efficient predators of juvenile salmon” and they “congregate wherever salmon density is high.” Alexander (1979) was able to attribute 15 percent of annual mortality of age 0 to 1 brook trout in a Michigan River to avian predators and 58 percent to piscivorous brown trout (Salmo trutta).

Because of the presence of predatory birds in Lake Washington and Lake Sammamish, avian predation must be considered among potential threats to juvenile salmonids. Common mergansers are abundant in the spring. Double-crested cormorants are common in Lake Washington, typically perching on the log booms at Union Bay and May Creek rather than on docks and bulkheads. Cormorants also commonly perch on individual piles (Warner, pers. comm., 7 July 2000). Western grebes inhabit enclosed bays (and some marinas). Gulls are common in the lake, perching on log booms and on low docks (Warner, pers. comm., 7 July 2000). Gulls are known predators of juvenile salmonids (Ruggerone 1986).
Table 2. The timing of the annual littoral zone occurrence of the common fish species in Lake Washington (similar data were not obtained for Lake Sammamish). Dashed black lines indicate presence, blank areas indicate absence. Footnotes appear on the following page.

<table>
<thead>
<tr>
<th>Species</th>
<th>Presence in the Littoral Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prickly Sculpin$^1$</td>
<td>-----------------------------------------------</td>
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<tr>
<td>Longfin Smelt$^2$</td>
<td>-----------------------------------------------</td>
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<tr>
<td>Sockeye Salmon$^3$</td>
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<tr>
<td>Chinook Salmon$^4$</td>
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<tr>
<td>Coho Salmon$^5$</td>
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<tr>
<td>Rainbow Trout$^6$</td>
<td>-----------------------------------------------</td>
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<tr>
<td>Cutthroat Trout$^7$</td>
<td>-----------------------------------------------</td>
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<tr>
<td>Native Char$^8$</td>
<td>-----------------------------------------------</td>
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<td>Stickleback$^9$</td>
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<td>Peamouth$^{10}$</td>
<td>-----------------------------------------------</td>
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<tr>
<td>*Yellow Perch$^{11}$</td>
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<tr>
<td>N. Pikeminnow$^{12}$</td>
<td>-----------------------------------------------</td>
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<tr>
<td>Largescale Sucker$^{13}$</td>
<td>-----------------------------------------------</td>
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<tr>
<td>*Brown Bullhead$^{14}$</td>
<td>-----------------------------------------------</td>
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<tr>
<td>*Smallmouth Bass$^{15}$</td>
<td>------- -----------------------------------------------</td>
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<tr>
<td>*Largemouth Bass$^{16}$</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>*Common Carp$^{17}$</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Kokanee</td>
<td>Insufficient data</td>
</tr>
<tr>
<td>Mountain Whitefish$^{18}$</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>*Pumpkinseed$^{19}$</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>*Tench$^{20}$</td>
<td>-----------------------------------------------</td>
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</tbody>
</table>

**Month**

|-------|------|------|-------|-------|-----|------|------|------|-------|------|------|------|
* Indicates an exotic species.
1 Rickard (1978)
3 Martz (1996), Beauchamp (unpublished data)
4, 5 Fresh (unpublished data), Beauchamp (unpublished data)
6 Beauchamp (1987, 1990)
7 Beauchamp et al. (1992)
8 Beauchamp (unpublished data), USFWS (unpublished data)
9 Traynor (1973), Beauchamp (unpublished data)
10 Nishimoto (1973), Beauchamp (unpublished data)
11 Bartoo (1972), Nishimoto (1973), Nelson (1977)
12 Bartoo (1972), Olney (1975), Brocksmith (1999)
13 Beauchamp (unpublished data)
14 Beauchamp (unpublished data)
15 Beauchamp (unpublished data), Fayram (1996)
16 Stein (1970)
17-20 Beauchamp (unpublished data)
Shorezone Structures and Salmonid Predators.

Many of the predators that juvenile chinook are exposed to are active, cruising hunters (i.e., other salmonids, many piscivorous birds, northern pikeminnow). Smallmouth and largemouth bass generally utilize ambush or habituation foraging strategies (Hobson 1979). Fayram and Sibley (2000) determined that smallmouth bass in Lake Washington occupied littoral home ranges that radiated 100 to 200 meters from the focal point and generally did not extend below 8-meter depths. Because of this propensity for ambush foraging and shoreline orientation, bass are expected to benefit from artificial structures placed in the littoral zone. Yellow perch utilize “non-structural” areas (Paxton and Stevenson 1979). Recent evidence of the role of cutthroat trout as the major predator of juvenile salmonids in Lake Washington (Lake Washington Sockeye Studies Interim Workshop 2000), raises the question of whether cutthroat trout might also benefit from shorezone development, regardless of their foraging method. Shoreline development could potentially increase the rate of predation on juvenile chinook by several principal means: 1) reducing prey refuge habitat by modifying the structure of the shoreline (critical in all predator-prey interactions, but especially critical for prey of mobile predators such as cutthroat trout); 2) providing concealment structures for ambush predators such as bass and sculpin; 3) creating enough structure to reduce bass home range sizes; 4) providing artificial lighting that allows for around-the-clock foraging by predators; 5) potentially increasing migration routes for smolts and rearing fry, thus increasing exposure to predators; and 6) potentially increasing the bass population by increasing the amount of potential spawning habitat.

Bass are generalist piscivores, eating salmonids when their distributions overlap. In a study of the impacts of introduced fish in lakes of the northeastern United States, Whittier and Kincaid (1999) observed that native brook trout populations had been nearly extirpated, or had to be maintained by stocking, in lakes where smallmouth bass had been introduced. Salmonids were a greater proportion of the diet of largemouth bass than of smallmouth bass in Lake Sammamish (Pflug 1981). Tabor et al. (2000) observed the opposite in the Lake Washington Ship Canal. Pflug (1981) proposed that bass exploitation of the seasonal abundance of outmigrating salmonids was responsible for the unusually high growth rate of bass in Lake Sammamish. An analogous situation exists in coastal Massachusetts lakes where exploitation of anadromous herring contributes to the production of “trophy” bass (Yako et al. 2000).

Much of the bass predation on salmonids in the Lake Washington system corresponds with the out-migration of smolts in the spring and summer (Stein 1970; Pflug 1981; Pflug and Pauley 1984; Fayram and Sibley 2000; Tabor et al. 2000). This phenomenon has also been observed in the Columbia River (Gray and Rondorf 1986; Vigg et al. 1991; Poe et al. 1991; Zimmerman 1999). In the mid-Columbia River, ocean-type chinook fry were the only identified salmonids found in smallmouth bass stomachs by Tabor et al. (1993). The Columbia River studies indicated that salmonids were only seasonally abundant in bass diets, and that other fish species, crayfish, and other invertebrates provided the bulk of bass prey items. The Lake Washington Ship Canal may be an exception due to the tight bottleneck that it imposes on outmigrating salmon smolts. Preliminary evidence from a study by Tabor et al. (2000) indicates large populations of
both largemouth and smallmouth bass in the Ship Canal coinciding with the
outmigration of salmon smolts. Analysis of stomach contents indicated that age-0+
chinook were the predominant salmonid prey item, constituting approximately 50
percent of the diet of smallmouth bass; preliminary consumption rates for April – July
1999 were 0.3 smolts/stomach for smallmouth bass and 0.1 smolts/stomach for
largemouth bass (Tabor et al. 2000).

As discussed above, patterns of bass predation in the Lake Washington Ship Canal are
similar to those in the Columbia River. Preliminary analysis of Ship Canal smallmouth
bass stomach-contents from May through July 1999 found that salmonids represented
approximately 60 percent of the diet of bass from 200 to 249 mm, and 50 percent of the
diet in bass 250 mm and larger (Tabor et al. 2000). The large numbers of bass in the
Ship Canal, and their high rates of consumption of salmon smolts (primarily chinook but
also coho and sockeye), pose a substantial threat to chinook salmon migrating from the
Lake Washington system; however, actual losses due to predation and the proportion of
the smolt population these losses represent have not been computed yet (Tabor et al.
2000). Consumption estimates from limited preliminary sampling in 1997 by the
Muckleshoot Indian Tribe indicate that as many as 100,000 chinook smolts could have
been consumed in a 90-day migration period (Warner, pers. comm., 7 July 2000).

The distributional overlap of chinook with bass in the Lake Washington system is more
prolonged than in the mid-Columbia River due to a temperature regime that favors bass.
Water temperatures in Lake Washington typically exceed 10°C by mid-April, and 15°C
by June (http://dnr.metrokc.gov/wlr/waterres/lakes/wash.htm). Thus, the peak of
chinook outmigration from Lake Washington (June) corresponds with increasing bass
activity and metabolic demands. Furthermore, the outmigration of chinook juveniles
continues into late August, prolonging the distributional overlap of chinook and bass.
Predation rates in the Ship Canal have likely increased in response to climate change
and its effects on predator metabolism. Increasing water temperatures in Lake Union
from 1973 to 1996 have produced an estimated increase in predation rates of 18
percent, 16 percent, 13 percent and 9 percent for smallmouth bass, rainbow trout,
northern pikeminnow, and largemouth bass, respectively (Stock et al. 2000). Thus, with
projected increases in global temperatures over time, predation rates on juvenile
salmonids will likely continue to increase even if predator populations and other habitat
variables remain constant.

Potential Impacts of Shoreline Development

**Historical Changes**

The conditions currently experienced by chinook and coho salmon, and bull trout in the
Lake Washington watershed result from considerable human alterations of the
environment. The lowering of Lake Washington that resulted from the construction of
the Ship Canal and Hiram Chittenden Locks (completed in 1916), and concurrent
elimination of the Black River and diversion of the Cedar River into Lake Washington
were the most monumental modifications. Lake Union was connected to Lake
Washington via the Montlake Cut, and the former outlet to Lake Union was enlarged to form the Fremont Cut. Locating the locks near the western terminus of Salmon Bay converted the formerly saltwater inlet into a freshwater channel, eliminating over 7 km (4 mi.) of estuarine habitat (Chrzastowski 1983). Lowering the lake and diverting the Cedar River affected both the fish populations and the condition of the habitat. Cedar River fish stocks were locally adapted to a riverine migration and an extensive estuary, instead of the current lengthy lacustrine migration and an abrupt entry from warm, fresh water into significantly colder, more saline conditions below the locks. Lake Washington and Lake Sammamish fish stocks, while accustomed to the lengthy lacustrine migration, were also adapted to an extensive estuary. The approximately 9-foot reduction in lake level eliminated much of the available shallow-water and freshwater marsh habitat, and decreased the length of the shoreline. Chrzastowski (1983) reports a loss of 15.3 km (9.5 miles) of shoreline, and an estimated loss of 410 hectares (1,013 acres) of wetland resulting from the lowering of the lake.

The channelization and straightening of the Sammamish River, at a loss of approximately 12 miles of river, eliminated the majority of riverine and off-channel rearing-habitat for juvenile salmon, disconnected the river from its floodplain, and eliminated riparian vegetation. The outlet weir on Lake Sammamish controls summer lake level and restricts flow to the Sammamish River during adult salmon migration. The Sammamish River now represents a substantial thermal migration-barrier to adult spawners. An additional consequence of the Sammamish River channelization, subsequent river trail construction, and removal of the riparian vegetation, is that migrating salmon lack significant refuge habitat and holding areas, and are subjected to disturbance by passing trail users (Malcom, pers. comm., 22 November 1999).

The regulation of the water level in Lake Washington by the USACE has eliminated the annual flood-driven seasonal inundation of the shoreline that shaped the structure of the macrophyte community. Historically, the lake would fluctuate as much as 7 feet during flood events (Chrzastowski 1983). The previously hardstem bulrush- and willow-dominated shoreline community has been replaced by developed shorelines with landscaped yards. The loss of natural shoreline has reduced complex shoreline features such as overhanging and emergent vegetation, woody debris (especially fallen trees with branches and/or rootwads intact), and gravel/cobble beaches. Evermann and Meek (1897) noted in 1896 that “the shore of Lake Washington is not well adapted to collecting with a seine” due to the abundant submerged woody debris, and dense underbrush, small trees, and tule (hardstem bulrush) that fringed the shoreline. Development of the shoreline of Lake Sammamish has reduced the once abundant overhanging vegetation and woody debris. Evermann and Meek (1897) noted in 1896 that the trees along the shore of Lake Sammamish were so dense that when water levels were high “…it is difficult to walk any distance along the shore without swinging from one bough of a tree to another.” The loss of native shoreline vegetation and wetlands in the two lakes has likely reduced allochthonous input of detritus and terrestrial insects. USACE water-level regulation has not similarly affected the shoreline of Lake Union, as the historical water-level fluctuation was similar to the present. Losses of wetland and shoreline vegetation in Lake Union are attributable to filling and shoreline development.
The woody debris, once abundant along the shoreline of Lakes Washington and Sammamish in their historical conditions, has been replaced with structurally simple piers. A survey of 1991 aerial photos estimated that 4 percent of the shallow-water habitat in Lake Washington and 2.5 percent in Lake Sammamish within 30.5 meters of the shore was covered by residential piers (ignoring coverage by commercial structures and vessels) (Malcom, pers. comm., 22 November 1999). Approximately 81 percent of the shoreline of Lake Washington is bulkheaded (Warner and Fresh 1999). The loss of complex habitat features (i.e., woody debris, overhanging vegetation, emergent vegetation), and shallow-water habitat in Lakes Washington and Sammamish has reduced the availability of refuge habitat and forage for juvenile salmonids. Restoring and preventing future losses of these habitat features should be priorities for agencies responsible for managing lakeshore development.

**Chemical Contaminants Associated with Piers, Docks and Bulkheads**

1. **Hydrocarbons within Lake Washington**

Direct causal links between bulkheads, piers and other artificial shorezone structures and hydrocarbon inputs are few. Those links that have been identified include the use of creosote-treated lumber (hydrocarbon flux) and localized increases in watercraft powered by internal combustion engines (hydrocarbon spillage and exhaust). Within urbanized regions, such as the Lake Washington watershed, the quantity of aliphatic and cyclic hydrocarbons entering the lake by boating activity and creosote-treated wood is most likely insignificant relative to the quantity of anthropogenic and biogenic hydrocarbons of all species entering the lake through urban runoff, atmospheric particulate fallout, and fluvial inputs (Latimer and Quinn 1998; Wakeham 1977; Jones et al. 1980; Green and Trett 1989). However, hydrocarbon input from boats and treated wood should not be considered trivial.

A. **Creosote and PAHs** - Creosote is primarily composed of polycyclic aromatic hydrocarbons (PAHs) (Hyötyläinen and Oikari 1998), which are known carcinogens, mutagens and teratogens (Chen et al. 1997; Hussain et al. 1998; Green and Trett 1989). PAHs are a common pyrolytic byproduct of all internal combustion engines and are now commonly found in most aquatic systems near industrialized and urbanized centers (Green and Trett 1989). PAHs are known to bio-accumulate proportionally to the number of carbon rings composing the parent compound, and have bio-accumulation factors ranging between 10,000 to 130,000 (Green and Trett 1989). Although PAHs are more commonly found as a contaminant within urban runoff (Latimer and Quinn 1998), boat exhaust (Smith et al. 1987), fuel spills, and other varied sources, under rare circumstances large quantities of creosote-treated lumber within confined bodies of water (such as San Diego Bay, California) can emit more PAHs (metric tons per year) than all other sources combined (Katz et al. 1995). In British Columbia, Goyette and Brooks (1998) found that significant PAH sediment contamination occurred within 7.5 meters of newly installed creosote piles in a marine inlet, but that significant biological effects on the infaunal community occurred within 0.65 meter. In the same study, Goyette and Brooks (1998) predicted that maximum sediment PAH concentrations should occur approximately 1,000 days post installation.
Overall, relatively little is known about the impacts of PAHs to aquatic organisms. Evidence for immunosuppression resulting from exposure to PAHs was reported by Arkoosh et al. (1998), who determined that chinook smolts from urban estuaries exhibited a higher cumulative mortality after exposure to the marine pathogen *Vibrio anguillarum* than smolts from a non-urban estuary. Tissue examinations of the chinook smolts indicated that those from the urban estuary had been exposed to higher levels of PAHs and PCBs than smolts from the non-urban estuary (Arkoosh et al. 1998). Studies of impacts to freshwater aquatic organisms by PAHs report inhibition of phytoplankton electron transport (Marwood et al. 1999); depression of growth and reproduction of *Daphnia* (Geiger and Buikema 1982); liver stress and formation of liver tumors and cataracts in rainbow trout (Hyötyläinen and Oikari 1998; Black et al. 1988; Laycock et al. 1999); and acute toxicity to the duckweed *Lemna gibba* (Ren et al. 1993). One study relating PAHs in freshwater sediments to human health quantified a greater than negligible lifetime increase in risk of skin cancer to persons swimming in areas with PAH-contaminated sediments (Hussain et al. 1998).

Although a few of these studies standardize and quantify lethal and sub-lethal effects (96 hr EC-50/LC-50 values), many studies employ unique exposure regimes and relative toxicity tests of unknown PAH mixtures, (I think a word may be missing), making comparisons between studies difficult (Malins 1982). Un-saturated PAHs appear to be most toxic, with effect concentration values for various freshwater and marine organisms ranging from 2 to 1,000 ppm, although many fishes have 96 hour LC-50 values between 10 and 100 ppm (Green and Trett 1989). Several studies have identified increased toxicity of PAHs exposed to ultra-violet light (Marwood et al. 1999; Laycock et al. 1999; Ren et al. 1993), an environmental condition more likely to occur within shallow littoral habitats. Additionally, photo-degraded hydrocarbons also tend to be more soluble than parent compounds, thus increasing their bioavailability (Green and Trett 1989).

### B. Watercraft Exhaust Emissions

Little study has been given to the role of watercraft exhaust, as a source of environmental aliphatic and cyclic hydrocarbon contamination. In the late 1960s and early ’70s several papers were published that discussed two-cycle outboard motor exhaust, although these documents provided only qualitative information regarding the extent of hydrocarbon input (Jones et al. 1980) (Citations A, B, C, none of which were acquired within the constraints of this effort). There seems to be agreement within this group of papers that two-cycle engine oil is a major source of hydrocarbon pollution within freshwater lakes (Jones et al. 1980), although other studies have estimated that relative to the overall hydrocarbon input into urbanized lakes such as Lake Washington, outboard engine operation likely contributes a very small fraction of total input, less than 1 percent (Wakeham 1977).

Two recent studies investigating the effects of watercraft exhaust in relatively pristine water bodies (one marine and one freshwater) have been conducted. The first study detected low levels of PAHs in sediments near power boat moorings at Green Island in the Great Barrier Reef (marine), but PAHs were not detected in measurable concentrations in water and clam tissue at the same locations or within sediments away from power boat moorings (Smith et al. 1987). The second study implicated watercraft
exhaust as the cause of seasonal increases in the water concentration of methyl tert-butyl ether (MTBE) at Donner Lake in California (Reuter et al. 1998), which is added to fuel mixtures to decrease emission of unburned hydrocarbons. MTBE is a known carcinogen, although very few studies have been conducted to determine this compound’s effects on aquatic organisms. Note: a significant reference on this topic (Correll 1999) was located at press time, but was not incorporated into this report due to lack of time.

2. Heavy Metal Contamination by CCA-Treated Wood

As a preventative to decay, lumber used to construct piers, docks, bulkheads and other structures experiencing regular marine and freshwater inundation are pressure treated with chromated copper arsenate (CCA). CCA is a mixture of metal oxides (chromium, copper and arsenic), each of which are highly toxic to marine and freshwater organisms in dissolved ionic form (Weis et al. 1998). Although the processes of pressure fixation of CCA to wood fibers is intended to prevent dissolution of toxic metals into the surrounding environment, contamination of water, sediment and biological organisms in proximity to CCA-treated wooden structures, especially within the first three weeks after installation, is common (Brooks 1994; Weis et al. 1998).

The toxicity of CCA leachates to freshwater and marine organisms is high, especially for copper ions which are toxic to most aquatic organisms even in comparatively low concentration, 10 to 100 ppb (Brooks 1996). Although the majority of toxicological research assessing the effects of copper, chromium and arsenic on aquatic biota has been conducted within marine waters, all three metals are known to be toxic to freshwater organisms (copper and arsenic slightly less toxic, chromium slightly more toxic) (Brooks 1996).

While substantial toxicity data for individual aquatic organisms/individual metal contaminants EC-50/LC-50 values exists, studies quantifying the impacts of leached metals in proximity to CCA-treated piers and bulkheads via in situ observations are few and limited to marine systems. Those studies that do exist have clearly demonstrated the capacity for these metals to leach into the environment in proximity to structures utilizing treated lumber. In certain circumstances, accumulations of metals leached from treated lumber have been detected in tissues of resident biota, although measurable impacts to individual organisms have been limited (Brooks 1996; Weis and Weis 1993). While new installations of CCA-treated wood structures can cause state and federal water quality standards for copper, chromium and arsenic to be exceeded in the short term (first 3 weeks), long term concentrations of these metals leaching from treated lumber is expected to remain below the effect levels for most aquatic organisms, especially in aquatic environments that are well flushed (Brooks 1996).

Three potentially useful literature reviews of the environmental risks associated with three common wood-preservatives used in aquatic environments were identified following the substantial completion of the present review. Brooks (1995a) reviewed creosote-treated wood products, Brooks (1995b) reviewed CCA-treated wood products, and Brooks (1995c) reviewed ammoniacal copper zinc arsenate (ACZA)-treated wood
products. These review documents are available in PDF or MS\textsuperscript{TM} Word formats from the Western Wood Preservers Institute at http://www.wwpinstitute.org/researchdocs/.

Another wood preservative, copper-8-quinolinolate (solubilized) (Cu-8), is commonly used for above-water components of shorezone structures. Studies of the effects of Cu-8 on aquatic organisms were not located in the course of this review. Cu-8 is considered non-toxic, and is approved for use by the U.S. Food and Drug Administration in wood-preserving applications where treated wood may contact foodstuffs (American Wood-Preservers’ Association 1962). It has also been found to not leach from treated textiles in running water (American Wood-Preservers’ Association 1962).

3. Remaining Issues

Two issues pertaining to piers, docks and bulkheads in the near-shore environment have not yet been addressed. Hydrocarbon-contaminated sediments may be disturbed during new pier, dock or bulkhead construction. There is a lack of published research regarding the location and degree of hydrocarbon sediment contamination levels within Lakes Washington and Sammamish, and a lack of research related to the effects of disturbance of hydrocarbon-contaminated sediments on aquatic organisms.

Household or industrial cleaning and preserving agents that may be applied to piers and docks could have adverse effects on aquatic organisms. No published research on this topic was identified. Additionally, the quantity of chemicals used for this purpose, and the types of chemicals used are unknown. The potential for adverse impacts from household cleaning products is exemplified by the recent fish kill in Thornton Creek, which was suspected to have been caused by a concrete cleaner, treated swimming pool water, or a combination (Birkland 2000).

The additional issue of the potential impacts of lawn-care products on aquatic systems was also not addressed due to time constraints. Many lawn-care products are labeled with warnings of the hazards to aquatic organisms that could result from the inappropriate use of those products. The propensity of the typical waterfront landowner to have a manicured lawn indicates the probability that a variety of pesticides, herbicides, and fertilizers may be routinely applied to those lawns.

Citations we did not collect, but would like to include.


Disruption of Physical Processes

Attenuation of wave energy, and sediment recruitment and transport are the primary physical processes that are altered by shoreline structures. When shallow littoral waters become partially or completely isolated from circulation with the main body of the lake, localized thermal, chemical, and physical regimes become established. These alterations can be beneficial to some species, but detrimental to others. When separated from the buffering effects of the main water body, littoral waters exhibit generally warmer and much greater diel temperature fluctuations. Larval forms of some fishes (e.g., catostomids and cyprinids) may benefit from the lack of wave energy and elevated temperatures, as could Eurasian milfoil (*Myriophyllum spicatum* L.). Erosion of an undeveloped shoreline by wave action results in a continuous input of sediment that is episodically supplemented by large inputs from slope failures. Sediment added to the system by erosion or slope failure is transported along shore by wave energy in the direction of prevailing winds (Lawrence and Davidson-Arnot 1997). Irregular shoreline orientation creates distinct areas of deposition and erosion (Nordstrom 1989). Shoreline areas lacking in sediment supply are prone to increased erosion of existing beach substrate, and the reduction of sediment sources in one area results in erosion in other areas (Lawrence and Davidson-Arnot 1997). Shoreline structures could potentially interrupt the process of sediment transport by preventing the input of sediment from the shore, disrupting wave energy, or blocking the movement of sediment along the shoreline.

Marine

Macdonald et al. (1994) concluded that shoreline armoring could deprive beaches of sediment recruitment from the uplands, resulting in scour of the existing substrate and ultimately reducing the beach to substrate particles too large to be mobilized by wave action. Erosion in front of bulkheads is exacerbated by reflected wave energy (Macdonald et al. 1994). However, Kraus and McDougal (1996), in an updated literature review of the effects of seawalls on beaches, concluded that reflected wave energy is “probably not a significant contributor to beach profile change or to scour in front of seawalls,” but the scour is more likely a result of along-shore processes, or a combination of long-shore and cross-shore processes. A gradient in sediment flux is necessary for scour or a reduction in beach profile to occur, and gradients typically occur along shore as a result of insufficient sediment supply (Kraus and McDougal 1996). Thus, the deprivation of sediment supply caused by bulkheads could ultimately result in lowering beach profiles in front of bulkheads and increased erosion at neighboring properties, including properties without bulkheads. Reflected wave energy at seawalls could contribute to the suspension of particles, thus facilitating their transport (Kraus and McDougal 1996).

These processes would be expected to occur in Lakes Washington and Sammamish at a smaller scale due to the relatively reduced energy of the lacustrine systems. The implications for ESA-listed salmonids are uncertain. Changes in sediment composition could affect prey availability, habitat availability, and spawning. Juvenile fall chinook in the Columbia and Snake Rivers showed a preference for shallow water over sand
substrates (Key et al. 1994a and 1994b; Garland and Tiffan 1999), and preliminary data indicates a similar preference by chinook fry in Lake Washington (Tabor, pers. comm., 9 June 2000). A reduction in fine sediments (from an interruption of supply) and shallow water due to bulkhead construction could reduce the availability of shallow sandy habitat.

Lakes/Rivers

Lorang et al. (1993) investigated shoreline changes that resulted from lake-level regulation in Flathead Lake, Montana, and found that docks and seawalls “intercept the natural supply and migration of plunge zone gravels, resulting in accelerated, localized backshore erosion on the downdrift side and heavy aggregation of migrating gravels on the updrift side.” An effect of the regulation of the level of Flathead Lake was that the extended high lake level (similar to Lake Washington - early spring filling, extended into late fall) prevented the summer establishment of riparian vegetation (Lorang et al. 1993). Historically, peak water levels in Flathead Lake increased steeply in May with spring runoff, peaked briefly in June, and declined steeply in July and August; beaches formed at high lake level were colonized by riparian vegetation over the summer (Lorang et al. 1993). These findings could have implications for the establishment of riparian and emergent vegetation in Lake Washington. Additionally, if gravels are captured around shorezone structures in Lake Washington, these accumulations could further enhance the attraction of smallmouth bass, and potentially increase the availability of desirable spawning substrates associated with these structures (see observations by Malcom, pers. comms., 1999).

Bonham (1983) proposed emergent vegetation as effective wave-energy attenuation and scour prevention, and as an alternative to armored shorelines. Bonham (1983) tested the ability of four species of emergent vegetation to attenuate wave energy in large British canals and rivers, and found that a 2-meter-wide bed of any of the four species on a 1v to 4h slope, was capable of dissipating approximately two-thirds of boat wake energy and inhibiting wave break. Rolletschek and Huehl (1997) described the impacts of reed-protecting structures on shorelines; however, only the abstract was available. The structures, apparently designed to protect shoreline marshes from wave action, enhanced the accumulation of organic sediments within the marshes, modifying sediment chemical properties (Rolletschek and Huehl 1997).

Effects on Predation and Prey-Refuge Habitat

Shorezone structures are expected to affect predation on ESA-listed salmonids by simplifying the shoreline (bulkheads eliminate shallow water, complex woody debris, overhanging vegetation, and complex substrate, and create energetically unfavorable shoreline conditions); providing foraging habitat (shade and overhead cover) for structurally-oriented ambush predators, specifically largemouth and smallmouth bass (piers); and by extending the duration of predation by allowing visual predators to forage at night (piers with artificial lighting). Due to their life history strategies, largemouth and smallmouth bass are the predators most likely to benefit from shorezone structures; additional discussion of the ecology of largemouth and smallmouth bass is warranted.
(see “Bass” section above), as well as a brief discussion of general predator-prey interactions. However, cutthroat trout are the primary predator of salmonids in the nearshore from February through June, and in the offshore for the rest of the year (Warner, pers. comm., 7 July 2000). The effects of shorezone structures on the efficiency of cutthroat predation on salmonids are unknown. It is likely that the loss of complex refuge habitat resulting from shorezone development would represent a disadvantage to juvenile salmonids in the presence of mobile predators such as cutthroat trout.

**Predator-prey Interactions**

For juvenile salmonids, the net loss in complex cover resulting from the replacement of natural shorelines with docks and bulkheads may be critical. Historically, the littoral zone of Lake Washington contained abundant aquatic and shoreline vegetation, and woody debris (Evermann and Meek 1897; Stein 1970). The lowering of the water level and substantial shoreline development have eliminated much of the shallow-water habitat available to juvenile salmon. Docks and piles may provide shallow-water cover for juvenile salmon, but they also provide cover for bass. Cooper and Crowder (1979) stated that “reducing structural complexity may remove prey refuges and subject the remaining prey to high risk until they are decimated.” Docks, piles, and bulkheads are relatively simple structural elements compared with rootwads and trees with branches, and other forms of natural cover found along undisturbed shorelines.

Sustainable predator-prey interactions in general require the existence of prey refuge to prevent the extermination of the prey organism. Numerous studies have reported increased use of complex cover (e.g., aquatic vegetation, woody debris, substrate interstices, and undercut banks) by prey fishes in the presence of predators, and reduced foraging efficiency of predators due to habitat complexity (e.g., Bugert and Bjornn 1991; Persson and Eklov 1995; Werner and Hall 1988; Tabor and Wurtsbaugh 1991; Wood and Hand 1985). Savino and Stein (1989) demonstrated that refuge is critical for prey fish survival; their study found that largemouth bass captured all prey fish that strayed from areas with aquatic vegetation into open water. Bass also eliminated all prey fish from pools that provided no refuge in a study by Schlosser (1987), while predator and prey were able to coexist in pools with complex cover. Hixon and Beets (1993) provided evidence of the value of complexity in a study of marine reef fish; prey fish were most abundant on reefs where refuge size closely matched the body size of the prey species, and where the number of refuge holes was not limiting. Lynch and Johnson (1989) showed similar results for juvenile bluegill (*Lepomis macrochirus*) in fresh water. Gotceitas and Colgan (1989) found that prey fish in fresh water preferentially selected refuge habitat with greater complexity than was necessary to significantly reduce foraging success of predators. Helfman (1979) suggested that the utilization of small floating objects on bright days by prey fish was related to the visual advantage the prey fish gained by being shaded over a predator approaching from the brightly lit surrounding area.

Shallow water functions as a refuge from predation for small fish, especially in the absence of complex habitat features such as woody debris or submerged vegetation. In
Schlosser’s study (1987), bass eliminated prey fish from structurally simple pools either by direct consumption, or by forcing the prey fish into shallow-water habitats, thus subjecting prey fish to potentially decreased feeding opportunities. Bass predation also excluded grazing minnows from all but the shallow sections of pools in Oklahoma streams studied by Power et al. (1985). Ruiz et al. (1993) reported that mummichogs (*Fundulus heteroclitus*) (<51 mm) in a subestuary of Chesapeake Bay preferentially occupied shallow water (<35 cm) in the absence of submerged aquatic vegetation. Collins et al. (1995a) found that feeding rates by small fish (<100 mm) in two Ontario shield lakes were 10 times higher in shallow water (<20 cm) than in the rest of the littoral zone. Littoral slope has been negatively correlated with fish numbers and positively correlated with fish size (Randall et al. 1996). Brown (1998) observed no piscivores in “littoral fringe” (within 2.5 m of shore) transects in Lake Joseph, Ontario.

While most of the above studies on predator-prey interactions were from warmwater systems, studies of juvenile salmonid response to predators are analogous. Juvenile salmonids modify their behavior in the presence of predators by seeking or orienting to complex refuge (Gregory and Levings 1996; Reinhardt and Healey 1997), emigrating from areas with predators (Bugert and Bjornn 1991), aggregating (Tabor and Wurtsbaugh 1991), and adopting diel vertical migrations (Eggers 1978). The response of juvenile salmonids to predators increases with experience (Healey and Reinhardt 1995) and body size (Reinhardt and Healey 1997). Behavioral responses can be influenced by environmental factors such as visibility. Turbidity reduces predator-avoidance behavior in salmonids (Gregory and Levings 1996; Gregory 1993), and reduces prey mortality rates by reducing the prey-encounter rates of predators (Ginetz and Larkin 1976; Gregory and Levings 1998; Beauchamp et al. 1999). Salmonid predators also modify their behaviors in response to habitat complexity. Piscivorous brook trout in Quebec lakes switched foraging tactics from active cruising to ambushimg when prey refuges were present (East and Magnan 1991).

Simplification of shoreline habitat, reducing the availability of prey refuge-habitat, should be avoided. Predator-prey interactions modify the behavior of both predator and prey species. Prey refuges are essential for the continued existence of vulnerable prey species. Complex habitat features that exclude predators, physically or through risk-aversion, can function as prey refuge. Examples of effective prey refuge may include shallow water, complex substrate, aquatic and emergent vegetation, overhanging terrestrial vegetation, undercut banks, and woody debris. Efforts to restore habitat function along lakeshores should be encouraged.

**Shorezone Structures**

Separating the effects of shorezone structures on juvenile salmon into discussions of the effects of individual structures in isolation may not yield the most appropriate conclusions since development seldom occurs as an isolated structure. The effects of shoreline development in its entirety should also be included in the discussion. Jennings et al. (1999) stated that “fish do not respond to shoreline structures: rather, they respond to a suite of habitat characteristics that are the result of the structure, changes to the riparian zone associated with its placement (vegetation and woody
structure removal), and often, intensive riparian zone management that occurs on developed properties.” Brazner (1997) found that sites adjacent to human development in Green Bay, Lake Michigan had fewer fish and species, and had more disturbance-tolerant fish assemblages. Fish species richness and abundance were highest in undeveloped wetland habitats (Brazner 1997). Species richness and total fish abundance were less at developed sites than at undeveloped sites in the littoral zone of Spirit Lake, Iowa (Bryan and Scarnecchia 1992). Poe et al. (1986) found that an undeveloped bay was characterized by a percid-cyprinid-cyprinodontid assemblage, while a developed bay (bulkheaded shoreline, frequent dredging, low macrophyte species richness, reduced water quality) was dominated by a centrarchid (bass, sunfish) assemblage. Both Poe et al. (1999) and (Bryan and Scarnecchia 1992) found that fish species richness was positively correlated with macrophyte species richness. Lange (1999) provided evidence that residential shoreline development is “a likely agent in causing system-wide disruption to fish....” Sites with combinations of development structures (i.e., dock and bank stabilization) had low fish abundance and richness (Lange 1999). Lange (1999) generally concluded that the results of cluster analysis indicated that “sites associated with high occurrence of all forms of development and low occurrence of vegetation, tended to have the lowest total abundance and species richness, regardless of observational scale.” Both Jennings et al. (1999) and Lange (1999) found that the scale of one’s observations affects conclusions, and the cumulative impacts of multiple development features may be substantial. With at least 81 percent of Lake Washington shoreline bulkheaded and at least 2.5 percent and 4 percent of the shallow-water habitat covered with residential piers in Lakes Sammamish and Washington, respectively, the potential for cumulative adverse impacts is significant.

It is within this context - that shoreline development in general degrades aquatic communities - that we examine the effects of individual structure types on those communities. Individual structure types often occur together, confounding inference about their respective impacts. Additionally, the extrapolation of results among systems can be uncertain due to the physical and biological differences between systems. However, a negative response to human disturbance and habitat alteration is consistent among diverse aquatic/marine communities.

Piers

As discussed above, bass utilize structural features (natural or artificial) for both foraging and spawning. Christensen et al. (1996) found a significantly negative correlation of lakeshore development with CWD in 16 lakes in northern Wisconsin and upper Michigan. Qualitative observations in Lake Washington indicate that little woody debris can be found along developed sections of the shoreline. Piers provide alternative sources of shade, overhead cover, and in-water structure (piles and boatlifts) that bass could utilize for foraging and spawning, in the absence of natural features. Observations by Stein (1970) and Pflug (1981) in Lakes Washington and Sammamish respectively, indicate that bass do occasionally occupy piers.
Freshwater: As expected, the literature review did not produce any studies of the relationship between piers and bass predation on juvenile salmonids. Studies from freshwater systems also lacked evidence for predator aggregations associated with piers. A study in Lake Washington found no significant differences in catch-per-unit-effort of any fish species between under-pier and control sites, but few bass were captured (White 1975). However, evidence for the use of piers by bass in Lakes Washington and Sammamish was located. Stein (1970) reported that largemouth bass were commonly found under piers in Lake Washington during the spring, but considered natural cover to be their preferred habitat. Unpublished results of a study by the Muckleshoot Indian Tribe in Lake Sammamish indicated that smallmouth bass were preferentially locating nests proximate to residential piers (Mudge, pers. comm., 13 April 2000). Although residential piers only covered approximately 13 percent of the nearshore zone (0-20 m from shore), 32 percent of the smallmouth bass nests were within 2 meters of piers, and 54 percent were within 2 meters of a pier or other artificial structure (i.e., isolated piles, water pipes, boat launch rails, tires, rebar) (Malcom, pers. comm., 13 April 2000). Shade was apparently not a critical attraction feature of piers for spawning smallmouth bass; instead, the attraction was to physical structure provided by piers, further evidenced by the location of nests adjacent to non-shading structures such as isolated piles (Malcom, pers. comm., 13 April 2000). This finding does not indicate that shade was unimportant to foraging smallmouth bass, only that bass were not preferentially locating nest sites in shady locations. The findings of Malcom (pers. comm., 13 April 2000) corroborate the findings of Vogele and Rainwater (1975), who also found that smallmouth bass nests were not closely associated with sheltered habitat in Bull Shoals Reservoir. The majority of smallmouth bass nests were beside submerged stumps in gravel and rubble substrates, while largemouth bass nests were either under artificial brush shelters or adjacent to a submerged log, rock, or tree base (Vogele and Rainwater 1975).

Additional evidence for a connection between bass and piers comes from unpublished data. WDFW personnel electrofishing for bass in 50 to 70 local (western Washington) lakes observed that bass were more often associated with natural structures such as brush piles, beaver lodges, and overhanging willows and, to a lesser degree, were found under docks or adjacent to piles, but empirical evidence to support these observations was not collected (Bonar, pers. comm., 13 June 2000). Qualitative observations by Bonar (pers. comm., 13 June 2000) suggest that structures concentrate bass in lakes where structure is limiting. One-third of the largemouth bass in Lake Baldwin, Florida showed a significant preference for piers in the absence of aquatic vegetation (Colle et al. 1989).

Two studies (that did not include bass) of freshwater fish use of piers did not find evidence of predator aggregation. Ward et al. (1994) did not find a relationship between shoreline development (including piers) and northern pikeminnow predation on outmigrating chinook and steelhead in the lower Willamette River, Oregon. Northern pikeminnow were more abundant along undeveloped than developed reaches of the lower Willamette River (Ward et al. 1994). In a study in Lake Tahoe by Beauchamp et al. (1994), day and night patterns in fish density and species composition were similar.
between docks and open shoreline. Neither of these studies specifically investigated the relationship between piers and bass or cutthroat predation on salmonids.

**Marine or Estuarine:** Several studies from East Coast estuarine systems provided contradictory results that may reflect differences in systems and study designs. Low fish abundance and species richness under piers compared with pile field and open-water sites (Able et al. 1998), and low fish growth rates under piers compared with pier edges and open-water (Duffy-Anderson and Able 1999) have been reported in the Hudson River estuary. Conversely, in the Rhode River estuary, Toft et al. (1995) reported significantly greater abundance of several fish species under piers than 10 meters away. Local studies of estuarine systems that included salmonids were more consistent, indicating that juvenile salmonids forage under piers, and that predator aggregations were not observed. Ratté (1985) reported that juvenile chinook and coho salmon foraged under a large commercial pier in the Commencement Bay estuary, Washington, and that no aggregations of predators or selective predation on salmonids was observed. Juvenile chum and pink salmon were attracted to a large pier complex (submarine berth) during daylight at the U.S. Navy Bangor submarine base on Hood Canal, but aggregations of predators were not observed (Prinslow et al. 1979 and 1980). Findings from marine and estuarine systems should be considered to be the least applicable to the Lake Washington system.

**Rock Crib Structures:** Several studies have examined the effects of shoreline development in general on various indices of fish community structure (e.g., Poe et al. 1986; Brown 1998; Lange 1999; Jennings et al. 1999). Of these studies, Brown (1998) and Lange (1999), while examining the effects of shoreline development in general, included analysis of fish response to moorage structures in Lake Joseph and Lake Simcoe, Ontario, respectively. The moorage structures in these Ontario lakes differ somewhat from the typical structures found in local lakes. The majority of the moorage structures on Lake Washington are piers supported by piles (typically wood piles, 20-30 cm in diameter). The majority (> 85%) of the structures in Brown’s (1998) study on Lake Joseph were crib structures, that is docks or boathouses supported by log cribs filled with boulders; only 8 percent were piers supported by piles. While not a typical design for residential piers in Lake Washington, these types of structures are common in the Ship Canal. Lange (1999) examined fish response to a variety of structure types at three different scales in Lake Simcoe, differentiating between structures supported by piles ("temporary docks") or cribs ("permanent docks"). Significant negative effects of temporary docks (most similar to our local piers) on fish richness or abundance in Lake Simcoe were not observed at any scale (Lange 1999). Crib-supported docks did have a significant positive effect on fish abundance at the two largest scales (244 m, 488 m), but not at the smallest scale (122 m) (Lange 1999). Brown (1998) also found that crib structures increased densities of forage fish (< 100 mm) in the littoral fringe on exposed shorelines or in areas where CWD had been removed. Brown (1998) speculated that interstitial spaces within crib structures provided refuge from waves and predation for small fish along exposed shorelines. In Lake Tahoe, up to ten-fold higher densities and a greater diversity of small fishes were associated with rock-crib structures, whereas fish assemblages around pile piers did not differ from paired adjacent areas without shorezone structures (Beauchamp et al. 1994); however, bass and other centrarchids
were absent from the main basin of Lake Tahoe at the time of this study. Brown (1998) observed (qualitatively) large numbers of piscivores beyond the littoral fringe around crib structures in Lake Joseph, and suggested that their presence was a response to the abundance of forage fish.

Conclusions: These findings, when considered with existing knowledge of bass ecology, suggest that bass prefer natural cover for foraging, and preferentially site nests adjacent to structures, but bass utilize piers, piles, and other artificial structures for foraging and nesting in lieu of natural cover or structure. Piers and piles differ from natural cover/structure elements such as brush piles, primarily in their lack of structural complexity. This difference is critical for prey fish, which rely on structural complexity for survival in the presence of predators, particularly mobile predators such as cutthroat trout. In developed lakes, piers become the dominant structural features at the expense of natural complex structures such as woody debris and emergent vegetation. That bass and other predators gain an advantage over prey fish in structurally simple environments is substantiated by findings that bass (especially smallmouth bass) persist or thrive along developed shorelines, while other species decline (Brown 1998; Bryan and Scarnecchia 1992; Poe et al. 1986; Lange 1999). Recognition of this advantage to bass and other predators necessitates a cautious scrutiny of proposed new and modified piers while awaiting results from the direct studies on the relationship between piers and other shorezone structures, and bass predation on salmonids that are currently underway (i.e., the studies of Roger Tabor, USFWS; Kurt Fresh, WDFW; Rod Malcom and Eric Warner, Muckleshoot Tribal Fisheries). Regardless of the development proposal, any project that would potentially reduce the structural complexity of the shorezone should be considered likely to adversely affect ESA-listed salmonids. New piers should also be considered as new, structurally simple habitat elements that provide cover and structure to spawning and foraging bass, and perhaps other predators. Replacement piers and pier modifications should be viewed by regulatory agencies as opportunities to regain some habitat function and minimize overwater coverage (see “Productivity” section below).

It is useful to ask what features of piers make them attractive to bass in the lacustrine environment. Male bass preferentially locate nests adjacent to structural features such as rocks or logs, apparently to reduce the perimeter that must be guarded or to provide visual isolation from nearby conspecifics (Heidinger 1975). Thus, for spawning bass, pier elements that protrude from the substrate (i.e., piles, boatlifts, etc.) may be attractive. The initial data suggests that this is the case for smallmouth bass (Malcom, pers. comm., 13 April 2000). The structure provided by piers and boatlifts may potentially increase spawning habitat and/or reproductive success of bass.

It is less clear what pier features primarily attract foraging bass: shade, overhead structure independent of shade, vertical structural elements, or a combination of features. The finding that largemouth bass were more likely to hover under large swimming floats than small study floats, and that fish were generally not observed under “sham” floats consisting of wood frames only, suggests that shading may be key, and that the dimensions of the area shaded may also be important (Helfman 1979). Anecdotal evidence from anglers supports the hypothesis of the importance of the
dimensions of the overwater area, as fishing efforts are directed at the portions of piers with the most surface area (broad ells). Despite circumstantial evidence and an intuitive connection, direct evidence for a correlation between pier shade-production and bass occupation was not located in the course of this review. The circumstantial evidence does indicate a need for both further study and critical appraisal of pier design in the interim. Studies investigating the effects of light-transmitting devices (prisms, grating) on bass use of piers would also be useful. Prisms are currently being mandated as mitigation for overwater coverage by several municipalities on Lake Washington and Lake Sammamish. However, their ability to reduce bass attraction to piers has not been proven, despite their ability to transmit ambient light.

One additional note on piers in Lake Washington is the prevalence of illegal lake-water withdrawals. Many waterfront property owners have illegal pump systems for withdrawing water from Lake Washington. This may be a critical source of water loss during the dry season, and could ultimately affect fish passage at the Ballard locks.

**Bulkheads**

Studies of the relationship between shoreline armoring and predation on juvenile chinook or coho salmon in Lake Washington and Lake Sammamish were not found. Cautious conclusions about the effects of shoreline armoring on predation can be drawn from studies of predator-prey interactions and the habitat use by small non-salmonids in other north-temperate lakes, and studies of salmonid habitat use in large rivers and reservoirs. While no direct links were identified between predation and bulkheads, an intuitive connection exists between the loss of complex, shallow-water foraging habitat for juvenile salmonids and an increased exposure to potential predation. Bulkheads could directly affect predation on juvenile salmonids by eliminating shallow-water refuge habitat or, indirectly, by the elimination of shoreline vegetation and in-water woody debris that generally accompanies bulkhead construction. The importance of shallow-water refuge habitat and complex habitat features to small fish has been discussed above. Juvenile fall chinook salmon in the Columbia and Snake Rivers and (preliminary results suggest) Lake Washington have demonstrated a preference for shallow, low-angle shorelines, although the motivation for this observed preference has not been fully investigated (Key et al. 1994a and 1994b; Garland and Tiffan 1999; Tabor, pers. comm., 9 June 2000). Placing bulkheads waterward of ordinary high water (OHW) eliminates the shallow water identified by Collins et al. (1995b) as critical for foraging, refuge, and migration of small fish (< 100 mm). The simplification of the shoreline (i.e., removal of CWD and shoreline vegetation) that typically accompanies bulkhead construction (Christensen et al. 1996) further reduces refuge habitat. Lange (1999) found that bank stabilization (i.e., various forms of erosion control structures referred to as “bulkheads”) was negatively correlated to fish abundance and species richness at all spatial scales investigated in Lake Simcoe, Ontario.

The finding that both fish species richness and abundance were negatively correlated with bulkheads at every scale (Lange 1999) indicates that fish in Lake Simcoe generally avoid bulkheads. Juvenile fall chinook in the Columbia and Snake Rivers were found to avoid riprap shorelines (Key et al. 1994a and 1994b; Garland and Tiffan 1999). Young-
of-year bass in Lake Joseph, Ontario, did not exhibit a preference for spatially complex habitat in Brown’s (1998) study, and may represent an exception to the avoidance theory. Jennings et al. (1999) found that species richness was greater along riprap bulkheads than smooth vertical bulkheads in 17 Wisconsin lakes. Riprapped shorelines in the study by Jennings et al. (1999) also had greater species richness than unarmored shorelines (does not imply natural, only the lack of armoring structure), but they cautioned that the findings were an artifact of the scale of the investigation, the heterogeneity of the unarmored sites, and the increased effort required to obtain estimates of species richness at unarmored sites. Converting lakes entirely to riprapped shoreline would ultimately reduce species richness at the lake scale, but in situations where hard shoreline armoring is necessary, riprap would be preferred over vertical walls for fish habitat (Jennings et al. 1999) (the specifications of the various shorelines compared by Jennings et al. 1999 are available in a report that was not obtained for this review - Jennings et al. 1996). However, Jennings et al. (1999) were not considering a situation where an endangered species could be potentially jeopardized by the shoreline protection method. Riprap may provide greater habitat heterogeneity and ultimately greater species richness than smooth vertical bulkheads, but the effects of habitat heterogeneity on predation were not investigated.

The use of riprap shoreline protection in Lake Washington could provide concealment habitat to the most abundant native piscivores - cottids. Tabor et al. (1998) reported predation on salmonid juveniles by sculpins greater than or equal to 50 mm in length. Few such sculpin were found over sand/mud substrates relative to gravel/cobble substrates in Lake Washington, due to the lack of refuge habitat in sand/mud substrate (Tabor et al. 1998). In Lake Washington and the Cedar River, cottid size was generally positively correlated with substrate size, and riprap shorelines had large cottids relative to sites with smaller substrate particles (Tabor et al. 1998). Bulkheads in Lakes Washington and Sammamish are typically nearly vertical, and constructed of large boulders with large interstitial spaces. The large interstitial spaces found within riprap shorelines provide concealment to abundant, large native cottids.

In summary, bulkheads eliminate shallow-water habitat and complex habitat features that may function as critical prey-refuge for juvenile chinook and coho salmon. Bulkheads have been shown to reduce the diversity and abundance of all fish species except smallmouth bass in other north-temperate lakes. Riprap bulkheads, which provide interstitial spaces that can be utilized by a variety of invertebrate and fish species, may provide refuge habitat for piscivorous sculpin, while also eliminating the shallow water refuge for juvenile salmonids. No evidence was found for positive effects of shoreline armoring on aquatic species.

Lighting

Studies of the effect of pier lighting, on predation of juvenile salmonids in lakes were not found in the course of this review. Western grebes have been observed foraging at night around artificial lights in Lake Washington (Tabor, pers. comm., 9 June 2000). Grebes, blue herons, and other birds have been observed feeding at night on the Cedar delta in the portion that is lit up by The Boeing Company lights (Warner, pers. comm., 7
Prey behavior can influence light-mediated predation rates by both increasing exposure to predators by slowing migration rates through rivers, and reducing capture efficiency by increasing avoidance behavior. In freshwater laboratory experiments, Tabor et al. (1998) found that prickly and torrent sculpin were capable of preying on sockeye fry in complete darkness, but predation rate declined with increasing light intensity. An increase in predator avoidance ability by sockeye fry with increasing light intensity may explain this inverse relationship (Tabor et al. 1998). Petersen and Gadomski (1994) observed a similar relationship (decreasing predation rate with increasing light intensity) between northern squawfish (northern pikeminnow) and juvenile chinook salmon, and offered the same explanation, as did Howick and O’Brien (1983) for bass-bluegill interactions and Mazur (Univ. of Washington, unpubl. data) for juvenile trout responding to lake trout. Alteration (slowing) of migratory behavior and subsequent increased sculpin predation rates on sockeye fry with increasing light intensity were observed in simulated stream experiments (Tabor et al. 1998).

The nocturnal behavior of juvenile chinook and coho and their predators in Lake Washington and Lake Sammamish, and their response to lighting is poorly understood. Chinook fry have been observed primarily resting on the bottom during night snorkel surveys in Lake Washington (Tabor, pers. comm., 11 July 2000). Reimers (1971) observed that juvenile chinook delayed downstream migration until the darkest part of the night in the Sixes River, Oregon, a result similar to the delay in sockeye migration with increasing light observed by Tabor et al. (1998) in the Cedar River. Key et al. (1994b) found that few juvenile fall chinook were caught during night sampling (relative to diurnal catches) in McNary Reservoir, and proposed that the fish were inactive during night seining. Studies of whether or not chinook or coho juveniles exhibit nocturnal inactivity in Lake Washington were not located. It is possible that the artificial ambient lighting regime in the urbanized basin of Lake Washington may produce uncharacteristic behavior in both juvenile salmonids and their predators. Until more information is available, one should not assume that lighting of overwater or shoreline structures does not affect predator-prey interactions.

Studies from a marine system indicated that wharf lighting could attract juvenile chum and pink salmon (Salo et al. 1977; Prinslow et al. 1979; Prinslow et al. 1980). Significant predation on juvenile chum salmon was not observed in the area of a lighted wharf in Hood Canal, Washington (Prinslow et al. 1980). Whether the behavior of juvenile chinook and coho salmon and their predators in freshwater would behave similarly to chum and pink salmon and their predators in the marine environment remains uncertain and should not be assumed.

Effects on Productivity

Light Intensity and Primary Production

Studies from Lake Washington: Overwater structures reduce the amount of light available to phytoplankton and aquatic macrophytes, which can ultimately reduce primary production. White (1975) compared light intensity and primary
production/biomass ratios of phytoplankton at sampling stations under overwater structures, and at control stations outside of overwater structures in Lake Washington. As expected, light intensity was higher at all control stations compared with intensities measured under overwater structures. Surface light intensities at open water stations on sunny days inhibited phytoplankton production in the upper 60 cm of the water column. Production/biomass ratios measured at stations outside of piers reached maximum levels at depths from 1 to 2 meters. Surface phytoplankton production/biomass ratios under narrow residential piers or at the edge of large overwater structures exceeded those measured at open water stations due to the reduction in surface light intensity. However, phytoplankton production/biomass ratios from outside stations exceeded those from under-pier stations from a depth of about 60 cm to the maximum depth measured. White (1975) suggested that, while narrow residential piers do not significantly reduce surface phytoplankton production, the reduction is inversely proportional to shading, as illustrated by the low production/biomass ratios observed under a residential pier with skirting, a boathouse, and an overwater apartment complex.

White (1975) did not comment on the reduced production/biomass ratios of shaded sites at depth, compared to open-water control sites, nor did he measure periphyton or macrophyte abundance and production under and outside of overwater structures. The reduced light intensity observed under all overwater structures when compared with open-water control sites, resulted in reduced total water-column phytoplankton production/biomass ratios, and likely reduced periphyton and macrophyte production as well. White (1975) did not attempt to measure the cumulative loss in primary productivity that would ultimately result from the collective overwater coverage of numerous residential and commercial structures. While the loss in productivity from a single, narrow, residential structure may be insignificant, the cumulative impact of thousands of narrow piers is likely to be a significant reduction in primary productivity.

A comparison of the benthic invertebrates under, and outside of, overwater structures in Lake Washington revealed complex patterns of abundance and/or distribution in the benthic community, with some organisms more abundant under, than outside of, piers in spring and less abundant in fall (White 1975). Possible explanations for the observed patterns include variations in phototaxis with life-history stage and differences in forage availability during fall and spring (White 1975). Macrophytes were absent or sparse under piers; grazing invertebrates would be found outside piers where macrophytes were abundant in the fall, but under piers, where they could graze on periphyton, in the spring when macrophytes were sparse (White 1975).

Studies from other systems: Loflin (1995) reported that docks in two Florida marine locations produced distinct areas in their shadow that were nearly devoid of seagrass, and that were significantly correlated with total dock surface area. Shading from docks also produced changes in seagrass species composition and reduced epiphytic loading on grass blades (Loflin 1995). The percent cover of epifauna on primary kelp blades was less under piers than on perimeter piles at a marine site in Portsea, Australia (Fletcher and Day 1983). Shaded piles in Sydney, Australia had different epibiotic assemblages than unshaded piles or adjacent rocky reefs (Glasby 1999a; 1999b).
Epibiotic assemblages on unshaded piles were composed of filamentous and foliose algae (primary producers), while communities on shaded piles were composed of filter feeders (Glasby 1999b).

At a Long Island Sound location, Iannuzzi et al. (1996) predicted that construction of an 800-slip marina would reduce macroalgal production by 17%, but that reduction would be compensated for by microalgal production on the hard attachment surfaces of the marina. The Long Island Sound site was a high-energy marine system with radical changes in energy, sediment composition, and turbidity expected to result from construction of the marina (Iannuzzi et al. 1996). The references from this and the preceding paragraph were studies of marine systems. Extrapolating their results to freshwater systems may not be entirely appropriate. However, the responses of macro- and microalgae to reductions in light intensity resulting from overwater structures would be expected to be similar among systems.

Another expected effect of shoreline structures includes the loss of allochthonous nutrient input resulting from the removal of shoreline vegetation. France and Peters (1995) estimated the annual litter input to a northern Ontario lake from 1 m of forested shoreline to be 32-g dry weight. Allochthonous litter input per unit offshore distance was related to the size of riparian trees, their proximity to the shoreline, and the elevation of their canopy (France and Peters 1995). Riparian deforestation resulted in annual reductions of up to 17.8 g of dissolved organic carbon and 2.9 g of total phosphorous per meter of shoreline in oligotrophic Canadian shield lakes, reducing primary production by up to 9 percent (France et al. 1996). The implications are less serious for mesotrophic urban lakes where increased phosphorous loading is problematic. However, Eggers et al. (1978) concluded that the littoral benthic community in Lake Washington was resource limited. Increasing allochthonous litter input from shoreline vegetation on Lakes Washington and Sammamish could increase forage for juvenile salmonids and the forage fish of bull trout in the littoral zones. The permanent removal of shoreline vegetation for bulkhead construction, and for unobstructed views may affect the forage base of ESA-listed salmonids by reducing allochthonous input to the littoral zone. An incidental effect of shoreline vegetation removal is likely to be an increase in diel temperature fluctuation in the littoral zone due to loss of shade (Steedman et al. 1998), especially in littoral areas that have been isolated from the main water mass by artificial structures.

In summary: Evidence from Lake Washington indicates that single narrow residential piers do not significantly reduce surface planktonic primary productivity, but the productivity losses below 60 cm, and from reduced macrophyte productivity were not investigated. Cumulative reductions in primary productivity resulting from numerous overwater structures were not measured, but could be substantial. Comparisons of benthic primary production (epiphytes) in Lake Washington were not made. The effects of overwater structures on invertebrate production in Lake Washington have not been conclusively established. Evidence from marine systems indicated that epibiotic assemblages are affected by shade, with primary producers being replaced by consumers. Removal of shoreline vegetation could reduce allochthonous input of nutrients.
While the deck prisms mentioned above that are being mandated by some municipalities as mitigation for overwater coverage have not been tested for efficacy at reducing bass attraction to piers, they do transmit ambient light. Thus, they may be useful for retrofitting existing piers to restore the primary productivity loss from those structures.

**Aquatic Vegetation Control**

Control of “nuisance” aquatic macrophytes by lakeshore property owners is another potential source of lost productivity. Aside from the importance of macrophytes in primary production, numerous studies have indicated the importance of littoral vegetation for increased fish production (e.g., Randall et al. 1996). The most significant effect on fish of development of the shoreline of an Iowa lake was the removal of aquatic macrophytes by lakeshore residents (Bryan and Scarnecchia 1992). Methods for vegetation control include active harvesting, chemical controls, and covering of the substrate with materials that block vegetation growth. Engel (1984) compared removable and non-removable materials for aquatic vegetation control, and concluded that even removable screens with large pore sizes nearly eliminated benthic invertebrates. Despite the generally undesirable effects of macrophyte removal, there are situations where the reduction of aquatic macrophytes may benefit fish. Dissolved oxygen (DO) levels under dense patches of Eurasian milfoil and fragrant white water lily (*Nymphaea odorata*) were lethal to caged steelhead trout in Lake Washington in a study by Frodge et al. (1995). Native species of aquatic macrophytes found in Lake Washington typically do not form large monotypic stands with dense surface mats such as those found to reduce DO concentrations (Frodge, pers. comm., 10 July 2000).

**Physical Effects**

*Lake Washington:* The physical effects of bulkheads on benthic organisms are expected to depend upon both the designs of bulkheads and the material from which bulkheads are constructed. White (1975) compared benthic invertebrate abundance at various depths in front of bulkheaded shorelines, developed shorelines without bulkheads, and along natural shorelines in Lake Washington. White’s (1975) results were inconclusive, indicating no clear trends in invertebrate abundance. However, White (1975) did not report the position relative to OHW of the bulkheads in his study, nor did he measure invertebrate abundance immediately waterward (at the toe) of bulkheads.

Results from White’s (1979) study provide inconclusive evidence for an adverse affect of bulkheads on the benthic community within local lakes. Smooth vertical structures would be expected to reflect wave energy in a non-random manner. Complex non-vertical bulkheads, such as those constructed of boulders, would be expected to reflect wave energy in a random manner. Reflected wave energy would produce a chaotic, high-energy environment for epibenthic and infaunal invertebrates within a zone adjacent to the bulkhead. The benthic community within this zone would be expected to have lower invertebrate abundance, richness, and diversity than lower energy zones.
**Estuarine Systems:** Only one study was obtained that specifically examined the effects of shoreline armoring on infaunal organisms, and the study system was an estuary with a sand beach. Spalding (1998) concluded that sediments were finer and better sorted immediately adjacent to bulkheads than at similar elevations at control sites, and that meiofauna densities increased with distance from bulkheads in a New Jersey estuary. Bulkheads had the greatest influence on sediment characteristics and meiofaunal densities when located waterward of wavebreak, or when subjected to high wave energy (Spalding 1998). Spalding’s (1998) study was of sandy estuarine beaches with tidal influences - drastically different from the typical beaches in local lakes; she was also sampling organisms within the swash zone of the beach. Thus, Spalding’s (1998) results may have limited applicability to our local lakeshores. However, the findings of Spalding’s (1998) study should not be ignored. Chironomid larvae are the primary prey items for juvenile chinook and coho salmon, and could be adversely affected by bulkhead-induced changes in sediment composition. A lack of affect of bulkheads on infaunal organisms should not be concluded without further investigation. Byrne (1995) described a year-long study designed to test whether there was a difference in the species composition and abundance of macroinvertebrates and fish inhabiting bulkheaded and non-bulkheaded shore zones in a manmade estuarine lagoon. Results from Byrne’s (1995) study could not be obtained, only a summary of the study design.

A comparison of the macroinvertebrate community structure on rip-rap bulkheads and smooth retaining walls was conducted using simulated rip-rap and patio blocks of similar surface area placed along three different shorelines (rip-rap, vertical retaining wall, and natural shoreline) in three Wisconsin lakes (Schmude et al. 1998). As expected, the complex artificial substrate had significantly greater abundance and taxa richness of macroinvertebrates than the two-dimensional patio blocks, but no significant differences in abundance or richness were observed among shoreline types.

In summary, only one study investigating the effects of shoreline armoring on benthic organisms in freshwater was located, and it did not provide conclusive evidence for an adverse affect. The findings of Spalding (1998) indicating a change in sediment composition and meiofauna density in front of bulkheads along sandy estuarine shorelines imply that bulkheads could adversely affect benthic organisms in freshwater lakes, and that further investigation is necessary.

**Effects on Fish Migration**

There is concern that bulkheads and piers may interrupt the migration of juvenile salmonids along the shorelines of Tri-County lakes. No studies investigating the migration of chinook and coho salmon along armored shorelines or under piers in lakes were located during this review. Chinook fry in Lake Washington appear to avoid riprap and cobble shorelines (Tabor, pers. comm., 9 June 2000). Studies of juvenile fall chinook in the Columbia and Snake Rivers found that they avoid riprap shorelines (Key et al. 1994a and 1994b; Garland and Tiffan 1999). Studies of non-salmonids in other north-temperate lakes were located. Collins et al. (1995b) observed that daytime small fish (<100 mm) traffic in the shallow "fringe zone" along natural shorelines in three Ontario lakes was 2.5 times higher than along shorelines with manicured lawns. The
shorelines with manicured lawns in Collins’ (1995b) study were not bulkheaded, but did have characteristics typical of bulkheaded shorelines - no overhanging vegetation or complex woody debris. Juvenile salmonids and small fish in general may be reluctant to traverse shoreline habitat that does not provide prey refuge in some form (i.e., shallow water, overhead cover, and complex structure). Jennings et al. (1999) found that vertical bulkheads had the greatest average water depth compared with riprap and unarmored shorelines in Wisconsin lakes. Vertical, smooth bulkheads in deep water without overhanging vegetation would represent the least favorable passage and forage conditions.

Studies from marine/estuarine systems have concentrated on the effects of marinas. Concerns about juvenile salmonids and baitfish entrapment, and subsequent increased predation were unconfirmed; schooling of juvenile salmonids in marinas appeared to be volitional, and the primary concern was water quality related to poor marina design (Cardwell and Koons 1981). Taylor and Willey (1997) found no evidence for disrupted migration of juvenile chinook or coho salmon, or increased predation in an Elliott Bay marina, but theirs was an observational study only, not a controlled study. Heiser and Finn (1970), in a qualitative study, observed that juvenile pink and chum salmon were reluctant to migrate past a vertical or near-vertical bulkhead, but that riprap bulkheads with an approximately 45° slope did not hinder passage. The critical differences identified by Heiser and Finn (1970) between the vertical bulkheads and riprap bulkheads were that the vertical structures lacked complex refuge and shallow water, features preferred by migrating juvenile pink and chum salmon. These observations may not apply to freshwater lakes. Bulkheads in Lakes Washington and Sammamish are typically nearly vertical and constructed of large boulders, unlike the riprap bulkheads in Heiser and Finns’ (1970) report.

Piers did not affect migration of sub-yearling or yearling chinook migrating through the lower Willamette River in Oregon (Ward et al. 1994). The only indication of an influence on behavior was that sub-yearling chinook were found uncharacteristically close to shore in shallow water around a wharf with closely-spaced piles that created a large backwater with a soft bottom (Ward et al. 1994). The chinook in the Ward et al. (1994) study may have been responding more to the velocity refuge provided by the piles than other factors; velocity refuge would not be a factor in the lacustrine environment. Ratté (1985) observed no reluctance in juvenile chinook or coho to swim under large commercial piers in Commencement Bay, Washington. Outmigrating pink and chum salmon in Hood Canal were attracted to the explosives-handling wharf at the U.S. Navy’s Bangor submarine base, but migration was not significantly delayed (Prinslow et al. 1979; Prinslow et al. 1980). Overall, none of these studies provided evidence for a delay in migration caused by piers in riverine or estuarine systems. No studies of the effects of piers on salmonid migrations in lakes were identified.

Summary: No studies were located that specifically investigated the effects of piers and armored shorelines on the migration of juvenile chinook and coho salmon along lakeshores. Evidence from the Columbia and Snake Rivers indicates that juvenile chinook avoid riprap shorelines, and studies from north-temperate lakes in Ontario indicate that small non-salmonids are less likely to traverse structurally simple
shorelines than naturally complex shorelines. Collectively, these studies indicate that concern over a migrational disruption caused by bulkheads in lakes is warranted. Information about pier-related migrational disruptions in lakes was not obtained. The question remains whether juvenile salmonids in lakes migrate under, or otherwise utilize, piers, or if they avoid them and/or traverse their perimeter.

**Effects of Recreational and Construction Activity**

**Construction Activity**

The activities necessary for construction of shorezone structures can have direct impacts on ESA-listed salmonids. As enumerated above, the primary impacts of construction activities considered by NMFS, aside from the actual crushing of individual fish, are turbidity produced during pile driving and bulkhead construction/removal, and the effects of shock waves produced by pile driving. Numerous studies have documented the detrimental affects of chronic exposure of salmonids to turbid water in riverine environments (e.g., Sigler et al. 1984). Physiological effects are only apparent after prolonged exposure (3-5 days in the case of Sigler et al. 1984), and chinook and coho juveniles will emigrate from turbid water (Scrivener 1994; Murray and Rosenau 1989; Skeesick 1970; Sigler et al. 1984). However, even low turbidity levels can produce a variety of sublethal effects (i.e., reduced survival, reduced growth, reduced food conversion, reduced feeding, altered diet, stress, disease, avoidance, displacement, altered behavior [including predator avoidance behavior]) that could ultimately reduce the fitness of the individual (reviewed in Lloyd 1987). Further, even minor increases in turbidity in a clear lake can result in significant reductions in primary productivity both through reduction in light penetration and physical coverage of the benthos (Lloyd 1987). Contractors conforming to BMPs specified by WDFW utilize floating “sedimentation control curtains” to contain turbid water, allowing turbidity to settle before removing the curtain. Turbidity from an individual construction activity would not represent a permanent sediment source and would not produce conditions of chronic exposure, but it could be acute. The possibility also exists that fish could be trapped within the sedimentation control curtain, and thus exposed to potentially lethal turbidity levels. Nevertheless, to minimize potential impacts, the Services restrict construction activity to periods when ESA-listed salmonids are least likely to inhabit the area of construction. In the case of NMFS, “allowable construction windows” for the protection of chinook have not been established.

**Pile Driving:** The expected effects of pile driving on juvenile salmonids can be generally summarized as disruptions of normal behavior. The shock waves generated by pile driving could potentially disrupt the foraging behavior of juvenile salmonids, cause them to move away from the shoreline or exhibit a startle response, or delay migratory progress. Only one published study (Feist et al. 1996) of the effects of pile driving on juvenile salmonids was located. Feist et al. (1996) studied the effects of vibratory and drop hammer pile driving on the behavior of juvenile chum and pink salmon in Puget Sound at the Everett Homeport. They determined that salmonids were capable of detecting the sound of drop-hammer pile driving at least 600 meters away, and that the sound was at least 20 dB above ambient levels at 593 meters. Data collected from the
vibratory hammer location was insufficient to allow appropriate analysis; thus, only data analysis from the drop-hammer location was reported. Juvenile pink and chum salmon did not change their distance from shore or cease foraging in response to pile driving, but there were significant differences in the distributions and sizes of fish schools, and behavior within schools on pile driving days versus non-pile-driving days. On pile driving days, there were nearly half the number of fish schools on the construction side of the site than on non-pile-driving days. One concern with pile driving is that the sound will “mask” the sound of an approaching predator, or that salmon would become habituated to the sound and fail to hear the approach of a predator. Qualitative observations indicated that fish had habituated to the sound of pile driving (Feist et al. 1996).

Caveats about the study by Feist et al. (1996) are that this was a study of pink and chum juveniles in a marine environment, not chinook juveniles in freshwater. Second, the study did not investigate the impacts of pile driving on adult salmon behavior. Third, the study investigates one site during one season, and relies predominantly on human observation in the assessment of fish behavior. The extrapolation of these results to other locations, particularly freshwater systems with different species and age classes, may not be valid. Despite these caveats, the implications are that salmonids do respond to pile driving, and until pile-driving effects on freshwater systems are investigated, regulators should assume the potential for adverse affects on ESA-listed salmonids in lakes.

Recreational Activities

The effects of recreational activities on ESA-listed salmonids are unknown. Direct effects of boating or swimming on salmonids are expected to be disruptions of salmonid behavior or physical injury due to contact with the boat or entrainment in the propulsion system. Migrating adult chinook in the ship canal have been tracked at depths as shallow as 1 meter (Warner, pers. comm., 7 July 2000), exposing them to potential boat contact. Beak Consultants Incorporated (1998) cited Weitkamp (1982) as indicating “that juvenile salmonids in marine environments near piers returned to their normal behavior immediately after a boat passed.” The implications of this statement are that juvenile salmonid behavior was temporarily disrupted by boats. However, we were unable to obtain a copy of the Weitkamp (1982) document, and thus cannot verify this implication or describe the conditions under which the potential disturbance occurred. Mosich and Arthington (1998) reviewed the impacts of power boating and water skiing on lakes and reservoirs, and identified direct boat contact and propeller action as sources of injury to aquatic organisms. In the only direct reference to salmonids, Sutherland and Ogle (1975) cited in Mosich and Arthington (1998) describe significant mortality of chinook eggs resulting from pressure fluctuations created by passing jet boats in shallow water.

Indirect effects of boating on salmonids involve adverse impacts to habitat quality. Substantiated impacts that were discussed at a workshop held at Woods Hole Oceanographic Institute in 1994 include: sediment and contaminant resuspension and resultant turbidity, laceration of aquatic vegetation with loss of faunal habitat and
substrate stability, toxic effects of chemical emissions of boat engines, increased
turbulence, shearing of plankton, shorebird disturbance, and the biological effects of
chemically treated wood used in dock and bulkhead construction (Crawford et al. 1998).
The complete proceedings of the workshop (a book) was unavailable, but the abstract
was obtained. The abstract indicated that, while the above potential impacts had been
identified, impacts remain “inadequately defined and described,” and that sufficient
evidence exists to infer that recreational boating is not an environmentally benign
activity (Crawford et al. 1998). Mosich and Arthington (1998) in their review of literature
on lakes presented a list of impacts similar to that of Crawford et al. (1998), but also
added chemical impacts from hydrocarbons, erosion of banks and destruction of
emergent vegetation, introduction of plant fragments and plankton via jet-propulsion
systems and boat propellers and trailers, and the biological impacts of sediment
resuspension and erosion (i.e., clogging of respiratory structures of fish and
invertebrates, reduced photosynthesis, increased nutrient availability). Crawford et al.
(1998) expressed concern that the potential for impacts in temperate climates was
exacerbated by the “unfortunate synchrony…between the peak season of boating and
the occurrence of planktonic embryonic and larval stages of vertebrates and
invertebrates in estuaries and coastal waters.” This same concern has application to
freshwater environments to some degree.

Bonham (1983) described the effects of boats and their wakes on river and canal
shorelines with specific attention to the effects on emergent and submergent vegetation.
Boat wakes erode shorelines and wash soil from the roots of emergent vegetation;
emergent vegetation is subsequently uprooted by the wakes (Bonham 1983). Loflin
(1995) reported scarring of seagrass flats from boat propellers. Asplund and Cook
(1999) discussed the advantages and limitations of “no-wake zones” for protecting
fragile lakeshore environments. Unfortunately, only the abstract of this document was
obtained, so further comment on Asplund and Cook’s (1999) discussion is not possible.
Mosich and Arthington (1998) indicated that boat traffic close to shore had the greatest
erosive affect. Collins et al. (1995b) found that feeding by small fish in Lake Rosseau,
Ontario was suppressed by disturbance from boat wakes.

Literature on the impacts of recreational swimming on salmonids was not obtained. As
mentioned above, the expected impact is a disruption of salmonid behavior. The rapid
movements and splashing of a recreational swimmer would be expected to disturb the
foraging behavior of salmonids to some degree. Recreational water use, including
boating and swimming (people and pets), could occur independent of the construction
and maintenance of docks and bulkheads at private residences. There is recognition
that the construction and maintenance of those structures facilitates some recreational
activities, and thus some recreational activities are an interrelated or indirect affect of
the structures.
Conclusions and Recommendations

Conclusions

As expected, analysis of the literature collected for this review has both answered questions, and revealed new questions. The following will be a summary of the findings of this review arranged in two categories: what the review tells us, and what the review does not tell us.

What the literature review tells us.

1. Most chinook salmon enter Lake Washington as fry from January through March; they are closely oriented to the shoreline during this period, preferring shallow, sandy beaches. A second wave enters the lake as smolts in May and June. Smolt outmigration peaks in May and June, but extends at least through August. The majority of coho salmon enter the lake as smolts in May and June.

2. The primary predator of juvenile salmonids in Lake Washington is cutthroat trout. Their distribution closely overlaps that of chinook fry, subjecting age-0+ chinook to cutthroat predation for the duration of their rearing and migration.

3. The distributions of bass (smallmouth and largemouth) overlap that of chinook juveniles, from April through the end of smolt outmigration.

4. The majority of known bass predation on juvenile salmonids occurs in the Ship Canal. Smallmouth bass are the primary predator, preying most heavily on chinook juveniles due to their small size relative to sockeye and coho yearlings.

5. Bass are structurally oriented for both spawning and foraging, and smallmouth bass may prefer artificial structures such as piles for nest sites. Both species will utilize artificial structures in lieu of natural structure, and piers may concentrate bass in systems that lack natural structure (such as Lakes Washington, Sammamish and Union).

6. Small prey fish (i.e., chinook and coho fry) require complex habitat such as rootwads, undercut banks, overhanging vegetation, and CWD, and also shallow water as refuge habitat from the numerous predators within the Lake Washington system.

7. Piers are structurally simple, lacking the complexity necessary to function as prey-refuge habitat. Thus, they confer an advantage to predatory fish and birds over vulnerable juvenile salmonids.

8. Bulkheads are also structurally simple relative to undisturbed shorelines. Bulkhead construction generally entails the permanent removal of CWD and other complex features such as shoreline vegetation, which eliminates the sources of future CWD. Bulkheads waterward of OHW eliminate shallow-water refuge and foraging habitat of juvenile salmonids. Bulkheads with large interstitial spaces provide concealment
habitat for sculpin, which prey upon juvenile chinook. Chinook fry appear to avoid bulkheads, which may affect their dispersal.

9. Shorezone development, and specifically the proliferation of bulkheads and bulkheads in combination with piers, consistently results in a reduction of fish and invertebrate diversity and the dominance of the fish assemblage by disturbance-tolerant species (centrarchids - primarily smallmouth bass), and the extirpation of rare species.

10. Bulkheads interrupt the recruitment and transport of native sediment to lakes, resulting in both local and along-shore erosion. Piers also disrupt sediment transport. The resultant changes in sediment composition and distribution may affect bass and salmonid spawning (as well as other species), and could also affect the distribution and abundance of invertebrate prey items of juvenile salmonids.

11. Piers reduce primary productivity by both phytoplankton, and macro- and microfauna. The amount of reduction is a function of the reduction in light intensity by the structure.

12. Removal of shoreline vegetation can reduce the allochthonous input (terrestrial insects and detritus) to the lake, ultimately affecting productivity.

13. Sediment and water contamination can result from leaching of PAHs and heavy metals from treated wood. Hydrocarbon input from two-stroke watercraft engines can be a significant factor in water quality reductions in lakes. However, in urban drainages, and Lake Washington in particular, outboard motors contribute less than 1 percent of PAH input. Chinook smolts exposed to an estuary contaminated with heavy metals and PAHs exhibited suppressed immune responses.

14. Artificial lighting retards migratory progress of sockeye fry, subjecting them to increased predation. Lights from industrial areas in south Lake Washington facilitate nocturnal foraging by piscivorous birds.

15. Pile driving can affect the distribution and behavior of juvenile salmonids in the marine environment over long distances, and appears to produce a habituation to the sound that could prevent a fish from sensing an approaching predator.

16. Minor turbidity increases can cause significant reductions in lake productivity, and produce sublethal effects in salmonids that could reduce their fitness and survival. Acute exposure to high turbidity can be lethal for salmonids.

17. Boating is not an environmentally benign activity. Potential impacts range from spreading exotic species of plants and plankton to physical injury or death to fish.

18. The artificial water level regime maintained in Lake Washington for operation of the Ballard locks during boating season may inhibit the establishment of emergent vegetation along the shoreline.
19. Emergent vegetation can be an effective barrier for attenuation of wave energy.

*What the literature review does not tell us:*

1. How do juvenile salmonids respond to piers, bulkheads, and other artificial structures in local lakes (i.e., do they seek or avoid them, will they swim under or go around)? Is response size-dependent? Do variations in design (configuration, materials) affect prey response to structures?

2. Is there a relationship between piers and predation on juvenile salmonids (by all predators, but especially bass and cutthroat, and avian predators) in local lakes? How are the structures utilized by the various predators?

3. Which characteristics or combination of characteristics (shade, cover, structure, etc.) of piers attract bass (or other predators) in local lakes? How do variations in design (configuration, materials) affect predator attraction?

4. Do prisms and grating change predator or prey response to piers? How effectively do they reduce shading *in situ*?

5. How do bulkheads and piers affect sediment distribution/composition and benthic invertebrate distribution and abundance in local lakes?

6. How does pier lighting affect the behavior of chinook fry and their predators in Lake Washington and Lake Sammamish, and ultimately the predation rate on chinook fry?

7. How do juvenile salmonids and their prey, and adult salmonids respond to drop-hammer and vibratory pile driving in lakes?

8. What are the cumulative impacts of overwater coverage on total lake productivity from the existing structures on Lakes Washington, Sammamish, and Union?

9. How do juvenile salmonids in local lakes respond to temporary construction-related turbidity?

10. What is the current contribution of two-stroke marine engine emissions to PAH contamination in local lakes? How is the productivity of the lakes, and the health of fish, being affected?

11. How pervasive is the use of dock-cleaning chemicals by homeowners around local lakes, and what chemicals are being used? What hazard does this chemical use pose to fish? Same questions for lawn-care products.

12. How do juvenile and adult salmonids respond to local boating and swimming activity?

13. How do changes in sediment distribution/composition affect populations of bass?
With these answers and questions, we have a framework for directing our future research efforts, and for determining our regulatory responsibilities.

**Recommendations**

These recommendations reflect a conservative approach based on the significant findings and uncertainties identified in the literature review. The most important point of this review is the verification of the intuitive relationship between shorezone development and the loss of properly functioning shorezone habitat (including riparian and littoral zones and their interconnection). The dependence on quality shoreline habitat of sensitive juvenile salmonids and the continual onslaught on the quality of that habitat within an urbanizing watershed was juxtaposed throughout the literature reviewed for this report. The ultimate goal of regulatory personnel charged with protecting ESA-listed salmonid species, or other fish species, should be the protection of that species' critical habitat. With that goal in mind, prevention of the continued simplification of shoreline habitat within the lakes of the Tri-County area is the primary recommendation from this report to policy makers and regulators.

Secondary recommendations follow:

1. New bulkheads should not be permitted unless a critical personal property loss can be demonstrated. In most cases, there are soft alternatives to shoreline armoring. If bulkheads are determined necessary, make every effort to pull the structure shoreward of OHW.

2. Encourage the removal of bulkheads in favor of shoreline restorations [i.e., native emergent and riparian plant species, low-gradient beach (or as appropriate for specific site), native structural elements (CWD, rock) in combination with emergent vegetation for wave energy attenuation]. Such designs have been successfully incorporated into recovery efforts in the Great Lakes (Schollen 1995).

3. Encourage property owners to retain driftwood and fallen trees on their properties.

4. Shorezone construction should not occur during the January through June period when juvenile chinook are most likely to be in the littoral zone. More restrictive allowable construction windows would be appropriate in some areas (i.e., Ship Canal, north end of Lake Washington, south end of Lake Washington, and near mouths of spawning tributaries in Lakes Washington and Sammamish). Consider site proximity to a spawning stream or river, and the likely timing of juvenile and adult migration.

5. Instigate an aggressive bass removal campaign in confined areas, such as the Ship Canal, utilizing unlimited catch restrictions and bounties if necessary.

6. Consider a “no new piers” policy as the best option for protecting fish and fish habitat. Encourage the use of floats or buoys instead. If politically impractical, see #7 below.
7. No net increase in overwater coverage should occur in the Lake Washington system - permits for new construction should be contingent on permits for replacement structures. Only replacement structures that demonstrate a reduction in overwater coverage should be permitted. The amount of overwater coverage eliminated from the replacement pier could be held in a “surface area mitigation bank,” which new piers would have to draw from. Gradually lower the total net coverage over local lakes.

8. All piers, both new and replacement structures, should be restricted to a 3.5-foot-wide cantilever bridge that spans the nearshore area to a narrow moorage structure of the minimum size necessary to moor the applicant’s boat.

9. Cantilever bridge structures should be gratered, and as high off the water as practicable, and moorage structures should be no less than 24 inches above OHW. Floating structures should have maximum light penetration, and be removed annually after boating season.

10. Prisms and grating should be studied to determine their efficacy at providing sufficient ambient light for macrophyte production under piers. The best products should be utilized in all new or replacement overwater structures to minimize losses of primary productivity.

11. Minimize the number of piles used in all structures. Study pile dimension to provide evidence for or against mandated pile dimension. Require the removal of existing treated piles if present.

12. Every shorezone development application should be considered an opportunity for a habitat improvement project. Require shoreline restoration as mitigation for shorezone structures.

13. Do not permit shoreline or pier lighting unless future studies suggest otherwise.

14. Discourage the use of pesticides, herbicides, fertilizers, and cleaners, especially near or over the water.

15. Consider phasing-out sales of two-stroke outboard marine engines.

16. Aggressively enforce a “no lake-water withdrawal” policy with waterfront property owners.

Future research should focus on the 13 questions in the “what the literature review does not tell us” section. Two studies that could result in a relatively rapid regulatory response would be the determination of the effectiveness of prisms and grating for facilitating macrophyte growth under piers, and a study of the effects of the two methods of pile driving on salmonids in local lakes. Results from each of these studies could be used immediately to determine WDFW Hydraulic Project Approval (HPA) or municipal requirements for pier design and construction methods. Another top priority might be a
determination of the response of predators and prey to pier lighting, since having that knowledge could produce a rapid regulatory response.

Studies should be directed at determining the predator population response to shorezone alterations and structures; do these alterations and structures enhance predator abundance or simply concentrate the population in predictable areas? If predator populations are limited by factors other than structure availability, placing additional structures may not increase their abundance.

What is the spatial and temporal correlation between artificial structures, gravel, juvenile salmon and predators? Can cause and effect be demonstrated experimentally (i.e., perform a replicated before-after-control-treatment experiment where piles are introduced in “accretion” and “non-accretion” zones, and monitor for one to two years for changes in substrate and fish use).

Our understanding of how various pier designs affect salmonid/bass (and salmonid/salmonid) interactions remains limited. The basis of bass attraction to piers and piles is poorly understood. Spawning bass are attracted to structures protruding from the substrate, but it is unknown which pier features attract foraging bass. Circumstantial evidence suggests that the amount of shade or the area of overhead coverage provided by a structure is important to foraging bass. Investigations of bass utilization of structures of various designs are necessary. How salmonids and their predators respond to light-transmitting pier design elements (i.e., prisms, grating), overhead cover, and piles of various diameters requires investigation. Until investigations of prisms and grating are complete, they should not be relied upon as a mitigation measure that reduces bass attraction.

Finally, the summer boating season corresponds with the highest water levels in Lake Washington. Erosion caused by power boating can be severe. The high water levels that occur during the periods of heaviest boat use increase the potential of boat wake-induced erosion damage around the lake. Efforts to restore natural shorelines in Lake Washington will be hindered by artificially maintaining a high summer lake-level. The ecological implications of the continuation of the existing water-level management regime in Lake Washington should be critically examined.

**Ongoing and Further Study**

There are a number of ongoing studies within the Lake Washington system from which results will be available to the public in the near future. Roger Tabor (USFWS) and staff from the Muckleshoot Indian Tribe’s Fisheries Department have been studying the predation by largemouth and smallmouth bass and northern pikeminnow on salmon smolts in the Lake Washington Ship Canal and in the Lake proper. Preliminary results from this study were presented at the North Pacific International Chapter-American Fisheries Society meeting from 10 to 12 April 2000, and were included in this document (Tabor et al. 2000). Kurt Fresh (WDFW) is currently studying the timing of entry and distribution of juvenile chinook salmon in Lake Washington; details on the availability of results are pending. Rod Malcom (MITFD) has three reports in preparation:


Details on the availability of these reports were not available.

Additional studies on docks and bulkheads may be currently in progress in the region but information was unavailable at the time of publication.
Acknowledgments

We thank B. Footen, K. Walter, E. Warner, and R. Malcom of the Muckleshoot Indian Tribe Fisheries Division for assistance in developing the scope of the review, for reviewing an earlier draft of this report, and for sharing information. We also thank K. Fresh, WDFW, and R. Tabor, USFWS for reviewing an earlier draft of this report, and sharing information. We thank A. Myers of The Watershed Company for editorial support. We thank Kit Paulsen, City of Bellevue, for developing the original scope of the project, for functioning as our liaison at the City of Bellevue, for reviewing every draft of this report, and for orchestrating the cooperative effort between The Watershed Company and the University of Washington Cooperative Fish and Wildlife Research Unit.
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Crafting a Lake Protection Ordinance

by Karen Cappiella and Tom Schueler

Introduction

Lake protection ordinances are an essential tool for protecting the quality of the 41 million acres of lakes and reservoirs in the United States that are under increasing development pressure. This article describes how to craft an ordinance to protect and maintain the quality of lakes from the pressures of both shoreline and watershed development. An effective lake protection ordinance extends over four major zones: the actual shoreline, a forested buffer extending landward, a shoreland protection area that extends further, and finally, a watershed-wide zone used to control pollutant loadings to the lake or reservoir as a whole.

A lake protection ordinance (LPO) is particularly critical around urban lakes, to guide how and where new development will occur. Historically, there has been limited guidance on how to craft an effective LPO that protects lake resources, maintains the quality of the recreational experience, and accommodates the property rights of landowners. Traditionally, most LPOs have primarily focused on a relatively narrow ring of land around the shoreline where development is most visible. However, given that lakes are so strongly influenced by runoff from their watersheds, they often need to be managed from a watershed perspective.

Key Factors to Consider in Lake Protection

Techniques for protecting lakes are markedly different from those used to protect streams. A watershed manager must account for nine factors that are unique to the ecology of lakes and the nature of development that occurs around them:

Shoreline development is a unique form of development.

Lake shorelines also tend to be developed incrementally over time. It is rare that the lakefront is developed as a single subdivision (which would be much easier to regulate). Rather, shoreline development often happens on a “lot-by-lot” basis, whereby individual lakefront lots are sold and subdivided to build second homes or cottages, often on a custom basis. In addition, each home and its accessory structures tend to be continuously “improved” or expanded by successive owners, to meet their changing tastes and recreational needs. Consequently, an LPO should be written to provide continuous regulation of the shoreline development process.

Since lakefront property is so desirable, it is quite common to have intense lakefront development in otherwise lightly developed watersheds. This presents a real challenge for protecting lakes in rural areas, since these communities typically have limited staff and development review experience.
Lake protection focuses on phosphorus reduction.

An explicit goal of many LPOs is to maintain the trophic state of the lake, which usually means preventing or reducing phosphorus inputs. Most lakes are extremely sensitive to additional phosphorus inputs from future waterfront or watershed development. Consequently, the overall development density in these watersheds should generally be very low.

Lake managers have several tools to reduce phosphorus inputs from new development in a lake watershed. They include limits on the total amount of new development, shoreline and stream buffers, and the use of stormwater treatment practices designed to remove phosphorus from stormwater runoff. In practice, most managers elect to use all of these tools, and to apply them across the entire watershed draining to the lake. In particular, stormwater treatment practices are often designed to achieve a specific target for phosphorus removal. The LPO often provides very specific instructions to engineers on which stormwater treatment practices to use, how much runoff they need to treat, and how they should be designed to promote greater phosphorus removal. A handful of communities have adopted stormwater performance criteria that call for no increase in phosphorus loading from new development sites (MDEP, 1992; Kitchell, this issue).

Importance of a natural shoreline.

The natural beauty of a lake’s shoreline, with its ever-changing panorama of water, light and wildlife, is a prime attraction for lakefront development. Lake property owners as well as lake users consistently report that their primary use of the lake or reason for visiting is to view the scenery (Warbach et al., 1990; Anderson et al., 1998). This is why lakefront properties nearly always command a considerable premium in terms of land prices. To the extent that a LPO will preserve the natural look of the shorelines, they can maintain or enhance the value of property (CBP, 1998). In one Maine case study, increased water clarity due to the addition of lake buffers increased property values by $11 to $200 per foot of shoreline property (Michael et al., 1996). Consequently, shoreline buffers can be justified based on a common economic interest as much as an environmental one.

Shoreline buffers can be justified based on a common economic interest as much as an environmental one.

Direct influence of shoreline vegetation on fish and wildlife.

Natural shoreline vegetation has a direct influence on the ecological integrity of a lake, as it provides shade, leaf litter, woody debris, protection from erosion, and littoral habitat. These benefits are extensively reviewed in Engel and Pederson (1998), and selected research is profiled in Table 1.

Studies in a variety of lake settings have demonstrated a strong relationship between declining fish abundance or diversity and increasing shoreline development, as measured by several indices (Hinch and Collins, 1993; Hinch et al., 1994; Bryan and Scarnecchia, 1992; Chick and McIvor, 1994). Fish foraging and spawning have also been shown to decline as a direct function of cottage or home density around the lakeshore (Engel and Pederson, 1998). Most fish species spend at least part of their lifecycle in the littoral zone of the shoreline. Emergent and submersgent plants and coarse woody debris are critical habitat elements in the littoral zone, and each of these is highly vulnerable to shoreline development (Christensen et al., 1995).

Many birds, such as eagles, loons and songbirds, tend to avoid developed lakes, and several researchers have noted that they depart at a relatively low rate of cottage development (Johnson and Brown, 1990; Voight and Broadfoot, 1995; Heimberger et al., 1983). In some cases, the avoidance is due to a loss of nesting sites or perches to spot prey, while in others it reflects a lack of tolerance for noise or disturbance within or along the lakeshore. In contrast, some bird species favor a densely developed shoreline, such as mallards, geese and gulls.

Similar relationships have been discovered for amphibians and reptiles, which utilize the lakeshore to bask, feed, nest and overwinter (Engel and Pederson, 1998). Natural lakeshore habitat has also been found to be important for deer and other mammals (Buehler et al., 1991). Conversely, many species suffer from increased predation and harassment by pets along more developed shorelines.

Intense pressures for shoreline improvement and clearing.

A lake shoreline is unique in that it remains under continuous pressure for shoreline “improvements” well after the initial development has been completed. Many lakefront property owners install docks, piers, stairs, gazebos, boathouses, boat ramps, bulkheads and other structures on or near the shoreline. At the same time, the forest buffer is under relentless pressure to be converted into a tidier lawn or an unobstructed view.
Figures 2 and 3 are examples of shoreline lots with unregulated and regulated “improvements.”

While the individual effect of each of these improvements is relatively minor, their cumulative impact on the integrity and attractiveness of a shoreline buffer can be severe. For example, a survey of users in a Minnesota lake found that a majority of the respondents felt that multiple shoreline structures and lawns had a negative impact on the lake (Warbach et al., 1990).

When a person is on a lake, he wants to see a natural shoreline. Yet, when the same person is on the shore, he wants to see a lake. This can create a lot of pressure on the buffer, as property owners clear trees and remove vegetation to promote a better view of the lake. However, one individual’s quest for a better view of the lake diminishes the quality of the view for another. Thus, all property owners share a common interest in limiting clearing along the shoreline to screen their neighbors, while still getting at least a decent glimpse of the lake themselves. Consequently, an LPO needs to carefully prescribe how and where view corridors can be created, and include realistic measures to inform land owners on what uses, structures and activities are restricted or prohibited in the shoreline buffer zone.

Recreational issues are paramount management concern.

Lakes that are actively used for fishing, boating, swimming and other forms of recreation require direct access to the shoreline and across the buffer. While some lakes do have public access and central facilities (such as boat ramps, swimming beaches, etc.), many do not. In these lakes, each waterfront owner creates his or her own recreational access. This can create an inherent conflict between the property owners and outside users of the lakes. Therefore, although the shoreline buffer usually remains in private ownership, it is important to address issues of both public and private recreational access in an LPO.

Table 1. Recent Research Documenting Ecological Benefits of Shoreline Buffers

<table>
<thead>
<tr>
<th>Key Finding</th>
<th>Reference</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse woody debris positively correlated with riparian tree density and negatively correlated with lakeshore cabin density</td>
<td>Christensen et al., 1996</td>
<td>17 north temperate lakes in northern Wisconsin and the Upper Peninsula of Michigan</td>
</tr>
<tr>
<td>Less fish activity, less fish feeding, and increased wave disturbance in fringe zones adjacent to lawns versus undeveloped shorelines</td>
<td>Collins et al., no date</td>
<td>2 sites on Lake Rosseau, Ontario, an oligotrophic lake</td>
</tr>
<tr>
<td>Increase in development and decrease in vegetative cover is correlated with decrease in lakeside populations of whitetailed deer</td>
<td>Voight and Broadfoot, 1995</td>
<td>Lake Muskoka, Ontario</td>
</tr>
<tr>
<td>Increase in development and decrease in vegetative cover is correlated with decrease in shoreline populations of nesting bald eagles</td>
<td>Buehler et al., 1991</td>
<td>Chesapeake Bay Shorelines</td>
</tr>
<tr>
<td>Increase in development and decrease in vegetative cover is correlated with decrease in lakeside populations of loons</td>
<td>Heimberger et al., 1983</td>
<td>Northern Ontario lake</td>
</tr>
<tr>
<td>Increase in development and decrease in vegetative cover is correlated with decrease in lakeside populations of songbirds</td>
<td>Johnson and Brown, 1990</td>
<td>Eastern Maine lake</td>
</tr>
<tr>
<td>Species richness and abundance of fish were greater along undeveloped shorelines versus developed shorelines in nearshore and intermediate depth zones</td>
<td>Bryan and Scarneccia, 1992</td>
<td>Spirit Lake, Iowa, 2266 hectare glacial lake</td>
</tr>
<tr>
<td>Decrease in plant cover from human activity is correlated with a decrease in fish abundance</td>
<td>Chick and McIvor, 1994</td>
<td>Lake Okeechobee, Florida</td>
</tr>
<tr>
<td>Decrease in plant cover from human activity is correlated with a decrease in fish abundance</td>
<td>Hinch and Collins, 1993</td>
<td>Ontario</td>
</tr>
</tbody>
</table>
Recreational conflicts are not only confined to the shoreline buffer, but often extend into the lake itself. A recurring conflict involves whether or not motorized water craft will be allowed on the lake, either because of concerns over noise, safety, wakes or potential pollutant sources. Many water utilities restrict or prohibit motorized watercraft on water supply lakes, since two-stroke engines can be a significant source of hydrocarbons, lead and phosphorus to the lake. In recent years, conflicts have erupted over the noise, wakes and safety of personal watercraft, such as jet skis. Figure 4 is an example of how conflicts over lake recreational use can be managed by designating specific areas of the lake to each activity. Consequently, residents or local agencies may want to address these issues as part of the LPO or a lake management plan.

Prominence of septic systems.

Lakefront developments are often serviced by septic systems because of their seasonal use or distance from wastewater treatment plants. Because of their proximity to the lake, septic systems can become a potential source of subsurface phosphorus seepage to a lake. Indeed, many researchers have identified failing or poorly functioning waterfront septic systems as an important and controllable source of phosphorus and nitrogen in a wide range of lake systems (Harper, 1995; Childs et al., 1974; Gilliam and Patmont, 1983; Grant, no date; Kerfoot and Skinner, 1981; Robertson and Harman, 1999; and Arnade, 1999). One of the primary functions of the shoreline buffer is to create distance from the leach field and the shoreline, thereby providing as much soil treatment as possible in such a confined area. Watershed-wide septic system regulations may also be a key element of an LPO, particularly in watersheds that have potentially high septic system density or unsuitable soils. More information about septic system impacts on lakes can be found in Swann (this issue).

Lake associations available for enforcement or education.

The lake and its shorelines are a classic case example of the “commons,” where the actions of one user or owner can diminish the quality of life for another. Often lakefront property owners recognize that they share a common interest in some form of self-regulation. This has led to the formation of hundreds of lake associations across the country to promote better local lake management. In many lakes, these associations are similar to homeowners associations, in that they are self-governing and self-financing. As such, a lake association can play a pivotal role in education and enforcement of the LPO, through legally binding covenants on individual properties. The North American Lake Management Society (NALMS) has excellent materials on its website on how to establish a new lake management association or energize an older one (www.nalms.org). Lake associations are particularly valuable in educating shoreline landowners about LPO provisions that directly affect them.

Lake protection ordinances must be customized for unique lake conditions and water quality goals.

While this article presents an overall framework for crafting an LPO, it is important to keep in mind that the actual details of each ordinance will differ for every lake. For example, more stringent criteria are often applied to lakes that are a primary water supply, as compared to a reservoir used for recreation or flood control. Similarly, managers will usually adopt more stringent criteria in order to maintain the character of a phosphorus-sensitive lake in a wilderness setting, as compared to a highly eutrophic lake in a more urban setting. In some lakes, the LPO is primarily used to regulate competing recreational or shoreline interests, while others may be driven more by the need to reduce phosphorus loads.
In nearly all lakes, the ability to achieve management goals for a lake is heavily influenced by the amount and type of prior development along the shoreline or within the watershed. Thus, lake managers should engage both lake users and watershed residents to set realistic goals for lake protection very early in the ordinance process. In addition, communities that have many lakes and reservoirs may want to classify them in order to manage them better. An example is the state of Minnesota’s lake classification system shown in Table 2.

### The Four Zones of Lake Protection

The four primary zones of lake protection are the shoreline, shoreline buffer, shoreland protection area, and the lake’s contributing watershed (see Figure 5). The development criteria within each of the four zones are often different and include the following:

1. Zone geometry
2. Vegetative target
3. Allowable uses
4. Restricted uses
5. Septic system siting
6. Stormwater treatment practice design
7. Residential lot design requirements
8. Zoning
9. Enforcement
10. Education

The key development criteria for the four zones of an LPO are compared in a condensed fashion in Table 3.

In general, the four-zone approach to lake protection is most restrictive at the shoreline, and is more flexible as one progresses further up into the watershed. Greater detail on the key criteria for a lake protection ordinance is provided in the following pages.

### Zone 1: Shoreline

The shoreline begins as the point where the mean high water mark meets the land. Given the importance of the shoreline to lake ecology and screening, it is essential that this zone be retained in a natural state, with minimal disturbance of native vegetation. A common approach to manage the shoreline is to require shoreline permits for any activity that modifies, alters, clears or otherwise disturbs the natural shoreline. Permits, which can be required by a local or state agency, place limits on tree clearing, bulkheading and rip-rapping. Exceptions may be granted to clear small...
areas for allowable uses, as defined later. The permit process should require the applicant to demonstrate that natural methods of shoreline stabilization, such as bioengineering, are not feasible before retaining walls, riprap or bulkheads are allowed to stabilize the shoreline. Some communities may also specify low or no wake areas, set boat speed limits and exclude motorized watercraft in their LPOs in order to prevent shoreline erosion (Standing et al., 1997).

### Table 3. Development Criteria for the Four Zones of an LPO

<table>
<thead>
<tr>
<th>Criteria:</th>
<th>Shoreline</th>
<th>Shoreline Buffer</th>
<th>Shoreland Protection Area</th>
<th>Watershed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defined as:</td>
<td>high water mark</td>
<td>50 to 150 feet</td>
<td>250 to 1000 feet</td>
<td>divide of contributing watershed</td>
</tr>
<tr>
<td></td>
<td>(HWM)</td>
<td>from HWM, 300</td>
<td>from HWM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>feet for source</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetation target for the zone</td>
<td>maintain natural shoreline, no disturbance without permit</td>
<td>forest or native vegetation, maximum view corridor of 30 feet</td>
<td>maximum clearing limits on individual lots of 25 to 50%</td>
<td>forested buffers for tributary streams</td>
</tr>
<tr>
<td>Allowable Uses</td>
<td>Bioengineering,</td>
<td>walkways,</td>
<td>residential homes,</td>
<td>most are allowed</td>
</tr>
<tr>
<td></td>
<td>1 pier or dock</td>
<td>boathouses within</td>
<td>septic systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>per frontage, 1</td>
<td>the view corridor</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>stairway</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restricted Uses</td>
<td>boathouses and</td>
<td>no permanent</td>
<td>commercial or industrial zones, uses with hazmat spill risk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>other accessory</td>
<td>structures, no</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>structures, rip</td>
<td>impervious cover</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>rap, bulkheads</td>
<td>or other land</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>disturbing activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Septic Systems</td>
<td>n/a</td>
<td>not allowed</td>
<td>setback 100 to 200 feet</td>
<td>design, feasibility or inspection criteria to reduce failure</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>from HWM</td>
<td></td>
</tr>
<tr>
<td>Stormwater</td>
<td>no new pipe</td>
<td>no stormwater</td>
<td>presumed to be achieved by</td>
<td>stormwater treatment practices required to remove target phosphorus levels</td>
</tr>
<tr>
<td></td>
<td>outfalls to lake</td>
<td>practices allowed</td>
<td>environmentally sensitive site design</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>(except for</td>
<td></td>
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<td></td>
<td></td>
<td>practices at boat</td>
<td></td>
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<td></td>
<td></td>
<td>launching)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lot Requirements</td>
<td>n/a</td>
<td>n/a</td>
<td>minimum lot size,</td>
<td>open space subdivisions and better site design to reduce impervious cover</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>minimum frontage,</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>max impervious cover,</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>limit rooftop runoff</td>
<td></td>
</tr>
<tr>
<td>Zoning</td>
<td>establish</td>
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<td></td>
<td>requirements and</td>
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<tr>
<td></td>
<td>density in a lake</td>
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<tr>
<td></td>
<td>protection overlay district or a comprehensive plan</td>
<td></td>
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</tr>
<tr>
<td>Enforcement</td>
<td>local or state</td>
<td></td>
<td></td>
<td>lake association or watershed organization</td>
</tr>
<tr>
<td></td>
<td>permit</td>
<td></td>
<td></td>
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<tr>
<td>Education</td>
<td>lake association</td>
<td></td>
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<tr>
<td></td>
<td>and/or resource</td>
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<td></td>
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<tr>
<td></td>
<td>agency</td>
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</table>
width to six feet or less. Normally, pre-existing structures are exempted from the shoreline permit process, but they may not be significantly expanded without one (Bernthal and Jones, 1998).

**Restricted Uses**

Many communities prohibit tree clearing or grading along the shoreline, although individual trees can be removed for safety purposes. Boathouses and other accessory structures are generally prohibited within the narrow shoreline zone. In addition, no new stormwater outfalls should be allowed that discharge to the shoreline.

**Zone 2: Shoreline Buffer**

When natural shoreline buffers are maintained, they protect the integrity of the shoreline, provide habitat for wildlife and fish, reduce the likelihood of erosion, and help to reduce runoff and pollutant loads (Engel and Pederson, 1998; Wenger, 1999; Fuller, 1995). In addition, natural shoreline buffers support the aesthetic and recreational values that make lakefront development so desirable and economically attractive. Natural shoreline buffers also protect the physical and ecological integrity of lakes by providing shade, leaf litter, woody debris, erosion protection, and habitat.

A common base width for a shoreline buffer is 75 feet (Heraty, 1993), although widths typically range from 50 to 150 feet. If a lake is used as a source of drinking water or is very pristine, buffer widths of 200 to 300 feet are often used (RICRMC, 1994; Standing et al., 1997; Kitchell, this issue). The base width of a shoreline buffer should be expanded to include steep slopes or wetlands, or contracted when pre-existing development is located close to the shoreline. Some communities set the base width of the shoreline buffer based on the surface area of the individual lake, and require wider buffers around their larger lakes. Most communities now clearly prescribe how the buffer will be delineated within the LPO. For natural lakes, the natural mean high water level is a good benchmark, whereas the water line at “full pond” is often used for reservoirs.

**Vegetation Management**

The vegetative target for the shoreline buffer is mature forest or native vegetation. This may involve actively re-vegetating areas or letting them gradually return to their natural state. Depending on the region, the natural state will not always be a forest. The use of native plants within the buffer usually requires less maintenance, and these plants are easier to establish. Some communities set specific restoration goals for the shoreline buffer. For example, New Hampshire requires that a plan be submitted that describes the species, number, and basal area of trees proposed for replanting a natural woodland buffer (Springs, 1999).

Tree clearing for view corridors or access trails is inevitable, so many LPOs do allow for some clearing, or have guidelines for thinning or removing of dead trees. For example, Rhode Island Coastal Zone Buffer Program and Maine Shoreland Protection Standards indicate that shoreline access paths can be no more than six feet wide and follow a winding path that does not promote erosion (see Figure 6).

In addition, clearing for a view corridor is generally limited to no more than 25% of the length of the shoreline for residential lots of two acres or less (RICRMC, 1994). Other communities have opted for a more operational criteria, allowing a single view corridor per lot, and no opening greater than 250 square feet in the forest canopy.
as measured from the outer limits of the tree crown (MDEP, 1999). Still others allow clearing of no more than 40% of the basal area of trees within 100 feet of the shoreline (Bernthal and Jones, 1998).

**Allowable Uses**

Allowable uses in the shoreline buffer should be limited to clearing for shoreline access paths and view corridors. Many communities also permit trails and passive recreation within the buffer zone. In addition, boathouses and other accessory structures may be allowed within the buffer, but must be set back at least 25 feet from the shoreline. Some shoreline zoning ordinances also place limits on the number and square foot area of boathouses and other structures (Bernthal and Jones, 1998). An exemption is usually provided for public recreation facilities such as boat ramps and public beaches. Careful planning is needed to develop public facilities in a manner that minimizes clearing of the shoreline. In some cases, stormwater practices such as perimeter sand filters can be installed to treat direct runoff from boat ramps and associated parking lots.

**Restricted Uses**

Many land uses and activities are restricted or excluded from the shoreline buffer zone. These include paved surfaces, primary structures, grading, pesticide application, mowing, motorized vehicles, or any other activity that causes soil disturbance or contributes to pollution. In addition, septic tanks and drain fields are excluded from the shoreline buffer, and often must be set back an even greater distance into the shoreland protection zone.

**Stormwater Treatment**

The natural vegetation of the shoreline buffer acts to slow down and spread out runoff and promotes infiltration in the soil, thereby reducing the need to treat the quality of stormwater runoff. In this sense, the natural shoreline buffer is the last line of defense for treating stormwater. More importantly, stormwater treatment practices designed to treat stormwater from upland sources should not be located within the buffer. Many communities also prescribe that no new pipes or channels be constructed to convey stormwater across the shoreline buffer (i.e., sheetflow conditions must be maintained).

**Enforcement and Education**

The LPO should specify who is responsible for enforcing and managing the shoreline buffer during and after construction. A lake association can be a good candidate to perform this role, since the shoreline buffer often falls within the boundaries of most lake associations. In addition, lake associations may have the authority to extend covenants from their members to establish shoreline buffers on existing waterfront lots that otherwise might be grandfathered. The North American Lake Management Society publishes several useful lake management references (www.nalms.org). The Terrene Institute also publishes The Lake Pocket Book as a useful guide.

Regardless of whether the shoreline buffer is enforced by a lake association or a local agency, it is important that the LPO contain provisions to notify owners and contractors about the boundaries and restrictions of the buffer. Some useful techniques include marking buffer boundaries with permanent signs that describe allowable uses; clearly delimiting the buffer boundaries on all construction plans, maps, deeds and property surveys; and verifying that new owners are fully informed about uses/limits when waterfront property is sold.

The LPO should contain a series of progressively tougher enforcement actions for owners and contractors who violate the provisions of the buffer, beginning with a notice of violation with time to correct. If these administrative remedies fail, then fines, property liens, stop work orders, restoration liability and other sanctions should be available.

Enforcement measures can and will create needless conflict with many waterfront owners if they are not accompanied by strong and continuous programs to educate residents about the value of shoreline buffers, and the limits that they impose on their land. Lake managers should strive to reach every landowner with a mailing, meeting or visit to ensure they understand the rules. The enforcement agency can directly educate owners during annual buffer walks to check on encroachment, and provide information on how residents can become better stewards through reforestation and shoreline bufferscaping programs. Lake managers should strive to integrate buffer education with other water quality and recreation messages they want to deliver, whether they are boating or fishing regulations, septic system cleanouts or lake management issues. Waterfront owners may also want to know about techniques to slow the spread of invasive species such as zebra mussels and Eurasian water milfoil, which are an increasing problem in many lakes (Klessig et al., 1993). Techniques to prevent the spread of invasive species may include boat cleaning or boat pumpout facilities at centralized locations.
Zone 3: Shoreland Protection Area

The shoreland protection area extends beyond the shoreline buffer and is primarily intended to regulate the geometry and nature of development on lots adjacent to a lake. In a way, the shoreland protection area is a special overlay zone for residential development, and includes various setbacks, impervious cover limits and forest conservation requirements.

The width for a shoreland protection area typically ranges from 250 to 1,000 feet, as measured from the shoreline. The state of Minnesota has a similar zone where shoreland standards apply to all land within 1,000 feet of the lake (ILCC, 1996). The actual width depends on the underlying lot size or zoning category in the area. In general, as lot size increases, the width of the shoreland protection area increases. At a minimum, the shoreland protection area should extend at least two lot lengths outward from the lake. Often, the exact boundaries of the shoreland protection area are expanded to account for bluffs, wetlands, steep slopes, erodible soils, or other sensitive natural features around the lake.

Vegetation

Since development will occur in the shoreland protection area, vegetative targets are much less restrictive than along the shoreline or in the shoreline buffer zones. Maximum clearing limits are imposed in this zone to keep the building footprints as small as possible and conserve natural areas. A typical example is prescribed under the Maine Shoreland Zoning guidelines, which limit clearing during construction to no more than 25% of total lot area or 10,000 square feet, whichever is less (MDEP, 1999, see Figure 7). In Waupaca County, Wisconsin, no more than 50% of each shoreland lot or 25,000 square feet, whichever is less, may be disturbed for residential or commercial construction (Standing et al., 1997).

Restricted Uses

A primary reason for establishing the shoreland protection area as a zoning district is to exclude or set back uses or activities that have the potential to degrade the water quality of the lake or detract from its scenic character. Consequently, a long list of uses and activities are often excluded from the shoreland protection area.

Examples of land uses that are frequently considered to be non-conforming include livestock operations; facilities that generate, store or dispose of hazardous materials; landfills; junkyards; surface discharges from sewage treatment plants; golf courses (unless they have an approved integrated pest management plan); above or below ground storage tanks; stormwater hotspots (MDE, 2000); and non-residential roads.

In addition, most communities consider the shoreland protection area to be an exclusively residential zone, with exceptions for water-dependent operations (such as boat launching areas, private campgrounds, and the like). Consequently, industrial, commercial, or institutional developments are often excluded from this zone, particularly if the lake is a primary drinking water supply.
Shoreland protection areas frequently require setbacks, the most common being a 100 to 200 foot setback for septic tanks and drain fields, as measured from the shoreline. From a practical standpoint, this means that septic systems need to be located well beyond the outward boundary of the shoreline buffer. Figure 8 illustrates this concept.

Setbacks for septic systems may vary depending on the lake’s use and watershed characteristics. For example, the state of Virginia requires a 100 foot septic system setback from a stream; New Hampshire requires a 125 foot septic system setback for areas with porous soils; the New York City reservoir system has a 300 foot setback for absorption fields, and a 500 foot setback for septic systems; and the state of Maine prohibits septic systems in Resource Protection Districts (CWP, 1995a; Spring, 1999; NRC, 2000; MDEP, 1999).

A few LPOs regulate the use of fertilizer or pesticides in the shoreland protection area. For example, the New Hampshire Comprehensive Shoreline Protection Act limits the use of any fertilizer in protected areas, and limits fertilizer use outside these areas to low phosphate, slow release nitrogen fertilizer or limestone (Springs, 1999). In other watersheds, the use of pesticides is prohibited in this zone. For example, the herbicide atrazine may not be applied within 200 feet of natural lakes or reservoirs in the New York City reservoir watersheds (NRC, 2000). While these restrictions are admirable from an environmental standpoint, they are often difficult or impossible to enforce with individual property owners.

**Environmentally-Sensitive Shoreland Design**

In practice, it is very difficult to effectively treat the quality of stormwater runoff generated by development within the shoreland protection area with conventional stormwater practices such as ponds, wetlands, or filters. Constraints such as the proximity to the lake, small drainage area, poor conveyance and the need to stay out of the shoreline buffer make it a major challenge to engineer treatment practices in the zone. Therefore, the stormwater strategy in the shoreland protection area is to minimize the creation and concentration of stormwater runoff through environmentally sensitive shoreland development techniques. These development techniques include site fingerprinting, impervious cover limits, minimum lot sizes and natural conveyance. As a practical matter, then, stormwater treatment is achieved through site design requirements within the shoreland protection area. Lots that meet the design requirements are presumed to automatically comply with any stormwater requirements. Figure 9 illustrates how environmentally sensitive shoreland design can be applied in a typical lakefront residential lot.

Environmentally sensitive shoreland design techniques for residential lots include the following:

**Minimum Lot Sizes and Minimum Shoreline Frontages**

Since the shoreline is a finite resource, many communities have sought to limit the intensity of lakefront development through minimum lot sizes and shoreline frontage distances. Minimum lot sizes tend to range from slightly less than one acre to five acres or more. For Maine lakes, minimum lot size for residential development in the shoreland zone is 60,000 square feet, with a corresponding minimum shoreline frontage of 300 feet (MDEP, 1999), while Minnesota lots adjacent to Natural Environment lakes have a minimum lot size of 80,000 square feet (Bernthal and Jones, 1998). Once again, lakes or reservoirs that are a primary source of drinking water or undeveloped lakes that are being protected because of their natural beauty tend to use very large lot zoning typically greater than five acres (Standing, 1997; Kitchell, 2001, this issue).

**A Maximum Limit for Impervious Cover on the Lot**

The LPO often specifies a maximum amount of imperviousness for the shoreland zone. We generally recommend a 10 to 15% as an impervious cover limit.
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for residential lots in the shoreland protection area. However, this percentage can vary depending on land use, lot size, and the desired level of development around a lake. For example, Shawano County, Wisconsin has a limit of 8% impervious cover on lots within 300 feet of the lake’s ordinary high water mark (Standing, 1997), while the state of New Hampshire has a 20% impervious cover limit for alternative developments such as PUDs, which incorporate residential and commercial areas in a planned community (Bernthal and Jones, 1998).

Site Fingerprinting

Many communities specify that a minimum fraction of the lot be conserved in natural cover, and mandate that the lot cannot be cleared or otherwise disturbed during site construction, nor converted to lawn afterwards. Normally, area that must be conserved includes the shoreline buffer and additional areas within the shoreland protection area. For the lot as a whole, the target for natural cover conservation will vary according to zoning category, but typically ranges from 40 to 75%. Figures 10 and 11 contrast conventional and alternative techniques for clearing a site for development.

Grading Limits

Any grading at the site should promote sheetflow, and avoid concentrating runoff. Often, driveways comprise much of the grading in the shoreland protection zone. In this respect, driveways should be graded to follow contours and avoid the need for ditches. Otherwise, driveways should be constructed of more permeable material, such as river rock, blue stone, gravel or grass pavers. If the lot has a slope greater than 10%, or is less than one acre in size, berms, depressions or terraces may be required to capture runoff and encourage infiltration at the outer boundary of the shoreline buffer.

Rooftop Disconnection

Residential rooftop runoff can be easily disconnected and conveyed as sheetflow across vegetated areas or into the buffer. In practical terms, this means that downspouts should not be connected to any conveyance system. If soils are not suitable, then dry wells, french drains or rain barrels can be used to store rooftop runoff. Figure 12 illustrates how to use a rain barrel to store rooftop runoff.

Limitations on Back Lot Development

Lake managers constantly struggle with the issue of backlot development, which drives up the overall density of shoreline development. Backlot development allows off-water lots to share a narrow strip of waterfront land that provides access to the water. This often results in over-development of the lakeshore to accommodate docks and access points for a large number of people. Several zoning techniques can limit backlot development. First, zoning regulations can prohibit the development of shore lots with more than one owner or establish limits on the number of off-water lots served by one access lot (Standing, 1997). Alternatively, minimum lot sizes can be established for off-water lots by extending the width of the shoreland protection area further from the lake. Figure 13 illustrates the backlot or "keyhole" development concept.
Establishing shoreline buffer zones may not always be enough to protect a lake from the impact of land development, particularly if it is sensitive to increased phosphorus inputs. If significant land development is expected in a lake watershed, the LPO must be designed to create a fourth management zone that encompasses the watershed as a whole.

From a watershed perspective, it may be necessary to control all sources of phosphorus to the lake in order to meet water quality goals. In this case, the LPO should define how and where the eight tools of watershed protection should be applied (CWP, 1998). Often, this may require a watershed plan that estimates current and future impervious cover, and investigates major (and controllable) phosphorus sources. Still, some generalizations can be made on how the eight tools can be applied to protect lakes, as discussed in the following paragraphs.

**Watershed Zoning/Land Use Planning**

Given the current limits of stormwater treatment described by Caraco (this issue), it is evident that the water quality of many lakes can only be maintained if limits are set on the cumulative amount of watershed development. While the exact development threshold often depends on the combined geometry of each individual lake and its watershed, most lakes can sustain only a rather low density of development, as measured by indicators such as impervious cover or lot size. The notion that a carrying capacity for development exists for many lakes has long been advanced by many limnologists (Wetzel, 1975; Wetzel, 1990; Vollenweider, 1968 and 1975).

Consequently, one of the first tasks of a lake manager is to compute current and future phosphorus budgets for the watershed as a whole. These budgets help determine how much extra phosphorus load can be expected in the future, and how much this load can be reduced by stormwater treatment practices in the watershed. If the budget indicates that phosphorus loads will still exceed desired targets even if stormwater treatment practices are widely applied across the watershed, then additional land use controls may be needed. Lake managers have typically relied on three complementary land use strategies to minimize development density in lake watersheds.

**Large-lot Zoning**

Residential land in the watershed is often zoned for large-lot development, with minimum lot sizes of one, two, five or even 20 acres. The basic reasoning is that large lots have comparatively low impervious cover, even if it spreads development over a potentially greater area than would otherwise occur. In addition, communities may allow developers the option to cluster development within these large lot zones, if shared septic systems are allowed.

**Land Use Exclusion**

Commercial and industrial zones are often minimized or excluded from the watershed in order to minimize spill risk, and to reduce impervious cover. Often these zones are not feasible for development if a community elects not to extend sewer into the watershed, given the larger volumes of wastewater that they generate.
Reliance on Septic Systems

Communities often choose to rely on septic systems for wastewater disposal within lake watersheds for two reasons. First, most communities find that it is not economical to service large lot development with sewers. Second, the presence of sewers can often induce more development density than originally intended. Therefore, a lack of sewer capacity acts as a secondary growth control, and can reduce pressures to rezone land to a higher density in the future.

While these land use strategies have been widely applied, they may not be appropriate for every lake watershed. For example, it may not be desirable to extend large lot zoning or exclude commercial development when a lake has a very large watershed, or has already experienced a great deal of past development. The strategy can also backfire if unsuitable soils or site conditions make widespread septic system failure likely, or if the community has no capacity to inspect and manage septic systems over time. These situations call for a more sophisticated land use strategy that may involve down-zoning, transferable development rights, or watershed-based zoning (CWP, 1998).

Another important component of zoning is a careful assessment of existing water pollution hazards in the watershed, with a strong emphasis on land uses or activities that may pose a risk of spills or accidental discharges. In particular, the potential risk of spills from existing or planned roadways should be assessed, and contingency response plans prepared.

Land Conservation

Land conservation is a critical tool for limiting where land development takes place in a lake watershed. Many communities have secured easements or acquired land in the watershed for the express purpose of lake protection. Generally, shorelines, shoreline buffers, and tributary streams are the key land acquisition priorities, although large wetlands and public access areas may also be preferred.

Stream Buffers

Stream buffers are an integral part of any watershed protection strategy, and an LPO should strongly recommend establishing them throughout the watershed. The buffer should apply to all perennial streams that drain to the lake. The basic design of stream buffers is described in Schueler (1995), and model ordinances can be found at the Stormwater Manager’s Resource Center (www.stormwatercenter.net). In some cases, stream buffers in lake watersheds have a variable width depending on the distance of the stream from the primary water intake. A good example of this concept can be found in Georgia’s reservoir protection standards, which require a 150 foot buffer around the reservoir, a 100 foot buffer along streams within a seven mile radius of the reservoir, and a 50 foot buffer along streams outside the seven mile radius for watersheds less than 100 square miles (Burnett and Ashley, 1992).

Better Site Design

Communities may also want to encourage open space designs for residential subdivisions located outside of the shoreland protection area, since clustering has been shown to reduce the phosphorus loadings (Zielinski, 2000). Narrower road standards and the use of roadside swales are also particularly appropriate in most lake watersheds.
Lakes are especially vulnerable to the impacts of sedimentation and turbidity generated from upstream construction sites.

**Erosion and Sediment Control**

Lakes are especially vulnerable to the impacts of sedimentation and turbidity generated from upstream construction sites. Consequently, erosion and sediment control (ESC) plans are normally required at new development sites in lake watersheds. ESC requirements need to be adjusted to reflect the prevailing development conditions around lakes. For example, if most of the development will be constructed on large lots or by individual contractors working on a single lot, it may be important to have both a low area threshold for triggering ESC plans, as well as a simple checklist approach for preparing ESC plans for individual lots.

**Stormwater Treatment Practices**

Stormwater treatment practices in the watershed are often designed to achieve a specific target for phosphorus removal. Local ordinance and design manuals often give very specific instructions to engineers on what stormwater treatment practices to use, how much runoff they need to treat, and how they should be designed to promote greater phosphorus removal. Depending on the phosphorus sensitivity of the lake and the amount of future development forecasted, lake managers may elect to establish specific stormwater phosphorus removal targets in the LPO.

A number of communities have adopted stormwater performance criteria that set forth specific phosphorus load reductions from new development sites. Typically, they require an engineer to calculate the phosphorus load before and after the site is developed, and then design a stormwater treatment system that can eliminate the difference (MDEP, 1992; Kitchell, this issue). Most communities prescribe the Simple Method (Schueler, 1987) to compute post development loads, and provide tables that indicate the estimated phosphorus removal capability associated with each practice (see Caraco, this issue). Depending on the site, the engineer may need to choose a stormwater practice with a higher phosphorus removal capability, reduce the impervious cover of the site, capture a greater volume of stormwater runoff, or install more than one practice on the site. If a designer still cannot meet their phosphorus load reduction target, they may have the option of providing an offset or a fee in-lieu for phosphorus reduction elsewhere in the watershed.

**Wastewater Discharges in Lake Watersheds**

Communities are often sharply divided on how to manage and dispose of wastewater in lake watersheds, given that treated wastewater is often a major component of a lake’s phosphorus budget. Most have adopted one of three broad strategies to manage wastewater, depending on the degree to which they wish to limit development and their confidence in septic systems:

**Reliance on Septic Systems**

This strategy prohibits any surface discharges of treated wastewater within a lake watershed, and relies instead on septic systems to dispose of wastewater on individual sites. The strategy is frequently employed in drinking water reservoirs and to maintain low residential density in other lake watersheds. The success of this strategy requires effective phosphorus removal by septic systems, which in turn may require stringent requirements throughout the watershed, particularly if the overall density of tanks is high (Swann, this issue). Regulations in the watershed typically establish criteria for soil suitability, minimum lot size and drainfield area and a greater shoreline setback from the lake during initial construction. Of equal importance is the establishment of a management authority to inspect, maintain and rehabilitate septic systems after they are built.

**Limited Sewer Relief**

Failing septic systems are sometimes found to be a major water quality problem along the shoreline, and a common remedy is to extend a sewer to connect to clusters of failing units. Sewers may also be needed to accommodate denser development elsewhere in the watershed. In either case, while wastewater is collected by sewers, it is pumped out of the lake watershed for subsequent treatment and discharge.
Reliance on Sewer

In some watersheds, communities have had such poor experience with septic systems that they rely instead on sewers to dispose of wastewater. Often, these communities are concerned with bacteria and phosphorus discharges from failing septic systems or package plants, or have large areas of the watershed that are simply not suitable for septic treatment. Some communities pump the sewage out of the watershed for treatment, while others rely on advanced wastewater treatment within the watershed.

In phosphorus-sensitive lakes, it is important to deal with all sources of phosphorus in the watershed. Many developing watersheds still have active agricultural operations that can contribute significant nonpoint phosphorus loads. Consequently, lake managers should carefully evaluate agricultural sources, such as row crops, confined animal feeding operations, dairies, hobby farms and grazing livestock, and cooperate with farmers and ranchers to implement needed best management practices.

Watershed Stewardship

The watershed is often the best scale at which to perform public education and outreach. In lake watersheds, the outreach effort strives to meet two broad objectives. The first objective is to create an awareness among all watershed residents that they are connected to the lake downstream. Once residents become more connected to the lake, the next objective is to educate them about specific ways they can have a positive influence on lake quality through their daily actions. These include activities such as lawn fertilization, car washing, septic cleanouts, fall leaf disposal, and pet waste disposal (CWP, 2000). Indeed, many of the most progressive watershed education programs have been created for lake watersheds. Examples include Lake Sammamish, Washington, and Lake Harriet, Minnesota (PCP, 1998; MDA, 1998). Figure 14 shows a graphic used on a billboard for the Lake Harriet Watershed Awareness Project.

Lawn care has traditionally been the primary focus of many lake education efforts, which is not surprising given the potential phosphorus inputs from careless fertilization (CWP, 1995b). A handful of communities have gone as far as to place restrictions on the use of fertilizer/pesticide applications throughout the watershed (Springs, 1999; NRC, 2000). Other communities promote fertilizer formulations that do not include phosphorus. Most communities have stressed direct technical assistance to homeowners on how to reduce or eliminate the use of fertilizer and pesticides. Several excellent fact sheets have been developed to educate lake residents about environmentally friendly shoreline landscaping techniques (PWD, 1995; UWEX, 1994).

Summary: The Lake as a Commons

Garret Hardin, in his famous essay on the tragedy of the commons, observed that the quality of a shared resource will always be degraded when everyone has access, but no one has control or ownership. Resource degradation can only be averted, he argued, if the parties agree to some form of self-regulation in order to minimize their collective impact on the resource (Hardin, 1968).

In this sense, a lake is a classic example of a commons. Most of the residents in the watershed use the lake in some way, and all residents influence it directly through their impact on the watershed. The very qualities that attracted current residents to a lake are likely to lure new ones. As a consequence, most lakes will expe-
rience constant growth pressures along their shorelines and in their watersheds. An LPO is an effective framework for regulating the nature of development within the lake “commons.”

While lake communities often face tough choices about which precise criteria to apply within each of the four lake protection zones, they possess an inherent advantage when it comes to watershed protection. Most residents already place a high value on lake quality, whether it means natural scenery, good fishing, pure drinking water or a place to float. These shared values provide a strong foundation to reach a consensus for greater lake protection.

References


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North American Lake Management Society (NALMS). Website: www.nalms.org


September 22, 2008

Mr. Mark Eberlein  
Regional Environmental Officer  
U.S. Department of Homeland Security  
Federal Emergency Management Agency  
Region X  
130-228th Street SW  
Bothell, Washington 98021-97963755

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the on-going National Flood Insurance Program carried out in the Puget Sound area in Washington State. HUC 17110020 Puget Sound.

Dear Mr. Eberlein:

The enclosed document contains a biological opinion prepared by the National Marine Fisheries Service pursuant to section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), on the effects of certain on-going elements of the National Flood Insurance Program throughout Puget Sound in Washington State. This biological opinion is provided to the Federal Emergency Management Agency in accordance with the judicial order in \textit{NWF v. FEMA}, 345 F. Supp. 2d 1151 (W.D. Wash. 2004). This biological opinion is based on the information provided in the February 2006 Biological Evaluation, numerous meetings, and phone calls, emails, and letters exchanged on the program. A complete administrative record of this consultation is on file at the National Marine Fisheries Service’s Washington State Habitat Office in Lacey, Washington.

The National Marine Fisheries Service provides this biological opinion following consultation with the Federal Emergency Management Agency on effects of the National Flood Insurance Program on listed species found within the Puget Sound region, which are Puget Sound Chinook salmon (\textit{Oncorhynchus tshawytscha}), Puget Sound steelhead (\textit{O. mykiss}), Hood Canal summer-run chum salmon (\textit{O. keta}), Lake Ozette sockeye salmon (\textit{O. nerka}), and Southern Resident killer whales (\textit{Orcinus orca}). In the biological opinion, the National Marine Fisheries Service concludes that the proposed action is likely to jeopardize the continued existence of Puget Sound Chinook salmon, Puget Sound steelhead, Hood Canal summer-run chum salmon, and Southern Resident killer whales, and is likely to adversely modify Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, and Southern Resident killer whale critical habitat (Puget Sound steelhead critical habitat is not designated
at this time). The proposed action is not likely to jeopardize Lake Ozette sockeye salmon or adversely modify Lake Ozette sockeye salmon critical habitat.

As required under the Endangered Species Act for consultations concluding with Jeopardy and Adverse Modification determinations, the National Marine Fisheries Service discussed with the Federal Emergency Management Agency, the availability of a reasonable and prudent alternative that the Federal Emergency Management Agency can take to avoid violation of the Federal Emergency Management Agency’s Endangered Species Act section 7(a)(2) responsibilities (50 CFR 402.14(g)(5)). Reasonable and prudent alternatives refer to alternative actions identified during formal consultation that 1) can be implemented in a manner consistent with the intended purpose of the action, 2) that can be implemented consistent with the scope of the Federal agency's legal authority and jurisdiction, 3) that is economically and technologically feasible, and 4) that the Director believes would avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat (50 CFR 402.02) The biological opinion includes a reasonable and prudent alternative which can be implemented to avoid jeopardy and adverse modification of critical habitat, while meeting each of the other requirements listed above. Accordingly, the National Marine Fisheries Service prepared an Incidental Take Statement describing and exempting the extent of incidental take reasonably certain to occur under the reasonable and prudent alternative.

If you have questions, please contact DeeAnn Kirkpatrick of National Marine Fisheries Service’s Washington State Habitat Office at (206) 526-4452 or via email at deeann.kirkpatrick@noaa.gov.

Sincerely,

D. Robert Lohn
Regional Administrator

Enclosure
action:

- Reduced productivity and abundance and eventual extinction of PS Chinook salmon populations contributing to the whales’ prey base reduces the representation of diversity in life-histories, resiliency in withstanding stochastic events, and redundancy to ensure there is a margin of safety for the salmon and whales to withstand catastrophic events. These reductions increase the extinction risk of salmon and Southern Residents.

- Long-term extirpation of all populations of the PS Chinook salmon ESU, Hood Canal summer-run chum salmon ESU, and PS Steelhead DPS in addition to anticipated long-term population-level effects on non-listed salmonids would decrease the geographic continuity of salmon-bearing watersheds in inland waters, which would alter the movement of migrating salmon in space and time and increase the likelihood for localized depletions in prey.

- Adverse modification of PCEs of critical habitat for listed entities of salmon degrades the same habitat for non-listed salmonids. This habitat degradation is likely to reduce the long-term productivity and abundance of non-listed salmonids returning to watersheds across the State of Washington, further reducing prey available to Southern Residents.

The NMFS concludes that the proposed action is likely to appreciably diminish the likelihood of the Southern Resident’s survival and recovery by affecting their numbers, reproduction, or distribution, and significantly changes the conservation value of essential features of its critical habitat. It is, therefore, NMFS’ determination that implementation of the NFIP is likely to jeopardize the continued existence of the species and adversely modify critical habitat.

**Reasonable and Prudent Alternative**

During formal consultation, NMFS determined that the proposed action would jeopardize the continued existence of PS Chinook salmon, PS steelhead, Hood Canal chum salmon, and SRKWs. The proposed action would also destroy or adversely modify critical habitat for PS Chinook salmon, Hood Canal chum salmon, and SRKWs. Therefore, NMFS must discuss with FEMA, the availability of Reasonable and Prudent Alternatives (RPA) that FEMA can take to avoid violation of FEMA’s ESA section 7(a)(2) responsibilities (50 CFR 402.14(g)(5)). Reasonable and prudent alternatives refer to alternative actions identified during formal consultation that 1) can be implemented in a manner consistent with the intended purpose of the action, 2) can be implemented consistent with the scope of the Federal agency’s legal authority and jurisdiction, 3) are economically and technologically feasible, and 4) that the Director believes would avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat (50 CFR 402.02) This section presents FEMA with an RPA which can be implemented to avoid jeopardy and adverse modification of critical habitat, while meeting each of the other requirements listed above.

The RPA outlined below consists of modifications to the discretionary elements of the NFIP that
will prevent or minimize additional displacement of floodplain habitat important to the survival and recovery of listed species in the Puget Sound region. By minimizing future habitat losses and by utilizing its authorities to encourage the restoration of floodplain habitat through the removal of structures and other measures where feasible, FEMA can both avoid the likelihood of jeopardizing listed species through NFIP implementation and fulfill the NFIP’s purpose of reducing the risk of flood losses by encouraging land-use practices that constrict floodplain development.

The NMFS’ jeopardy and adverse modification determinations were based on the action’s effects on habitat and habitat forming processes essential to supporting salmon and steelhead life histories in riverine and floodplain portions of the watersheds surrounding Puget Sound. Therefore, an RPA needs to address the ways in which the action affects those habitats. The RPA is designed to guide future development away from floodplains that are essential to the recovery of listed species. The FEMA, working with local and state governments, will encourage appropriate land use decisions that constrict development of land that is exposed to flood risk. Implementation of the RPA will simultaneously reduce adverse effects to listed salmonid species and reduce risk of economic loss from flood events. Where development that harms species or habitat takes place, appropriate mitigation is required to restore habitat functions.

Reasonable and Prudent Alternative Element 1 -- Notification of Consultation Outcome.

The FEMA shall notify all NFIP participating communities in Puget Sound that development consistent with the NFIP jeopardizes listed Chinook salmon, chum salmon, steelhead, and killer whales based on potential take of listed fish, and the destruction or adverse modification of critical habitat. The notification will include information identifying communities that influence Tier 1 and Tier 2 fish populations (See Appendix 3). The notification will also suggest measures for avoiding and minimizing take including but not limited to, 1) recommending that communities voluntarily implement a temporary moratorium on floodplain development that adversely impacts species or their habitat, and 2) explaining that when jurisdictions adopt the criteria in RPA Element 3, they will have ESA coverage under the take exemption of this Opinion. This element is to be implemented within 30 days of the issuance of this Opinion.

This element informs all NFIP participating jurisdiction that rely on the NFIP minimum standards for their floodplain management ordinances that their current implementation will harm listed salmonids and adversely affect critical habitat. This information affords such jurisdictions the opportunity to take immediate steps to revise floodplain management practices and ordinances pro-actively to reduce or avoid such effects, and in many circumstances this action can be taken more quickly than FEMA’s implementation of some RPA elements. Earlier implementation would be beneficial to all listed species’ survival and recovery potential. Such notification is within FEMA’s jurisdiction, and requires only a moderate expenditure of resources.

20 Appendix 3 is a prioritized listing of fish populations intended to assist FEMA in focusing its RPA implementation efforts on areas most important to the survival and recovery of the listed species subject to this consultation. NMFS may revise this list as new information becomes available and will advise FEMA as to any revisions relevant to implementation of this RPA.
Reasonable and Prudent Alternative Element 2--Mapping.

The FEMA shall make the following changes to the mapping program of the proposed action to achieve the habitat-based objectives stated above, to avoid jeopardy of the species and adverse modification of the critical habitat. The FEMA shall implement the following changes to the mapping program within six months of the issuance of this Opinion, and report progress to NMFS on an annual basis on all sub-elements below.

A. The FEMA shall process Letters of Map Change caused by manmade alterations only when the proponent has factored in the effects of the alterations on channel and floodplain habitat function for listed salmon, and has demonstrated that the alteration avoids habitat functional changes, or that the proponent has mitigated for the habitat functional changes resulting from the alteration with appropriate habitat measures that benefit the affected salmonid populations. The FEMA will ensure that effects from habitat alterations that are reasonably certain to occur but might occur later in time, such as changes in storm water quantity, quality, and treatment, decreased riparian vegetation, lost large woody debris, increased bank armoring, and impaired channel migration, are also mitigated. The FEMA will report to NMFS on the results of mitigation for manmade floodplain changes that become the basis for map revision requests. During the time period subsequent to the issuance of this Opinion and prior to full implementation of this element, FEMA will engage in ESA consultation with NMFS prior to processing LOMCs related to manmade floodplain alterations.

B. The FEMA will prioritize their mapping activities based upon the presence of sensitive salmon populations as identified in Appendix 3.

C. The FEMA shall ensure that floodplain modeling incorporates on-the-ground data to increase the accuracy of maps depicting the floodplain. For multi-thread channels, FEMA shall produce and distribute a Technical Bulletin recommending the use of unsteady state hydraulic models to map the boundaries of the 100-year floodplain. In addition, FEMA will use a 2-dimensional model in estuarine floodplains and in other areas, when applicable.

The FEMA will also revise map modeling methods to consider future conditions and the cumulative effects from the issuance of this Opinion and prior to full implementation of this element, FEMA will engage in ESA consultation with NMFS prior to processing LOMCs related to manmade floodplain alterations.

D. The FEMA shall encourage communities to evaluate and identify the risk of flooding behind 100 year levees based on anticipated future conditions and the cumulative effects from future land-use change. Future conditions considered should include changes in the watershed, its floodplain, its hydrology, and climate change.
Taken together, these changes to the proposed mapping element of the NFIP contribute to avoiding jeopardy and adverse modification of critical habitat by increasing the accuracy of maps depicting floodplains, which are a habitat resource for salmonids. The changes also protect habitat function through the tracking of LOMRs, and requiring mitigation for LOMCs (FEMA would only issue LOMCs for man made changes when the for floodplain functional change is provided). The FEMA prioritization of mapping activities to focus on areas necessary to support VSPs means that the protection of floodplain resources for priority populations will occur earlier than in other locations. The RPA mapping element requires the use of more accurate computer models from those typically used under the proposed action, where appropriate to map the 100-year floodplain for multiple thread channels and estuarine floodplains, providing more comprehensive and accurate mapping of these resources in complex areas.

Tracking floodplain development and analyzing effects enables better application of habitat protection and mitigation measures. Assessment and analysis in the mapping process is likely to moderate land-use changes in floodplains providing functional salmon and steelhead habitat by either avoiding or mitigating for land use changes that affect salmon habitat. The FEMA can work with affected communities to adjust previous approaches to construction in these areas in response to their analysis of effects on the existing salmonid habitat value.

Refining the modeling used to identify complex channels enables FEMA to better protect salmon and their habitat in modeled areas by more accurately identifying floodplains. Prioritizing map updates in NFIP participating communities identified by NMFS as areas particularly important to conserving PS Chinook salmon, steelhead, and chum salmon, gives those communities the most accurate information possible with which to evaluate and respond to the effects of land use change and construction on listed species. Detailed maps also help protect salmon and steelhead habitat by enabling more refined application of minimum floodplain management criteria.

The mapping RPA element meets each of the other RPA criteria (economic feasibility, intended purpose of the action, and within the agency’s authority) in that the RPA element merely refines activities within the existing program to account more specifically for the effects of the mapping element on listed salmon and steelhead. The FEMA has four areas of discretion in their mapping program. These include the level of study performed in the FIS, including the designation of a regulatory floodway, review and issuance of CLOMRs, CLOMR-Fs and LOMAs, requirements associated with LOMRs and LOMR-Fs, and Map Modernization/Risk MAP. The RPA does nothing to exceed or abridge that authority. Therefore, actions described in the mapping RPA element are within the scope of FEMA’s legal authority for mapping actions and meet the intended purpose of the proposed action.

Reasonable and Prudent Alternative Element 3 – Floodplain Management Criteria

The FEMA shall modify its implementation of the NFIP minimum criteria in NFIP communities in the Puget Sound Region in order to prevent and/or minimize the degradation of channel and floodplain habitat, as described below. In addition FEMA will report progress to NMFS on an annual basis on all sub-elements below.
A. As soon as possible upon issuance of this Opinion, FEMA shall revise its implementation of the current NFIP minimum criteria so that the following measures, necessary for protecting listed salmonids, are carried out in the Puget Sound Region as described in Appendix 4 (Minimum Criteria) and summarized below:

1. Allow no development in the floodway, the CMZ plus 50 feet (as identified according to Ecology 2003), and the riparian buffer zone (RBZ, as described by the Department of Natural Resources 2007 stream typing system and WDFW’s 1997 stream buffer guidelines), and floodway (as mapped by the FIRM).

Or

2. The local jurisdiction with permitting authority must demonstrate to FEMA that any proposed development in the FEMA designated floodway, the CMZ plus 50 feet (as identified according to Ecology 2003), and the riparian buffer zone (RBZ, as described by the Department of Natural Resources 2007 stream typing system and WDFW’s 1997 stream buffer guidelines) does not adversely affect water quality, water quantity, flood volumes, flood velocities, spawning substrate, and/or floodplain refugia for listed salmonids.

3. In addition to either 1 or 2 above, either:
   a. Prohibit development in the 100-year floodplain,
   
   OR
   
   b. If development within the 100-year floodplain but outside the RBZ, is permitted, any loss of floodplain storage shall be avoided, rectified or compensated for. An example of compensation is the creation of an equivalent area and volume of floodwater storage and fish habitat through a balanced cut and fill program that provides fish refugia habitat and prevents fish stranding. Additionally, indirect adverse effects of development in the floodplain (effects to stormwater, riparian vegetation, bank stability, channel migration, hyporheic zones, wetlands, etc.) must also be mitigated such that equivalent or better salmon habitat protection is provided. (See Appendix 4 for more detail on how to comply with this criteria). Using option 3.A.3.b will require tracking the projects that occur and reporting to FEMA on a semi-annual basis (see 3.D. below).

For development within the 100 year floodplain permitted under 3.A.3.b, construction in the floodplain shall use Low Impact Development (LID) methods (generally requiring infiltration of all on-site stormwater), such as those described in the Low Impact Development Technical Guidance Manual for Puget Sound (Puget Sound Action Team and WSU/Pierce County Extension 2002) to minimize or avoid stormwater effects.

4. Any improvements or repairs to existing structures that result in a greater than 10 percent increase of the structure footprint must mitigate for any adverse effects to species or their habitat as described in 3.A.3.b.
B. The FEMA shall implement RPA Element 3.A by ensuring that all participating NFIP communities in the Puget Sound region implement land-use management measures consistent with the criteria as soon as practicable, but in no event later than three years from the date of this Opinion.

1. The FEMA shall focus its implementation efforts first on communities located in areas of “Tier 1” salmon populations, secondly on communities located in areas of “Tier 2” salmon populations, and then on the remaining Puget Sound NFIP communities (see Appendix 3 for an explanation of Tier 1 and 2 populations and a list of jurisdictions where they are located). The FEMA shall demonstrate compliance with the following benchmarks:

   a. Thirty-five percent of NFIP jurisdictions in the Puget Sound Region shall have implemented the criteria set forth in RPA Element 3.A within two years of this issuance of this opinion, including 100 percent of Tier I jurisdictions;

   b. Seventy percent of NFIP jurisdictions in the Puget Sound Region shall have implemented the criteria set forth in RPA Element 3.A within two and a half years of the issuance of this opinion, including 100 percent of Tier 2 jurisdictions; and

   c. One hundred percent of NFIP jurisdictions within the Puget Sound Region shall have implemented the criteria set forth in RPA Element 3.A within three years of the issuance of this Opinion.

2. Until all Puget Sound communities have implemented the criteria set forth in RPA Element 3.A, the FEMA shall report annually to NMFS on the status of its efforts to implement the RPA and the number of Puget Sound NFIP jurisdictions that have implemented the revised criteria.

C. Interim Actions. In the time period between the issuance of this Opinion, and the full implementation of RPA 3.A by participating communities, FEMA shall advise the Puget Sound NFIP communities that they must keep track of all floodplain permits that they issue and report this information to FEMA on an annual basis. The FEMA will provide this information to NMFS annually, highlighting any permits that allowed development affecting channel or floodplain habitat, or resulted in indirect effects to salmonid habitat from stormwater, removal of riparian vegetation, bank armoring, changes in the CMZ, large wood input, or gravel recruitment, etc. If NMFS finds that any unmitigated actions affecting listed species have occurred as a result of these permits, NMFS will advise FEMA to this effect, and FEMA will ensure that mitigation is provided prior to the next reporting period. Mitigation actions shall comport with those habitat restoration and enhancement actions consulted on in the programmatic consultation between NMFS and the COE, entitled Washington State Fish Passage and Habitat Enhancement Restoration Programmatic, NMFS Tracking No. 2008-03598.

D. Long term actions. Communities that have adopted the minimum criteria option allowing
equivalent cut and fill (3.A.3.b. above), must report to FEMA on the number of projects that take place in the floodplain and the effectiveness of the mitigation. If based on FEMA’s annual reporting, NMFS finds that the mitigation is not fully effective, FEMA shall ensure that further mitigation is provided for these actions through RPA Element 6 or through other means available to the community (e.g., mitigation banks) and shall reflect these actions in the next annual report. Mitigation actions shall comport with those habitat restoration and enhancement actions consulted on in the programmatic consultation between NMFS and the COE, entitled Washington State Fish Passage and Habitat Enhancement Restoration Programmatic, NMFS Tracking No. 2008-03598.

Under RPA Element 3, Floodplain Management Criteria, the performance measures for developing in the floodway, CMZ and RBZ will ensure that development within a designated riparian buffer zone (RMZ, measured from the OHW of the stream channel depending on stream type), the CMZ plus 50 feet, the mapped floodway, and the 100-year floodplain, will not result in adverse habitat effects. This will also allow activities with primarily beneficial effects to still occur within those zones. The NFIP as currently implemented allows development in the floodplain, the CMZ, and the riparian buffer, as long as it is at or above the BFE. The NMFS expects that this part of the RPA will prevent further degradation of channel function and estuarine and freshwater floodplain function in areas that would otherwise be prone to new development, thus maintaining the current value of the habitat in the RBZ and 100-year floodplain for listed salmon.

If communities choose to address impacts with equivalent cut and fill measures, development will be allowed in the floodplain with accompanying mitigation (similar area and volume of habitat and flood storage are provided to protect listed salmon and habitat). In addition, no unmitigated effects from floodplain development are allowed arising from changes in stormwater discharge, riparian vegetation, channel migration, large wood input, gravel recruitment, the hyporheic zone, wetlands, and bank stability. The NMFS expects that this option will provide protection equivalent to the no development in the floodplain criteria in most cases, thereby maintaining the value of existing habitat in areas of new development. If NFIP and FEMA annual reporting reveals that equivalent protection is not provided, NMFS shall advise FEMA, and FEMA or the community are responsible for providing the remaining mitigation through either RPA Element 6, or other means available to the community.

For both minimum criteria options, the use of LID (Low Impact Development) methods to minimize increased volumes and decreased water quality of stormwater from development is required. As currently implemented, the NFIP does not specify any requirements for stormwater management in the floodplain, even though increased stormwater runoff from development contributes to increased streams flows that cause flood damage, and to decreased water quality during flood events. This requirement for stormwater control and treatment will minimize the effects on both water quality and quantity from new development, as LID methods will require infiltration and dispersion of stormwater runoff to duplicate the frequency, timing, duration and quality of pre-development (historic) stormwater discharges.

The RPA at element 3 also addresses re-development of existing buildings in the floodplain by addressing the effects of re-development of structures that exceed ten percent of the current
footprint instead of the 50 percent of market value, which is currently allowed. The NMFS expects this will minimize the adverse effects of re-development associated with existing buildings in the floodplain, thereby further minimizing the effects on critical habitat and listed species. In addition, any re-development in the floodplain requires mitigation for all direct and indirect effects of re-development.

The FEMA must report to NMFS on their progress in meeting timelines and benchmarks for implementing the revised floodplain management criteria and ensuring communities adopt these criteria as soon as possible, and in no event later than the specified deadlines. These timeline and benchmarks are intended to ensure that protection is provided to channel and floodplain habitat and listed salmon species in a timely manner. In addition, FEMA will provide floodplain permit information to NMFS on an annual basis, until the new criteria are fully implemented, highlighting any permits that allowed development affecting channel or floodplain habitat, or resulted in indirect effects to salmonid habitat from stormwater, removal of riparian vegetation, bank armoring, etc. If NMFS finds that any unmitigated actions affecting listed species have occurred as a result of these permits, FEMA will ensure mitigation for these actions through RPA Element 6.

Also, communities will provide information to FEMA on a semi-annual basis, documenting the projects that took place in the floodplain using the mitigated equivalent cut and fill option. Communities will report on the expected effects to listed salmon habitat, the planned mitigation to compensate for the effects, and the success of the mitigation outcome. If the mitigation is found to not provide equivalent compensation for effects, the community or FEMA is responsible for providing additional mitigation to address the shortfall in habitat function. Providing this shortfall protection will ensure that development that occurs in the floodplain will provide habitat function similar to the no development in the floodplain criteria, thereby maintaining the value of existing habitat in areas of new development. This step is necessary as several scientific publications document the limited success of compensatory mitigation to date, particularly for wetlands (National Academy of Sciences 2001, Washington Department of Ecology 2001). Evaluating the results also provides an opportunity to adapt actions and/or implement alternatives to more effectively maintain habitat function in the 100-year floodplain (e.g., increasing mitigation ratios, more monitoring, etc.).

This RPA element meets each of the other RPA criteria (intended purpose of the action, within the agency’s authority, and economic feasibility) in that the RPA element merely refines activities within the existing program to account more specifically for the effects of the minimum criteria on listed salmon and steelhead. This RPA element is consistent with the intended purposes of the NFIP as these measures would constrict the extent of new development in the floodplain, achieving a decrease of property exposed to flood damage. The minimum criteria actions would limit development of the floodplain or provide equivalent mitigation for development in the floodplain (preventing more structures from being at risk of flooding and preserving salmon habitat), maintaining or minimizing stormwater runoff inputs to rivers (maintaining flood severity or frequency of floods and water quality), and maintaining currently functioning riparian corridors, CMZs, and bank stability.
According to the BE and the governing law, FEMA has discretion in establishing the minimum floodplain management criteria. The NFIA states that the purposes of the minimum criteria are to: (1) constrict the development of land which is exposed to flood damage where appropriate, (2) guide the development of proposed construction away from locations which are threatened by flood hazards, (3) assist in reducing damage caused by floods, and (4) otherwise improve the long-range land management and use of flood-prone areas. 42 U.S.C. 4102(c). Also, the statute indicates that FEMA is to revise the criteria “from time to time.”21 Id. Therefore, actions identified in the minimum criteria element of the RPA are all within FEMA’s legal authority.

Finally, many of the measures in this RPA element have already been suggested and/or supported by FEMA’s own Model Floodplain Ordinance (FEMA 2002a). As such FEMA has demonstrated its finding that they are economically feasible. Furthermore, they are addressed in other scientific and technical literature on the subject (see for example, Association of State Floodplain Managers 2007, among others). Also, many of the RPA minimum criteria elements are already carried out by NFIP participating communities such as King and Pierce counties, under their own local authorities, further demonstrating their economic feasibility.

Reasonable and Prudent Alternative Element 4 -- Community Rating System.

The FEMA shall make the following changes to the CRS to achieve some or all of the habitat-based objectives stated above, within 9 months following the issuance of this Opinion by providing examples and models on specific elements of the CRS, and through newsletters, meetings, e-mails, etc. (e.g., the CRS class offered spring 2009). In addition FEMA will work with NMFS to ensure that the next version of the CRS manual (2011), will incorporate these new requirements.

A. Change CRS stormwater credits to create an incentive for the use of Low Impact Development (LID) methods (decreasing the need for added stormwater treatment) in the floodplain, per the Low Impact Development Technical Guidance Manual for Puget Sound (PSAT 2005).

B. Change the CRS point awards to increase the number of points available for preservation of open space where listed species are present, giving additional credits for areas to be preserved that have been identified in NMFS adopted salmon recovery plans.

C. Change the CRS criteria to award points for retaining and increasing riparian functions, particularly in areas where riparian function has been identified as a limiting factor for listed ESUs by the limiting factors analysis in salmon recovery plans. (For example, on the White River and lower Skagit for PS Chinook salmon populations and on Salmon and Snow Creeks for Hood Canal summer chum salmon populations, riparian function has been identified as a most influential limiting factor, that is currently in poor condition) (see Appendix 1).

21 FEMA’s regulations provide that, when FEMA revises the criteria, communities have six months within which to revise their floodplain management regulations to meet the new criteria. 44 CFR 60.7.
D. Change the CRS point awards to reduce the number of points available for structural changes that reduce the amount of functional floodplain, such as levees, berms, floodwalls, diversions, and storm sewer improvements, including enclosing open channels and constructing small reservoirs.

E. Award points for setting levees back (moving levees out of the CMZ and/or as far away from the channel as possible) and restoring riparian and floodplain function. Points shall also be awarded for dismantling pre-existing levees in part or whole, in order to restore floodplain function in the reconnected floodplain, when such action is part of a comprehensive flood damage reduction plan.

F. Increase CRS criteria and credit for encouraging pre-FIRM development to move out of the floodplain.

G. In conjunction with NMFS, FEMA shall encourage the use of levee vegetation management maintenance practices that benefit listed salmonids under Activity 620. The FEMA shall clarify and emphasize that when levee owners document NFIP levee maintenance as part of annual CRS recertification, professional engineers other than the COE can serve in this capacity. This may enable jurisdictions to retain larger woody vegetation on levees for the benefit of listed salmonids, and receive the maximum number of CRS credits under Activity 620.

H. Include a category of actions that benefit listed salmonids, and weight these credits so that communities seeking CRS class improvements will have incentive to choose actions that are beneficial to salmon in order to achieve such class improvement.

I. Add CRS criteria to credit communities that implement an active buyout program for purchasing and removing buildings from the floodplain, for acquisition of property, flood easements, and/or development rights to preserve open space areas of floodplain.

The CRS RPA element upgrades the CRS criteria, increases credits for actions beneficial to salmon, and decreases credits for actions that are detrimental to fish. Participation would be voluntary but encouraged through potential decreases in flood insurance rates and decreased extent of property exposed to potential flood damage. These changes combine to provide communities with incentive to minimize the effects of stormwater runoff generated by NFIP-covered development and construction in the floodplain. In addition, the CRS RPA element would encourage open space and riparian vegetation preservation, discontinue the maintenance of small levees, move levees farther away from the channel, receive maximum CRS credits for maintaining levee vegetation that benefits listed salmonids, and implement a property buyout program that would decrease the extent to which previously insured, flood damaged property is rebuilt. Simultaneously, the CRS would reduce the incentive to construct new levees and other flood control structures. As well, the CRS program would emphasize actions beneficial to listed salmon and steelhead, by including a category of actions beneficial to salmonids and weighting credits in that category to provide an incentive for communities to implement those activities. Taken together, all of these changes would enable certain floodplain functional processes to improve supporting each of the salmonid lifestages supported in those places. These habitat-
based objectives would be accomplished through decreasing constraints on channel migration leading to increased channel complexity and the creation of off-channel refugia from high flows that are especially important to juvenile salmon. Increased riparian vegetation reduce water temperature, increase bank stability, cover, detritus and food availability, and recruit large wood (in some cases, at some point in the future). Improving these processes increases the ability of those places to better support salmonid life histories that occur there.

This RPA element is consistent with the intended purposes of the NFIP as these measures would constrict new development in the floodplain, achieving a decrease of property exposed to flood damage. The CRS-creditable actions could include minimizing stormwater runoff inputs to rivers (potentially decreasing flood severity or frequency of floods), move development out of the floodplain (reducing the number of structures at risk of flooding), and moving levees away from the channel (increasing low velocity flood storage areas, rather than confining and moving flood flows downstream at high volumes and velocities).

The CRS criteria and credit rating system are largely discretionary. Therefore, the CRS element of the RPA (requiring revisions to some of the credit points and credit criteria), are all within FEMA’s authority. Also, an express purpose of the CRS program, as stated by Congress, is to “encourage the adoption of measures that protect natural and beneficial floodplain functions,” which supports the conclusion that FEMA has discretion to adapt the program so as to protect listed species and their habitats.

Finally, many of the measures in this RPA element have already been suggested and/or supported by FEMA’s own Model Floodplain Ordinance (FEMA 2002a). As such FEMA has demonstrated its finding that they are economically feasible. Many of RPA elements are already carried out by NFIP participating communities under their own local authorities, where they are classified as exceeding the NFIP minimum criteria, and often earn credits under the CRS program. As such, this RPA element is also consistent with the intended purpose of the proposed action and within FEMA’s agency authority to implement.

Reasonable and Prudent Alternative Element 5 -- Addressing the Effects of Levee Vegetation Maintenance and Certain Types of Construction in the Floodplain. To address the effects of these two factors, FEMA shall make the following changes to the proposed action to achieve some or all of the habitat-based objectives described above. In addition, FEMA will report progress to NMFS on an annual basis on all sub-elements below. These elements shall be implemented within one year from the date of this Opinion.

A. The FEMA shall not recognize levees that are certified by the COE utilizing COE vegetation standards unless it is demonstrated that the standard will not adversely affect species or their habitat.

B. The FEMA shall revise their procedure memoranda to reflect that levee owners that opt for an increased levee vegetation standard that removes them from the PL 84-99 program shall not be disqualified from emergency funding for repairs from flood damage if the levee is otherwise certified by a professional engineer. These memoranda shall be revised and adopted within one year of issuance of this Opinion.
C. To address the contribution of increased runoff and modified flood hydrographs from development, FEMA shall use and encourage grantees to use Hazard Mitigation grant funding and the Flood Mitigation Assistance Program for projects that reduce flood risk and also benefits salmonids, such as floodplain acquisition, purchase of floodplain development rights, levee setbacks, and/or creation of flood easements, placing priority on lands identified for salmon recovery (by salmon recovery plans). For example, in Salmon and Snow Creeks, increases in peak flows are a limiting factor for Hood Canal chum salmon, that lead to scour of redds in both creeks Appendix 1). The number of projects completed each year shall be reported to NMFS for the first three years of implementing the RPA.

D. Recognize new levees and floodwalls only if they include all of the following features:

- the natural channel migration pattern remains intact (or if presently confined, is allowed to expand to its natural pattern),
- bioengineering methods are used to stabilize the banks,
- large wood is incorporated into the levee setback area,
- riparian vegetation is included in the design, and
- no increase occurs to upstream and downstream flood levels, volumes and velocities.

These RPA changes to the proposed action addressing vegetation management issues require FEMA to recognize only vegetation management standards that enable the riparian vegetation to function in support of salmon habitat forming processes. Some of the habitat processes that occur in riparian habitat are listed above, including temperature maintenance, bank stability, food and cover for rearing and migrating juvenile salmon. Under the RPA, levee owners that maintain riparian vegetation would remain eligible for funding for flood repairs, eliminating the existing incentive to denude levees of even minimally functional riparian vegetation.

Furthermore, FEMA would encourage Washington state to prioritize funding for floodplain acquisition, purchase of development rights, levee setbacks, and creation of flood easements in areas identified in salmon recovery plans that have already been reviewed and approved by NMFS as supporting the conservation of affected populations of PS Chinook salmon and Hood Canal chum salmon. The combination of recognizing new levee vegetation standards and funding for flood repairs will encourage more levee owners to follow FEMA standards instead of COE standards, which will increase riparian function and the quality of salmon habitat. The NMFS also expects increased funding for floodplain–related projects will speed up the process of acquiring and/or protecting these important lands, and aid in salmon recovery. And, any new floodwalls and levees recognized by FEMA would not be allowed to confine channel dynamics, or alter flood flows and habitat elements that are necessary for salmon survival and recovery.

These changes to the NFIP are both within the intended purpose of the NFIP and within FEMA’s authority under the NFIP. Under its existing regulations, FEMA has discretion to recognize “fish friendly” vegetation maintenance standards in 44 CFR 65.10. Furthermore, FEMA has policy authority (“Policy for Rehabilitation Assistance for Levees and Other Flood Control Works -No. 9524.3”) regarding eligibility for emergency repair funding. The FEMA has authority to access Hazard Mitigation grant funding under the Stafford Act, even though it is a separate law from the NFIA, as the ESA states that action agencies shall use their authorities to further the purposes of the ESA. And FEMA has the direct authority to use Flood Assistance Account Program for
Reasonable and Prudent Alternative Element 6 -- Floodplain Mitigation Activities
For any development actions in floodplains proceeding consistent with current NFIP requirements, that occur during the period prior to full implementation of RPA elements 2, 3, and 5, and that degrade channel or floodplain habitat in NFIP communities (including from the indirect effects of development in the floodplain), and for any development for which FEMA, in coordination with NMFS pursuant to RPA 3 finds that additional mitigation is necessary, FEMA shall ensure that appropriate mitigation occurs. For example, FEMA may assist in floodplain mitigation/restoration activities as identified in the PS Recovery Plan, via contribution of financial, technical, or physical (labor or equipment) support. The FEMA shall focus floodplain restoration activities and assistance first in Tier 1 areas, to provide the most significant habitat protections. Mitigation actions shall comport with those habitat restoration and enhancement actions consulted on in the programmatic consultation between NMFS and the COE, entitled Washington State Fish Passage and Habitat Enhancement Restoration Programmatic, NMFS Tracking No. 2008-03598.

This RPA element is intended to mitigate for effects from any NFIP actions that occur during implementation of RPA elements 2, 3, and 5 that degrade channel or floodplain habitat in NFIP communities, including from the indirect effects of development in the floodplain. This mitigation RPA element provides a mechanism for ensuring that if unmitigated development takes place in the floodplain during the interim period while the RPA is being implemented, that the loss of those floodplain and habitat functions will be mitigated by either FEMA or the community where the development occurred. In concert with RPA elements 7 (monitoring) and 1 (notification), this element is intended to address the possible increase in development in floodplains resulting from the implementation of stricter floodplain requirements, and provide equivalent mitigation for direct and indirect impacts to the channel and floodplain. This element, together with RPA 3.D. will also ensure that mitigation efforts function effectively over the long term. The FEMA has authority to access Hazard Mitigation Grant Funding under the Stafford Act, and the Flood Assistance Account Program for floodplain related actions. As such this RPA element meets the RPA criteria of being within the agency’s authority, the intended purpose of the program, and the economic feasibility.

RPA Element 7 -- Monitoring and Adaptive Management
The FEMA shall report to NMFS on an annual basis regarding progress on meeting timelines and implementing RPA elements 1-6 and all sub-elements as specified above. As a result of this review, NMFS will determine, in coordination with FEMA, if some alternate actions or additional changes in RPA elements are needed to avoid jeopardy and adverse modification of critical habitat. This will be particularly important in assessing on-the-ground NFIP effects that are occurring, such as continued development in the floodplain, through either issuance of LOMCs or floodplain development permits. If NMFS determines that adverse effects to channel and floodplain habitat were not avoided or not mitigated as intended as a result of NFIP actions, FEMA will ensure that mitigation for these floodplain and/or channel impacts is provided consistent with RPA element 6, described above.

This monitoring and adaptive management RPA element provides a mechanism to check on
three components of FEMA’s progress in avoiding jeopardy during the implementation of the RPA: 1) checking on FEMA’s success in meeting the timelines for implementing each element of the RPA, 2) evaluating whether additional or alternate actions are needed to achieve the same outcomes as the original RPA elements, and 3) determining whether NFIP actions have avoided or mitigated effects to salmon habitat in floodplains in the interim period, while the longer term RPA actions are being fully implemented. This last component is in part intended to address the concern that more rapid development may take place in floodplains during this period when pending change in regulations would restrict floodplain development. The combination of RPA element 1 (notifying communities regarding their take liability) and RPA element 7 (keeping track of development actions during the interim period) is expected to decrease the rate and extent of development in the floodplain during this period following the issuance of this Opinion. If floodplain development is not being avoided or mitigated, restoration actions must be implemented (RPA element 6). This RPA element meets the intended purpose of the action as development in the floodplain would only occur if all effects to salmon habitat are mitigated, and if this is the case, development would be reasonably safe from flooding. This RPA element is within the Agency’s authority and is economically feasible, as it is only checking on implementation of the program as it moves toward addressing more specifically the primary effects of the mapping and minimum criteria elements of the program on listed salmon and steelhead.

Findings on the Reasonable and Prudent Alternative. A reasonable and prudent alternative to the proposed action is one that avoids jeopardy by ensuring that the action’s effects do not appreciably increase the risks to the species’ potential for survival or to the species’ potential for recovery. It also must avoid destruction or adverse modification of designated critical habitat. The alternative action must also be 1) consistent with the intended purpose of the action, 2) within the scope of the Federal agency’s legal authority and jurisdiction, and 3) economically and technologically feasible. The discussion above includes an element-by-element explanation of how the RPA meets these standards. This section contains supplemental information showing that the combined RPA elements meet these requirements.

The RPA avoids jeopardy to listed salmonids and Southern Resident Killer Whales. There will be a period of time during which FEMA will have to undertake revisions to its implementation of the NFIP in order to fully implement the RPA. Therefore, NMFS must ensure in its evaluation of the RPA, that any adverse effects that occur during the implementation period will also avoid jeopardy to listed species.

The RPA at element 2, changes to floodplain mapping, will occur within six months of the issuance of this Opinion. After that time, FEMA will not process LOMCs based on manmade floodplain alterations unless the proponent demonstrates that any adverse habitat effects are mitigated. Prior to full implementation, FEMA will continue to engage in ESA 7(a)(2) consultations with NMFS on LOMCs (as they have done during this consultation process), which will provide a mechanism for ensuring that any mitigation necessary to avoid jeopardizing listed species will be required during the implementation period. Other provisions of RPA element 2 are aimed at improving the long-term accuracy of FEMA’s floodplain mapping program. The NMFS does not believe that measurable adverse effects will accrue during the six month implementation period for these mapping elements because: (1) the amount of development in
floodplains that is likely to occur in the six months following the issuance of this Opinion is likely to be significantly lower than the human population growth rate, due to current conditions of economic downturn; and (3) this anticipated low level of degraded or lost floodplain function could diminish carrying capacity where it occurs, but only influences the short term risk of jeopardy in those landscapes that affect habitat of Tier 1 fish populations.

The RPA at element 3 includes an implementation schedule that ensures that the most sensitive (Tier 1) populations will obtain the benefit of the enhanced floodplain management criteria within one year of the issuance of this Opinion; Tier 2 populations will obtain those benefits within two years; and all populations within three years. While floodplain development adversely affecting these populations could occur during the implementation period, mitigation for such effects would be required under RPA elements 3, and 6, thereby ensuring that overall habitat function is retained. The Incidental Take Statement provided with this Opinion contains an estimate of the amount of land that may be adversely affecting by floodplain development during the implementation period, as follows:

- Whatcom County at the rate of 2.1 percent per year over 72.6 square miles of floodplain, equaling a loss of approximately 1.5 square miles of floodplain per year.
- Skagit County at the rate of 1.9 percent per year over 180.9 square miles of floodplain equaling a loss of approximately 3.4 square miles of floodplain per year
- Mason County at the rate of 1.6 percent per year over 56.9 square miles of floodplain equaling a loss of approximately .9 square miles per year
- Kitsap County at the rate of .7 percent per year over 7.6 square miles of floodplain equaling a loss of approximately 0.05 square miles
- Clallam County at the rate of .3 percent per year over 77 square miles of floodplain equaling a loss of approximately 0.2 square miles per year
- Jefferson County at the rate of .8 percent per year over 33.8 square miles of floodplain equaling a loss of approximately 0.2 square miles per year
- Island County at the rate of .9 percent per year over 8.9 square miles of floodplain equaling a loss of approximately 0.08 square miles per year
- San Juan County at the rate of 2.7 percent year over 9.6 square miles of floodplain equaling a loss of approximately 0.2 square miles per year
- Snohomish County at the rate of 2.2 percent year over 116 square miles of floodplain equaling a loss of approximately 2.5 square miles per year

In the above jurisdictions, NMFS estimates that the degradation or loss of a given percentage of 100-year floodplain habitat will expose a percentage of the fish from populations that rely on those habitats, to unfavorable conditions during 100 year flood events. Although the RPA requires that these impacts be mitigated, habitat losses that occur prior to the implementation of the mitigation may adversely affect fish populations, if 100-year or lesser flood events occur during that time-frame.

The NMFS assumes that because juvenile Chinook salmon prefer edge habitats, and salmonids with protracted life history in freshwater environments rely on floodplains for refugia from high volume and velocity floodwaters, that the percentage of a fish population exposed to degraded or diminished floodplain refugia could be very high. Of the percentage of fish from a given
population exposed to floodplain habitat loss or degradation through floodplain development, a subset would be injured or killed, but this percentage is impossible to estimate given the distribution of fish within the inundated area will not be uniform and the reduction in floodplain function would not affect all individual fish equally. Applying the basic biological principle of carrying capacity, NMFS assumes that the percentage of floodplain degradation will result in a comparable percentage of harm among juveniles of the fish populations exposed to the modified habitat during the base flood. By this, NMFS means that the likelihood of injury or mortality is increased due to behavioral changes in the juvenile fish, resulting from changes in the floodplain habitat, at a 1-to-1 ratio of harm to habitat degradation.

The likelihood of a “base flood” that would inundate the 100 year floodplain is predicted by FEMA at one percent chance of occurrence per year (smaller flood events occur with greater frequency, which will also expose fish to effects of floodplain habitat loss or degradation, though less extensively because the duration of inundation shorter and amount of landscape inundated is smaller). Because the prioritization for implementing the RPA requires that communities affecting Tier 1 populations implement the revisions within one year, the chance that fish will be exposed to unmitigated floodplain development in any particular location influencing Tier 1 populations, is only one percent. Due to the small amount of floodplain habitat anticipated to be affected during the implementation period, the low likelihood of a significant flood event in any given location, and the required mitigation measures, NMFS does not believe that adverse habitat effects during the implementation period for RPA 3 will rise to a level that will appreciably reduce the survival or recovery of the listed species.

The RPA at element 4, changes to the CRS program, must be implemented within nine months of the issuance of this Opinion. The CRS changes are expected to provide benefits to listed species over the long term, by providing incentive for communities to undertake actions that enhance salmonid habitat. Because the CRS program is voluntary, NMFS does not rely heavily on RPA 4 in this 7(a)(2) analysis. The NMFS does not believe that appreciable adverse effects will accrue to listed species during the nine month implementation period, because most elements of the CRS have beneficial effects to salmonid habitat, and few elements have adverse effects. Few Puget Sound communities that participate in the CRS are currently implementing those CRS elements with adverse effects to salmonid habitat habitat (Dan Sokol, pers. comm. Sept. 17, 2008).

The RPA at element 5 contains a number of sub-elements that will be phased in over a 1-year period. Levee vegetation and new levee and floodwall standards consistent with RPA elements 5.A, 5.B, and 5.C are expected to result in enhanced edge shoreline habitat, increasing the value of habitat for juvenile rearing as the RPA is implemented. Although the status quo may be retained during the one-year implementation period, NMFS believes that any short-term adverse effects will be offset by long-term habitat improvements, as the revised levee and floodwall standards are implemented. Also element 5.C will ensure that Hazard Mitigation grant funding and the Flood Mitigation Assistance Program are used for projects that both reduce flood losses and enhance floodplain habitat, which NMFS expects will result in long-term benefits to listed species.
The RPA at elements 6 and 7 require mitigation for any otherwise-unmitigated adverse effects that occur during the implementation period, as well as a monitoring and adaptive management program to ensure that both interim and long-term mitigation actions function as intended. These elements provide further assurance that any manmade floodplain alterations that occur during the RPA implementation period would not be likely to appreciably reduce the survival or recovery prospects of the species subject to this consultation.

After full implementation of the RPA, the rate of floodplain development is expected to slow across all NFIP jurisdictions, and losses of floodplain habitat are expected to be mitigated by creation of additional floodplain storage areas designed to afford fish refugia during riverine and estuarine flooding. The NMFS expects that there will be a degree of temporary degradation to floodplain habitats during the period of time that the mitigation floodplain areas become successfully revegetated to provide the full range of habitat values (e.g., preybase). This may result in a small amount of injury or mortality among juvenile fish seeking floodplain refugia, over a period of roughly 5 years in each mitigation site, while plantings become established to create fully functional floodplain refugia for listed fish; the amount of mortality or injury attributable to the individual mitigation sites will be variable, and will depend in part upon the quality of the habitat that the mitigation site is replacing. Changes in instream conditions and channel characteristics arising from floodplain development (due to stormwater contaminants, increased velocity and volumes during floods, and decreased baseflows from interrupted by horheic recharge) are expected to remain relatively static after the RPA is fully implemented.

The RPA elements requiring floodplain preservation through more stringent minimum floodplain management criteria, when combined with more accurate mapping of floodplains, together would maintain functional floodplain and channel habitat at close to current levels in undeveloped floodplains throughout Puget Sound. The RPA elements requiring mitigation for effects to salmon habitat caused by development allowed in the floodplain and CMZ, may enhance survival among juvenile salmonids by creating more floodplain refugia in suitable habitat areas, even as floodplain development removes refugia in degraded locations. Together, by revising the floodplain mapping and floodplain development criteria, degradation and loss of floodplain function and connectivity as limiting factors will not be further aggravated. By preserving current levels of floodplain function and connectivity, the risk to survival of listed salmonids from FEMA’s NFIP program implementation will not increase. Protecting these floodplain areas from additional development is particularly important given the expected increases in flood frequency and severity caused by new development and climate change as cumulative effects.

In existing developed areas of the floodplain, future adverse effects to floodplain and channel habitat would be minimized compared to current land use practices, however even current levels of floodplain function would not be maintained even with the more stringent minimum standards. The RPA at element 5 over the long term, will increase riparian function and enlarge areas of floodplain function, as existing levees are moved farther away from the channel, and levee vegetation management enhances riparian function. The RPA element 5 requirements to mitigate for stormwater runoff will result in retention of flood storage and conveyance areas, and will minimize the impact of watershed changes which normally increase the severity and frequency of floods, flood damage, and habitat damage in the action area. Mitigation for
development in floodplains (RPA element 3) and mitigation in floodplain areas affecting Tier 1 Chinook salmon populations will create habitat over the baseline condition, and the alleviation of some degree of disconnected floodplain and or degraded floodplain condition. Because these actions will restore conditions that improve productivity and abundance among populations that are at high risk of extirpation themselves, and which provide significant contribution of viability elements to the overall ESUs, these mitigation actions effects will increase the likelihood of salmonid recovery. Improved likelihood of salmonids recovery creates a corollary increase in the likelihood of SRKW recovery due to the improvements to preybase availability throughout much of the SRKW habitat.

Together, each of these sub-elements add up to changes in the proposed action so that the NFIP would avoid jeopardy (decrease risks to survival potential and recovery potential) of PS Chinook salmon, PS steelhead, Hood Canal chum salmon. By avoiding jeopardy to salmonids, the primary prey of and SRKWs, jeopardy to SRKW is also avoided.

The alternative avoids the destruction or adverse modification of critical habitat of salmonids and Southern Resident Killer Whales. The RPA also avoids the destruction of PS Chinook salmon, Hood Canal chum salmon critical habitat because several RPA elements both slow the rate of loss, and limit the amount of loss, of floodplain connectivity, a primary constituent element of critical habitat. Other RPA elements require enhancement of floodplain connectivity, and the improvement of that PCE will in turn improve the conservation value of critical habitat where those improvements occur. Other PCEs that will be maintained or improved through the RPA are water quality, water quantity conditions, riparian habitat conditions, and channel function through habitat forming processes that will be preserved and enhanced by both the more stringent minimum criteria and the mitigation requirements of the RPA. The RPA also avoids adverse modification of SRKW critical habitat by preserving and enhancing the salmonids preybase, prey being a primary constituent element of SRKW critical habitat.

The alternative is consistent with the intended purpose of the NFIP. The primary purposes of the NFIP is to reduce the risks of flooding to life and property by encouraging development away from property within the one percent per year flood hazard landscape, and to reduce government costs in the repair of post flood conditions by requiring insurance among those who live in the one percent per year flood hazard landscape. The RPA is consistent with both of these purposes by identifying more accurately where the likelihood of flooding exists, and then by making future development in such locations less likely to occur. In this way, those who should be insured will be identified and this will assist in shifting more recovery costs away from the government; less development in floodplains means less property and fewer lives will be exposed to flood risks. Furthermore, when FEMA requested consultation on the proposed NFIP, the agency identified the range of its discretion in administering the NFIP, in the consultation initiation package. When developing the RPA, NMFS considered information in the initiation package, in addition to FEMA’s express statutory and regulatory authority for each aspect of the NFIP program that NMFS analyzed in making the jeopardy and adverse modification determinations.

The alternative is economically and technologically feasible. Many RPA elements will involve additional administrative responsibilities for FEMA, such as tracking floodplain development,
evaluating mitigation activities, and reporting to and coordinating with NMFS. This may require moderate expenditures of additional resources. Almost all RPA elements regarding the minimum criteria were drawn from FEMA’s own publication on higher regulatory requirements designed to safeguard aquatic habitat conditions for fish, which was drafted with the assistance of the Services as an ESA 7(a)(1) effort. Many RPA elements are currently practiced by local jurisdictions in Washington State. The FEMA and COE partnership for Map Modernization currently focuses on digitizing current maps, and verifying whether levees provide sufficient protection against the 100 year flood to be identified as the edge of the 100 year floodplain. To implement RPA elements on mapping, FEMA could redirect its map modernization fiscal and staff resources to more correctly identifying where the risk of the 1 percent chance flood will occur, rather than merely digitizing old and potentially inaccurate maps.

Based on these considerations and the foregoing description of the RPA, NMFS finds that the RPA meets each of the criteria stated at 50 CFR 402.02.

**Incidental Take Statement for the Reasonable and Prudent Alternative**

Listed fish species occur in the action area and are exposed to the effects of FEMA’s NFIP implementation. The NFIP sets the criteria for identifying floodplains and mapping them. The NFIP also sets the minimum standards used by participating cities and counties to manage development in floodplains. Taken together, these program elements result in the modification of habitat and the habitat forming processes that fish rely on to express their normal behaviors and life histories. Some exposed individuals will respond to these habitat effects by changing normal behaviors; in some cases to their detriment. Some fish will be injured by changed habitat conditions, and some will die because of habitat changes affected by NFIP implementation. The habitat modification caused by the NFIP include adverse effects on water quality (contaminants causing olfactory inhibition, impairing prey-base, and increasing sub-lethal health effects) and adverse effects on water quantity conditions in streams and river channels (scouring out suitable spawning substrate, increasing fine sediment load, excess velocity and volume fatiguing and flushing out juvenile fish, insufficient summer flows), as well as declining function in, and declining amounts of, floodplain habitat (increasing mortality among juveniles that require but cannot find flood refugia). Take will continue to occur from these sources at a rate generally consistent with past rates of development-related adverse effects until the RPA is implemented. Such take of listed fish is not the purpose of the proposed action, but is incidental. The rate of incidental take will decline as the RPA is implemented.
The NMFS must estimate the extent of take expected to occur from implementation of the RPA so as to frame the limits of the take exemption provided in this Incidental Take Statement. These limits set thresholds which, if exceeded, would be bases for reinitiating consultation. Despite the use of best scientific and commercial data available, NMFS cannot quantify the specific number of adult or juvenile fish, or incubating eggs, or fry, that would be injured or killed by implementation of the NFIP RPA. Assessing the number of animals injured or killed by implementing the NFIP RPA is not possible because FEMA’s implementation of the NFIP RPA will occur over an period of time, during which time the presence of listed fish is variable, the numbers of fish that will occur in any given cohort of fish are also highly variable, and the number of exposed animals and the susceptibility of those fish to injury or death is highly variable and unpredictable. In contrast, the extent of habitat likely to be affected by the NFIP RPA can be estimated. In cases where specific numbers of animals injured or killed cannot be estimated, NMFS quantifies the extent of take by identifying geographic and temporal limits for take.

The following sections of this document describe the extent of take that NMFS anticipates will occur as a result of the Proposed Action as modified by the RPA. If actual take exceeds an amount or (geographic and temporal) extent specified here, the exemption from the prohibition on take will be invalid for that excess amount, and re-initiation of consultation will be required.

**Method for Calculating the Extent of Take**

NMFS expects that take from habitat modification from floodplain development authorized by local governments consistent with the minimum criteria provided in the NFIP RPA will occur according to three factors: the human population growth-rate, the amount of developable mapped floodplain, the effectiveness of the required mitigation, and the timeframe in which FEMA implements the RPA.

**Human Population Growth-rate.** The NMFS’ estimate of the rate of development is based on recent human population growth rates by county, as identified by the Washington State Office of Financial Management and Growth Management Plans by County. Because growth is expected to be at higher rates inside mapped urban growth boundaries of urban areas, and lower outside (in rural, non-planning areas), NMFS relies on the WOFM growth rates by county as its starting point, since counties include both urban (GMA planning areas) and rural (non-GMA planning areas). The NMFS assumes that a county’s population growth-rate influences development similarly among developable floodplain and non-floodplain lands, as floodplain areas include both urban growth areas, and rural settings.

**Floodplain Lands by County.** Floodplain areas fall into three categories: 1) areas inside the current city limits, which are largely already developed, and therefore retain very little habitat function or value for listed fish, and as a baseline condition contribute to lost floodplain connectivity and function as a limiting factor; 2) areas designated as UGA (outside the city limits, inside the UGA, inside the county), where future development is expected to occur earlier and more densely than in the rural county lands, as intended by the GMA; 3) areas in the county (outside the city limits and outside the designated UGAs). Therefore, the basic equation for estimating a rate of floodplain loss by county due to human population growth would be
(Square miles of SFHAs by county), minus (current city Limits) equals (SFHAs in UGA and in the County), times (the projected annual population growth-rate).

The amount of mapped floodplain in the action area, exclusive of floodplains in incorporated towns and cities, in:

- Whatcom County is 72.6 square miles
- Skagit County is 180.9 square miles
- Mason County is 56.91 square miles
- Kitsap County is 7.6 square miles
- Clallam County is 77.09 square miles
- Jefferson County is 33.8 square miles
- Island County is 8.93 square miles
- San Juan County is 9.64 square miles
- Snohomish County is 116.42 square miles
- King County is 46.01 square miles
- Thurston County 49.18 is square miles
- Pierce County is 65.44 square miles

**RPA Implementation Period.** The RPA will be implemented over a period of time not to exceed 3 years, after which all NFIP jurisdictions in the Puget Sound area will have implemented the enhanced floodplain management criteria that will avoid or minimize degradation of floodplain habitat. During the implementation period, NMFS expects some habitat modification will result from floodplain development that takes place consistent with the current NFIP minimum standards and mapping protocols, at roughly the same rate and pattern as existed prior to this consultation. The rate of development and consequent habitat impact is expected to be influenced by two additional issues – economic conditions and regulatory pressure. Economic conditions are currently in a downturn, which would serve to depress growth from the WOFM projections, however anticipated regulatory “tightening” of development criteria may act as an inducement to growth, as landowners seek to vest their development options before new regulatory restrictions become effective. In these circumstances, the incentive to build before the RPA is implemented within a given jurisdiction may increase the rate of development. Because the result of these competing pressures cannot be predicted, NMFS relies on the best available information regarding growth rate levels from the preceding decade to estimate development and corollary take, as identified by WOFM, per county.

**Extent of Anticipated Take**

*For the RPA implementation period,* which shall not exceed 3 years, NMFS expects take in the form of harm to occur in:

- Whatcom County at the rate of 2.1 percent per year over 72.6 square miles of floodplain, equaling a loss of approximately 1.5 square miles of floodplain per year.
• Skagit County at the rate of 1.9 percent per year over 180.9 square miles of floodplain equaling a loss of approximately 3.4 square miles of floodplain per year
• Mason County at the rate of 1.6 percent per year over 56.9 square miles of floodplain equaling a loss of approximately .9 square miles per year
• Kitsap County at the rate of .7 percent per year over 7.6 square miles of floodplain equaling a loss of approximately 0.05 square miles
• Clallam County at the rate of .3 percent per year over 77 square miles of floodplain equaling a loss of approximately 0.2 square miles per year
• Jefferson County at the rate of .8 percent per year over 33.8 square miles of floodplain equaling a loss of approximately 0.2 square miles per year
• Island County at the rate of .9 percent per year over 8.9 square miles of floodplain equaling a loss of approximately 0.08 square miles per year
• San Juan County at the rate of 2.7 percent per year over 9.6 square miles of floodplain equaling a loss of approximately 0.2 square miles per year
• Snohomish County at the rate of 2.2 percent per year over 116 square miles of floodplain equaling a loss of approximately 2.5 square miles per year.

In the above jurisdictions, NMFS estimates that the degradation or loss of a given percentage of 100-year floodplain habitat will expose a percentage of the fish from populations that rely on those habitats, to unfavorable conditions during 100 year flood events. Although the RPA requires that these impacts be mitigated, habitat losses that occur prior to the implementation of the mitigation may adversely affect fish populations, if 100-year or lesser flood events occur during that time-frame.

The NMFS assumes that because juvenile Chinook salmon prefer edge habitats, and salmonids with protracted lifehistory in freshwater environments rely on floodplains for refugia from high volume and velocity floodwaters, that the percentage of a fish population exposed to degraded or diminished floodplain refugia could be very high. Of the percentage of fish from a given population exposed to floodplain habitat loss or degradation through floodplain development, a subset would be injured or killed, but this percentage is impossible to estimate given the distribution of fish within the inundated area will not be uniform and the reduction in floodplain function would not affect all individual fish equally. Applying the basic biological principle of carrying capacity, NMFS assumes that the percentage of floodplain degradation will result in a comparable percentage of harm among juveniles of the fish populations exposed to the modified habitat during the base flood. By this, NMFS means that the likelihood of injury or mortality is increased due to behavioral changes in the juvenile fish, resulting from changes in the floodplain habitat, at a 1-to-1 ratio of harm to habitat degradation.

The likelihood of a “base flood” that would inundate the 100 year floodplain is predicted by FEMA at 1 percent chance of occurrence per year (smaller flood events occur with greater frequency, which will also expose fish to effects of floodplain habitat loss or degradation, though less extensively because the duration of inundation shorter and amount of landscape inundated is smaller). Because the prioritization for implementing the RPA requires that communities affecting Tier 1 populations implement the revisions within one year, the chance that fish will be exposed to unmitigated floodplain development in any particular location influencing Tier 1 populations, is only one percent.
Because King and Pierce Counties have floodplain management regulations significantly more restrictive than the NFIP minimum requirements, NMFS expects the extent of take in the form of harm due to floodplain loss from development will be at significantly lower rates than the population growth rates:

- King County’s growth rate over the last decade was 13 percent, which would translate to approximately 1.3 percent per year. In King County, 70 percent of the urban growth area is in floodplain. However, King County has multiple floodplain management ordinances that exceed the current NFIP minimum criteria, which allow less development than would occur with the FEMA minimum criteria, and which also requires mitigation for that development that does occur within the floodplain – together these minimize the effects of floodplain development on fish habitat and habitat forming processes. These criteria include a zero-rise floodway requirement (.01 foot rise in conveyance areas is measurable – and development that creates this much rise is not allowed); a balanced cut and fill requirement to avoid loss of flood water storage, and which must be hydraulically connected and constructed at the same topographic elevation; no development is allowed at all in the floodway except for farmhouses and farm pads for livestock; the floodway includes velocity and depth criteria (3 feet deep or 3 ft per second is part of the no build criteria); in order to subdivide floodplain lots there must be at least 5,000 square feet of buildable land outside of the zero rise floodway; severe CMZs are not buildable; dry-proofing is required, rather than FEMA’s “wet flood-proofing” to avoid contamination of floodwaters with stored chemicals; no substantial improvement is allowed for buildings located in floodways except farmhouses or historic buildings; and temporary structures must be removed from zero rise floodway prior to flood season. King County has also withdrawn several levees from the PL 84-99 and FEMA certification processes, allowing King County to retain larger amounts of vegetation on levees to benefit riparian and aquatic habitat and habitat forming processes.

- Pierce County’s growth rate over the last decade was 17 percent, or an approximate 1.7 percent per year. Pierce County regulates most floodplains as floodways, using flood depth and flood velocity data to additionally restrict development. Because fill is largely prohibited in floodways, identifying significant portions of the floodplain as floodway due to depth or velocity, Pierce County precludes more floodplain development than it would under the NFIP minimum standards, Pierce County also requires compensating volume of flood storage, hydrologically connected to the affected river, when fill is authorized in floodplains. Pierce County recently completed its designation of a channel migration for the Puyallup and Carbon system, further restricting areas where development can occur. Pierce County has also completed two miles of levee setbacks, re-establishing floodplain function, and levee vegetation management on the Lower Puyallup levee system is governed by a Lands Claim Settlement Agreement recognizing that increased levels of vegetation are necessary to ensure a minimum level of riparian habitat to benefit the Puyallup Tribe’s reserved fishing rights.

Thus, despite human population growth rates commensurate with other fast-growing counties, NMFS’ expectation is that levels of take from arising from floodplain loss will accrue at roughly
0.15 percent in King and Pierce Counties, exclusively. Development permitted by the incorporated cities or towns inside the boundaries of these Counties is not governed by County ordinances, and instead rely primarily on current NFIP minimum requirements.

*After full implementation of the RPA,* the rate of floodplain development is expected to slow across all NFIP jurisdictions, and losses of floodplain habitat are expected to be mitigated by creation additional floodplain storage areas designed to afford fish refugia in during riverine and estuarine flooding. The NMFS expects that there will be temporary degradation to floodplain habitats during the period of time that the mitigation floodplain areas become successfully revegetated to provide the full range of habitat values (eg, preybase). This may result in a small amount of take over a period of up to 5 years in each mitigation site, while plantings become established to create fully functional floodplain refugia for listed fish. Changes in instream conditions and channel characteristics arising from floodplain development (due to stormwater contaminants, increased velocity and volumes during floods, and decreased baseflows from interrupted hyporheic recharge) are expected to remain relatively static after the RPA is fully implemented.

**Take Exemption.** Take from reduced carrying capacity corollary to all floodplain development is exempt up to a rate of 0.15 percent per year floodplain loss, within the regulatory jurisdictions of King and Pierce Counties, based upon the more stringent floodplain management requirements of those jurisdictions. Take is exempted in all other county and municipal NFIP jurisdictions as soon as they implement the floodplain management criteria set forth in RPA element 3, provided the activity resulting in take is carried out in conformance with RPA element 3, including applicable mitigation requirements.

Take is exempted for all floodplain development that occurs within the regulatory jurisdictions of Kitsap, and San Juan Counties, and the municipalities therein, because the amount of developable floodplain is low, the anticipated amount of development is low, there are no PS Chinook salmon in freshwater environments in these jurisdictions, and the number of listed steelhead in freshwater environments is low in these geographies.

For the remaining counties in the Puget Sound region, take accruing from decreased carrying capacity corollary to floodplain loss or degradation is exempted as followings:

- In Whatcom County at the rate of 2.1 percent per year, equaling a loss of approximately 1.5 square miles of floodplain per year.
- In Skagit County at the rate of 1.9 percent per year equaling a loss of approximately 3.4 square miles of floodplain per year
- In Mason County at the rate of 1.6 percent per year equaling a loss of approximately 0.9 square miles per year
- In Clallam County at the rate of .3 percent per year equaling a loss of approximately 0.2 square miles per year
- In Jefferson County at the rate of .8 percent per year equaling a loss of approximately 0.2 square miles per year
- In Island County at the rate of .9 percent per year plain equaling a loss of approximately 0.08 square miles per year
• In Snohomish County at the rate of 2.2 percent year equaling a loss of approximately 2.5 square miles per year.

Take that results from floodplain modification in excess of these measurable levels is not exempt. Take that occurs from actions not in compliance with the RPA (above) is not exempt – specifically, take at the above described rates is exempt only for a period of 1 year following the issuance of this Opinion in NFIP jurisdictions influencing Tier 1 populations, for 2 years in NFIP jurisdictions influencing Tier 2 populations, and for 3 years in all other NFIP jurisdictions, and is exempt only to the extent that the mitigation required by the RPA is provided. Take that occurs for development not in compliance with the Reasonable and Prudent Measures (RPMs) and/or the Terms and Conditions (T and Cs) (below) is also not covered by the exemption described in this Opinion.

Reasonable and Prudent Measures

Reasonable and prudent measures (RPMs) are nondiscretionary measures to avoid or minimize take that the action agency and its cooperators must carry out for the exemption from the prohibition against taking listed species in ESA section 7(o)(2) to apply. During the course of consultation, NMFS determined that the proposed action would both jeopardize the listed species considered in this consultation and destroy or adversely modify their critical habitat. As required in such circumstances, NMFS developed an RPA with FEMA that meets each of the RPA criteria, including the requirement that the RPA avoids jeopardy of the species and adverse modification of critical habitat. In achieving these results, the RPA changes the proposed NFIP in a way that reduces, minimizes, or avoids habitat modification that would have resulted in take of the species considered. Since implementing the RPA fully minimizes take in and of itself, NMFS has not identified further measures for minimizing the anticipated extent of take beyond full implementation of the RPA.

The FEMA has the continuing duty to regulate the activities covered by the NFIP RPA where discretionary Federal involvement or control over the action has been retained or is authorized by law. The protective coverage of section 7(o)(2) will lapse if FEMA fails to exercise its discretion to adhere to, or to require adherence (where an applicant is involved), to the terms and conditions of the incidental take statement. Similarly, if any community that participates in the NFIP fails to act in accordance with the terms and conditions of the incidental take statement, protective coverage for that community will lapse.

The FEMA shall minimize incidental take caused by implementing the NFIP by:

1. Ensuring implementation of a monitoring and reporting program to confirm that the take exemption based on the extent of habitat modified by the NFIP according to the rates identified in this statement is not exceeded. Reporting shall occur annually on October 1, beginning one year from the date of this biological opinion.

2. Ensuring that take caused during construction and function of mitigation projects is minimized. This includes FEMA’s mitigation via funding or otherwise facilitating floodplain restoration projects affecting Tier 1 populations during the RPA.
implementation period (RPA 6); and mitigation required for all Floodplain development projects that otherwise have no other Federal nexus.

3. Ensuring that all NFIP participating communities that influence Tier 1 salmonid populations have mitigation for all floodplain development after the issuance of this biological opinion, including during the period prior to full implementation of the RPA.

Terms and Conditions
To be exempt from the prohibitions of section 9 of the ESA, FEMA and its cooperators must fully comply with the elements of the RPA described above.

a. To implement RPM1 (Compliance and Effectiveness Monitoring) - In the interim period pending complete implementation of the NFIP RPA, FEMA shall report to NMFS on an annual basis regarding progress on meeting timelines and implementing RPA elements 1-5.

b. To implement RPM 2 (Mitigation) – If FEMA’s reporting indicates that floodplain function was lost through fill and/or development, then FEMA shall ensure that floodplain mitigation and/or restoration activities take place. This may include FEMA’s contribution of financial, technical, or physical (labor or equipment) support or other activities by FEMA or the affected communities. These actions are intended to mitigate for any NFIP actions that will occur during implementation of RPA elements 2-5 (Terms and Conditions B through E) that degrade channel or floodplain habitat in NFIP communities, and FEMA shall coordinate with NMFS to determine that adequate compensation will result from such mitigation. Moreover, such mitigation projects shall have design or review with NMFS or WDFW to ensure a minimum of construction related effects, and that enhanced or offset floodplain habitat will function as intended.

c. To implement RPM 3 (Tier One Area Mitigation) – the FEMA reporting shall detail development and corollary mitigation for those NFIP jurisdictions that affect Tier One populations.

Section 7(a)(1) Conservation Recommendations.

The FEMA should coordinate levee maintenance protocols with COE and Services in a watershed based approach that reduces floodplain encroachment and minimizes flood volume, velocity, and scour problems caused by confining the channel by levees. This should include working with sponsors to identify levees that restrict floodplain function, and developing a process to start setting back levees and restoring floodplain functions.

The FEMA should work with the COE and NMFS to develop joint levee vegetation standards to allow retention of native riparian vegetation, based on the most recent best available science. Examples of potential changes include using height restriction rather than diameter restriction in order to minimize potential levee damage from toppling, and giving preference
to limbing lower branches to allow visual access and flood fight access rather than tree removal.

The FEMA should consider identifying certain CRS activities that are beneficial to listed salmon and floodplain function, and phasing them in as additional standards and requirements for community participation in the NFIP.

The FEMA should revise the criteria for floodplain acquisition, easements, and development right purchases to include acquisition of land currently without structures as a means to preserve flood storage and reduce future costs of flooding.

The FEMA should develop and implement procedures by which the Director can mandate implementation of mitigation measures for structures that would be beneficial to fish where it would be cost effective. Those who use their flood insurance claim payment for mitigation should be further rewarded by receiving an additional increment of support in the form of a grant.

The FEMA should adopt a coordinated, watershed-based, multi-objective approach for all water resource activities. This approach should include coordination with efforts to improve water quality, quantity, and supply; the creation and maintenance of upland storage; and coordinated planning among upstream, downstream, rural, and urbanized localities within the same watershed.

The FEMA should evaluate the Pre-Disaster Mitigation Program to determine the kinds of mitigation measures that are being funded and implemented, and their effectiveness in reducing losses and protecting floodplain resources. Likewise, the activities funded by the Flood Mitigation Assistance Program, especially those related to reducing repetitive losses, should be compiled and long-term impacts analyzed, to establish future program priorities.

Compliance with Executive Order 11988 should be overseen and enforced to provide the stated protection for, and preservation of, floodplain functions and values.

The FEMA should approach the Office of Management and Budget to seek a reassessment of the regulations governing benefit/cost analyses. Benefits in a benefit/cost analysis should include recreation benefits, avoided damage to land use (erosion, crop losses, etc.), increase in real estate values due to proximity to open space, ecosystem improvements including protection of salmon habitat, and revenue of discount rates.

The FEMA should re-establish its National Benefit/Cost Analysis Team—a group of experts that can offer advice and guidance in program policy and implementation—to evaluate FEMA’s benefit/cost procedures. The team should include representatives of a broad range of stakeholders, including state and local personnel. A study should be done of the feasibility of a unified floods-only benefit/cost method that would be used by both FEMA and the COE. Better methods for quantifying the economic benefits of natural resources (such as salmon habitat) and cultural resources should be developed, adopted, and applied.
governments, the National Wildlife Federation, and similarly interested or concerned members of the public.

Individual copies were provided to the above-listed entities. This consultation will be posted on the NMFS Northwest Region website (http://www.nwr.noaa.gov). The format and naming adheres to conventional standards for style.

**Integrity:** This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, ‘Security of Automated Information Resources,’ Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

**Objectivity:**

**Information Product Category:** Natural Resource Plan.

**Standards:** This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA Regulations, 50 CFR 402.01, *et seq.*, and the MSA implementing regulations regarding EFH, 50 CFR 600.920(j).

**Best Available Information:** This consultation and supporting documents use the best available information, as referenced in the Literature Cited section. The analyses in this Opinion/EFH consultation contain more background on information sources and quality.

**Referencing:** All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

**Review Process:** This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with Northwest Region ESA quality control and assurance processes.


Church, M. 2002. Geomorphic Thresholds in Riverine Landscapes. Freshwater Biology 47.


FEMA. 2002. Biological Assessment Of The National Flood Insurance Program (NFIP) In
New Mexico  Under the Endangered Species Act of 1973 May 14, 2002


FEMA. 2004. MT-1 Form, FEMA Form 81-87, FEMA Mitigation Division Hazard Identification Branch, Alexandria VA.
http://www.fema.gov/plan/prevent/fhm/frm_form.shtm


Lavoy, L., Fishery Biologist, Washington Department of Fish and Wildlife, March 20, 2008.  Personal communication with Alison Agness, NMFS Protected Resources Division, regarding WDFW unpublished data for average recent year actual Chinook catch for Puget Sound marine sport fishery and Puget Sound pre-terminal net and troll fishery.


Lestelle, L.C., McConnaha, W.E., Blair, G.; Watson B.  2005.  Chinook Salmon Use of Floodplain, Secondary Channel, and Non-Natal Tributary Habitats in Rivers of Western North America Application to the Willamette River (Oregon) and Formulation of Species-Habitat Rules for EDT Analysis


Administrator. NMFS Tracking Number F/NWR/2008/02612.


Reimers, P.E. 1973. The Length of Resicence of Juvenile Fall Chinook Salmon in the Sixes


207


Shields, D. 1991. Woody vegetation and riprap stability along the Sacramento River mile 84.5-


Task Force on the Natural and Beneficial Functions of the Floodplain. 2002. The Natural and Beneficial Functions of Floodplains. A Report for Congress by the Task Force on the Natural and Beneficial Functions of the Floodplain, Chaired by FEMA.


Tynan, Tim. NMFS, Propagation and Tributary Fisheries Branch, Lacey, WA. March 19, 2008. Personal communication with Alison Agness, NMFS, Protected Resources Division, regarding Area 4(B) run and escapement levels by Puget Sound sub-region for 1999-2005, with a side table showing hatchery v. wild Chinook break-outs.


WDF (Washington Department of Fisheries), and WWTIT (Western Washington Treaty Indian Tribes). 1993. 1992 Washington State salmon and steelhead stock inventory (SASSI). Internal Report to Washington Department of Fisheries and Wildlife,
WDFW and PNPTT (Point-No-Point Treaty Tribes). 2007. Summer Chum Salmon Conservation Initiative; An Implementation Plan To Recover Summer Chum Salmon in the Hood Canal and Strait of Juan de Fuca Region Supplemental Report No. 7 (December 2007)


Wild Steelhead Coalition. 2006. The Status of Wild Steelhead and Their Management in Western Washington: Strategies for Conservation and Recreation. Wild Steelhead Coalition, 218 Main St., Box #264, Kirkland, WA 98033


APPENDIX 1.

Excel spreadsheet showing habitat limiting factors for Puget Sound Rivers
<table>
<thead>
<tr>
<th>ESU/ WRIA Population/Stock</th>
<th>Community/Start Date/Total Yrs</th>
<th>River/Number of Policies</th>
<th>% change in County since Start Date, OFM/% change in County by 2025</th>
<th>Watershed Rating/ LF-Floodplain</th>
<th>Watershed Rating/ LF-Riparian</th>
<th>Watershed Rating/ LF-Flows</th>
<th>Watershed Rating/ LF-Bank and Channel</th>
<th>ESU Limiting Factors/FP, Rip, Flow, B&amp;C</th>
<th>Future threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nooksack</td>
<td>Ferndale 1983, 24 MS 93 9155</td>
<td>Poor-Y: One of 7 significant habitat factors listed, particularly on the SF (p. 157, WP). Levees and dikes constrain river, eliminate sides channels for fish rearing and refuge. Poor-Loss of large trees along the rivers and trib limits shade and instream wood (p.160, WP) Poor-Low flows discussed, not related to floodplains (p. 161, WP) Poor- increased sediment from erosion and mass wasting due to lack of riparian and LWD, channel instability of the both Forks due to levees and dikes (p. 160 WP)</td>
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<td>Yes</td>
<td>Human Pop growth increase of 50% by 2022 (p. 152)</td>
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<td></td>
<td>Lynnden 1982, 25 MS 13 9740 MS, NF, SF 801 77796 (33%) [67.98%]32% Poor-Y Poor Poor Poor Yes</td>
<td>Poor-Y Poor Poor Poor Yes</td>
<td>Poor- Lower Skagit, Upper Skagit and Suiattle rivers have significant riparian degradation; between 38-75% of riparian area that support spawning and early rearing are degraded (p.181, WP). Poor - Low flows related to water withdrawals, not floodplains (p. 182 WP). Data not known at time of publication - Hydromodification (bank armoring) - Lower Skagit has lost 60% of its natural banks and off-channel areas. Overall loss of delta area in 73%. Net reduction in pocket estuary habitat at 80%. Sediment budgets show current levels are higher than historic and contribute to scouring and filling of channel (p. 181, 182 WP).</td>
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<td>Skagit Mt. Vernon 1983, 22 MS 994 22280 MS, NF, SF</td>
<td>Poor-Y: Five of twelve limiting factors related to floodplain issues are: degraded riparian zones, sedimentation and mass wasting, hydromodification, loss of delta habitat and connectivity, loss of pocket estuaries and connectivity (p. 181, WP). Poor - Lower Skagit, Upper Skagit and Suiattle rivers have significant riparian degradation; between 38-75% of riparian area that support spawning and early rearing are degraded (p.181, WP). Poor - Low flows related to water withdrawals, not floodplains (p. 182 WP). Data not known at time of publication - Hydromodification (bank armoring) - Lower Skagit has lost 60% of its natural banks and off-channel areas. Overall loss of delta area in 73%. Net reduction in pocket estuary habitat at 80%. Sediment budgets show current levels are higher than historic and contribute to scouring and filling of channel (p. 181, 182 WP).</td>
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<td>Burlington 1985, 22</td>
<td>MS</td>
<td>1183</td>
<td>7190</td>
<td>Poor-Y</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Unknown</td>
<td>Yes</td>
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<tr>
<td>Skagit Co. 1985, 22</td>
<td>LS, US</td>
<td>2544</td>
<td>45442 (31%, 29%)</td>
<td>Poor, Good-Y</td>
<td>Poor-Good</td>
<td>Poor-Good</td>
<td>Unknown</td>
<td>Yes</td>
<td>1985, 22 LS, US 2544 45442 (31%, 29%) Poor, Good-Y Poor-Good Poor-Good Unknown Yes</td>
</tr>
<tr>
<td>Pu-White</td>
<td>Pierce Co 1987, 20</td>
<td>Pu, White</td>
<td>982</td>
<td>332980 (28%)</td>
<td>Poor-Y</td>
<td>Good/Poor-Y: One of significant habitat limiting factors – loss of floodplain processes and off-channel habitat from levee areas (p. 278, WP).</td>
<td>Poor - one of significant habitat limiting factors - about 5% of the riparian habitat is rated as high quality; lack of LWD, riparian habitat is fragmented and disconnected, increased channel instability from lack of LWD (p. 278 WP).</td>
<td>Poor - flows issues related to dam diversions discussed (p. 277-278, WP).</td>
<td>Poor - Fish access to spawning and rearing habitat limited by dikes and stream channelization projects plus others. Sediment deposition in Dumas Bay occurring at accelerated rate due to increases in shoreline armoring and clearing vegetation on slopes (p. 277, WP).</td>
</tr>
<tr>
<td>Paynup 1980, 27</td>
<td>Paynup</td>
<td>282</td>
<td>29865</td>
<td>Poor-Y</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Yes</td>
<td>1980, 27 Paynup 282 29865 Poor-Y Poor Poor Poor Yes</td>
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<tr>
<td>Sumner 1980, 27</td>
<td>White</td>
<td>169</td>
<td>7657</td>
<td>Good-Y</td>
<td>Poor</td>
<td>Poor</td>
<td>Poor</td>
<td>Yes</td>
<td>1980, 27 White 169 7657 Good-Y Poor Poor Poor Yes</td>
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<tr>
<td>Mid-Hood Canal</td>
<td>Jefferson Co. 1982, 25</td>
<td>Duckabush</td>
<td>119</td>
<td>14370 (22%)</td>
<td>Poor-Y</td>
<td>Poor</td>
<td>Poor</td>
<td>Yes</td>
<td>1982, 25 Buckabush 131 14370 (22%) Poor-Y Poor Poor Poor Yes</td>
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<tr>
<td>ESU/ WRIA</td>
<td>Population/Stock</td>
<td>Community/Start Date/Total Yrs</td>
<td>River</td>
<td>Number of Policies</td>
<td>(Total census, FEMA), % Pop Growth by WRIA 1990-2001, PSAT</td>
<td>% change in County since Start Date, OFM] % change in County by 2025</td>
<td>Watershed Rating/ LF-Floodplain</td>
<td>Watershed Rating/ LF-Riparian</td>
<td>Watershed Rating/ LF-Flows</td>
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<td>Dungeness-Elwha</td>
<td>Clallam Co. 1980, 27</td>
<td>Dungeness</td>
<td>355</td>
<td>33800 (16%)</td>
<td>Poor Y: Dikes and levees (p. 323, WP) limit fish refuge, overwintering and scour eggs. Need 9 miles of floodplain restoration; to reduce gradient, velocities, scour and bank erosion (p. 325, WP).</td>
<td>Good?! - Both upper and lower watershed logged (p. 323, WP). Restore riparian corridor throughout lower mainstem to improve habitat and functions (p. 325, WP).</td>
<td>Good?! - Water withdrawal issues related to irrigation, domestic and business uses limit salmon spawning and rearing habitat (p. 325, WP).</td>
<td>Poor - Need 9 miles of dike removal and bank revegetation to increase meanders and reduce gradient, velocities, scour and bank erosion (p. 325, WP).</td>
<td>yes</td>
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<td>Ducks-bush (16)</td>
<td>Jefferson Co 1982, 23</td>
<td>DB 119</td>
<td>14370 (22%)</td>
<td>[59.6%]34%</td>
<td>Poor - Y: Loss of FW floodplain for ag and residential dev, affecting spawning and incubation, loss of estuarian habitat by diking affecting juvenilization and migration (p. 166-7).</td>
<td>Poor - Floodplain forest logged of old growth reducing potential for LWD recruitment to channel (p.167).</td>
<td>Good - no discussion</td>
<td>Good/Poor - Channel simplified in late 1800s by scouring from splash dams, LWD removal, and floodplain conversion; lower reaches channelized and diked causing channel aggradation, FS logging roads contribute to sedimentation problems (p. 166).</td>
<td>Yes (p. 184) Need to address loss of floodplain habitat.</td>
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<td>Dose (16)</td>
<td>Jefferson Co 1982, 23</td>
<td>DS 14371 (22%)</td>
<td>14371 (22%)</td>
<td>[59.6%]34%</td>
<td>Poor-Y: same w/ conversion of fp to ag and residential, diking for dev (p. 168-9).</td>
<td>Poor - same as Dackabush (p. 168-9).</td>
<td>Fair - no discussion</td>
<td>Poor - same as Duckabush (p. 168-9).</td>
<td>Yes (p. 178) Need floodplain mgt plan for Dosewallips</td>
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<td>Lilliwaup-16</td>
<td>Mason Co 1988, 16</td>
<td>LW 295</td>
<td>49405 (22%)</td>
<td>[45.1%]30.5%</td>
<td>Poor-Y (sc): Loss of side channel and diked estuarine area for dev as LF, location of devs critical having disproportionate effect on functional value of estuary (p.194-5).</td>
<td>Good? - Elimination of riparian forest decreased LWD recruitment sources for creek and estuary (p.195).</td>
<td>Good? - no discussion</td>
<td>Good/Poor - Altered age and species composition of riparian forest lack of LWD contributing to reduced channel complexity, channel instability and reed scour in peak events (p.194).</td>
<td>Yes (p. 201) Need to address loss of side channels and estuarine loss. Remove dikes to restore side channels (p. 204)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quilcene (17)</td>
<td>Jefferson Co 1982, 23</td>
<td>QC 119</td>
<td>14370 (34%)</td>
<td>[59.6%]34%</td>
<td>Poor-Y: Loss of FW floodplain listed as limiting factor in Big. Loss of estuarian habitat due to diking mentioned in Big and Little affecting spawning and migration (p. 137).</td>
<td>Poor - About 50% of Big and Little riparian is deciduous dominated with no riparian forest; future recruitment is poor to moderate (p. 137-8).</td>
<td>Fair? - Low flows of 5. 13 CFS in Little threaten spawning; more assessment is needed (p.137).</td>
<td>Poor - Logging roads contribute to sediment problems in Big; banks are hardened with riprap in lower Little; bank armoring and dike construction exacerbates flooding and channel scour in Big; channel instability in both (p.137-8).</td>
<td>Yes (p. 146) Need to address loss of side channels</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESU/WRIA</td>
<td>Population/Stock</td>
<td>Community/Start Date/Total Yrs</td>
<td>River</td>
<td>Number of Policies</td>
<td>(Total census, FEMA), % Pop Growth by WRIA 1990-2001, PSAT</td>
<td>[% change in County since Start Date, OFM] % change in County by 2025</td>
<td>Watershed Rating/ LF-Floodplain</td>
<td>Watershed Rating/ LF-Riparian</td>
<td>Watershed Rating/ LF-Flows</td>
<td>Watershed Rating/ LF-Bank and Channel</td>
<td>ESU Limiting Factors/ FP, Rip, Flow, B&amp;C</td>
<td>Future threats</td>
</tr>
<tr>
<td>----------</td>
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<td>----------------------------------------------------------</td>
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<td>----------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Salmon/ Snow (17)</td>
<td>Jefferson Co 1982, 25</td>
<td>SS</td>
<td>119</td>
<td>14370 (34%)</td>
<td>[59.6%]34%</td>
<td>Poor-Y(sc): Loss of side channels as LF affecting spawning and incubation (p. 103-4).</td>
<td>Poor - Limiting Factor and lost or degraded in both creeks; 75% or more of riparian area is young forest or ag in both creeks (p. 103-4).</td>
<td>Fair - Increases in peak flows a LF and leads to scour of redds in Salmon creek; Increased peak flow and low summer flows LF for spawning and incubation in Snow Creek (p.103-4).</td>
<td>Poor - Fines and aggradation LF in both creeks; re-routing of channel and loss of instream complexity in Snow creek (p. 103-4).</td>
<td>Poor - LF include loss of LWD, bank hardening, channel instability, loss of side channels, aggradation , increased bed scour (p. 101).</td>
<td>Yes (p.116) Need to address loss of side channels</td>
<td></td>
</tr>
<tr>
<td>JimmyCL (17)</td>
<td>Clallam Co 1980, 27</td>
<td>JCL</td>
<td>355</td>
<td>33800 (34%)</td>
<td>[25.9%]16%</td>
<td>Poor-Y(sc): Loss of side channels as LF affecting spawning and incubation (p. 101).</td>
<td>Net rated - LF- mature forest lost to 62% of riparian in young forest, ag, roads and dikes, res. use (p.101-2).</td>
<td>Fair - increased peak flows leads to increased bed scour affecting spawning and incubation (p.101).</td>
<td>Poor - LF include loss of LWD, bank hardening, channel instability, loss of side channels, aggradation , increased bed scour (p. 101).</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 4: Minimum Criteria

It is the purpose of the following criteria to maintain streams and floodplains in their natural state to the maximum extent possible so they support healthy biological ecosystems, by: 1) assuring that flood loss reduction measures under the NFIP protect natural floodplain functions and riparian habitat, and the natural processes that create and maintain fish habitat, and 2) preventing or minimizing loss of hydraulic, geomorphic, and ecological functions of freshwater and estuarine floodplains and stream channels.

In all 100-year floodplain areas (SFHAs) the following criteria apply:

1. **Restrict Development in the Riparian Buffer Zone** for all watercourses including off channel areas (areas outside this zone but within the Special Flood Hazard Area) to provide necessary protection to the RBZ. The RBZ is the greater of the following:
   - 150 feet measured perpendicularly from ordinary high water for Type S (Shorelines of the State) and F (fish-bearing) streams; 100 feet for N (nonsalmonid-bearing) streams, lakes and marine shorelines, and 50 feet for U (untyped) streams,
   - the Channel Migration Zone plus 50 feet; and
   - the mapped Floodway.

The Riparian Buffer Zone is an overlay zone that encompasses lands as defined above on either side of all streams, and for all other watercourses including off channel areas. The RBZ is a no-disturbance zone, other than for activities that will not adversely affect habitat function. Any property or portion thereof that lies within the RBZ is subject to the restrictions of the RBZ, as well as any zoning restrictions that apply to the parcel in the underlying zone. Restrictions in this area apply to all development, per the definition of development. Uses that are not

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22 The lateral extent of likely movement along a stream reach during the next one hundred years with evidence of active stream channel movement over the past one hundred years. Evidence of active movement can be provided from aerial photos or specific channel and valley bottom characteristics. A time frame of one hundred years was chosen because aerial photos and field evidence can be used to evaluate movement in this time frame. Also, this time span typically represents the time it takes to grow mature trees that can provide functional large woody debris to most streams. In large meandering rivers a more detailed analysis can be conducted to relate bank erosion processes and the time required to grow trees that function as stable large woody debris.

With the exception of shorelands in or meeting the criteria for the "natural" and "rural conservancy" environments, areas separated from the active channel by legally existing artificial channel constraints that limit bank erosion and channel avulsion without hydraulic connections shall not be considered within the CMZ. All areas, including areas within the "natural" and "rural conservancy" environments, separated from the natural channel by legally existing structures designed to withstand the 100-year flood shall not be considered within the CMZ. A tributary stream or other hydraulic connection allowing listed species fish passage draining through a dike or other constricting structure shall be considered part of the CMZ.

23 Development. Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, storage of equipment or materials, or any other activity which results in the removal of substantial amounts of vegetation or in the alteration of natural site characteristics located within the area of special flood hazard.
permitted unless shown not to adversely affect water quality, water quantity, flood volumes, flood velocities, spawning substrate, and/or floodplain refugia for listed salmon, include the following: new buildings, including accessory buildings; new impervious surfaces; removal of native vegetation; new clearing, grading, filling, land-disturbing activity or other “development” (see definition), other than for the purpose of replacing non-native vegetation with native vegetation, and for other approved restoration work; septic tanks and drain fields, dumping of any materials, hazardous or sanitary waste landfills; receiving areas for toxic or hazardous waste or other contaminants; and, stream relocations, unless the primary function of the action is to restore natural ecological function.

In the RMZ the following uses are allowed: [1] repair or remodel of an existing building in its existing footprint, including buildings damaged by fire or other casualties; [2] removal of noxious weeds; [3] replacement of non-native vegetation with native vegetation; [4] ongoing activities such as lawn and garden maintenance; [5] removal of hazard trees; [6] normal maintenance of public utilities and facilities; and [7] restoration or enhancement of floodplains, riparian areas and streams that meets Federal and State standards

2. **Protect fish habitat and flood storage in the remaining 100-year floodplain (outside the RMZ) by either:**

   a.) Prohibiting development in the 100-year floodplain, OR

   b.) Providing compensation for any effects to floodwater storage and fish habitat function within the 100-year floodplain.

Any development in the 100-year floodplain must be compensated, for example, through the creation of an equivalent area and volume of floodwater storage and fish habitat through a balanced cut and fill program. The new flood storage/habitat area must be graded and vegetated to allow fish refugia during flood events and return to the main channel as floodwaters recede without creating stranding risks. In addition, equivalent area, if not located on site, must be located in priority floodplain restoration areas identified in the ESU Recovery Plan for listed species.

3. **Mitigate for all indirect effects of development in the floodplain** (effects to stormwater, riparian vegetation, bank stability, channel migration, hyporheic zones, wetlands, LWD, etc.) such that equivalent or better salmon habitat protection is provided.

   Stormwater. Reduce flood volumes and stormwater runoff from new development by ensuring that increased volumes of stormwater reach the river at the same frequency, timing, and duration as historical runoff. Low Impact Development (LID) methods are required to treat and infiltrate runoff as described in PSAT 2002. These methods generally include various practices for infiltrating stormwater to provide water quality treatment, match historical runoff durations, and preserve base flows.
Riparian vegetation: Maintain or replace riparian function by providing equivalent area, diversity, and function of riparian vegetation as currently exists on the site (per WDFW riparian management recommendations (Knutson and Naef 1997).

Bank Stability: Bank stabilization measures along salmonid-bearing streams, channel migration zones, and along estuarine and marine shorelines must be minimized to the maximum extent possible. If bank stabilization measures are necessary, bioengineered armoring of streambanks and shorelines must be used (per the Integrated Streambank Protection Guidelines 2003 (for riverine shorelines) or the State Shorelines Guidelines on bank stabilization (2003) (for estuarine and marine shorelines).

Channel migration. No activity is allowed that limits the natural meandering pattern of the channel migration zone, however, natural channel migration patterns may be enhanced or restored (see Rapp and Abbe 2003, for delineating channel migration zones).

Hyporheic zones. No activity is allowed that interferes with the natural exchange of flow between surface water, groundwater and the hyporheic zone, however, natural hyporheic exchange may be enhanced or restored (see Bolton and Shelberg. 2001 for hyporheic zone issues).

Wetlands. Wetland function must be maintained or replaced by providing equivalent function per Washington State Department of Ecology (McMillan 1998) regulations.

LWD. Any LWD removed from the floodplain must be replaced in kind, replicating or improving the quantity, size, and species of the existing LWD (per WDFW Aquatic Habitat guidelines).

In the 100-year floodplain outside the Riparian Buffer Zone the following apply:

1) For buildable lots partially in the floodplain, require structures to be located on the portion of the lot outside of the mapped floodplain. Where a buildable lot is fully in the floodplain, structures must be sited in the location that has the least impact on listed salmon, e.g., located as far from the stream or river as possible on the lot, placing structures on the highest land on the lot, orienting structures parallel to flow rather than perpendicular, and avoiding disruption of active hyporheic exchange on a site.

2) Require zoning to maintain a low density (e.g., 5-acre lots or greater) of floodplain development to reduce the damage potential within the floodplain to both property and habitat, and help maintain flood storage and conveyance capacity.

3) All structures must be set back at least 15 feet from the RBZ and shall be sited as close to the 100-year floodplain boundary as possible.

4) In an effort to site structures as far away from the watercourse and RBZ as possible, the applicant will be apprised of the elevations of the 10-year and 50-year floods in detailed study
areas at the same time that the (city, county) provides the 100-year elevation as a part of the permit review. The applicant, in addition to plotting the 100-year elevation near the building site, will also plot the 10 and 50-year elevations on the land. The purpose is to show the applicant the significantly lower risk of placing the structure further away from the watercourse.

5) Structures built using post, pier, piling or stemwall construction may require less mitigation than structures built on earth fill, but must provide equivalent mitigation for lost fish habitat and indirect effects from development.

6) Creation of new impervious surfaces\(^\text{24}\) shall not exceed 10 percent of the surface area of the portion of the lot in the floodplain unless mitigation is provided.

7) Removal of native vegetation must leave 65 percent of the surface area of the portion of the lot in the floodplain in an undeveloped state; the 65 percent pertains to the entire portion of the lot in the floodplain, including that area in the RBZ, where removal of native vegetation is generally prohibited.

8) The proposed action must be designed and located so that it will not require new structural flood protection (e.g., levees).

9) During the floodplain permit review process, applicants shall be notified that their property contains land within the Riparian Buffer Zone and/or 100-year floodplain, and that the applicant is required to record a Notice on Title on the property before a permit may be issued. Applicants shall be further notified that development in the RBZ and 100-year floodplain can only occur according to the above criteria.

10) New road crossings over streams are prohibited.

11) Concepts of cluster development, density transfer, credits and bonuses, planned unit development, and transfer of development rights shall be employed wherever possible.

12) Any flood information that is more restrictive or detailed than the FEMA data can be used for flood loss reduction and/or fisheries habitat management purposes, including data on channel migration, more restrictive floodways, maps showing future build-out and global climate change conditions, specific maps from watershed or related studies that show riparian habitat areas, or similar maps.

In the RBZ and the floodplain the following re-development criteria apply:

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\(^{24}\) Any material or land alteration (i.e. clearing, grading, etc.) which reduces or prevents absorption of storm water into the ground. That hard surface area which either prevents or retards the entry of water into the soil, water that had entered under natural conditions prior to development; and/or that hard surface area that causes water to run off the surface in greater quantities or at an increased rate of flow from that present under natural conditions prior to development. Common impervious surfaces include, but are not limited to: rooftops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, gravel roads, and packed earthen materials.
1) Require that expansion to existing buildings in the floodplain be limited to no more than 10 percent of the existing footprint (i.e., when building and other structures such as garages are substantially damaged or expanded in the floodplain), unless mitigation for any adverse effects to floodplain habitat is provided, as described above.

4. **Communities choosing to implement the mitigation option** (2.b. above) must track the projects for which they issue floodplain development permits, including effects to flood storage, fish habitat, and all indirect direct of development. The expected development effects, the equivalent mitigation provided, and the success of the mitigation in replacing the affected fish habitat and flood storage functions shall be reported to FEMA on a semi-annual basis (according to the monitoring requirements in RPA element 3.D)
Funding for this project was funded in part through a grant from the United States Environmental Protection Agency (EPA Region 10 and EPA Headquarters Grant #’s CD-970018-01 and CD-970585-01, Ralph Rogers, grant officer). The views herein are those of the authors and do not necessarily reflect the views of EPA.

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5.5.4 Summary of Key Points

- Human actions can reduce the effectiveness of buffers in the long term through removal of buffer vegetation, soil compaction, sediment loading, and dumping of garbage.

- Buffers may lose their effectiveness to disperse surface flows over time as flows create rills and channels, causing erosion within the buffer.

- Leaving narrow strips of trees can result in tree loss due to blowdown.

- Buffers may become saturated with sediment over time and become less effective at removing pollutants. The literature indicates that this should be considered when determining buffer widths.

5.5.6 Summary of Buffer Ranges and Characteristics from the Literature

The following discussion summarizes the many suggestions and recommendations in the literature for how buffer widths can be established. Many of these were found in synthesis documents that summarize scientific literature on buffers and then draw general conclusions. The recommendations in most of these syntheses are remarkably consistent. Taken together with the great number of site-specific studies cited in the syntheses, they present what should be considered "fundamental principles" for buffers.

At its most basic level, the science on wetland buffers identifies four criteria that should be considered in determining the width of a buffer (Castelle et al. 1992b, Desbonnet et al. 1994, Norman 1996, McMillan 2000, Todd 2000):

- The functions and values of the aquatic resource to be protected by the buffer

- The characteristics of the buffer itself and of the watershed contributing to the aquatic resource

- The intensity of the adjacent land use (or proposed land use) and the expected impacts that result from that land use

- The specific functions that the buffer is supposed to provide; for habitat functions this includes the targeted species to be managed and an understanding of its habitat requirements

The feasibility or possibility of incorporating those four considerations into determining buffer dimensions is dependent upon the jurisdiction in question. Ideally, buffer widths should be tailored to these four factors. However, the authors that recommend considering these factors also acknowledge that the scientific basis for determining the width of a buffer is often superseded by political expediency. Buffers are more often
determined administratively as standard or fixed dimensions that may, or may not, be correlated with the criteria listed above.

Table 5-7 presents a summary of the buffer ranges recommended by the authors who conducted literature reviews or syntheses on buffer effectiveness. Minimums ranged from 25 feet (8 m) to 197 feet (60 m). Maximums ranged from 98 feet (30 m) for some land uses to 350 feet (107 m).

**Table 5-7. Summary of recommendations for buffer dimensions from the literature.**

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Date</th>
<th>Minimum Buffer</th>
<th>Maximum Buffer</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Castelle et al.</td>
<td>1994</td>
<td>50 to 100 feet (15 - 30m)</td>
<td></td>
<td>“Minimum buffers necessary to protect wetlands and streams under most circumstances”</td>
</tr>
<tr>
<td>Fischer et al.</td>
<td>2000</td>
<td>98 feet (30 m)</td>
<td>328 feet (100 m)</td>
<td>Larger buffer for reptiles, amphibians, birds and mammals</td>
</tr>
<tr>
<td>Groffman et al.</td>
<td>1991a</td>
<td>197 feet (60 m)</td>
<td>328 feet (100 m)</td>
<td>For most wildlife needs</td>
</tr>
<tr>
<td>Howard and Allen</td>
<td>1989</td>
<td>197 feet (60 m)</td>
<td></td>
<td>For most wildlife needs</td>
</tr>
<tr>
<td>McMillan</td>
<td>2000</td>
<td>25 feet (8 m)</td>
<td>350 feet (107 m)</td>
<td>Case by case, using a rating system and the intensity of proposed or existing land use for protecting most wetland functions</td>
</tr>
<tr>
<td>Norman</td>
<td>1996</td>
<td>164 feet (50 m)</td>
<td></td>
<td>To protect wetland functions; more may be required to protect more “sensitive wildlife species”</td>
</tr>
</tbody>
</table>

Table 5-8 is taken from one of the most comprehensive buffer syntheses published (Desbonnet et al. 1994). The authors of the synthesis looked at several hundred articles and reports on buffers. This table presents the information in a format that outlines the general effectiveness of different buffer widths at removing pollutants and providing habitat.
Table 5-8. A summary of the effectiveness of pollutant removal and the value of the wildlife habitat of vegetated buffers according to buffer width (Desbonnet et al. 1994).

<table>
<thead>
<tr>
<th>Buffer Width in Feet (Meters)</th>
<th>Pollutant Removal Effectiveness</th>
<th>Wildlife Habitat Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 feet (5 m)</td>
<td>Approximately 50% or greater sediment and pollutant removal</td>
<td>Poor habitat value; useful for temporary activities of wildlife</td>
</tr>
<tr>
<td>32 feet (10 m)</td>
<td>Approximately 60% or greater sediment and pollutant removal</td>
<td>Minimally protects stream habitat; poor habitat value; useful for temporary activities of wildlife</td>
</tr>
<tr>
<td>49 feet (15 m)</td>
<td>Greater than 60% sediment and pollutant removal</td>
<td>Minimal general wildlife and avian habitat value</td>
</tr>
<tr>
<td>66 feet (20 m)</td>
<td>Greater than 70% sediment and pollutant removal</td>
<td>Minimal wildlife habitat value; some value as avian habitat</td>
</tr>
<tr>
<td>98 feet (30 m)</td>
<td>Approximately 70% or greater sediment and pollutant removal</td>
<td>May have use as a wildlife travel corridor as well as general avian habitat</td>
</tr>
<tr>
<td>164 feet (50 m)</td>
<td>Approximately 75% or greater sediment and pollutant removal</td>
<td>Minimal general wildlife habitat value</td>
</tr>
<tr>
<td>246 feet (75 m)</td>
<td>Approximately 80% or greater sediment and pollutant removal</td>
<td>Fair to good general wildlife and avian habitat value</td>
</tr>
<tr>
<td>328 feet (100 m)</td>
<td>Approximately 80% or greater sediment and pollutant removal</td>
<td>Good general wildlife habitat value; may protect significant wildlife habitat</td>
</tr>
<tr>
<td>656 feet (200 m)</td>
<td>Approximately 90% or greater sediment and pollutant removal</td>
<td>Excellent general wildlife value; likely to support a diverse community</td>
</tr>
<tr>
<td>1,968 feet (600 m)</td>
<td>Approximately 99% or greater sediment and pollutant removal</td>
<td>Excellent general wildlife value; supports a diverse community; protection of significant species</td>
</tr>
</tbody>
</table>

Castelle et al. (1994), summarizing research conducted primarily before 1990, concluded “buffers necessary to protect wetlands and streams should be a minimum of 49 to 98 feet (15 to 30 m) in width under most circumstances.” They note that the lower end of the spectrum is the minimum necessary to maintain physical and chemical processes, while the upper end of the spectrum may be the minimum necessary to maintain biological processes. The Castelle et al. report of 1994 does not identify appropriate maximums. McMillan (2000) recommends an approach to determining buffers that attempts to balance predictability with flexibility by setting standard buffer widths that can be altered on a case-by-case basis to adapt to site-specific factors. This approach for determining buffer width incorporates a rating system for wetlands, plus an assessment of the intensity of proposed or existing adjacent land use, to establish buffer widths ranging from 25 to 350 feet (8 to 107 m). It is perhaps the method that is closest to fitting the four bulleted criteria outlined at the beginning of this section. It incorporates an understanding of the condition of the wetland, the buffer, and the proposed adjacent land use.

Several other authors also suggest that considering site-specific factors enhances the effectiveness of buffer strips over using fixed-width buffers (Steinblums et al. 1984,
Norman 1996, Todd 2000). Belt and O’Laughlin (1994) note that, “The fixed minimum-width approach enjoys the virtue of simplicity in application, but has the potential for providing either not enough or too much protection.”

Liquori (2000) also cautions against using fixed buffer widths to protect long-term ecological functioning of buffers and their associated aquatic resources. He notes that many of the functions that buffers provide are directly related to physical characteristics and biological processes within the buffers. Informed with site-specific information, a case-by-case argument could be made for establishing buffer widths. “The nature of the [functions a buffer provides] may significantly depend upon riparian structure both locally and as a mosaic over the watershed scale.”

In urban settings, larger buffer widths are often prescribed in anticipation of future impacts from adjacent land use and activity upstream in the watershed. The most important criterion for determining buffer width is identification of the various functions the buffer is expected to provide (Todd 2000).

In agricultural lands, Welsch (1991) identifies a three-zone approach for establishing buffers:

- **Zone 1** consists of riparian-type trees and shrubs immediately adjacent to the stream, water body, or wetland. It should be a minimum 13 feet (4 m) wide, or adjusted to include the entire riparian area (the area with year-long or seasonal soil-moisture regime influenced by the stream or water body). Minimum length should be the length of the proposed disturbance outside the riparian management zones, or “the longest distance possible.”

- **Zone 2** extends upslope from Zone 1 and consists of vegetation that may be periodically harvested as it matures. A minimum distance of 20 feet (6 m) should be allowed for this zone for small streams or water bodies; for larger streams or water bodies the total of Zones 1 and 2 can be increased up to 98 feet (30 m) or 30% of the geomorphic floodplain (whichever is less). Minimum length should match that of Zone 1. Zone 2 can be an active harvest zone, but trees and vegetation need to be left to provide soil holding and filtering capacity.

- **Zone 3** is added upslope of Zone 2 if adjacent land (away from the aquatic resource) is cultivated cropland or another land use with the potential for erosion or sediment production. Zone 3 is a vegetated filter strip and should be wide enough to control “concentrated flow erosion from cultivated cropland.” Zone 3 vegetation should be established prior to the establishment of Zones 1 and 2.

This zonal approach is recommended for active agricultural activities, which implies the regular creation of conditions with high erosion potential (grazing or tilling). It also allows more active use of the central portion of the buffer and active management of the outer area of the buffer.

Townsend and Robinson (2001) build on this zonal approach and recommend guidance on maintenance of canopy coverage and closure. They suggest using species that readily
resprout from stumps or roots in the areas nearest the stream channels (to allow the vegetation to respond to flood damage and/or beaver activity). They stress the need for ongoing maintenance, especially in Zone 3, to ensure that erosive flows are not causing rills or channelized flows into Zone 2. They also note that, while most of these buffers will be applied on an ownership basis, greater benefit would be realized if the concept of zoned buffers were applied on a watershed basis.

Other recommendations are based on wildlife species of particular interest. Based on their study of waterbirds in Florida, Rodgers and Smith (1997) recommend a buffer width of 328 feet (100 m) to ensure that birds will not be triggered into an “approach” response, a state which occurs prior to actual flushing. They derived this figure by analyzing the flushing distance from human approach for 16 species, then adding 131 feet (40 m) to that distance. The 131-foot (40 m) distance was derived from previous work which found that birds became alert (stopped their ongoing behavior and focused on the approaching human) in a range of 82 to 131 feet (25 to 40 m).

<table>
<thead>
<tr>
<th>5.5.6.1 Summary of Key Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Many researchers have recommended using four basic criteria to determine the width of a buffer:</td>
</tr>
<tr>
<td>– the functions and values of the aquatic resource to be protected by the buffer</td>
</tr>
<tr>
<td>– the characteristics of the buffer itself and of the watershed contributing to the aquatic resource</td>
</tr>
<tr>
<td>– the intensity of the adjacent land use (or proposed land use) and the expected impacts that result from that land use</td>
</tr>
<tr>
<td>– the specific functions that the buffer is supposed to provide including the targeted species to be managed and an understanding of their habitat needs</td>
</tr>
<tr>
<td>• Protecting wildlife habitat functions of wetlands generally requires larger buffers than protecting water quality functions of wetlands</td>
</tr>
<tr>
<td>• Effective buffer widths should be based on the above factors. They generally should range from:</td>
</tr>
<tr>
<td>25 to 75 feet (8 to 23 m) for wetlands with minimal habitat functions and low-intensity land uses adjacent to the wetland</td>
</tr>
<tr>
<td>75 to 150 feet (15 to 46 m) for wetlands with moderate habitat functions and moderate or high-intensity land uses adjacent to the wetland</td>
</tr>
<tr>
<td>150 to 300+ feet (46 to 92+ m) for wetlands with high habitat functions, regardless of the intensity of the land uses adjacent to the wetland</td>
</tr>
<tr>
<td>• Fixed-width buffers may not adequately address the issues of habitat fragmentation and population dynamics. Several researchers have recommended</td>
</tr>
</tbody>
</table>
5.6 Chapter Summary and Conclusions

Wetlands are defined using well established language that is generally consistent between federal and state laws. However, certain wetland types are sometimes excluded from regulation. These include small wetlands, isolated wetlands, and wetlands that are designated as Prior Converted Croplands (PCC). The scientific literature makes clear that small wetlands and isolated wetlands provide important functions and does not provide any rationale for excluding these wetlands from regulation. Little scientific information is available on PCC, but there is no evidence to suggest that they are unimportant in providing wetland functions. They retain many of the characteristics necessary to provide multiple wetland functions.

Wetland delineation is conducted according to either the federal or state delineation manual. These manuals are consistent and, when applied correctly, will result in the same wetland boundary. Wetland rating systems are a useful tool for grouping wetlands based on their needs for protection. The most widely used method in Washington is the state’s rating system which places wetlands in categories based on their rarity, sensitivity, irreplaceability, and functions.

Wetland buffers are a critical tool for protecting wetland functions. Findings regarding buffer functions and effectiveness are consistent in recommending that the width of a buffer should be related to the wetland functions that need protection, the land-use activities from which the wetland is being buffered, and the characteristics of the buffer itself. These factors, derived from the many studies of wetland buffers and other aquatic resources, can be thought of as the "fundamental principles" that are recommended to determine the widths and characteristics of buffers.

The literature confirms that for water quality improvement (e.g., sediment removal and nutrient uptake) there is a non-linear relationship between buffer width and increased effectiveness. Sediment removal and nutrient uptake are provided at the greatest rates within the immediate outer portions of a buffer (nearest the source of sediment/nutrient), with increasingly larger widths of buffers required to obtain measurable increases in those functions. Additionally, the long-term effectiveness of buffers in providing such mechanical and biological processes is not well documented in the literature. However, the literature suggests that buffers may have a carrying capacity or limit to their ability to remove pollutants. Future research on this topic is needed.

Compared to the widths needed for sediment removal and nutrient uptake, the literature has documented the need for significantly wider buffers to protect or maintain habitat functions for wildlife species that are closely associated with wetlands, as well as for populations that use wetlands. Research confirms that many wildlife species and guilds are dependent upon wetlands for only portions of their life cycles, and that they require upland habitats adjacent to the wetland to meet all their life needs. Without adequate
upland habitat adjacent to wetlands, these habitat functions are lost. Some species use upland habitats that are far from the source wetland. The literature documents that, without access to appropriate upland habitat and the opportunity to move between wetlands and other habitats across a landscape, it is not possible to maintain viable populations of many species. Beyond simply providing adequate upland habitat adjacent to a single wetland, the literature on the maintenance of wildlife populations finds that it is necessary to link habitat types, including wetlands and uplands, across a landscape in order to maintain genetically viable populations.

Several authors who suggested recommendations for buffer widths based on their own synthesis of the literature have recommended variable widths based on the conditions of the wetland, the conditions of the buffer, the proposed land uses adjacent to the buffer, and what functions are intended to be managed. For protection and maintenance of wildlife habitat functions of wetlands, these studies suggest that effective buffer widths should be based on the above factors and generally should range from: 25 to 75 feet (8 to 23 m) for wetlands with minimal habitat functions and low-intensity land uses adjacent to wetlands; 50 to 150 feet (15 to 46 m) for wetlands with moderate habitat functions and moderate or high-intensity land use that is adjacent; and 150 to 300+ feet (46 to 92+ m) for wetlands with high habitat functions depending on the intensity of the adjacent land use. However, several authors noted that protection and maintenance of viable wildlife populations for many species requires habitat connections via corridors and large habitat patches.

Chapter 6 continues the discussion of regulatory tools used to manage wetlands by discussing wetland compensatory mitigation and its effectiveness.
Wetlands in Washington State

Volume 2: Guidance for Protecting and Managing Wetlands

Final
Appendix 8-C
Guidance on Widths of Buffers and Ratios for Compensatory Mitigation for Use with the Western Washington Wetland Rating System

8C.1 Introduction

This appendix provides guidance on widths of buffers, ratios for compensatory mitigation, and other measures for protecting wetlands that are linked to the Washington State Wetland Rating System for Western Washington-Revised (Hruby 2004b). Refer to Appendix 8-D for guidance for eastern Washington. Appendices 8-C through 8-F have been formatted similar to the main text of this volume (i.e., with a numbering system) to help with organization.

The tables below list the recommended widths of buffers for various alternatives, examples of measures to minimize impacts, and ratios for compensatory mitigation.

- **Table 8C-1.** Width of buffers needed to protect wetlands in western Washington if impacts from land use and wetland functions are NOT incorporated (Buffer Alternative 1). [Page 4]
- **Table 8C-2.** Width of buffers based on wetland category and modified by the intensity of the impacts from changes in proposed land use (Buffer Alternative 2). [Page 5]
- **Table 8C-3.** Types of land uses that can result in high, moderate, and low levels of impacts to adjacent wetlands (used in Buffer Alternatives 2 and 3). [Page 5]
- **Table 8C-4.** Width of buffers needed to protect Category IV wetlands in western Washington (Buffer Alternative 3). [Page 6]
- **Table 8C-5.** Width of buffers needed to protect Category III wetlands in western Washington (Buffer Alternative 3). [Page 6]
- **Table 8C-6.** Width of buffers needed to protect Category II wetlands in western Washington (Buffer Alternative 3). [Page 7]
- **Table 8C-7.** Width of buffers needed to protect Category I wetlands in western Washington (Buffer Alternative 3). [Page 8]
- **Table 8C-8.** Examples of measures to minimize impacts to wetlands from different types of activities. [Page 10]
8C.2 Widths of Buffers

Requiring buffers of a specific width has been one of the primary methods by which local jurisdictions in Washington have protected the functions and values of wetlands. Generally, buffers are the uplands adjacent to an aquatic resource that can, through various physical, chemical, and biological processes, reduce impacts to wetlands from adjacent land uses. The physical characteristics of buffers (e.g., slope, soils, vegetation, and width) determine how well buffers reduce the adverse impacts of human development. These characteristics are discussed in detail in Chapter 5, Volume 1.

In addition to reducing the impacts of adjacent land uses, buffers also protect and maintain a wide variety of functions and values provided by wetlands. For example, buffers can provide the terrestrial habitats needed by many species of wildlife that use wetlands to meet some of their needs.

The review of the scientific literature has shown, however, that buffers alone cannot adequately protect all functions that a wetland performs. Additional guidance is, therefore, provided on other ways in which wetlands can be managed and regulated to provide some of the necessary protection that buffers alone do not provide. The following guidance for protecting the functions and values of wetlands is based on their category as determined through the rating system for western Washington.
Basic assumptions for using the guidance on widths for buffers

Recommendations for widths of buffers assume that:

- The wetland has been categorized using the Washington State Wetland Rating System for Western Washington-Revised (Hruby 2004b).

- The buffer is vegetated with native plant communities that are appropriate for the ecoregion or with a plant community that provides similar functions. Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. The U.S. Environmental Protection Agency maintains updated maps of ecoregions that are available at http://www.epa.gov/naaujydh/pages/models/ecoregions.htm. Ecoregions currently mapped for Washington are: Coast Range, Puget Lowland, Cascades, Eastern Cascades Slopes and Foothills, North Cascades, Columbia Plateau, Blue Mountains, and Northern Rockies.

- If the vegetation in the buffer is disturbed (grazed, mowed, etc.), proponents planning changes to land use that will increase impacts to wetlands need to rehabilitate the buffer with native plant communities that are appropriate for the ecoregion, or with a plant community that provides similar functions.

- The width of the buffer is measured along the horizontal plane (see drawing below):  

```
\[\text{Measurement of buffer width}\]
```

- The buffer will remain relatively undisturbed in the future within the width specified.

Three alternatives for protecting the functions of wetlands using buffers are described in the following sections:

- **Buffer Alternative 1.** Width based only on wetland category.

- **Buffer Alternative 2.** Width based on wetland category and the intensity of impacts from proposed changes in land use.

- **Buffer Alternative 3.** Width based on wetland category, intensity of impacts, and wetland functions or special characteristics. This alternative has two options for determining the widths of buffers when they are based on the score for habitat. Alternative 3 provides three buffer widths based on habitat scores, while Alternative 3A provides a graduated scale of widths for buffers based on habitat scores.

The buffer widths recommended for each alternative were based on the review of scientific information in Volume 1. The guidance in this appendix synthesizes the information about the types and sizes of buffers needed to protect the functions and special characteristics of wetlands.
Appendices 8-C and 8-D do not provide the metric equivalents for buffer widths even though most of the research on buffers uses the metric scale. This decision was made because most local governments use the English Customary measures. For example, a buffer width is set at 50 feet rather than 15 meters.

8C.2.1 Buffer Alternative 1: Width Based Only on Wetland Category

This alternative, in which the width of buffers is based only on the category of the wetland, is the simplest (Table 8C-1). The width recommended for each category of wetland in Alternative 1 is the widest recommended for that category in both Alternatives 2 and 3 (discussed below). Alternative 1 provides the least flexibility because many different types of wetlands and types of human impacts are combined. For example, not all wetlands that fall into Category I or II need a 300-foot buffer. If no distinctions are made between the wetlands that fall into Category I or II, all wetlands that fall into these categories have to be protected with a 300-foot buffer so adequate protection is provided for those wetlands that do need a buffer this wide. Also, the widths recommended for this alternative are those needed to protect the wetland from proposed land uses that have the greatest impacts since no distinctions between impacts are made.

Table 8C-1. Width of buffers needed to protect wetlands in western Washington if impacts from land use and wetland functions are NOT incorporated (Buffer Alternative 1).

<table>
<thead>
<tr>
<th>Category of Wetland</th>
<th>Widths of Buffers</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>50 ft</td>
</tr>
<tr>
<td>III</td>
<td>150 ft</td>
</tr>
<tr>
<td>II</td>
<td>300 ft</td>
</tr>
<tr>
<td>I</td>
<td>300 ft</td>
</tr>
</tbody>
</table>

8C.2.2 Buffer Alternative 2: Width Based on Wetland Category and Modified by the Intensity of the Impacts from Proposed Land Use

The second alternative increases the regulatory flexibility by including the concept that not all proposed changes in land uses have the same level of impact (Table 8C-2). For example, one new residence being built on 5 acres of land near a wetland is expected to have a smaller impact than 20 houses built on the same 5 acres. Three categories of impacts from proposed land uses are outlined: land uses that can create high impacts, moderate impacts, and low impacts to wetlands. Different land uses that can cause these levels of impacts are listed in Table 8C-3.
Table 8C-2. Width of buffers needed to protect wetlands in western Washington considering impacts of proposed land uses (Buffer Alternative 2).

<table>
<thead>
<tr>
<th>Category of Wetland</th>
<th>Land Use with Low Impact *</th>
<th>Land Use with Moderate Impact *</th>
<th>Land Use with High Impact*</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>25 ft</td>
<td>40 ft</td>
<td>50 ft</td>
</tr>
<tr>
<td>III</td>
<td>75 ft</td>
<td>110 ft</td>
<td>150 ft</td>
</tr>
<tr>
<td>II</td>
<td>150 ft</td>
<td>225 ft</td>
<td>300 ft</td>
</tr>
<tr>
<td>I</td>
<td>150 ft</td>
<td>225 ft</td>
<td>300 ft</td>
</tr>
</tbody>
</table>

* See Table 8C-3 below for types of land uses that can result in low, moderate, and high impacts to wetlands.

Table 8C-3. Types of proposed land use that can result in high, moderate, and low levels of impacts to adjacent wetlands.

<table>
<thead>
<tr>
<th>Level of Impact from Proposed Change in Land Use</th>
<th>Types of Land Use Based on Common Zoning Designations *</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>• Commercial</td>
</tr>
<tr>
<td></td>
<td>• Urban</td>
</tr>
<tr>
<td></td>
<td>• Industrial</td>
</tr>
<tr>
<td></td>
<td>• Institutional</td>
</tr>
<tr>
<td></td>
<td>• Retail sales</td>
</tr>
<tr>
<td></td>
<td>• Residential (more than 1 unit/acre)</td>
</tr>
<tr>
<td></td>
<td>• Conversion to high-intensity agriculture (dairies, nurseries, greenhouses, growing and harvesting crops requiring annual tilling and raising and maintaining animals, etc.)</td>
</tr>
<tr>
<td></td>
<td>• High-intensity recreation (golf courses, ball fields, etc.)</td>
</tr>
<tr>
<td></td>
<td>• Hobby farms</td>
</tr>
<tr>
<td>Moderate</td>
<td>• Residential (1 unit/acre or less)</td>
</tr>
<tr>
<td></td>
<td>• Moderate-intensity open space (parks with biking, jogging, etc.)</td>
</tr>
<tr>
<td></td>
<td>• Conversion to moderate-intensity agriculture (orchards, hay fields, etc.)</td>
</tr>
<tr>
<td></td>
<td>• Paved trails</td>
</tr>
<tr>
<td></td>
<td>• Building of logging roads</td>
</tr>
<tr>
<td></td>
<td>• Utility corridor or right-of-way shared by several utilities and including access/maintenance road</td>
</tr>
<tr>
<td>Low</td>
<td>• Forestry (cutting of trees only)</td>
</tr>
<tr>
<td></td>
<td>• Low-intensity open space (hiking, bird-watching, preservation of natural resources, etc.)</td>
</tr>
<tr>
<td></td>
<td>• Unpaved trails</td>
</tr>
<tr>
<td></td>
<td>• Utility corridor without a maintenance road and little or no vegetation management.</td>
</tr>
</tbody>
</table>

* Local governments are encouraged to create land-use designations for zoning that are consistent with these examples.
8C.2.3 Buffer Alternative 3: Width Based on Wetland Category, Intensity of Impacts, Wetland Functions, or Special Characteristics

The third alternative provides the most flexibility by basing the widths of buffers on three factors: the wetland category, the intensity of the impacts (as used in Alternative 2), and the functions or special characteristics of the wetland that need to be protected as determined through the rating system. The recommended widths for buffers are shown in Tables 8C-4 to 8C-7. Using this alternative, a wetland may fall into more than one category in the table. For example, an interdunal wetland may be rated a Category III wetland because it is an isolated interdunal wetland, but it may be rated a Category II wetland based on its score for functions.

If a wetland meets more than one of the characteristics listed in Tables 8C-4 to 8C-7, the buffer recommended to protect the wetland is the widest one. For example, if a Category I wetland (Table 8C-7) scores 32 points for habitat and 27 points for water quality functions, a 300-foot buffer is needed for land uses with high impacts because the widths needed to protect habitat are wider than those needed for the other functions.

| Table 8C-4. Width of buffers needed to protect Category IV wetlands in western Washington (Buffer Alternative 3 for wetlands scoring less than 30 points for all functions). |
|---|---|---|
| Wetland Characteristics | Buffer Widths by Impact of Proposed Land Use | Other Measures Recommended for Protection |
| Score for all 3 basic functions is less than 30 points | Low - 25 ft Moderate – 40 ft High – 50 ft | No recommendations at this time¹ |

| Table 8C-5. Width of buffers needed to protect Category III wetlands in western Washington (Buffer Alternative 3 for wetlands scoring 30 – 50 points for all functions). |
|---|---|---|
| Wetland Characteristics | Buffer Widths by Impact of Proposed Land Use | Other Measures Recommended for Protection |
| Moderate level of function for habitat (score for habitat 20 - 28 points) | Low - 75 ft Moderate – 110 ft High – 150 ft | No recommendations at this time¹ |
| Not meeting above characteristic | Low - 40 ft Moderate – 60 ft High – 80 ft | No recommendations at this time¹ |

¹ No information on other measures for protection was available at the time this document was written. The Washington State Department of Ecology will continue to collect new information for future updates to this document.
Table 8C-6. Width of buffers needed to protect Category II wetlands in western Washington (Buffer Alternative 3 for wetlands scoring 51-69 points for all functions or having the “Special Characteristics” identified in the rating system).

<table>
<thead>
<tr>
<th>Wetland Characteristics</th>
<th>Buffer Widths by Impact of Proposed Land Use (Apply most protective if more than one criterion is met.)</th>
<th>Other Measures Recommended for Protection</th>
</tr>
</thead>
</table>
| High level of function for habitat (score for habitat 29 - 36 points) | Low - 150 ft  
Moderate – 225 ft  
High – 300 ft* | Maintain connections to other habitat areas |
| Moderate level of function for habitat (score for habitat 20 - 28 points) | Low - 75 ft  
Moderate – 110 ft  
High – 150 ft | No recommendations at this time\(^2\) |
| High level of function for water quality improvement and low for habitat (score for water quality 24 - 32 points; habitat less than 20 points) | Low - 50 ft  
Moderate – 75 ft  
High – 100 ft | No additional surface discharges of untreated runoff\(^2\) |
| Estuarine | Low - 75 ft  
Moderate – 110 ft  
High – 150 ft | No recommendations at this time\(^2\) |
| Interdunal | Low - 75 ft  
Moderate – 110 ft  
High – 150 ft | No recommendations at this time\(^2\) |
| Not meeting above characteristics | Low - 50 ft  
Moderate – 75 ft  
High – 100 ft | No recommendations at this time\(^2\) |

* Fifty of the 122 wetlands used to calibrate the rating system for western Washington were Category II. Of these 50, only five (10%) would require 300-foot buffers to protect them from high-impact land uses. The maximum buffer width for the remaining 45 wetlands would be 150 feet.

\(^2\) See footnote on the previous page.
Table 8C-7. Width of buffers needed to protect Category I wetlands in western Washington (Buffer Alternative 3 for wetlands scoring 70 points or more for all functions or having the “Special Characteristics” identified in the rating system).

<table>
<thead>
<tr>
<th>Wetland Characteristics</th>
<th>Buffer Widths by Impact of Proposed Land Use (Apply most protective if more than one criterion is met)</th>
<th>Other Measures Recommended for Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Heritage Wetlands</td>
<td>Low - 125 ft</td>
<td>No additional surface discharges to wetland or its tributaries</td>
</tr>
<tr>
<td></td>
<td>Moderate – 190 ft</td>
<td>No septic systems within 300 ft of wetland</td>
</tr>
<tr>
<td></td>
<td>High – 250 ft</td>
<td>Restore degraded parts of buffer</td>
</tr>
<tr>
<td>Bogs</td>
<td>Low - 125 ft</td>
<td>No additional surface discharges to wetland or its tributaries</td>
</tr>
<tr>
<td></td>
<td>Moderate – 190 ft</td>
<td>Restore degraded parts of buffer</td>
</tr>
<tr>
<td>Forested</td>
<td>Buffer width to be based on score for habitat functions or water quality functions</td>
<td>If forested wetland scores high for habitat, need to maintain connections to other habitat areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Restore degraded parts of buffer</td>
</tr>
<tr>
<td>Estuarine</td>
<td>Low - 100 ft</td>
<td>No recommendations at this time³</td>
</tr>
<tr>
<td></td>
<td>Moderate – 150 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High – 200 ft</td>
<td></td>
</tr>
<tr>
<td>Wetlands in Coastal Lagoons</td>
<td>Low - 100 ft</td>
<td>No recommendations at this time³</td>
</tr>
<tr>
<td></td>
<td>Moderate – 150 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High – 200 ft</td>
<td></td>
</tr>
<tr>
<td>High level of function for habitat (score for habitat 29 - 36 points)</td>
<td>Low – 150 ft</td>
<td>Maintain connections to other habitat areas</td>
</tr>
<tr>
<td></td>
<td>Moderate – 225 ft</td>
<td>Restore degraded parts of buffer</td>
</tr>
<tr>
<td>Moderate level of function for habitat (score for habitat 20 - 28 points)</td>
<td>Low – 75 ft</td>
<td>No recommendations at this time³</td>
</tr>
<tr>
<td></td>
<td>Moderate – 110 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High – 150 ft</td>
<td></td>
</tr>
<tr>
<td>High level of function for water quality improvement (24 – 32 points) and low for habitat (less than 20 points)</td>
<td>Low – 50 ft</td>
<td>No additional surface discharges of untreated runoff</td>
</tr>
<tr>
<td></td>
<td>Moderate – 75 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High – 100 ft</td>
<td></td>
</tr>
<tr>
<td>Not meeting any of the above characteristics</td>
<td>Low – 50 ft</td>
<td>No recommendations at this time³</td>
</tr>
<tr>
<td></td>
<td>Moderate – 75 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High – 100 ft</td>
<td></td>
</tr>
</tbody>
</table>

³ See footnote on page 6.
8C.2.4 Special Conditions for a Possible Reduction in Buffer Widths

8C.2.4.1 Condition 1: Reduction in Buffer Width Based on Reducing the Intensity of Impacts from Proposed Land Uses

The buffer widths recommended for proposed land uses with high-intensity impacts to wetlands can be reduced to those recommended for moderate-intensity impacts under the following conditions:

- For wetlands that score moderate or high for habitat (20 points or more for the habitat functions), the width of the buffer can be reduced if both of the following criteria are met:
  1) A relatively undisturbed, vegetated corridor at least 100-feet wide is protected between the wetland and any other Priority Habitats as defined by the Washington State Department of Fish and Wildlife ("relatively undisturbed" and "vegetated corridor" are defined in questions H 2.1 and H 2.2.1 of the Washington State Wetland Rating System for Western Washington – Revised, (Hruby 2004b)). Priority Habitats in western Washington include:
     - Wetlands
     - Riparian zones
     - Aspen stands
     - Cliffs
     - Prairies
     - Caves
     - Stands of Oregon White Oak
     - Old-growth forests
     - Estuary/estuary-like
     - Marine/estuarine shorelines
     - Eelgrass meadows
     - Talus slopes
     - Urban natural open space (for current definitions of Priority Habitats, see http://wdfw.wa.gov/hab/phshabs.htm)

     The corridor must be protected for the entire distance between the wetland and the Priority Habitat by some type of legal protection such as a conservation easement.

  2) Measures to minimize the impacts of different land uses on wetlands, such as the examples summarized in Table 8C-8, are applied.

- For wetlands that score less than 20 points for habitat, the buffer width can be reduced to that required for moderate land-use impacts by applying measures to minimize the impacts of the proposed land uses (see examples in Table 8C-8).
Table 8C-8. Examples of measures to minimize impacts to wetlands from proposed change in land use that have high impacts. (This is not a complete list of measures.)

<table>
<thead>
<tr>
<th>Examples of Disturbance</th>
<th>Activities and Uses that Cause Disturbances</th>
<th>Examples of Measures to Minimize Impacts</th>
</tr>
</thead>
</table>
| Lights                  | • Parking lots  
                           • Warehouses  
                           • Manufacturing  
                           • Residential | • Direct lights away from wetland |
| Noise                   | • Manufacturing  
                           • Residential | • Locate activity that generates noise away from wetland |
| Toxic runoff*           | • Parking lots  
                           • Roads  
                           • Manufacturing  
                           • Residential areas  
                           • Application of agricultural pesticides  
                           • Landscaping | • Route all new, untreated runoff away from wetland while ensuring wetland is not dewatered  
                           • Establish covenants limiting use of pesticides within 150 ft of wetland  
                           • Apply integrated pest management |
| Stormwater runoff       | • Parking lots  
                           • Roads  
                           • Manufacturing  
                           • Residential areas  
                           • Commercial  
                           • Landscaping | • Retrofit stormwater detention and treatment for roads and existing adjacent development  
                           • Prevent channelized flow from lawns that directly enters the buffer |
| Change in water regime  | • Impermeable surfaces  
                           • Lawns  
                           • Tilling | • Infiltrate or treat, detain, and disperse into buffer new runoff from impervious surfaces and new lawns |
| Pets and human disturbance | • Residential areas | • Use privacy fencing; plant dense vegetation to delineate buffer edge and to discourage disturbance using vegetation appropriate for the ecoregion; place wetland and its buffer in a separate tract |
| Dust                    | • Tilled fields | • Use best management practices to control dust |

* These examples are not necessarily adequate for minimizing toxic runoff if threatened or endangered species are present at the site.
8C.2.4.2 Condition 2: Reductions in Buffer Widths Where Existing Roads or Structures Lie Within the Buffer

Where a legally established, non-conforming use of the buffer exists (e.g., a road or structure that lies within the width of buffer recommended for that wetland), proposed actions in the buffer may be permitted as long as they do not increase the degree of non-conformity. This means no increase in the impacts to the wetland from activities in the buffer.

For example, if a land use with high impacts (e.g., building an urban road) is being proposed next to a Category II wetland with a moderate level of function for habitat, a 150-foot buffer would be needed to protect functions (see Table 8C-6). If, however, an existing urban road is already present and only 50 feet from the edge of the Category II wetland, the additional 100 feet of buffer may not be needed if the road is being widened. A vegetated buffer on the other side of the road would not help buffer the existing impacts to the wetland from the road. If the existing road is resurfaced or widened (e.g., to add a sidewalk) along the upland edge, without any further roadside development that would increase the degree of non-conformity, the additional buffer is not necessary. The associated increase in impervious surface from widening a road, however, may necessitate mitigation for impacts from stormwater.

If, however, the proposal is to build a new development (e.g., shopping center) along the upland side of the road, the impacts to the wetland and its functions may increase. This would increase the degree of non-conformity. The project proponent would need to provide the additional 100 feet of buffer extending beyond the road or apply buffer averaging (see Section 8C.2.6).

8C.2.4.3 Condition 3: Reduction in Buffer Widths Through an Individual Rural Stewardship Plan

A Rural Stewardship Plan (RSP) is the product of a collaborative effort between rural property owners and a local government to tailor a management plan specific for a rural parcel of land. The goal of the RSP is better management of wetlands than what would be achieved through strict adherence to regulations. In exchange, the landowner gains flexibility in the widths of buffers required, in clearing limits, and in other requirements found in the regulations. For example, dense development in rural residential areas can be treated as having a low level of impact when the development of the site is managed through a locally approved RSP. The voluntary agreement includes provisions for restoration, maintenance, and long-term monitoring and specifies the widths of buffers needed to protect each wetland within the RSP.
8C.2.5 Conditions for Increasing the Width of, or Enhancing, the Buffer

8C.2.5.1 Condition 1: Buffer is Not Vegetated with Plants Appropriate for the Region

The recommended widths for buffers are based on the assumption that the buffer is vegetated with a native plant community appropriate for the ecoregion or with one that performs similar functions. If the existing buffer is unvegetated, sparsely vegetated, or vegetated with invasive species that do not perform needed functions, the buffer should either be planted to create the appropriate plant community or the buffer should be widened to ensure that adequate functions of the buffer are provided. Generally, improving the vegetation will be more effective than widening the buffer.

8C.2.5.2 Condition 2: Buffer Has a Steep Slope

The review of the literature (Volume 1) indicates that the effectiveness of buffers at removing pollutants before they enter a wetland decreases as the slope increases. If a buffer is to be based on the score for its ability to improve water quality (see Tables 8C-4 through 8C-7) rather than habitat or other criteria, then the buffer should be increased by 50% if the slope is greater than 30% (a 3-foot rise for every 10 feet of horizontal distance).

8C.2.5.3 Condition 3: Buffer Is Used by Species Sensitive to Disturbance

If the wetland provides habitat for a species that is particularly sensitive to disturbance (such as a threatened or endangered species), the width of the buffer should be increased to provide adequate protection for the species based on its particular, life-history needs. Some buffer requirements for priority species are available on the Washington State Department of Fish and Wildlife web page (http://wdfw.wa.gov/hab/phsrecs.htm). The list of priority species for vertebrates is at http://wdfw.wa.gov/hab/phsvert.htm; for invertebrates it is at http://wdfw.wa.gov/hab/phsinvrt.htm. Information on the buffer widths needed by some threatened, endangered, and sensitive species of wildlife is provided in Appendix 8-H.

8C.2.6 Buffer Averaging

The widths of buffers may be averaged if this will improve the protection of wetland functions, or if it is the only way to allow for reasonable use of a parcel. There is no scientific information available to determine if averaging the widths of buffers actually protects functions of wetlands. The authors have concluded that averaging could be allowed in the following situations:

Averaging may not be used in conjunction with any of the other provisions for reductions in buffers (listed above).
• Averaging to improve wetland protection may be permitted when all of the following conditions are met:
  – The wetland has significant differences in characteristics that affect its habitat functions, such as a wetland with a forested component adjacent to a degraded emergent component or a “dual-rated” wetland with a Category I area adjacent to a lower rated area
  – The buffer is increased adjacent to the higher-functioning area of habitat or more sensitive portion of the wetland and decreased adjacent to the lower-functioning or less sensitive portion
  – The total area of the buffer after averaging is equal to the area required without averaging
  – The buffer at its narrowest point is never less than 3/4 of the required width
• Averaging to allow reasonable use of a parcel may be permitted when all of the following are met:
  – There are no feasible alternatives to the site design that could be accomplished without buffer averaging
  – The averaged buffer will not result in degradation of the wetland’s functions and values as demonstrated by a report from a qualified wetland professional (see Appendix 8-G for a definition of a qualified wetland professional)
  – The total buffer area after averaging is equal to the area required without averaging
  – The buffer at its narrowest point is never less than 3/4 of the required width

8C.2.7 Modifying Buffer Widths in Alternative 3 Using a Graduated Scale for the Habitat Functions (Alternative 3A)

Alternative 3 contains recommendations for protecting the habitat functions of wetlands using only three groupings of scores (0-19, 20-28, 29-36). As a result, a one-point difference between 28 and 29 can result in a 150-foot increase in the width of a buffer around a wetland. The habitat scores were divided into three groups to simplify the regulations based on this guidance. This division is not based on a characterization of risks since the scientific information indicates that the decrease in risk with increasing widths of buffers is relatively continuous for habitat functions.

Such a large increase in width with a one-point increase in the habitat score may be contentious. A jurisdiction may wish to reduce the increments in the widths for buffers by developing a more graduated (but inherently more complicated) scale based on the scores for habitat. Table 8C-9 provides one example of a graduated scale for widths of buffers where the width increases by 20 feet for every one point increase in the habitat score (Figure 8C-1 shows the buffer widths graphically).
Table 8C-9. Comparison of widths for buffers in Alternatives 3 (step-wise scale) and 3A (graduated scale) for proposed land uses with high impacts based on the score for habitat functions in western Washington

<table>
<thead>
<tr>
<th>Points for Habitat from Wetland Rating Form</th>
<th>19</th>
<th>20</th>
<th>21</th>
<th>22</th>
<th>23</th>
<th>24</th>
<th>25</th>
<th>26</th>
<th>27</th>
<th>28</th>
<th>29</th>
<th>30</th>
<th>31</th>
<th>32</th>
<th>33</th>
<th>34</th>
<th>35</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 3</td>
<td>100</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Alternative 3A</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>120</td>
<td>140</td>
<td>160</td>
<td>180</td>
<td>200</td>
<td>220</td>
<td>240</td>
<td>260</td>
<td>280</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
</tbody>
</table>

Figure 8C-1. Graphical comparison of widths for buffers in Alternative 3 and 3A for proposed land uses with high impacts based on the score for habitat functions in western Washington.
Other scales are possible as long as they keep within the limits established from the scientific information currently available: wetlands with scores for habitat that are higher than 31 points need buffers that are at least 300-feet wide; wetlands with a score of 26 points need buffers of at least 150 feet; and wetlands with a score of 22 points need buffers that are at least 100-feet wide.

These buffer widths can be further reduced by 25 percent if a proposed project with high impacts implements the mitigation measures such as those described in Table 8C-8. The measures are part of “Condition 1” in Section 8C.2.4 (Special Conditions for a Possible Reduction in Buffer Widths). The buffer widths under Buffer Alternatives 3 and 3A, and the corresponding 25 percent reduction (per buffer reduction condition 1) are shown in Table 8C-10 and represented graphically below in Figure 8C-2.

**Table 8C-10. Comparison of widths for buffers in Alternatives 3 (step-wise scale) and 3A (graduated scale) for proposed land uses with high impacts based on the score for habitat functions in western Washington if the impacts are mitigated.**

<table>
<thead>
<tr>
<th>Points for Habitat from Wetland Rating Form</th>
<th>19</th>
<th>20</th>
<th>21</th>
<th>22</th>
<th>23</th>
<th>24</th>
<th>25</th>
<th>26</th>
<th>27</th>
<th>28</th>
<th>29</th>
<th>30</th>
<th>31</th>
<th>32</th>
<th>33</th>
<th>34</th>
<th>35</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 3 (with mitigation of impacts)</td>
<td>75</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>225</td>
<td>225</td>
<td>225</td>
<td>225</td>
<td>225</td>
<td>225</td>
<td>225</td>
<td>225</td>
<td>225</td>
<td>225</td>
<td>225</td>
</tr>
<tr>
<td>Alternative 3A (with mitigation of impacts)</td>
<td>75</td>
<td>75</td>
<td>90</td>
<td>105</td>
<td>120</td>
<td>135</td>
<td>150</td>
<td>180</td>
<td>195</td>
<td>210</td>
<td>225</td>
<td>225</td>
<td>225</td>
<td>225</td>
<td>225</td>
<td>225</td>
<td>225</td>
<td>225</td>
</tr>
</tbody>
</table>
Figure 8C-2. Graphical comparison of widths for buffers in Alternatives 3 and 3A based on the score for habitat functions in western Washington with and without mitigating impacts of proposed development outside the buffer.

Alternatives 3 and 3A represent two separate approaches for determining widths of buffers for wetlands scoring between 20 and 31 points for the habitat functions. Local governments should select one of the two approaches and should not hybridize the approaches or adopt both at the same time.
8C.3 Ratios for Compensatory Mitigation

When the acreage required for compensatory mitigation is divided by the acreage of impact, the result is a number known variously as a replacement, compensation, or mitigation ratio. Compensatory mitigation ratios are used to help ensure that compensatory mitigation actions are adequate to offset unavoidable wetland impacts by requiring a greater amount of mitigation area than the area of impact. Requiring greater mitigation area helps compensate for the risk that a mitigation action will fail and for the time lag that occurs between the wetland impact and achieving a fully functioning mitigation site.

8C.3.1 Definitions of Types of Compensatory Mitigation

The ratios presented are based on the type of compensatory mitigation proposed (e.g., restoration, creation, and enhancement). In its Regulatory Guidance Letter 02-02, the U.S. Army Corps of Engineers provided definitions for these types of compensatory mitigation. For consistency, the authors of this document use the same definitions which are provided below.

**Restoration:** The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural or historic functions to a former or degraded wetland. For the purpose of tracking net gains in wetland acres, restoration is divided into:

- **Re-establishment.** The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural or historic functions to a former wetland. Re-establishment results in a gain in wetland acres (and functions). Activities could include removing fill material, plugging ditches, or breaking drain tiles.

- **Rehabilitation.** The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural or historic functions of a degraded wetland. Rehabilitation results in a gain in wetland function but does not result in a gain in wetland acres. Activities could involve breaching a dike to reconnect wetlands to a floodplain or return tidal influence to a wetland.

**Creation (Establishment):** The manipulation of the physical, chemical, or biological characteristics present to develop a wetland on an upland or deepwater site where a wetland did not previously exist. Establishment results in a gain in wetland acres. Activities typically involve excavation of upland soils to elevations that will produce a wetland hydroperiod, create hydric soils, and support the growth of hydrophytic plant species.

**Enhancement:** The manipulation of the physical, chemical, or biological characteristics of a wetland site to heighten, intensify, or improve specific function(s) or to change the growth stage or composition of the vegetation present. Enhancement is undertaken for specified purposes such as water quality improvement, flood water retention, or wildlife habitat. Enhancement results in a change in some wetland functions and can lead to a
decline in other wetland functions, but does not result in a gain in wetland acres. Activities typically consist of planting vegetation, controlling non-native or invasive species, modifying site elevations or the proportion of open water to influence hydroperiods, or some combination of these activities.

**Protection/Maintenance (Preservation):** Removing a threat to, or preventing the decline of, wetland conditions by an action in or near a wetland. This includes the purchase of land or easements, repairing water control structures or fences, or structural protection such as repairing a barrier island. This term also includes activities commonly associated with the term *preservation*. Preservation does not result in a gain of wetland acres, may result in a gain in functions, and will be used only in exceptional circumstances.

### Distinction between rehabilitation and enhancement

The distinction between rehabilitation and enhancement as defined above is not clear-cut and can be hard to understand. Actions that rehabilitate or enhance wetlands span a continuum of activities that cannot be defined by specific criteria.

**Rehabilitation**

- Actions that restore the original hydrogeomorphic (HGM) class, or subclass, to a wetland whose current HGM class, or subclass, has been changed by human activities
- Actions that restore the water regime that was present and maintained the wetland before human activities changed it

**Enhancement**

Any other actions taken in existing wetlands would be considered *enhancement*. Enhancement typically involves actions that provide gains in only one or a few functions and can lead to a decline in other functions. Enhancement actions often focus on structural or superficial improvements to a site and generally do not address larger-scale environmental processes.

For example, a wetland that was once a forested, riverine wetland was changed to a depressional, emergent wetland by the construction of a dike and through grazing. Rehabilitating the wetland would involve breaching the dike so the wetland becomes a riverine wetland again, discontinuing the grazing, and reforesting the area. Discontinuing the grazing and reforesting the wetland without re-establishing the links to the riverine system would be considered enhancement.
Basic assumptions for using the guidance on ratios

- The ratios are for a compensatory mitigation project that is concurrent with impacts to wetlands. If impacts are to be mitigated by using an approved and established mitigation bank, the rules and ratios applicable to the bank should be used.

- The ratios are based on the assumption that the category (based on the rating system for western Washington) and hydrogeomorphic (HGM) class or subclass of the wetland proposed as compensation are the same as the category and HGM class or subclass of the affected wetland (e.g., impacts to a Category II riverine wetland are compensated by creating, restoring, or enhancing a Category II riverine wetland).

- Ratios for projects in which the category and HGM class or subclass of wetlands proposed as compensation is not the same as that of the wetland affected will be determined on a case-by-case basis using the recommended ratios as a starting point. The ratios could be higher in such cases.

- The ratio for using rehabilitation as compensation is 2 times that for using re-establishment or creation (R/C) (2 acres of rehabilitation are equivalent to 1 acre of R/C). The ratio for using enhancement as compensation is 4 times that for using R/C (4 acres of enhancement are equivalent to 1 acre of R/C).

- Re-establishment or creation can be used in combination with rehabilitation or enhancement. For example, 1 acre of impact to a Category III wetland would require 2 acres of R/C. If an applicant provides 1 acre of R/C (i.e., replacing the lost acreage at a 1:1 ratio), the remaining 1 acre of R/C necessary to compensate for the impact could be substituted with 2 acres of rehabilitation or 4 acres of enhancement.

- Generally the use of enhancement alone as compensation is discouraged. Using enhancement in combination with the replacement of wetland area at a minimum of 1:1 through re-establishment or creation is preferred.

These ratios were developed to provide a starting point for further discussions with each proponent of compensatory mitigation. They are based on the observations of the success and risk of compensatory mitigation, as reviewed in Volume 1, and do not represent the specific risk or opportunities of any individual project.

As noted above, the ratios for compensatory mitigation are based on the assumption that the category and hydrogeomorphic (HGM) class or subclass of the affected wetland and the mitigation wetland are the same. The ratios may be adjusted either up or down if the category or HGM class or subclass of the wetland proposed for compensation is different. For example, ratios may be lower if impacts to a Category IV wetland are to be mitigated by creating a Category II wetland. The same is true for impacts to wetlands that currently would be considered atypical (see definition below).

Also, compensatory mitigation should not result in the creation, restoration, or enhancement of an atypical wetland. An atypical wetland is defined as a wetland whose design does not match the type of wetland that would be found in the geomorphic setting.
of the proposed site (i.e., the water source(s) and hydroperiod proposed for the mitigation site are not typical for the geomorphic setting). In addition, any designs that provide exaggerated morphology or require a berm or other engineered structures to hold back water would be considered atypical. For example, excavating a permanently inundated pond in an existing seasonally saturated or inundated wetland is one example of an enhancement project that could result in an atypical wetland. Another example would be excavating depressions in an existing wetland on a slope that required the construction of berms to impound water.

On a case-by-case basis, it is possible to use the scores from the Washington State wetland rating system to compare functions between the mitigation wetland and the impacted wetland. This information may also be used to adjust replacement ratios. Scores from the methods for assessing wetland functions (Hruby et al. 1999) provide another option to establish whether the functions lost will be replaced if both the affected wetland and the wetland used for compensation are of the same HGM class and subclass.

Mitigation ratios for projects in western Washington are shown in Table 8C-11. Refer to the text box on the basic assumptions on the previous page before reading the table. As mentioned previously, these ratios were developed to provide a starting point for further discussions with each proponent of compensatory mitigation. They only factor in the observations of mitigation success and risk at a programmatic level, and do not represent the specific risk or opportunity of any individual project.
### Table 8C-11. Mitigation ratios for projects in western Washington.

<table>
<thead>
<tr>
<th>Category and Type of Wetland Impacts</th>
<th>Re-establishment or Creation</th>
<th>Rehabilitation Only(^4)</th>
<th>Re-establishment or Creation (R/C) and Rehabilitation (RH)(^4)</th>
<th>Re-establishment or Creation (R/C) and Enhancement (E)(^5)</th>
<th>Enhancement Only(^4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Category IV</td>
<td>1.5:1</td>
<td>3:1</td>
<td>1:1 R/C and 1:1 RH</td>
<td>1:1 R/C and 2:1 E</td>
<td>6:1</td>
</tr>
<tr>
<td>All Category III</td>
<td>2:1</td>
<td>4:1</td>
<td>1:1 R/C and 2:1 RH</td>
<td>1:1 R/C and 4:1 E</td>
<td>8:1</td>
</tr>
<tr>
<td>Category II Estuarine</td>
<td>Case-by-case</td>
<td>4:1</td>
<td>1:1 R/C and 1:1 RH</td>
<td>1:1 R/C and 2:1 RH</td>
<td>6:1</td>
</tr>
<tr>
<td>Category II Interdunal</td>
<td>2:1</td>
<td>4:1</td>
<td>Not considered an option(^5)</td>
<td>Not considered an option(^5)</td>
<td>Case-by-case</td>
</tr>
<tr>
<td>All other Category II</td>
<td>3:1</td>
<td>6:1</td>
<td>1:1 R/C and 4:1 RH</td>
<td>1:1 R/C and 8:1 E</td>
<td>12:1</td>
</tr>
<tr>
<td>Category I Forested</td>
<td>6:1</td>
<td>12:1</td>
<td>1:1 R/C and 10:1 RH</td>
<td>1:1 R/C and 20:1 E</td>
<td>24:1</td>
</tr>
<tr>
<td>Category I based on score for functions</td>
<td>4:1</td>
<td>8:1</td>
<td>1:1 R/C and 6:1 RH</td>
<td>1:1 R/C and 12:1 E</td>
<td>16:1</td>
</tr>
<tr>
<td>Category I Natural Heritage site</td>
<td>Not considered possible(^6)</td>
<td>6:1</td>
<td>R/C not considered possible(^6)</td>
<td>R/C not considered possible(^6)</td>
<td>Case-by-case</td>
</tr>
<tr>
<td>Category I Coastal Lagoon</td>
<td>Not considered possible(^6)</td>
<td>6:1</td>
<td>R/C not considered possible(^6)</td>
<td>R/C not considered possible(^6)</td>
<td>Case-by-case</td>
</tr>
<tr>
<td>Category I Bog</td>
<td>Not considered possible(^6)</td>
<td>6:1</td>
<td>R/C not considered possible(^6)</td>
<td>R/C Not considered possible(^6)</td>
<td>Case-by-case</td>
</tr>
<tr>
<td>Category I Estuarine</td>
<td>Case-by-case</td>
<td>6:1</td>
<td>Case-by-case</td>
<td>Case-by-case</td>
<td>Case-by-case</td>
</tr>
</tbody>
</table>

**NOTE:** Preservation is discussed in the following section.

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\(^4\) These ratios are based on the assumption that the rehabilitation or enhancement actions implemented represent the average degree of improvement possible for the site. Proposals to implement more effective rehabilitation or enhancement actions may result in a lower ratio, while less effective actions may result in a higher ratio. The distinction between rehabilitation and enhancement is not clear-cut. Instead, rehabilitation and enhancement actions span a continuum. Proposals that fall within the gray area between rehabilitation and enhancement will result in a ratio that lies between the ratios for rehabilitation and the ratios for enhancement.

\(^5\) Due to the dynamic nature of interdunal systems, enhancement is not considered an ecologically appropriate action.

\(^6\) Natural Heritage sites, coastal lagoons, and bogs are considered irreplaceable wetlands because they perform some special functions that cannot be replaced through compensatory mitigation. Impacts to such wetlands would therefore result in a net loss of some functions no matter what kind of compensation is proposed.
8C.3.2 Conditions for Increasing or Reducing Replacement Ratios

Increases in replacement ratios are appropriate under the following circumstances:

- Success of the proposed restoration or creation is uncertain
- A long time will elapse between impact and establishment of wetland functions at the mitigation site
- Proposed mitigation will result in a lower category wetland or reduced functions relative to the wetland being impacted
- The impact was unauthorized

Reductions in replacement ratios are appropriate under the following circumstances:

- Documentation by a qualified wetland specialist (see Appendix 8-H) demonstrates that the proposed mitigation actions have a very high likelihood of success based on prior experience
- Documentation by a qualified wetland specialist demonstrates that the proposed actions for compensation will provide functions and values that are significantly greater than the wetland being affected
- The proposed actions for compensation are conducted in advance of the impact and are shown to be successful
- In wetlands where several HGM classes are found within one delineated boundary, the areas of the wetlands within each HGM class can be scored and rated separately and the ratios adjusted accordingly, if all of the following apply:
  - The wetland does not meet any of the criteria for wetlands with “Special Characteristics” as defined in the rating system
  - The rating and score for the entire wetland is provided along with the scores and ratings for each area with a different HGM class.
  - Impacts to the wetland are all within an area that has a different HGM class from the one used to establish the initial category
  - The proponents provide adequate hydrologic and geomorphic data to establish that the boundary between HGM classes lies at least 50 feet outside of the footprint of the impacts
8C.3.3 Replacement Ratios for Preservation

In some cases, preservation of existing wetlands may be acceptable as compensation for wetland losses. Acceptable sites for preservation include those that:

- Are important due to their landscape position
- Are rare or limited wetland types
- Provide high levels of functions

Ratios for preservation in combination with other forms of mitigation generally range from 10:1 to 20:1, as determined on a case-by-case basis, depending on the quality of the wetlands being impacted and the quality of the wetlands being preserved. Ratios for preservation as the sole means of mitigation generally start at 20:1. Specific ratios will depend upon the significance of the preservation project and the quality of the wetland resources lost.

See Chapter 8 (Section 8.3.7.2) and Appendix 8-B for more information on preservation and the criteria for its use as compensation.

8C.3.4 Replacement Ratios for Temporal Impacts and Conversions

When impacts to wetlands are not permanent, local governments often require some compensation for the temporal loss of wetland functions. *Temporal impacts* refer to impacts to those functions that will eventually be replaced but cannot achieve similar functionality in a short time. For example, clearing forested wetland vegetation for pipeline construction could result in the temporal loss of functions, such as songbird habitat provided by the tree canopy. It may take over 20 years to re-establish the level of function lost as a result of clearing the trees. Although the wetlands will be re-vegetated and over time it is anticipated that their previous level of functioning will be re-established, a temporal loss of functions will occur. There is also some risk of failure associated with the impacts or alterations, especially when soil is compacted by equipment, deep excavation is required, and pipeline trenches alter the water regime at the site.

Therefore, in addition to restoring the affected wetland to its previous condition, local governments should consider requiring compensation to account for the risk and temporal loss of wetland functions. Generally, the ratios for temporal impacts to forested and scrub-shrub wetlands are one-quarter of the recommended ratios for permanent impacts (refer to Table 8C-11), provided that the following measures are satisfied:

- An explanation of how hydric soil, especially deep organic soil, is stored and handled in the areas where the soil profile will be severely disturbed for a fairly significant depth or time
• Surface and groundwater flow patterns are maintained or can be restored immediately following construction

• A 10-year monitoring and maintenance plan is developed and implemented for the restored forest and scrub-shrub wetlands

• Disturbed buffers are re-vegetated and monitored

• Where appropriate, the hydoseed mix to be applied on re-establishment areas is identified

When impacts are to a native emergent community and there is a potential risk that its re-establishment will be unsuccessful, compensation for temporal loss and the potential risk should be required in addition to restoring the affected wetland and monitoring the site. If the impacts are to wetlands dominated by non-native vegetation (e.g., blackberry, reed canarygrass, or pasture grasses), restoration of the affected wetland with native species and monitoring after construction is generally all that is required.

Loss of functions due to the permanent conversion of wetlands from one type to another also requires compensation. When wetlands are not completely lost but are converted to another type, such as a forested wetland converted to an emergent or shrub wetland (e.g., for a utility right-of-way), some functions are lost or reduced.

The ratios for conversion of wetlands from one type to another will vary based on the degree of the alteration, but they are generally one-half of the recommended ratios for permanent impacts (refer to Table 8C-11).

Refer to Appendix 8-F for the rationale for the ratios provided in this appendix.