Salmon Overlay to the Snohomish Estuary Wetland Integration Plan

Prepared by:

City of Everett

and

Pentec Environmental

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Prepared by:

City of Everett
Planning and Community Development
2930 Wetmore Avenue, Suite 8-A
Everett, WA 98201

and

Pentec Environmental
Project No. 253-002
120 Third Avenue S, Suite 110
Edmonds, WA 98020
(425) 775-4682

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ACRONYMS

AU	assessment unit
cfs	cubic feet per second
City	City of Everett
CMMP	compensatory mitigation and monitoring plan
CSL	cleanup screening level
CWA	Clean Water Act
DNR	Washington State Department of Natural Resources
DOE	Washington State Department of Ecology
EMU	Ecological Management Unit
EPA	US Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
GIS	Geographic Information System
GMA	Growth Management Act
HDS	hypothetical development scenario
IVA	indicator value assessment
IVA-acres	IVA score per acre times AU area in acres – considered a measure of habitat functional area
LWD	large woody debris
MBRT	mitigation bank review team
MHHW	mean higher high water
MLLW	mean lower low water
MSL	mean sea level
NMFS	National Marine Fisheries Service
OHW	ordinary high water
ppt	parts per thousand
Port	Port of Everett

continued

ACRONYMS
(continued)

RM	river mile
SEPA	State Environmental Policy Act
SETAC	Snohomish Estuary Technical Advisory Committee
SEWIP	Snohomish Estuary Wetland Integration Plan
SQS	sediment quality standards
SSOTAC	Salmon Overlay Technical Advisory Committee
UGA	urban growth area
USFWS	US Fish and Wildlife Service
WAC	Washington Administrative Code
WCA	Wetland Complex Area
WDFW	Washington Department of Fish and Wildlife
WDW	Washington Department of Wildlife
WRIA	Water Resource Inventory Area
WWTIT	Western Washington Treaty Indian Tribes

SALMON OVERLAY TO THE SNOHOMISH ESTUARY WETLAND INTEGRATION PLAN

1.0 INTRODUCTION

1.1 BACKGROUND

The purpose of the Snohomish Estuary Wetland Integration Plan (SEWIP; City of Everett et al. 1997) was to integrate the wetland regulatory frameworks of federal, state and local agencies into one process on the basis of an agreed-upon plan, and thereby facilitate the cumbersome and complex regulations regarding these activities. With SEWIP, an attempt was made to provide a better, more scientific basis for making regulatory decisions and to make the regulatory process more efficient. The original SEWIP was developed by the interagency Snohomish Estuary Technical Advisory Committee (SETAC) and the Snohomish Estuary Users Committee working over a period of approximately 4 years (1993-1997). SEWIP included the following products:

1. Scientifically based models to assess the quality of vegetated wetlands and mudflats within the estuary for performing several ecological functions for fish, birds, invertebrates, mammals, and water quality improvement.

2. An inventory, based on field ratings as scored using the models, of the functions and values of the wetlands and mudflats in the study area.

3. A framework, agreed upon by all the regulatory agency representatives in the SETAC (but not adopted by any authority), for expediting review of development proposals through federal, state, and local permit processes.

The work was begun in 1993 with grants from the US Environmental Protection Agency (EPA) and Washington State Department of Ecology (DOE) and funding from the City of Everett (City) and the Port of Everett (Port). The original model development and inventory work was completed in 1994. Following this work, a second phase of the SEWIP was initiated to develop a management plan for the estuary. The management plan included the identification of projects for restoration and enhancement as well as a means to evaluate project impacts and mitigation ratios. This work was completed in April of 1997 and, like its predecessor, was funded by grants from EPA and DOE, and funds from the City and the Port.

1.2 REGULATORY SETTING/RELATION TO OTHER PLANS

Since 1997, two events have changed the context in which the SEWIP work will continue. First, SEWIP has not been formally adopted by any jurisdiction. However, it has been used as a reference tool to address some development proposals, including those of the Port (Pentec 1996a, 2000).

Second, chinook salmon (*Oncorhynchus tshawytscha*) and bull trout (*Salvelinus confluentus*) have been listed as "threatened" under the federal Endangered Species Act (ESA). These actions have had a sweeping effect on all local jurisdictions within the Evolutionarily Significant Unit (ESU) for Puget Sound chinook salmon, which includes the Snohomish Estuary. National Marine Fisheries Service (NMFS) staff have indicated their support for the concepts and technical approach embodied within the SEWIP (Donnelly, R., NMFS, pers. comm., 1999), and efforts are underway to incorporate elements of SEWIP into the City's revisions to their Shoreline Master Program and into the regional ESA response as part of an ESA Section 4(d) rule. Adoption of elements of SEWIP within the 4(d) rule by NMFS and the US Fish and Wildlife Service (USFWS) would mean that any incidental take of threatened species during activities conducted in accordance with SEWIP would be permitted.

1.3 OBJECTIVE OF THE SALMON OVERLAY

The revised mission and focus of this phase of SEWIP was to develop a "Salmon Overlay" to address these changed circumstances and respond to the listings of anadromous salmonids under ESA. The Salmon Overlay is seen as a tool to aid jurisdictions in responding to ESA and developing an appropriate management plan for the estuary as a component of a basinwide (Water Resource Inventory Area [WRIA] 7) management strategy for recovery of listed species. The Salmon Overlay identifies and rates the quality of the habitat of chinook and coho salmon (*O. kisutch*) and bull trout (native char) within the planning area and recommends areas with exceptional present values that should be preserved. It also notes locations with a high potential for habitat enhancement or restoration consistent with the life-cycle needs of these fish species.

The Salmon Overlay and Tidal Habitat Model do not address habitat needs for other species that may be listed in the future. However, they can provide guidance for implementing estuarywide management that incorporates the needs of multiple salmonid species.

Another intention of the SEWIP is to integrate the regulatory framework of federal, state, and local agencies into one process on the basis of an agreed-upon plan. Products and outcomes of the Salmon Overlay include the following:

1. A scientifically based Tidal Habitat Model that will characterize indicators of habitat functions within the study area specifically focusing on habitat for listed anadromous fish species.

2. An inventory, based on the Tidal Habitat Model, of the quality of habitats now available to listed species in the study area.

3. Identification of high-value habitats that should be preserved.

4. A listing and ranking of projects and opportunities for restoration/enhancement of habitat within the planning area.

5. A process for comparing potential development impacts within the urban growth areas (UGAs) of Everett, Marysville, and Mukilteo (part) with potential mitigation and restoration opportunities in the SEWIP planning area.

6. Recommended mitigation and restoration/enhancement policies for development.

The current SEWIP planning area (Figures 1.1 and 1.2; simply termed the “area” or the “estuary” throughout this document) includes the marine shorelines and nearshore areas of Port Gardner and Possession Sound from Mukilteo to the southern entrance to Tulalip Bay and upriver to the point of divergence of Ebey Slough from the mainstem (approximately river mile [RM] 8). Note that the original SEWIP area extended somewhat farther up the valley to an east–west line at approximately RM 9).

The Governor's Salmon Recovery Office has provided funding for the further development of the SEWIP, which is the focus of this report. Funding for additional fieldwork necessary to complete the inventory of existing habitat functions was provided by DOE, under Coastal Zone Management Grant No. G0000100.

1.4 DESCRIPTION OF DOCUMENT

This SEWIP Salmon Overlay is organized into seven chapters. These chapters present a "landscape analysis" of the estuary ecosystem based on rapid bioassessment of 132 habitat assessment units (AUs) within the area. The final product is a scientifically based management plan for the area that balances preservation, restoration/enhancement, continuation of existing beneficial economic uses, and expansion of beneficial economic uses in areas of habitats with lower performance of wetland functions, especially those associated with listed anadromous salmonids.

A brief outline of the remainder of this document is provided below.

Chapter 2: Salmon Overlay Process and Methods. Chapter 2 outlines the steps in developing the plan, beginning with a description of the composition and role of the SEWIP Salmon Overlay Technical Advisory Committee (SSOTAC). The process used to complete the remainder of the work is described, including methods and approach used to: (1) describe the existing environment and resources in the area; (2) develop and apply the Tidal Habitat Model; (3) conduct the mapping and inventory of the estuary; (4) identify a reasonable hypothetical development scenario; and (5) identify and prioritize restoration and enhancement sites and actions.

Chapter 3: Natural Resources of the Estuary and Nearshore. Chapter 3 describes changes that have occurred in the area and the existing physical and biological resources, including plants, fish, invertebrates (including shellfish), and wildlife. The concept of Ecological Management Units (EMUs) is introduced and the particular ecological features and land-use patterns of each are described.

Chapter 4: Inventory and Description of Existing Condition. This chapter contains the study area Geographic Information System (GIS) maps depicting: (1) the location of all 132 AUs and; (2) ranking of the AUs by their calculated scores on a scale of 1 to 100 for the two main functional attributes (chinook and coho salmon/bull trout) over the entire area, and by EMU. The process followed to define the hypothetical development scenario (HDS) is described. The loss of salmonid habitat, should full buildout of the development scenario occur, is calculated.

Chapter 5: Compensation Process and Policies. Chapter 5 contains the compensation policies developed for the area by the City and reviewed by the SSOTAC. The underlying rationale for each policy is explained. Recommendations are provided for monitoring, contingency plans, and adaptive management of projects using the SEWIP model and compensation policies. A set of mitigation actions that would be required to compensate for the impacts of full buildout of a hypothetical development scenario is described and analyzed.

Chapter 6: Management and Restoration Plan. Chapter 6 builds on the preceding chapters, which are prerequisite to developing the restoration plan. Chapter 6 presents the following information: (1) overall management goals; (2) recovery, restoration, and enhancement goals; (3) the location, type, and ranking of proposed restoration and enhancement sites and actions for the area; and (4) a summary of the proposed estuarine habitat recovery plan.

Chapter 7: Implementation Plan. Chapter 7 describes a strategy and process for implementation of the SEWIP Salmon Overlay in the context of City and WRIA 7 habitat restoration planning processes.

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Figure 1.1
Puget Sound Basin
and City of Everett

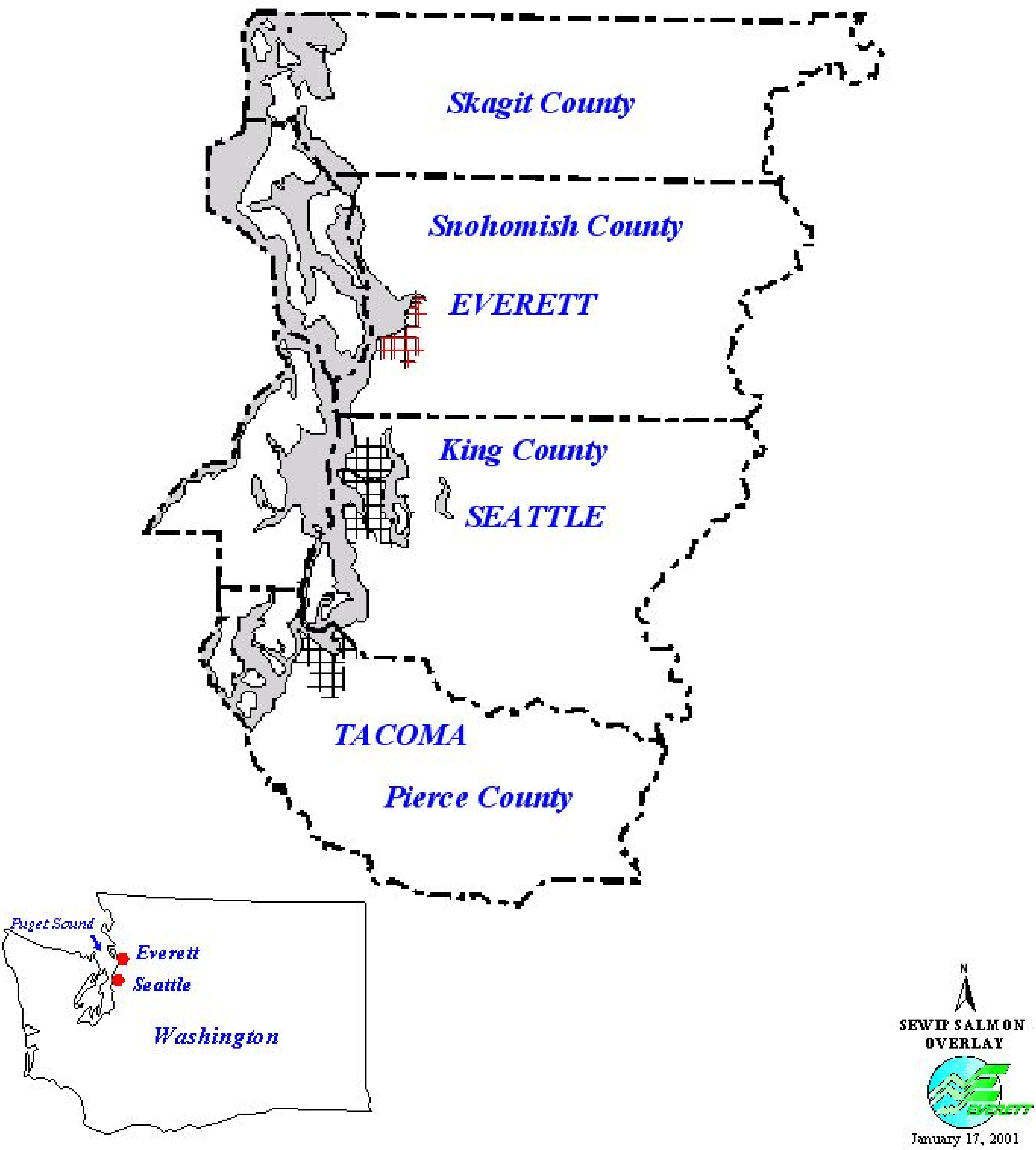
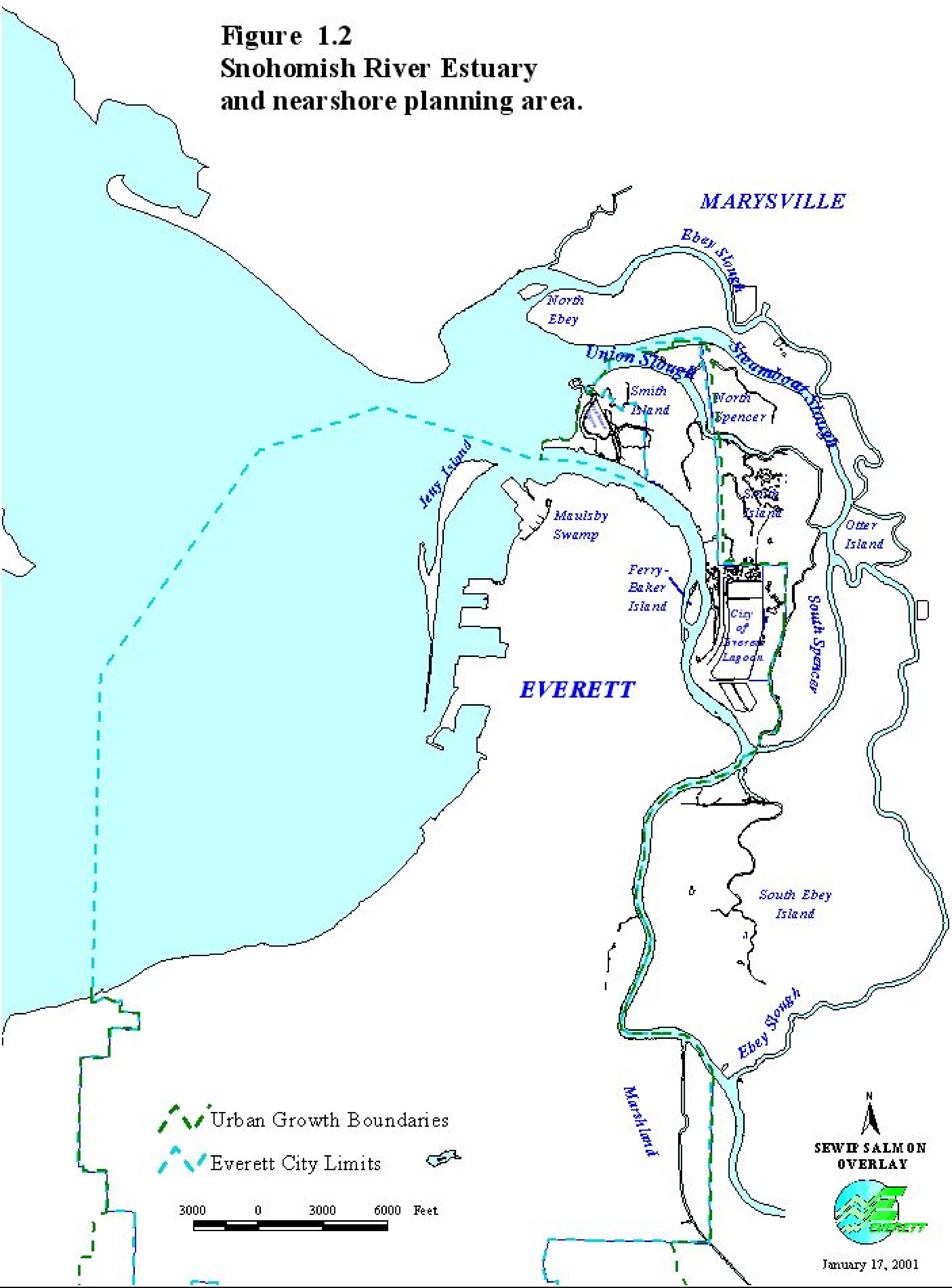


Figure 1.2
Snohomish River Estuary and nearshore planning area.



2.0 SALMON OVERLAY PROCESS AND METHODS

2.1 SSOTAC

The SSOTAC was formed to revise the original SEWIP Mudflat Model to reflect recent ESA listings of Puget Sound salmonids. The SSOTAC also reviewed the model application to the tidal habitats in the planning area (Chapter 4), participated in the revision of the compensatory mitigation policies (Chapter 5), and reviewed the Salmon Overlay restoration and management plan (Chapter 6) and implementation plan (Chapter 7). SSOTAC members included representatives from the City of Everett (City) and wetland and fishery biologists from the state Department of Ecology (DOE), Washington Department of Fish and Wildlife (WDFW), Snohomish County, and The Tulalip Tribes (Table 1.1). Their participation in this process does not imply an acceptance of this document by their respective organizations. Observers representing the Port and the City of Marysville were also present. The City contracted with fishery biologists and marine ecologists from Pentec Environmental (Pentec), a division of Hart Crowser, Inc., to provide technical assistance and analyses and to prepare draft text sections. While the SSOTAC reviewed all aspects of this document, the document was prepared by the City of Everett and their consultant with significant contributions from DOE staff, who drafted the restoration site analysis and prioritization. Although consensus was reached on major portions of the document, there was a lack of agreement on certain aspects of the model and the compensatory mitigation policies. A compilation of SSOTAC comments received on the draft Salmon Overlay, accompanied by theCity Planning Staff's responses to those comments, is provided as an attachment to this document.

2.2 DESCRIPTION OF EXISTING RESOURCES

Existing anadromous fish resources and habitat in the area were described based on existing published and "gray" literature, and summaries in the Snohomish River Basin Conditions and Issues Report (Pentec and NW GIS 1999), the Initial Snohomish River Basin Chinook Salmon Conservation/Recovery Technical Work Plan (WRIA 7 Technical Committee 1999), and Salmonid Habitat Loss and Restoration Potential Along the Snohomish River (Haas and Collins, in press). Information was also drawn from the personal knowledge of SSOTAC members and from field surveys conducted during this work.

Table 1.1 SSOTAC membership.

Name	Organization
Technical participants	
Paul Roberts (co-facilitator)	City of Everett, Planning Department
Dan Mathias	City of Everett, Public Works Department
Jon Houghton (co-facilitator)	Pentec Environmental
Eric Hagen	Pentec Environmental
Frank Leonetti	Pentec Environmental (Snohomish County after 10/00)
Dennis Gregoire	Port of Everett
Andy Haas	Snohomish County
Steve Hinton	Snohomish County (departed 6/00)
Kurt Nelson	The Tulalip Tribes
Erik Stockdale	Washington State Department of Ecology
Stephen Stanley	Washington State Department of Ecology
Michael Chamblin	Washington Department of Fish and Wildlife
Observers	
Paul Crane	City of Everett, Planning Department
Mary Cunningham	City of Everett, Planning Department
Liz Greenhagen	City of Everett, Planning Department
Jan Meston (coordinator/grant admin.)	City of Everett, Planning Department
Gloria Hirashima, Cheryl Dungan	City of Marysville

The SEWIP area was originally divided into EMUs on the basis of major hydrologic, physical, biological, and land-use characteristics (Pentec 1992a, City of Everett et al. 1997). The boundaries separating EMU 1, 2, and 3 were originally set based on field observations of present vegetation characteristics. The SSOTAC has reconsidered the boundaries in the lower estuary and modified them based in part on the definitions of historic boundaries between vegetation zones as defined by Haas and Collins (in press).

2.3 SEWIP TIDAL HABITAT MODEL

The SEWIP Tidal Habitat Model (the model) is the result of the SSOTAC's substantial modifications to the anadromous fish portion of the Mudflat Model, which was developed originally by an interagency technical advisory committee (City of Everett et al. 1997). The technical basis and applicability of the Mudflat Model to anadromous fish was reviewed and liberally modified by the SSOTAC over a period of monthly meetings held between November 1999 and May 2000. The committee revised the model to reflect best available science and current knowledge of tidal estuarine and nearshore habitat requirements of listed salmonids and of the manner in which various habitat indicators influence habitat quality. The model modifications were focused on accurately describing the quality of habitats in the estuary and adjacent nearshore areas for salmonids, with emphasis on chinook salmon, coho salmon, and native char (bull trout).

Essential ecological functions provided to anadromous salmonids by habitats in the SEWIP area include feeding (rearing), migration, predator avoidance, and saltwater/freshwater adaptation. Of these, all are important to juvenile salmonids and juvenile and adult char; all but feeding are important to adult chinook salmon. Juvenile rearing during freshwater/saltwater transition and adult saltwater/freshwater osmoregulatory adjustment are two functions that are provided in the estuary that can occur nowhere else in the habitat continuum used by Snohomish River system anadromous fish; these are considered to be obligate functions of the estuary and are afforded particular emphasis in the model, and in the compensation and restoration policies and plans outlined in Chapters 5 and 6.

The model follows the indicator value assessment (IVA) method of the original SEWIP models and is patterned after the approach of Hruby et al. (1995). As such, it describes the existing condition of habitat based on evident pathways, stressors, and indicators. As described by NMFS (1996), pathways are groups of environmental factors that can potentially affect anadromous salmonids and their habitats. Stressors are non-natural (i.e., created or induced by human activities) constraints on the condition of habitat or its ability to provide ecological function. Indicators are metrics or descriptions of important environmental conditions that define the condition of each pathway or stressor. With a few exceptions, the model does not address habitat-forming processes but merely describes the existing expression of those processes.

The model revision began with consideration of all aspects of estuarine and nearshore habitat that affect the quality of that habitat for performance of essential functions (Figure 2.1). Both positive and negative effects were listed.

The model assesses discrete units (i.e., AUs) of habitat that are delineated by physical changes in habitat types or hydrological boundaries between units of habitat (see Section 2.4). The model asks a series of “yes” or “no” questions about the hydrological, chemical, physical, geomorphological, biological, and landscape features (indicators) present within the AU. The SSOTAC developed these questions and assigned relative values for a positive response to each using an expert system.

Values were based on the degree to which each indicator was judged to be associated with the positive aspects of each function. Indicators strongly associated with the function being assessed were assigned a value of 3; those moderately associated were assigned a value of 2; those weakly associated with the function were assigned a value of 1. The “raw score,” in IVA units per acre, is simply the sum of all of the integers (1, 2, or 3) associated with a positive response to each question.

Aspects of some indicators were judged to be disproportionately beneficial (e.g., large areas of native marsh) or adverse (e.g., stressors such as hydromodification or chemical contamination) to such a degree that they were assigned positive or negative multipliers that are applied to the sum of the values from all the other indicators. Both the indicator value rankings of specific landscape features and the overall value multipliers were assigned metrics based upon evidence

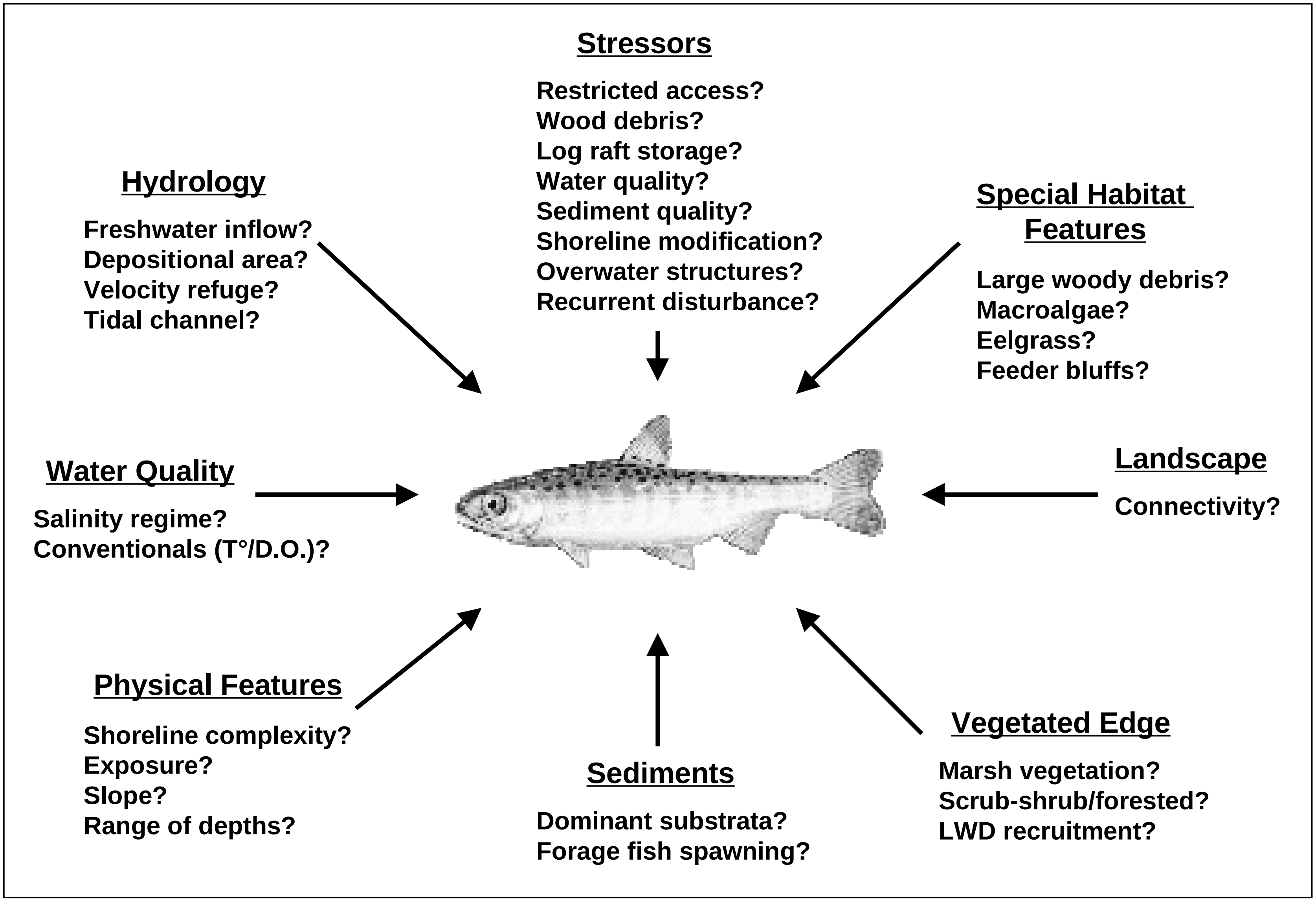


Figure 2.1 SEWIP tidal habitat conceptual model.

from the literature, where available, or, where literature was lacking, by the collective best professional judgment of the SSOTAC.

The sum of all the integer scores (the raw score) is multiplied by any applicable positive multipliers to obtain the "intermediate score." This score provides a measure of the potential habitat function that would be provided by the AU in the absence of any stressors. The intermediate score is then multiplied by the decimal fraction indicated in the model for any stressors present in the AU. The rationales for the selection of indicators and the assignment of values to the AU when the indicators were present are provided in Appendix A. Appendix A also presents the protocols used for field scoring of AUs. An example of the field inventory sheet is provided in Appendix B.

The model is intended to be applied in the field by teams of fishery biologists or estuarine ecologists knowledgeable about the estuarine and nearshore habitat requirements of salmonids and familiar with the rationales and protocols for the Tidal Habitat Model (Appendix A). Consensus should be reached in the field on the response (present or not) to each indicator question in Appendix B.

The Tidal Habitat Model is thus a scientific (rather than a statistical) model that incorporates a suite of environmental attributes believed to be important to the functioning of salmonid habitat. Based on best professional judgment of the SSOTAC as an expert system, each model attribute (indicator) has been assigned a level of importance in determining salmonid habitat functions. "Validation" of a scientific model is accomplished by establishing its applicability and utility to the problem at hand (Mobrand Biometrics unpublished). In the case of the Tidal Habitat Model, the problem at hand is the description of relative function of tidal habitat for salmonids. Although statistical calibration of the Tidal Habitat Model is not possible, its legitimacy for its intended uses can be demonstrated by field measurements that confirm the relationships between model indicators and model scores. The standard for a scientific model is to establish that it meets its purpose better than alternative models that are available (Mobrand Biometrics unpublished).

2.4 INVENTORY AND DESCRIPTION OF EXISTING CONDITIONS

The area AUs were first delineated on a series of 1998 aerial photographs obtained by Snohomish County from the Washington State Department of Natural Resources (DNR). This photo series included the County's hydromodification layer, indicating major categories of shoreline modification such as bulkheads, riprap, and dikes. These features were used in conjunction with major transitions in riparian condition or shoreline morphology in the initial delineation (done in the office) of AUs. This photo series was taken to the field and used as the base map and a primary data source for field assessment of each AU using the model and protocols. Some AU boundaries were adjusted on the basis of field observations of transitional conditions that were not evident in the photos alone.

Field surveys were completed in 4 days in late June and early July 2000. The scorings of AUs in this report are considered to be at a reconnaissance level wherein best professional judgment was used to visually estimate the level of certain indicators in each AU (e.g., bulkheads are present along 10 to 50 percent of AU; bulkheads present along less than 50 percent of AU). A more detailed application of the model would require additional work to actually measure the level or degree of presence of certain indicators.

Final AU boundaries were transferred onto a second series of 1996 aerial photographs available in the City's GIS system so that the area of each AU could be calculated. In defining the specific AU boundaries in the waterward and landward directions, the following conventions were used:

1. Waterward Boundary

    - For nearshore AUs in EMU 4 through 7, the waterward boundary was set at -30 ft mean lower low water (MLLW), the approximate limit of productive vegetative growth that directly forms habitat for salmonids (e.g., beds of bull kelp, *Nereocystis luetkeana*).

    - In the mainstem Snohomish River, waterward boundary was set at the edge of the dredged navigation channel or at the -10 ft MLLW contour, where bathymetric data were available.

- In other distributary channels and in the mainstem above the upper turning basin, the waterward boundary was set at 50 ft waterward of the lowest line of vegetation visible in aerial photos, except where more extensive shallow sand or mud bars were evident in aerial photos or from the field surveys; in those cases, the boundary was drawn 50 ft waterward of the lowest edge of the visible shallow-water area.

2. Landward Boundary

- In AUs lacking riparian vegetation (e.g., riprapped or bulkheaded areas) the boundary was set at mean higher high water (MHHW).

- In AUs scored as having a riparian buffer (either above or below ordinary high water [OHW]), the landward boundary was set at 25 ft landward of OHW or to the top of any adjacent dike, whichever was least.

- In AUs meeting the criterion for large woody debris (LWD) contribution, the boundary was set at potential tree height (187 ft) from OHW or to the limit of the trees that could contribute LWD, whichever was least. An exception was made for Otter Island; because of the forested wetland nature of the island and the presence of tidal channels penetrating well into the island, the entire island was considered part of the AU.

2.5 HYPOTHETICAL DEVELOPMENT SCENARIO (HDS)

An HDS was generated to evaluate whether sufficient area would be available in the estuary for compensatory mitigation for impacts to salmonid habitat resulting from a realistic maximum development scenario. Note that this HDS should not be confused with the proposed development footprints identified in the 1997 SEWIP (City of Everett et al. 1997).

The HDS was defined through a three-step process as that portion of the area within which future development may be expected to be focused and encouraged. The first step was to delineate areas that lie within the Growth Management Act (GMA) UGAs for the cities of Everett, Marysville, and Mukilteo (partial), and to identify currently developed areas (commercial, residential, industrial) within those boundaries.

The second step was to exclude from the scenario areas already identified in area land-use plans as having special habitat designations, such as the conservation areas along the west side of Jetty Island, and areas already designated as restoration or mitigation sites, such as the southeastern shoreline of Jetty Island and the Port's mitigation site along lower Union Slough.

The third step was identification of sites within the UGAs that were shown in the SEWIP inventory to have special habitat values or a high potential for restoration of critical habitat functions; i.e., those within the top-rated quartile (top 25 percent) of AUs within the UGAs. These AUs were excluded from the HDS (with the concurrence of the landowner; e.g., Ferry Baker Island).

The HDS is based on consideration of salmonid habitat conditions and the location of the urban growth boundary only. Policy decision-makers and regulatory agencies will also consider other land-use and resource information in making decisions for land-use designations, and in reviewing development and restoration proposals. For example, the 1997 SEWIP, policies in the Shoreline Act, and regulations in the Shoreline Master Program Guidelines will be used by the City in arriving at appropriate shoreline classifications within the City's Shoreline Master Program revisions. The resulting HDS is thus based on consideration of salmonid habitat conditions and functions only.

2.6 COMPENSATION PROCESS AND POLICIES

The process for use of the SEWIP Tidal Habitat Model and plan for assessing project impacts and defining acceptable compensatory mitigation was developed by the SSOTAC from the process and policies in the original SEWIP. That process and those policies were modified to ensure a net improvement in salmonid habitat functions and no net loss of habitat area associated with each permitted action, and that an overall net gain in habitat area results from allowed development. Recent summaries of mitigation and restoration success rates (Race and Fonseca 1996) and the recent listing of Puget Sound salmonids as threatened under the ESA were considered in making those modifications (Appendix C).

2.7 MANAGEMENT AND RESTORATION PLAN

The SEWIP Tidal Habitat Model scores for all AUs (IVA points) were multiplied by the acreage within each AU and summed over each EMU and over the entire estuary to define the baseline habitat condition in IVA-acres for listed salmonids (chinook and coho salmon/bull trout). The overall plan for management and restoration of the estuary was built from that baseline and considered as several separate elements.

2.7.1 Management of Development

The Tidal Habitat Model was used to calculate the development "debits," based on the IVA-acre losses of existing anadromous fish habitat that would result from full development (i.e., from full buildout of the HDS). Those debits were then compared to the "credits" that would be gained from required mitigation for those losses (based on the compensatory mitigation policies in Chapter 5) to arrive at a predicted net increase in IVA-acres that would result from full buildout of the HDS.

2.7.2 Restoration Potential

The restoration potential of selected AUs and adjacent, currently nontidal areas within the estuary was assessed as follows:

- By evaluating the suite of potential restoration actions that could be taken in or adjacent to the AU (e.g., establish riparian vegetation; breach dikes; reduce slopes); and

- By scoring the AU in its presumed restored condition, and then comparing the number of IVA-acres in the existing and restored conditions.

All AUs that would be impacted by the HDS were evaluated for their restoration potential through a variety of approaches (stressor removal, buffer enhancement, access improvement, and tidal restoration). A total of 25 sites within the entire SEWIP planning area were ranked for their tidal restoration potential, using a simple mathematical model. This model reflected potential salmonid habitat function scores that would be achieved, as calculated by the Tidal Habitat Model, and on the existing wildlife and water quality functions on the site, as calculated by 1997

SEWIP vegetated freshwater wetlands. The potential technical difficulties associated with project construction and the position of the site in the estuarine landscape were also considered. The ranking model is described in detail in Appendix D.

2.7.3 Restoration Plan

The overall restoration plan was developed to meet the following objectives:

- Move toward restoration of the natural landscape continuity within the estuary by increasing the proportion of habitat available to anadromous fish in the freshwater/saltwater transition areas of EMUs 2 and 3.

- Achieve a net increase in anadromous fish habitat area (acres) and habitat quality (IVA-acres) in each EMU; a scenario was explored that would increase habitat quality (IVA-acres) by a minimum of 20 percent in 15 years.

- Complement the WRIA 7 restoration goals for the estuary.

2.7.4 Implementation Plan

Existing and proposed land-use and shoreline management plans of jurisdictions within the planning area were examined and recommendations made for implementing the SEWIP Salmon Overlay as a part of salmon restoration plans within the jurisdictions.

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3.0 NATURAL RESOURCES
OF THE SNOHOMISH ESTUARY AND NEARSHORE

This chapter briefly describes the physical and biological resources of the Snohomish Estuary contained within seven EMUs (Figure 3.1). Special emphasis is given to anadromous salmonids and those habitats important to their production potential. This chapter amends and includes information presented in the previous SEWIP (City of Everett et al. 1997). Included is information on basin characteristics, historical changes, vegetation, fisheries, and wildlife. Information was drawn from the following sources: the 1979 Corps of Engineers Snohomish Estuary Wetlands Study (Shapiro & Associates 1979), the Snohomish River Wetlands Management Plan (Shapiro & Associates 1989), the Port of Everett Landscape Analysis for Port Gardner and the Snohomish River Estuary (Pentec 1992a), the Snohomish Estuary Wetland Integration Plan (City of Everett et al. 1997), the Initial Snohomish River Basin Chinook Salmon Conservation/Recovery Technical Work Plan (WRIA 7 Technical Committee 1999), and Salmon Habitat Loss and Restoration Potential Along the Snohomish River (Haas and Collins, in press).

3.1 PHYSICAL ENVIRONMENT

3.1.1 Basin Characteristics

The Snohomish River Estuary is approximately 9 mi long and 3 to 4.5 mi broad at its widest point, encompassing six major islands within its 19.5 mi^2. The estuary is at the mouth of the Snohomish River, which is the second largest Puget Sound watershed (1,780 mi^2). The Snohomish River runs from Monroe, 23 mi upstream from the mouth of the river, to the estuary at a gradient that averages 1 ft/mi. The lower portion of the Snohomish River basin is flood-protected with a series of levees built and maintained by independent diking and drainage districts.

The average annual runoff for the entire basin (Skykomish, Snoqualmie, and Snohomish rivers) is 7.09 million acre-ft with an average annual flow of 9,951 cubic feet per second (cfs) measured at Monroe in 1985 (Pacific Northwest River Basins Commission 1980, Williams et al. 1985). The maximum discharge for the Snohomish River was measured as 186,000 cfs during the flood of 1990 (Pentec 1992a).

3.1.2 Historical Changes

Haas and Collins (in press) report that, before anthropogenic changes, the Snohomish Estuary contained approximately 9,761 acres of tidal marsh between Priest Point and the head of Ebey Slough (excluding mudflats). Approximately one-sixth of this historical marsh area remains (Haas and Collins, in press). The greatest losses of marsh area have occurred in the forested riverine/tidal zone where timber harvest and diking (for agricultural development) eliminated 61 blind tidal channels. Additionally, diking has changed the channel edge environment of the mainstem Snohomish and the primary distributary sloughs. Haas and Collins (in press) estimate overall chinook smolt production potential in the Snohomish River has decreased by 35 percent, and the production potential in blind tidal channels has decreased by 73 percent.

3.2 ECOLOGICAL MANAGEMENT UNITS

The concept of EMUs is adapted from Pentec (1992a). The original concept combined existing land-use, hydrographic, and ecological factors in describing similar areas within the estuary. For the purposes of developing compensation policies for this Tidal Habitat Model, it was important to base EMU boundaries on existing and restored ecological factors rather than on current land-use conditions. Furthermore, an historical retrospective analysis of major vegetation zones delimited by dominant hydrogeomorphic conditions (e.g., hydrology, salinity, elevation [Haas and Collins, in press]) has contributed to our understanding and delineation of these EMUs (Figure 3.1), and has resulted in some changes from the EMU boundaries of the original SEWIP (City of Everett et al. 1997).

Therefore, the current boundaries are based on indicators of the degree of fresh water and marine influence to the head of Ebey Slough (Haas and Collins, in press), including plants (vascular and algae) and invertebrates along the tidally influenced estuary sloughs. For example, for systems with predominantly marine influence, the presence of eelgrass (*Zostera* spp.), brown algae (*Fucus gardneri* and *Laminaria saccharina*), seaside plantain (*Plantago maritima*), seaside arrowgrass (*Triglochin maritimum*), eastern softshell clam (*Mya arenaria*), and other marine species were used as indicators. For brackish water systems, the presence of Lyngby's sedge (*Carex lyngbyei*) and Baltic rush (*Juncus balticus*) were used as indicators. For freshwater systems, the presence of skunk cabbage (*Lysichiton americanum*), yellow marsh-marigold

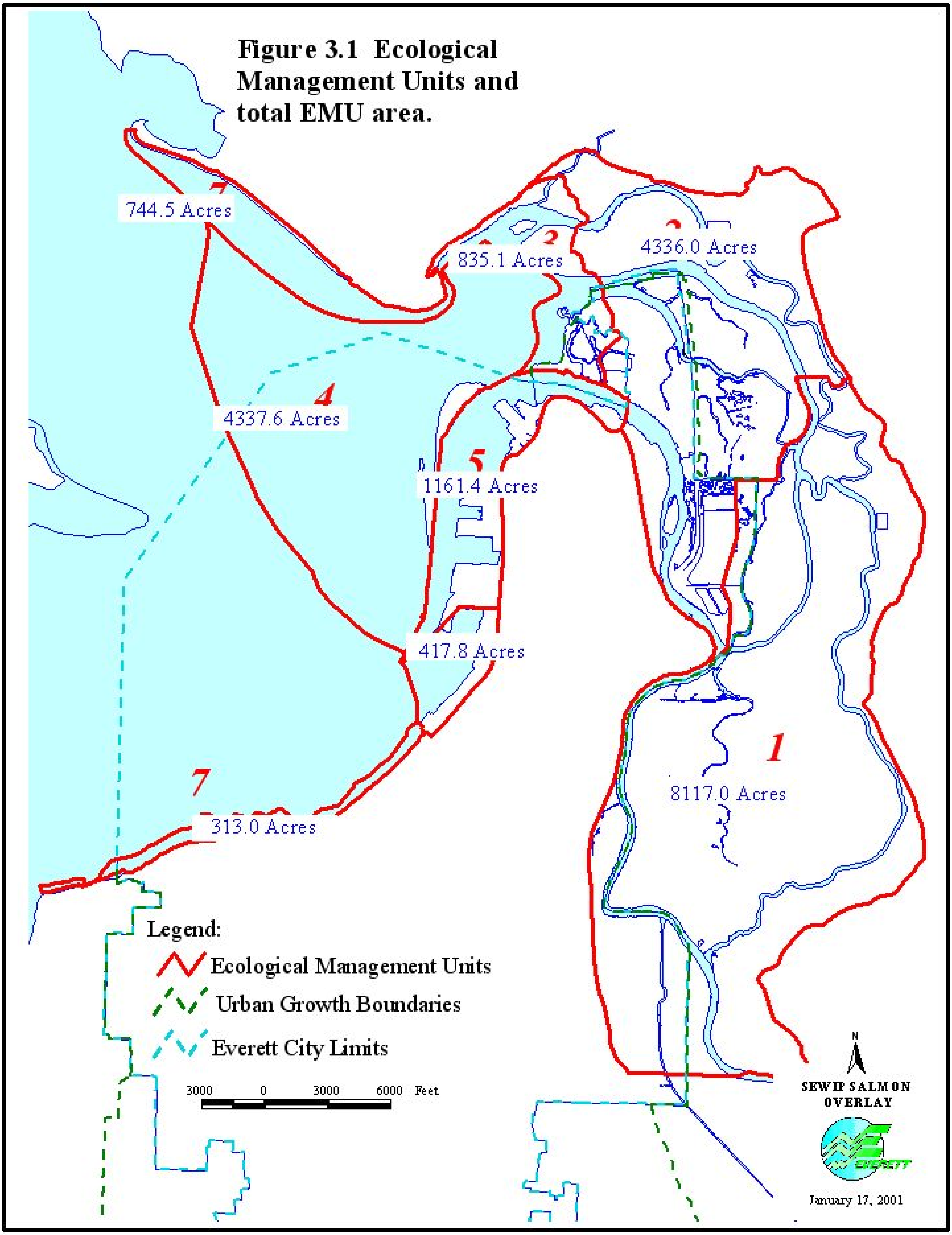

Figure 3.1 Ecological Management Units and total EMU area.

(*Caltha palustris*), reed canarygrass (*Phalaris arundinacea*), and dogwood (*Cornus sericea*) were used.

3.2.1 EMU 1 – Fluvial Fresh Water (Forested Riverine/Tidal)

EMU 1 generally includes freshwater wetlands in the southern portion of the estuary (Figure 3.1). Salt-sensitive plant species in this area include skunk cabbage, yellow marsh marigold, and red-osier dogwood. Historically the area was a mosaic of tidal marshes, forested wetlands, and sloughs that were flooded daily.

Today, however, the majority of wetlands within this EMU are diked and in agricultural production. Two notable exceptions are Otter Island, which was never diked, and South Spencer Island, which has been restored, in part, to intertidal influence. Two dead-end sloughs, Deadman and Deadwater, are hydrologically connected to the river. In EMU 1, river and slough banks are typically steep, consisting of sands with rock riprap and occasional pilings present on the Snohomish River. A narrow shoreline of sandy silts (mud) is present throughout most of the EMU.

EMU 1 is mostly within unincorporated Snohomish County, with only the left bank of the Snohomish River under the City of Everett's jurisdiction. The boundary between freshwater EMU 1 and brackish EMU 2 is located south of Mid-Ebey and Mid-Spencer islands on Ebey, Steamboat, and Union sloughs, and south of the junction of Steamboat Slough with the Snohomish River.

Agriculture has been the primary land use in this EMU, with the exception of log yards and a timber mill on the west side at the Simpson Lee property. Tidal restoration to improve salmon rearing habitat has occurred at a breached dike wetland at South Spencer Island.

3.2.2 EMU 2 – Fluvial Brackish Water (Emergent/Forested Transitional)

EMU 2 generally includes the northern portion of the estuary immediately east and west of I-5 (Figure 3.1). The area comprises brackish tidal marshes and diked palustrine marshes. Salt-tolerant and moderately tolerant plant species in this area include Lyngby's sedge, Baltic rush, seaside arrowgrass, and Pacific silverweed (*Potentilla pacifica*).

River and slough banks are moderately sloped and sandy, with rock riprap and pilings dominating banks along much of the Snohomish River mainstem. A narrow shoreline of sandy silts (mud) is present throughout most of the EMU. Wider shoreline mudflats are found primarily along Steamboat and Ebey sloughs at lower tides. Extensive tidal marshes with dendritic channel systems, interspersed with islands of forested wetlands, dominated this EMU before diking.

Historical industrial uses in this unit include the closed Weyerhaeuser mills and the Burlington Northern Railroad delta yard, in the southwest portion of the EMU, as well as boat storage and wood chip facilities on Smith Island. The middle portion of the unit, including Biringer Farm on North Spencer Island and the central portion of Smith Island, are in agricultural use. New uses include the City of Everett Waste Water Treatment Ponds and Langus Park on the southern portion of Smith Island.

This unit differs from EMU 1 in that the majority of the eastern islands (Mid- and North Ebey, and Mid-Spencer) have broken dikes and are subject to tidal inundation, and have reverted to a condition more closely resembling the predevelopment condition of the EMU. Additionally, tidal restoration has occurred at the Marysville sewer treatment mitigation site.

3.2.3 EMU 3 – River and Slough Mouths (Estuarine Emergent Marsh)

This EMU extends southwest along the Quilceda Creek tidal wetlands toward Priest Point, and south from the mouth of Quilceda Creek across saltmarsh and sandflats to the right bank of the Snohomish River west of SR 529 (Figure 3.1). Aquatic habitat consists of a combination of brackish wetlands, saltmarsh, and low-gradient mud- and sandflats. While considerable mixing of river and marine water occurs in this area, the saltwater influence results in the presence of marine species, such as eelgrass, brown and green algae, and eastern softshell clam. Salt-tolerant plant species, including Lyngby's sedge, Baltic rush, seaside arrowgrass, and seaside plantain, dominate the marsh vegetation.

Compared to EMUs 1 and 2, diking is limited in EMU 3 and confined to the west end of Smith Island. In contrast, the undiked portions of the unit at the mouths of Quilceda Creek and Ebey and Steamboat sloughs are close to the natural historical condition of this part of the estuary.

Log raft storage has been, and continues to be, the major industrial use in this unit. However, recent declines in timber harvest have resulted in substantial reductions in the intensity of log raft storage over the delta area in this EMU.

3.2.4 EMU 4 – Delta Sandflats

This EMU encompasses the extensive sand- and mudflats of the inner and outer Snohomish River delta, and those west of Jetty Island (Figure 3.1). Because the area is subject to the waves and currents of Puget Sound and salinities exceeding 30 parts per thousand (ppt), it is predominantly marine in character (Cowardin et al. 1979). Small brackish marshes and saltmarshes are found on Jetty Island, and extensive eelgrass beds are present west of the island. Salinities are affected by freshwater flows from the estuary; however, Jetty Island channels the majority of this flow east of the island and south into Port Gardner Bay. High river flows during winter months result in significant sediment accretion in this unit. The shorelines and shallow-water areas surrounding Jetty Island are highly productive, supporting many species of fish and invertebrates (Pentec 1996b).

The creation of Jetty Island from dredge spoils and material has been the major impact upon this unit. Before the creation of Jetty Island, this area consisted of intertidal and subtidal sand- and mudflats with meandering channels, but it lacked shoreline and island habitat. Deflection of approximately 50 percent of the Snohomish River flow and sediment down the lower Snohomish channel (EMU 5) likely has allowed expansion of eelgrass beds within EMU 4. A joint US Army Corps of Engineers/Port of Everett project constructed a 2,500-ft-long berm of dredged material on the west side of the island, greatly improving habitat for juvenile salmon, surf smelt and shorebirds (Pentec 1996a).

3.2.5 EMU 5 – Lower Snohomish Channel

EMU 5 contains highly modified or artificially created habitats in the Snohomish River channel. This EMU includes the industrialized area of the Everett waterfront between Preston Point southward to Naval Station Everett, and the east shore of Jetty Island (Figure 3.1). Before the construction of Jetty Island, this EMU resembled the extensive mud- and sandflats that persist today in EMUs 3 and 4. Other emergent marshes similar to Maulsby Swamp likely were present along the base of the bluff south toward the naval base. Farther south, the littoral area was probably composed of mixed sands, silt, and mud. The mainstem Snohomish River probably meandered out over the delta, but certainly was shallower and wider than its present configuration.

Much of shoreline along this portion of the Everett waterfront has been modified by hard structures, including rock riprap, pilings, concrete bulkheads, docks and adjacent roads, parking lots, and industrial yards and buildings. This area has been extensively dredged and filled, primarily for timber-related industries, since the inception of the City of Everett. Filling has occurred just south of Preston Point, at the 10th Street boat launch, the north and south marinas, and the naval base. It is estimated that this activity has reduced the area of historical intertidal mudflats by approximately 50 percent (Pentec 1992a). Extensive mudflats do persist waterward of Maulsby Swamp and along the east side of Jetty Island, but they have been extensively used for log raft storage.

3.2.6 EMU 6 – Everett Harbor (East Waterway)

The East Waterway was transformed into a deepwater port by dredging and filling in the early part of the last century, and has provided shipping and processing facilities for timber, pulp, and alumina. As a result, this EMU consists primarily of highly modified deep water and some limited shallow subtidal and intertidal habitat. Littoral habitats largely are associated with fill, as nearly all mudflat areas have been eliminated by dredging, fill, riprap, or bulkheads. This area is primarily marine (Figure 3.1).

Before alteration, EMU 6 was probably composed of beaches consisting of cobbles and mixed sands and silts similar to those that currently line the Mukilteo shoreline to the south.

3.2.7 EMU 7N, 7S – Port Gardner Nearshore, Tulalip Nearshore

This EMU includes intertidal beach habitat and subtidal areas to -30 ft MLLW. Mid- and upper-intertidal areas are composed of cobble and gravel, while lower intertidal and subtidal areas are predominantly mixed sands and silts. The EMU stretches from the entrance to Tulalip Bay south to Priest Point (EMU 7N, Figure 3.1), and from the mouth of Pigeon Creek (south Everett) southwest toward Mukilteo (EMU 7S, Figure 3.1). This EMU is primarily marine but is influenced by fresh water from the Snohomish River (especially Port Gardner) and local streams such as Pigeon creeks No. 1 and No. 2, Merrill and Ring creeks, Glenwood Creek, Narbeck Creek, and Powdermill Creek. Sediment flows from these creeks have created small to medium-sized deltas along the southern shoreline (EMU 7S). The upper beach in EMU 7S is highly modified by railroad lines. The Tulalip shoreline is less affected by single-family residential development and associated losses to riparian habitats from bulkheading, as substantial reaches of feeder bluffs remain (e.g., in the Mission Beach area).

3.3 BIOLOGICAL RESOURCES

3.3.1 Vegetation

All vegetation zones within the study area were classified in the original SEWIP (City of Everett et al. 1997) as estuarine or palustrine according to the Cowardin classification system (Cowardin et al. 1979). The vegetation zones described herein also reflect those described by Haas and Collins (in press).

3.3.1.1 Estuarine System

The estuarine system is limited upstream and landward to the point at which ocean-derived salts measure less than 0.5 percent during a period of average annual low flow: seaward to an imaginary line closing the mouth of river, bay, or sound; to the seaward limit of wetland emergents, shrubs, or trees not included in EMU 1; and to offshore areas of continuously diluted sea water. Wetland types therein are low and high saltmarsh, brackish marsh, brackish swamp, mudflat, and sandflat.

The dominant plant species by class observed in the estuary (partial list) are:

Estuarine Aquatic Bed (western portion of EMUs 3, 4, 5, and 7): *Zostera japonica* (dwarf eelgrass), Z. *marina* (native eelgrass), *Ulva* spp. (sea lettuce), *Fucus gardneri* and *Laminaria saccharina* (brown algae), *Enteromorpha* spp. (green algae).

(In EMU 2): *Callitriche heterophylla* (water chickweed).

Estuarine Emergent (found in EMUs 2, 3, and 4): *Carex lyngbyei* (Lyngby's sedge), *Salicornia virginica* (pickleweed), *Jaumea carnosa* (fleshy jaumea), *Deschampsia caespitosa*, (tufted hairgrass), *Hordeum bracyantherum* (meadow barley), *Distichlis spicata* (saltgrass), *Plantago maritima* (seaside plantain), *Potentilla pacifica* (Pacific silverweed), *Scirpus acutus/validus* (hard stem and soft stem bulrush), *Scirpus americanus* (three square bulrush), *Scirpus maritimus* (seacoast bulrush), *Triglochin maritimum* (seaside arrowgrass), *Typha angustifolia* (narrow-leaf cattail), *Typha latifolia* (common cattail), *Orthocarpus castillejoides* (paintbrush owl-clover), *Lilaeopsis occidentalis* (western lilaeopsis), *Aster subspicatus* (Douglas aster), *Grindelia integrifolia* (Puget Sound gum weed), *Atriplex patula* (saltbrush), *Heracleum lanatum* (cow parsnip), *Crepis* spp. (hawksbeard).

Estuarine Scrub-Shrub (EMU 2 and scattered locations in EMU 1 and EMU 3): *Lonicera involucrata* (black twinberry), *Rosa nutkana* (Nootka rose), *Physocarpus capitatus* (Pacific ninebark), *Malus fusca* (crabapple), *Rubus spectabilis* (salmonberry), *Spiraea douglasii* (hardhack spirea).

Estuarine Forested (EMU 1 and EMU 2): *Picea sitchensis* (Sitka spruce).

3.3.1.2 Palustrine System

The palustrine system is limited to all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean salts is less than 0.5 percent. Such wetland classes include rock bottom (not found in the study area), unconsolidated bottom, aquatic bed, unconsolidated shore, moss-lichen wetland, emergent wetland, scrub-shrub wetland, and forested wetlands. The dominant plant species by class observed in estuary EMUs (partial list) are:

Aquatic Bed Emergent, Tidal (primarily found in EMU 1): *Callitriche heterophylla* (water chickweed), *Nuphar luteum* (yellow pond lily).

Palustrine Emergent, Tidal (primarily found in EMU 1): *Lysichiton americanum* (skunk cabbage), *Phalaris arundinacea* (reed canarygrass), *Carex obnupta* (slough sedge), *Typha latifolia* (common cattail), *Caltha palustris* (yellow marsh-marigold), *Athyrium felix-femina* (lady fern), *Alisma plantago-aquatica* (broadleaf water plantain), *Sagittaria latifolia* (duck potato), *Oenanthe sarmentosa* (water parsley), *Veronica* spp. (speedwell), *Polystichum munitum* (swordfern).

Palustrine Scrub-Shrub, Tidal (primarily found EMU 1): *Cornus sericea* (red-osier dogwood), *Rosa nutkana* (Nootka rose), *Physocarpus capitatus* (Pacific ninebark), *Malus fusca* (crabapple), *Rubus spectabilis* (salmonberry), *Spiraea douglasii* (hardhack spirea).

Palustrine Forested, Tidal (primarily found in Management EMU 1): *Salix lasiandra* (Pacific willow), *Salix scouleriana* (Scouler's willow), *Picea sitchensis* (Sitka spruce), *Populus trichocarpa* (black cottonwood), *Thuja plicata* (western red cedar), *Alnus rubra* (red alder), *Rhamnus purshiana* (cascara).

3.3.2 Salmonids

The Snohomish River supports seven species of anadromous salmonids: chinook, coho, chum, and pink salmon; and steelhead, cutthroat, and Dolly Varden/bull trout. Chinook salmon and bull trout were listed as threatened with extinction under the ESA in 1999. Coho salmon are listed as a candidate species for federal protection. This section will focus on these species of concern. However, all species are important in recreational fisheries and five are important in commercial and Native American fisheries.

All species are organized by stock and differentiated by spawning and migration timing (adults and juveniles), geographic separation (spawning area), stock origin (native, non-native, mixed, unknown), and production type (wild, cultured, composite), or other biological characteristics (e.g., allozyme frequency and smolt age; Table 3.1). Within the Snohomish River system, the status (healthy, depressed, critical, extinct, and unknown) of species of concern has been determined with regard to trends in escapement, and with reference to escapement goals (WDFW and WWTIT 1994) (Table 3.2).

All species spawn in fresh water upstream from the estuary, and adult use of the estuary is mainly limited to migration and physiological transition. Adults (of different species) may return to fresh water during every month of the year, and spawning times vary by species and stock (Tables 3.1 and 3.3). There is considerable variation in the juvenile length of residence in estuaries—by species, stock type, and life stage (Table 3.3). Chinook, chum, and coho salmon are more dependent on the estuarine environment than pink salmon and steelhead, sea-run cutthroat, and Dolly Varden/bull trout. Juvenile salmonids are dependent on the estuary for feeding, physiological transition, migration, and refuge (from predation or displacement) as they migrate from fresh water to marine habitats.

In the upper estuary, refuge formed by LWD or deep back eddies may be important for adult salmon resting and osmoregulatory adjustment during upstream migration, in the same manner that woody debris functions as fish habitat for juvenile salmonids (Bisson et al. 1987).

3.3.2.1 Chinook Salmon

The use of and dependence on estuaries by juvenile chinook salmon is generally well understood (Healey 1991), although patterns of migration, growth, and residence naturally vary by watershed and by local life history. In the Snohomish River there are four recognized stocks of naturally spawning chinook salmon (Table 3.1): Snohomish River summer, Snohomish River fall, Bridal Veil Creek fall, and Wallace River summer/fall.

Fall (ocean-type) chinook stocks predominate in the Snohomish River and have the greatest estuarine dependence of all anadromous salmon and stock types. Fall chinook typically produce young-of-the-year fry that migrate to the estuary in their first year. Snohomish River fall chinook, however, produce a high proportion of yearling (stream-type) smolts (25 to 30 percent, WDFW unpublished data). Summer chinook may produce offspring, which migrate to the estuary either in their first year (ocean-type) or in their second year (stream-type). The degree of variation between these life history strategies is unknown. However, reliance on the estuarine environment by yearling smolts, as evidenced by their brief estuarine residence, is much less compared to ocean-type fry (Healey 1991).

After emerging from spawning gravel in February and March, fall chinook fry disperse downstream and utilize low-velocity mainstem margin and off-channel habitats. Riverine residence may last from a few weeks to a few months (Beauchamp 1986, Hayman et al. 1996). Downstream migration to the Snohomish River Estuary has been observed to commence in March or April, peak in late May or early June, and decline through late June and July (Beauchamp 1986, Beauchamp et al. 1987, Pentec 1992b). Peak catches have been observed earlier in the lower estuary (Quilceda Creek, lower Steamboat Slough) than in the upper estuary

Table 3.1 Snohomish River salmon stocks (from Pentec and NW GIS 1999).

Species/Stock	Origin	Production Type	Spawning Times	Spawning Habitat Locations
Chinook salmon				
Snohomish, summer	Native	Wild	September	Snohomish River-Larimer Creek to the confluence of the Skykomish and Snoqualmie rivers. Skykomish from the mouth to Austin Creek.
Wallace River, summer/fall	Mixed	Composite	September and October	Wallace River from mouth to Onley Creek.
Snohomish, fall	Native	Wild	Late September through October	Pilchuck River, Woods Creek, Elwell Creek, Sultan Creek.
				Snoqualmie River and tributaries to Snoqualmie Falls.
Bridal Veil Creek, fall	Native	Wild	Late September through October (Hendrick[1])	North Fork Skykomish, South Fork Skykomish and tributaries, Bridal Veil Creek.
Coho salmon				
Snohomish	Mixed	Wild	Late October through January	Pilchuck River, Quilceda Creek and tributaries, French Creek, Allen Creek and tributaries, Catherine Creek, Star Creek, Dubuque Creek, Panther Creek, Bunk Foss Creek, Pilchuck Creek and tributaries.
Skykomish	Mixed	Composite	Late October through January	Skykomish River from Woods Creek to Confluence with North and South Forks, Woods Creek, Richardson Creek, Sultan River, Wallace River, North Fork Skykomish River, Riley Slough, Howard Creek, Cady Creek.
South Fork Skykomish	Non-native	Wild	Late October through January	South Fork Skykomish River and major tributaries (including above Sunset Falls).
Snoqualmie	Mixed	Wild	Late October through January	Snoqualmie River from mouth to Snoqualmie Falls, Cherry Creek, Tolt River and tributaries, Tokul Creek, Raging River, Harris Creek, Stossel Creek, Griffin Creek, Patterson Creek, Lake Creek, Canyon Creek.
Native char	Native	Wild		

Table 3.2 Snohomish River salmon stock status and escapement data (from Pentec and NW GIS 1999).

		Escapement			
Species/Stock	**Status**	**Goal**	**Years**	**Range**	**Average**
Chinook salmon					
All stocks in basin		5,250	1956-1995	1,380-18,120	7,165
Snohomish, summer	Depressed		1979-1992	361-2,258	988
Wallace River, summer/fall	Healthy		1979-1991	200-2,850	1,000
Snohomish, fall	Depressed		1979-1991	908-2,635	1,700
Bridal Veil Creek, fall	Unknown		no data	no data	no data
Coho salmon					
All stocks in basin		70,000	1956-1995	11,300-157,000	57,341
Snohomish	Depressed		1983-1992	636-15,174	4,407
Skykomish	Healthy		1981-1992	833-19,439	9,177
South Fork Skykomish	Healthy		1967-1991	5,000-30,000	16,265
Snoqualmie	Healthy		1977-1992	10,183-56,920	28,817
Native char	Healthy	NA	1988-1999	500-1,000 (estimated*)	no data

*Source: Kraemer 2000.

Table 3.3 Snohomish River salmon stock run timing and juvenile freshwater residence (from Pentec and NW GIS 1999).

Species (Run)	Time of Adult Return	Spawning Season	Time in Fresh Water	Estuarine Residence Time
Chinook salmon, summer	June-July	Late Sept-Nov	90-180 days	April-July
Chinook salmon, fall	Aug-Sept	Fall	90-180 days	April-July
Coho salmon	Aug-Nov	Oct-Dec	1 year	March-May
Chum salmon	Sept-March	Sept-March	0-30 days	April-June
Pink salmon	Aug- Sept	Sept-Oct	0-7 days	April-June
Steelhead trout, winter	Nov-April	Jan-June	2-3 years	March-May
Steelhead trout, summer	May-Oct	Jan-June	2 years	March-May
Cutthroat trout, sea-run	Dec-June	Dec-June	1-4 years	Jan-Oct
Dolly Varden/bull trout	April-Aug	Sept-Oct	2-3 years	March-May

(Ferry Baker Island, Ebey Slough entry). Fall chinook sampled in marine waters were 5 to 10 mm larger on average than those fish remaining in fresh water in May and early June (Beauchamp 1986). Thus larger chinook may migrate earlier, or fish rearing in marine habitats may grow faster than their in-river counterparts. Both trends are probably true.

Fall chinook have a protracted estuarine residence, compared to other salmonids, as they grow and adapt to marine habitats. In the Skagit River, Congleton et al. (1981) reported that fall chinook may spend many months to over a year in the estuarine environment, taking advantage of foraging opportunities found there. Results from a Snohomish tidal channel mark-recapture study indicated that chinook spent 1 to 10 days in the same tidal channel (Beauchamp 1986). Some chinook were recaptured upstream after 6 to 8 days and more than 10 km from the release channel. Three other fish were recaptured 1 to 3 weeks later in transitional marine habitat (Port Gardner) 10 to 18 km downstream. Individual residence time of subyearling chinook in the Snohomish River Estuary likely ranges from 1 to 3 weeks before entry into nearby marine areas. Subyearling chinook were first observed in sublittoral habitats in late April. Catch abundance gradually increased from May to July, but never peaked dramatically. However, Beauchamp (1986) did not sample lower Snohomish River tidal sloughs until May; thus, residence time may be greater in these habitats than these estimates indicate. In other studies, sampling included February and March (Congleton et al. 1981, Warner and Fritz 1995), and subyearling chinook were observed.

Alternatively, the hatchery stock from the summer/fall Wallace River hatchery has a brief estuarine residence. These smolts are captured within 1 to 2 weeks of their release from the hatchery (Pentec 1992b). Nearly immediate emigration has also been observed with tagged hatchery-released chinook from the Stillaguamish River, the closest major basin to the north (Kirby 1995). In the nearby Duwamish River Estuary, Warner and Fritz (1995) determined that residence time was approximately 2 weeks, but they applied this figure only to the outmigrating hatchery population, not to wild fish. Levings et al. (1986) estimated that individual residence time of hatchery chinook in the Campbell River, British Columbia, estuary was only half as long as for wild chinook, which averaged 41 days. Hatchery chinook likely display a narrow variation in migration timing and limited estuarine residence compared to wild or natural fall chinook.

Yearling chinook are also present in the Snohomish River and Estuary, and represent an important variation in juvenile life history in the Snohomish River. Kirby (1995) reported that yearlings (larger than 100 mm) comprised a small but substantial proportion of the chinook catch (15.7 percent) in the Skykomish River near Monroe, in the upper and lower Snohomish River, and in Ebey Slough. In the estuary, yearling chinook (110 to 180 mm) were first observed in March or early April (Pentec 1992b), and abundance peaked from April 7 to 14 (Beauchamp 1986). Pentec (1992b) sampled over a period of 1 year in the estuary and did not observe any chinook in August, October, or December. Thus, it is unlikely that stream-type chinook use the estuary for overwintering.

Juvenile chinook use high tidal marshes on flooding tides and retreat to low-elevation tidal channels, mudflat, and delta front areas on ebb tides (Levy and Northcote 1981, 1982; Healey 1980, 1991). Beamer and Henderson (1995) reported that chinook and other salmonids used blind off-channel sites in the Skagit River Estuary at high densities during estuarine outmigration. Also, larger chinook appear to use deeper water offshore more readily than smaller fish. Hayman et al. (1996) determined that the greatest production of juvenile chinook salmon in the Skagit River Estuary came from emergent/forested transitional high intertidal habitat (60 percent), followed by estuarine emergent saltmarsh (36 percent), and forested riverine tidal habitat (4 percent). Hayman et al (1996) determined that large and small blind channels were the most productive habitat types. Pentec (1992b) observed that chinook smolts use marshes and channels in the Snohomish River Estuary from early April through mid-May 1991, but in June most fish were observed in the channels rather than in the marshes.

Juvenile chinook in estuaries are opportunistic feeders and will consume a variety of prey, as evidenced by spatial and temporal differences in diets. Small chinook tend to first use nearshore habitats producing benthic and epibenthic prey. Benthic prey resources are detritus-based; thus, much salmon production is ultimately based on upstream and local production of detritus. Morphological features of estuaries, such as vegetation, mudflats, and dendritic channels that trap detritus, become excellent prey resource areas for chinook. As chinook grow, migrate lower in estuaries, and physiologically adapt to sea water, a shift to deeper water and pelagic prey occurs.

Chinook smolts sampled in the lower Snohomish River Estuary in spring and early summer 1991 (Pentec 1991) fed on several insect taxa (mayflies, dipterans, and springtails) in tidal marshes. Gammarid amphipods (*Eogammarus* spp., *Corophium* spp.) were also important prey for chinook salmon in river channels in April. Overall, *Corophium* spp., cladocerans, and mysid crustaceans were important prey taxa, but not harpacticoid copepods (Pentec 1991). Cordell et al. (1999) sampled Snohomish River fish from a breached-dike restored tidal wetland site in 1998. The diet of chinook salmon was dominated by chironomids, larval fish, and amphipods (*Corophium* spp.), but varied with sampling date. In early April, chinook diet was dominated by amphipods, whereas in May, chironomids were relatively more important prey taxa. In June, ceratopogonid fly larvae and pupae were dominant (83 percent of prey weight) prey taxa. These results were similar to those of other studies of juvenile chinook salmon diets in the Pacific Northwest (Meyer et al. unpublished; Cordell et al. 1997, 1998). With increasing size, chinook tend to shift from a benthic prey base to a pelagic prey base as they move from marsh and mudflat habitats to nearshore and neritic habitats.

3.3.2.2 Coho Salmon

Coho smolts tend to move through the estuary later in the spring or summer than do other salmon smolts. In 1987 catches, their numbers peaked in the Snohomish River Estuary in mid-May (Beauchamp et al. 1987). Very few coho were caught in 1986 except in late April (Beauchamp 1986). Coho smolts sampled in a marsh habitat on Ebey Island in April 1991 had been feeding on springtails and dipterans (Pentec 1991). Coho in the lower Union Slough channel in early summer 1991 had been feeding exclusively on cladocerans, while those in the marshes had fed on a variety of insects, mites, and *Corophium*.

Two peaks were reported in the catches of juvenile coho salmon in the estuary by Pentec (1992b): mid- to late May and early July. Increased catches in mid- to late May resulted from hatchery releases 4 to 6 weeks earlier (Pentec 1992b). There was no release of suitable-sized fish preceding the early July peak in catches; the July peak might thus represent natural production. Typically, however, coho salmon smolts are considered one of the least shoreline-associated of the juvenile Pacific salmon (Healey 1982b), so a rapid migration from freshwater and estuarine systems is usually assumed. However, Pentec's (1992b) Ebey Marsh sampling site provided habitat used by presmolt coho salmon over a 6-week period. It is unlikely that sequential cohorts of coho salmon presmolts would have independently ended up in this marsh, so it is likely that coho salmon presmolts resided there for up to 6 weeks. The origin of these coho presmolts is not known, but they may have been hatchery releases in late January and March, or natural production. This finding and recent data reported by Cordell et al. (1999) suggest a greater use of estuaries, including the Snohomish River Estuary, by coho than has been reported elsewhere. Extended estuarine residence by coho (including age 0+) suggests that complex and variable habitat types would be required for these life history stages.

3.3.2.3 Bull Trout (Native Char)

Bull trout and Dolly Varden in Puget Sound have been shown to be distinct species (Leary and Allendorf 1997) and co-exist in the Snohomish River drainage (Skykomish River; WDFW 1998). However, which species is dominant is unclear and evidence suggests they may hybridize (WDW 1992, Kraemer 2000). WDFW treats both species (as “native char”) the same for management and regulatory purposes (WDFW 1998). Native char have adfluvial, fluvial, and resident behaviors in addition to anadromous behavior, although anadromy in bull trout has not been proven (King County Department of Natural Resources 2000). Native char are seldom found in streams warmer than 15°C.

Native char typically use pristine headwater areas to spawn (WDFW 1998). Spawning begins in late August, peaks in September and October, and ends in November. Fish in a given stream spawn over a period of 2 weeks or less. Almost immediately after spawning, adults begin to work their way back to the mainstem rivers, lakes, or reservoirs to overwinter. Some of these fish stay in these areas while others move into salt water in the spring. Native char will spawn a second or even third time. Kelts feed aggressively to recover from the stress of spawning (WDFW 1998).

Newly hatched anadromous native char emerge from the gravel in the spring (WDFW 1998). They typically spend 2 years in fresh water before they migrate to saltwater, the mainstem of rivers, or reservoirs, although there are populations of native char that do not exhibit this behavior. These fluvial char spend their entire lives in the same stretch of headwater stream. These fish may not mature until they are 7 to 8 years old and rarely reach sizes greater than 35 cm in length (WDFW 1998). After rearing for 2 to 3 years in their natal stream, some char may migrate to the mainstem river or to the sea, where they mature to adults. Char in the

Snohomish are generally about 150 mm in length at the time of first entry into estuarine areas (Kraemer 2000).

Native char are opportunistic feeders, eating aquatic insects, shrimp, snails, leeches, fish eggs, and fish. Early beliefs that these fish are serious predators of salmon and steelhead are generally not supported today (WDFW 1998). Kraemer (2000) reports that char in estuarine and marine waters are typically found in nearshore waters less than 3 m deep; these fish are highly piscivorous and grow rapidly on a diet consisting primarily of forage fish.

In general, returning anadromous adults migrate through the estuary and into fresh water in fall or early winter to overwinter until spawning the following August to November. However, use of the estuary by migratory bull trout is largely unknown. For example, a single juvenile (age 1+) native char was captured by Kirby (1995) in the 1993 chinook study, but none was captured by Pentec (1992b) in extensive beach-seining efforts in the lower Snohomish River and Estuary. Immature anadromous char are believed to overwinter in the Snohomish River above tidewater (Kraemer, C., WDFW, pers. comm. 2000) and two (257 and 370 mm) were captured in experimental fishing above the mouth of the Pilchuck River in late January 2001 (Pentec unpublished data). In April 1992, Pentec (1996) captured 10 native char at the north end of Jetty Island (3.3/set; average length 373 mm). One native char was trapped on May 27, 1997, in the breached dike restoration site at South Spencer Island (Cordell et al. 1998). This individual measured 200 mm, but it was presumed to be migrating to the ocean and to be feeding on smaller ocean-migrating salmon. In 1998, no bull trout were captured during spring sampling.

3.3.2.4 Other Salmonids

Chum salmon are strongly associated with estuarine habitats. After only a few days to a few weeks, chum migrate from mainstem river habitats to estuarine habitats. In the Snohomish River Estuary, chum are present from mid-April through the end of May and drop off sharply by mid-June (e.g., Pentec 1992b). Of sites sampled by Pentec, relatively high numbers of chum smolts were found inside the entrances to several remnant marshes. Likewise, in the tidally restored South Spencer Marsh, chum were present in late March through late May (Cordell et al. 1998, 1999). Lower in the estuary, high catch rates in Port Gardner were seen through the first weeks of May, but lesser numbers of chum were still being found in Port Gardner in early July (Beauchamp et al. 1987).

Juvenile chum salmon residence time in estuaries is second in length only to ocean-type (fall) chinook. Pentec (1992b) estimated maximum freshwater residence (both in the river and in the estuary) of chum salmon to be 12 to 52 days based on changes in the size of captured fish and known growth rates for the species. The proportion of this freshwater residency spent in the lower estuary study area cannot be estimated, but is assumed to be substantial based on measured residency in other estuaries. For example, residency of marked juvenile chum salmon in the Fraser River Estuary ranged up to 11 days (Levy and Northcote 1982), and marked juvenile chum salmon residencies in the Nanaimo Estuary ranged up to 3 weeks (Healey 1979; 1982a,b).

Chum salmon taken in the Snohomish River Estuary in spring and early summer of 1991 had been feeding on a variety of small crustaceans and insects (Pentec 1991). Harpacticoid copepods were the most important prey in both the channels and marshes in April, but dipteran insects were more important overall in early summer sampling. Several insects (mayflies, dipterans, and springtails) were also important in the marshes in both sampling periods. Gammarid amphipods (*Eogammarus, Corophium*) and harpacticoids were also very important prey for chum salmon in the river channels in April; insects, cladocerans, and harpacticoids were important prey in the channels in early summer.

Pink salmon smolts move through the estuary in even years only, following odd-year spawning by adults. Juvenile pink salmon migrate to the estuary and Puget Sound immediately after emergence from spawning gravels. However, juvenile pink salmon are less dependent on estuaries for rearing than other Pacific salmon, instead moving quickly into marine waters. At the head of Ebey Slough, pink salmon catches in beach-seine surveys (Beauchamp 1986) showed a sharp peak in mid- to late April 1986. However, Pentec (1992b) captured large numbers of pink smolts in late March 1992, suggesting that outmigration was well underway at the time 1986 surveys were initiated. The catches at this location dropped rapidly and reached zero by mid-May. Catches at stations lower in the estuary peaked about a week later, on average, suggesting that a group of fish might spend at least several days in transit through the last 8 mi of the river before entering Port Gardner. In 1998, only 15 pink salmon smolts were trapped in the South Spencer Island restored tidal marsh (Cordell et al. 1999).

Steelhead and cutthroat trout smolts are older and larger when they begin their ocean migration. Hence, their dependence on the estuary for growth, refuge, and osmoregulatory transition is reduced compared to chinook, chum, or coho. Limited numbers of steelhead and cutthroat trout smolts were sampled in estuary marshes by Pentec (1992b), primarily from mid-April through early July, although steelhead were captured through August. Cordell et al. (1998, 1999) sampled three steelhead in 1997 and one cutthroat in 1998 in a tidally restored marsh in May. The abundance of migrating steelhead likely is related to the timing of upstream hatchery releases in April and May. Whereas steelhead migrate to open ocean, cutthroat are often found close to the mouths of their home streams and in estuaries (Giger 1972), and seldom remain in salt water longer than 8 months before migrating upstream. Like anadromous char, searun cutthroat overwinter in the lower river above tidewater; three (262 to 342 mm) were captured in experimental fishing above the mouth of the Pilchuck River in late January 2001 (Pentec unpublished data).

3.3.3 Other Fish

In the Snohomish River Estuary, juvenile starry flounder (*Platichthys stellatus*) was the most widely distributed and abundant nonsalmonid fish species in the Pentec (1992b) survey. Primarily a marine/estuarine species, it is found on a variety of substrates and spawns in marine waters at depths greater than 45 m. Peamouth chub (*Mylocheilus caurinus*), the second most abundant nonsalmonid estuary species, was also widely distributed throughout the estuary. This species spawns on a gravel or rubble substrate and adults are frequently found in off-channel areas. Also widely distributed in the study area, the Pacific staghorn sculpin (*Leptocottus armatus*) was the third most abundant nonsalmonid species found in the estuary by Pentec (1992b). The freshwater prickly sculpin (*Cottus asper*) was relatively abundant in EMUs 1 and 2. Three-spined sticklebacks (*Gasterosteus aculeatus*), shiner perch (*Cymatogaster aggregata*), juvenile smelts, and lampreys were also found in the study area. Less abundant species included candlefish (*Thaleichthys pacificus*), Pacific herring (*Clupea pallasi*), and pumpkinseed (*Lepomis gibbosus*).

In the more marine EMUs 6 and 7, in Port Gardner and Possession Sound, starry flounder and English sole (*Parophrys vetulus*) are common flatfish (Pentec 1992a). Surf smelt (*Hypomesus pretiosus*) and sand lance (*Ammodytes hexapterus*) are both very important forage fish that are abundant in the shallow waters of EMUs 3, 4, 5, 6, and 7. Larval and juvenile surf smelt were very abundant in the Jetty Island lagoon in spring beach-seine sampling, with densities in the lagoon about 150 times higher than on exposed sandy beaches outside the lagoon (Pentec 1994). Numerous other species, typically associated with estuarine habitats for at least part of their life history, are also found in Port Gardner. These species include: tadpole sculpin (*Enophrys bison*), striped seaperch (*Embiotoca lateralis*), Pacific tomcod, (*Microgadus proximusin*), saddleback gunnel (*Pholis ornata*), sand sole (*Psettichthys melanostictus*), Pacific hake (*Merlucclus productus*), walleye pollock (*Theragra chalcogramma*), copper rockfish (*Sebastes caurinus*), spiny dogfish (*Squalus acanthias*), snake prickleback (*Lumpenus sagitta*), and bay goby (*Lepidogobius lepidus*).

3.3.4 Invertebrates

Common invertebrate species present in EMUs 3, 4, 5, 6, and 7 include: snails (*Littorina* spp.), mussels (*Mytilus* cf. *edulis*), clams (*Macoma balthica, Macoma* spp., *Cryptomya* spp.), cockles (*Clinocardium* sp.), jingle shells (*Pododesmus macroschisma*), polychaetes (*Nereis* spp., *Notomastus* spp., *Nephtys* spp., *Glycera* spp.), barnacles (*Balanus glandula*), shore crabs (*Hemigrapsus* spp.), isopods (*Gnorimosphaeroma oregonensis*), ghost shrimp (*Callianassa* sp.), blue mud shrimp (*Upogebia pugettensis*), Dungeness crab (*Cancer magister*), and red crab (*Cancer productus*). Anemones (*Mertridium senile*) are present in EMUs 3, 5, 6, and 7 (Pentec 1992a). Of these invertebrate species, Dungeness crab is the most significant commercially and is considered a priority species because of the limited habitat available in both the Everett area and Puget Sound.

Anemones are associated with pilings and rocky substrates. Snails, shore crabs, and isopods are associated with rocky, mixed-coarse, and mixed-fine substrates. Mussels are associated with pilings and with rocky, mixed-coarse, and mixed-fine substrates. Clams are associated with mixed-fine substrates, sandflats, mudflats, and shallow subtidal/soft bottom. Cockles are associated with sandflats. Polychaetes are associated with mixed-fine substrates, mudflats/mudbanks, and shallow subtidal/soft bottom. Barnacles are associated with pilings and with rocky, mixed-coarse, and mixed-fine substrates. Ghost shrimp are associated with sandflats and mudflats/mudbanks. Blue mud shrimp are associated with mudflats/mudbanks. Dungeness crab are associated with pilings, rocky substrates, sandflats, mudflats/mudbanks, and shallow subtidal/soft bottom. Red crab are associated with pilings, rocky and mixed-fine substrates, sandflats, and shallow subtidal/soft bottom (Pentec 1992a).

3.3.5 Other Wildlife

The Snohomish River Estuary is important as wildlife habitat on several geographic scales. Estuary habitats function locally as a corridor/refuge within the lower Snohomish River watershed for small mammals, herptiles, and invertebrates, and function regionally in the extended Snohomish River basin for medium and large mammals and birds. The estuary links urban and rural open space from the Puget Sound lowlands to the Cascade crest. Estuary wetland habitats also function regionally, nationally, and internationally as a stop-over and wintering area in the Pacific Flyway for migratory waterfowl, including ducks, geese, and swans; and neotropical migrants, such as certain passerines and raptors.

A variety of rare and uncommon species are present in addition to the great diversity of common species. During the field inventory process for SEWIP (City of Everett et al. 1997), 63 species of birds, 15 species of mammals, and four species of herptiles were observed in the estuary. During a 1978 to 1980 US Fish and Wildlife Service (USFWS) study of the estuary, a total of 116 species of migratory and resident birds was identified (Zeigler 1986). An example of the large numbers of individuals using the estuary is provided by a 1980 survey in which 17,524 ducks and geese were recorded in a single day.

Of the 62 “wetland associated” priority species listed by the state, approximately 40 occur in the estuary (Priority Habitat and Species Program, WDFW 1993). The status of these species ranges from federally endangered or threatened to state monitored (surveillance of a given species).

3.3.5.1 Birds

The Snohomish River Estuary is a staging and stop-over area for bird migration along the West Coast Flyway. Snohomish River Estuary habitats are also important to Puget Sound and resident bird populations.

The lower estuary supports a variety of marine birds, waterbirds, waterfowl, and raptors. Observed species in EMUs 2, 3, and 4 include red-breasted mergansers, loons, goldeneyes, scoters, western grebes, cormorants, pigeon guillemots, brants, eagles, ospreys, peregrine falcons, merlins, gulls, and terns (Carroll and Pentec 1992). Most species are more common in the winter than in other seasons of the year. The SEWIP field team counted over 60 active cormorant nests near the mouth of Union Slough during the summer of 1994 (City of Everett et al. 1997). Ospreys also nest on pilings, with about 15 nests located in the lower estuary (Meehan-Martin, P., Snohomish County, pers. comm., 1996). Marbled murrelets use Port Gardner Bay and Possession Sound for foraging (Carroll, J.R., Snohomish County, pers. comm., 1996).

Shorebirds use the estuary during both the spring and fall migrations, and some species are present nearly year-round (Pentec 1996c). Spring migration is dominated by shorebirds, and fall migration by waterfowl and raptors. During spring migration the number of shorebirds passing through the estuary is greater than during the fall migration, but there are fewer species except on Jetty Island (Carroll 1992). Dunlin and western sandpipers are the most common species in the spring. Baird's, sharp-tailed and pectoral sandpipers, and golden plovers, though uncommon, are sometimes observed during fall migration. Dowitchers, dunlin, black-bellied plovers, western sandpiper, and yellowlegs are common in both spring and fall (Meehan-Martin, P., Snohomish County, pers. comm., 1996; Pentec 1996c).

Because shorebirds feed on benthic invertebrates in fine sediment and mud, several mudflats within the study area are used heavily by shorebirds. These include: the Maulsby Mudflats, especially the area directly north of the 10th Street boat launch, which has less log rafting activity than the rest of the flats (Pentec 1996c); the Jetty Island berm and west Jetty Island, where 18 species of shorebirds have been observed and over 8,700 individuals were reported on April 27, 1995 (Pentec 1996a); South Spencer Island, where more than 50 western sandpipers have been observed at one time (Carroll, J.R., Snohomish County, pers. comm., 1996); and the mudflat area south of the sunken barges (breakwater) at the mouth of the estuary. The recent construction of Naval Station Everett has eliminated the Caspian and Arctic tern colonies in the estuary and significantly reduced the number of Caspian terns, a probable predator on juvenile salmonids, present during the spring and early summer.

Other water birds found in the estuary are American bittern, sora (breeding season), wintering common snipe, Virginia rails, and greater yellowlegs. Fourteen Virginia rails were observed at Spencer Island during the 1995 Christmas Bird Count (City of Everett et al. 1997).

A wide variety of waterfowl use the estuary, including northern shoveler ducks, American coots, ruddy ducks, northern pintail ducks, and several species that breed in the estuary, including Canada geese, mallard, and gadwall ducks. The flooded agricultural pastures and fields in EMUs 1 and 2 provide significant overwintering habitat for thousands of dabbling ducks and several trumpeter swans. Great blue heron use the drier portions of agricultural fields when higher tides reduce hunting opportunities outside of the dikes (Meehan-Martin, P., Snohomish County, pers. comm., 1996). A flock of snow geese and a rare emperor goose have been reported along the lower Snohomish channel (Pentec 1996a,c). Brant feed on eelgrass west of Jetty Island (100 to 290 individuals in January through March). Over 25 species of waterfowl have been observed on and just offshore of Jetty Island, including American wigeon (1,000 to 3,000 individuals in the October/November peak), which use the west shore of Jetty Island as a resting place at night (Carroll, J.R., Snohomish County, pers. comm., 1996; Pentec 1996a).

Raptor species are widely dispersed throughout the estuary habitats, including mudflats, emergent marshes, agricultural fields, and forested swamps. Species that nest in the estuary include red-tailed hawks, northern harriers, ospreys, Cooper's hawks, great horned owls, screech owls, and bald eagles. Bald eagles use the estuary because of the abundance of food available on the mudflats. Seven nesting pairs or bald eagles are confirmed in the estuary, and two additional pairs may be present (Carroll, J.R., Snohomish County, pers. comm., 1996; Carroll and Pentec 1992). Eagles prey on gulls and probably on stranded fish and crabs in the estuary mudflat areas. Eagles use mudflats year round, with the highest concentration occurring during April through June (due to the presence of subadults).

Osprey have been observed in the brackish marsh areas of the estuary, including southern EMU 2 and northern EMU 1, but are more common in the marine areas, where they nest on pilings. Peregrine falcons are present most of the year in the lower estuary and prey on shorebirds, waterfowl, and gulls (Carroll, J.R., Snohomish County, pers. comm., 1996). Occasional turkey vultures, which are cliff nesters and come from upland forested areas, have been seen scavenging in the estuary (Meehan-Martin, P., Snohomish County, pers. comm., 1996).

Seasonally flooded agricultural fields attract northern harriers, red-tailed hawks, peregrine falcons, rough-legged hawks, and merlin. The northern harriers, red-tailed hawks, and rough-legged hawks primarily hunt small mammals, while peregrine falcons prey on shorebirds, waterfowl, and gulls. Merlins prey on smaller birds. The Cooper's hawk and sharp-shinned hawk find refuge in the hedgerows and forested areas in the estuary (Meehan-Martin, P., Snohomish County, pers. comm., 1996).

Warblers and passerines migrate through the estuary in spring and fall, traveling as far north as Alaska. In the estuary, they are attracted to riparian corridors, scrub-shrub, and forested habitats. Numerous warblers have been observed at Spencer and Smith islands in the remaining riparian vegetation along the public access paths. Marsh wrens are common, as are red-winged blackbirds. Uncommon species include the Harris' sparrow and a nesting pair of purple martins near the 10th Street boat launch.

3.3.5.2 Mammals

River otters, mink, muskrats, weasels, beavers, coyotes, raccoons, and deer are all common throughout the estuary. Larger mammals, such as cougar or bear, are rarely observed in the estuary. This reflects the loss of upland habitat, the loss of forested habitat within the estuary, and the loss of corridors connecting the estuary to upland habitat.

Jetty Island observations include coyote (which cross over from Smith Island on the mudflats at low tide), river otter, Townsend's voles, and rats. Marine mammals in the estuary include California and Steller's sea lions and harbor seals (Carroll, J.R., Snohomish County, pers. comm., 1996). In spring and summer, migratory or resident gray whales are typically seen on the estuary delta front. A March 1995 aerial survey resulted in a count of 689 California sea lions on the East Waterway log boom adjacent to the Navy pier (Lambourn, D., WDFW Marine Mammal Investigations, pers. comm., 1995). Gray whales are a common spring migrant along the outer reaches of the Snohomish delta and north into Port Susan. Gray whales feed on benthic invertebrates and remained in the SEWIP study area through at least July 2000 (Houghton, J., Pentec, pers. obs.).

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4.0 INVENTORY AND DESCRIPTION OF EXISTING CONDITIONS, DEVELOPMENT IMPACTS, AND MITIGATION/RESTORATION POTENTIAL

4.1 OVERALL RANKING OF ASSESSMENT UNITS

In June and July 2000, 132 AUs were delineated and scored within the seven SEWIP EMUs (Figure 3.1) using the revised Tidal Habitat Model (see Section 2.4). Final AU scores ranged from 2 to 147.4 (all AU scores are in IVA units per acre). All AU scores were normalized to 100, and the final AU score range was 1.4 to 100 (Figure 4.1). Raw scores, intermediate positive multiplier scores, stressor values, final AU scores, IVA-acres, final normalized scores, and limiting species (chinook or bull trout/coho) are provided in Appendix E, Tables E.1 and E.2.

The frequency distribution of normalized scores was plotted with 2-unit intervals to identify logical groupings of scores, and by extension, habitat quality classifications (Figure 4.2). From the normalized score distribution, we determined that appropriate habitat classification breaks existed at scores of 16 (less than 16 equals low habitat quality), and at 42 (16 to 42 equals medium habitat quality; greater than 42 equals high habitat quality) (Figure 4.3). All the highest-ranking AUs (n = 35; the top 27 percent of AUs) had high raw score values and multiplier values greater than 1.9. Minimal stressors (negative multiplier 0.63 or higher; i.e., low stress) were present at only 10 of the 35 AUs. The largest concentration of these high-quality habitats was found to be along the eastern distributary channels (Figure 4.3). The three highest-scoring sites were Otter Island, Ferry Baker Island, and Quilceda Creek mouth (AUs 1.33, 2.46, and 2.01, respectively). The highest-scoring AUs were distributed throughout EMU 1 (n = 9), EMU 2 (n = 21), and EMU 3 (n = 3), EMU 4 (n = 1), and EMU 7 (n = 1). No other EMUs were represented among the top grouping of scores.

AUs scoring higher than 16, but less than 42, fell into an intermediate classification of habitat quality. This range of scores corresponded to the 43rd to 73rd percentile of the distribution shown in Figure 4.2. These AU scores typically (36 of 41 AUs) had intermediate to high raw scores and positive multipliers (up to 3.0). However, stressor multipliers were present in 15 of the 41 AUs. These AUs are considered to provide medium-quality habitat functions for listed salmonids and may (with the removal of stressors) have a good potential for restoration.

AUs scoring below 16 characteristically had low to intermediate raw scores, one or no positive multipliers, and one or more stressor (negative) multipliers. Because stressor multipliers outweighed positive multipliers, most final AU scores (non-normalized) in this group were less than their AU raw score. AU scores up to 16 corresponded to the lowest 42 percent of the distribution (Figure 4.2); in other words, nearly half of the AUs are deemed to provide only low-quality habitat functions for listed species.

IVA scores were strongly influenced by the number of positive multiplier habitat indicators observed in each AU. One AU had three positive multiplier indicators, 31 AUs had two positive multiplier indicators, and 33 AUs had one positive multiplier indicator; 67 AUs contained no positive multiplier habitat indicators (Figure 4.4). A tidal channel wetted at MLLW was scored in 28 AUs (Figure 4.5; Table 4.1). A marsh of native species occupying more than 25 percent of the AU was scored in 40 AUs (Figure 4.6). A riparian zone providing a significant source of LWD recruitment was scored in 27 AUs (Figure 4.7). Eelgrass or kelp occupying more than 25 percent of the total AU was scored in only three AUs (Figure 4.8). "Feeder bluffs" were scored in only two AUs (Figure 4.8; Table 4.1). In some cases, although an individual AU contained one or more of these important habitat indicators, the final AU IVA score was not high enough to be included in the 4th quartile of habitat scores.

IVA scores also were strongly influenced by the stressor indicator values observed. The number of stressors scored in each AU ranged from none to seven (Figure 4.9). Eighty-one AUs contained at least one stressor, and cumulative stressor multiplier values ranged from 0.9 (low stress) to 0.11 (high stress) (Appendix Table E.2). Fifty-one AUs contained no stressors (Figure 4.9). These AUs without stressors were restricted to EMUs 1, 2, 4, and 7. The two most frequently scored stressors were "riprap and vertical bulkheads extend below MHHW along >50 percent of the shore" (44 of 132 AUs), and "majority of riprap or vertical bulkheads extend below mean sea level (MSL)" (46 of 132 AUs; Table 4.1).

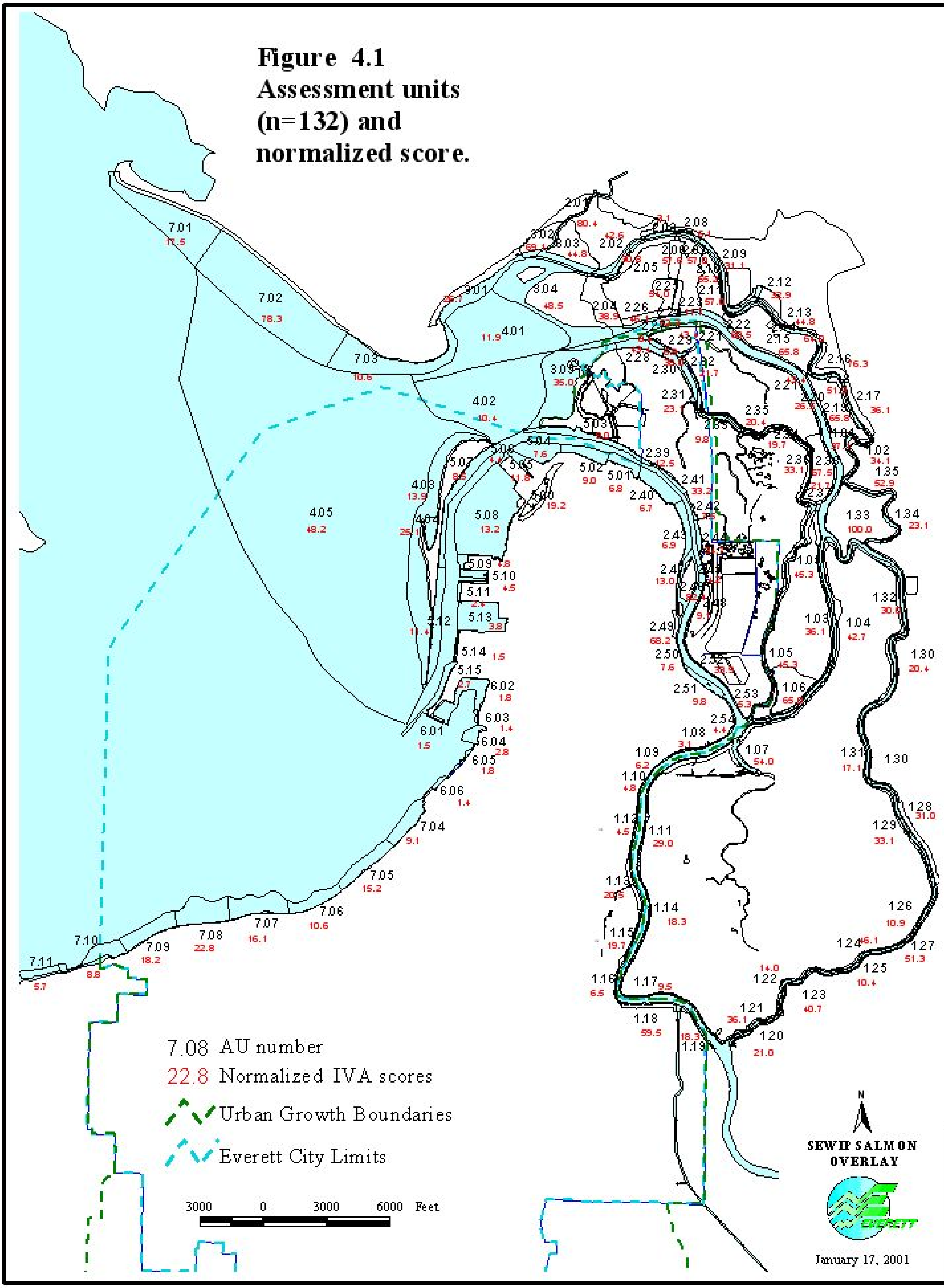


Figure 4.1 Assessment units (n=132) and normalized score.

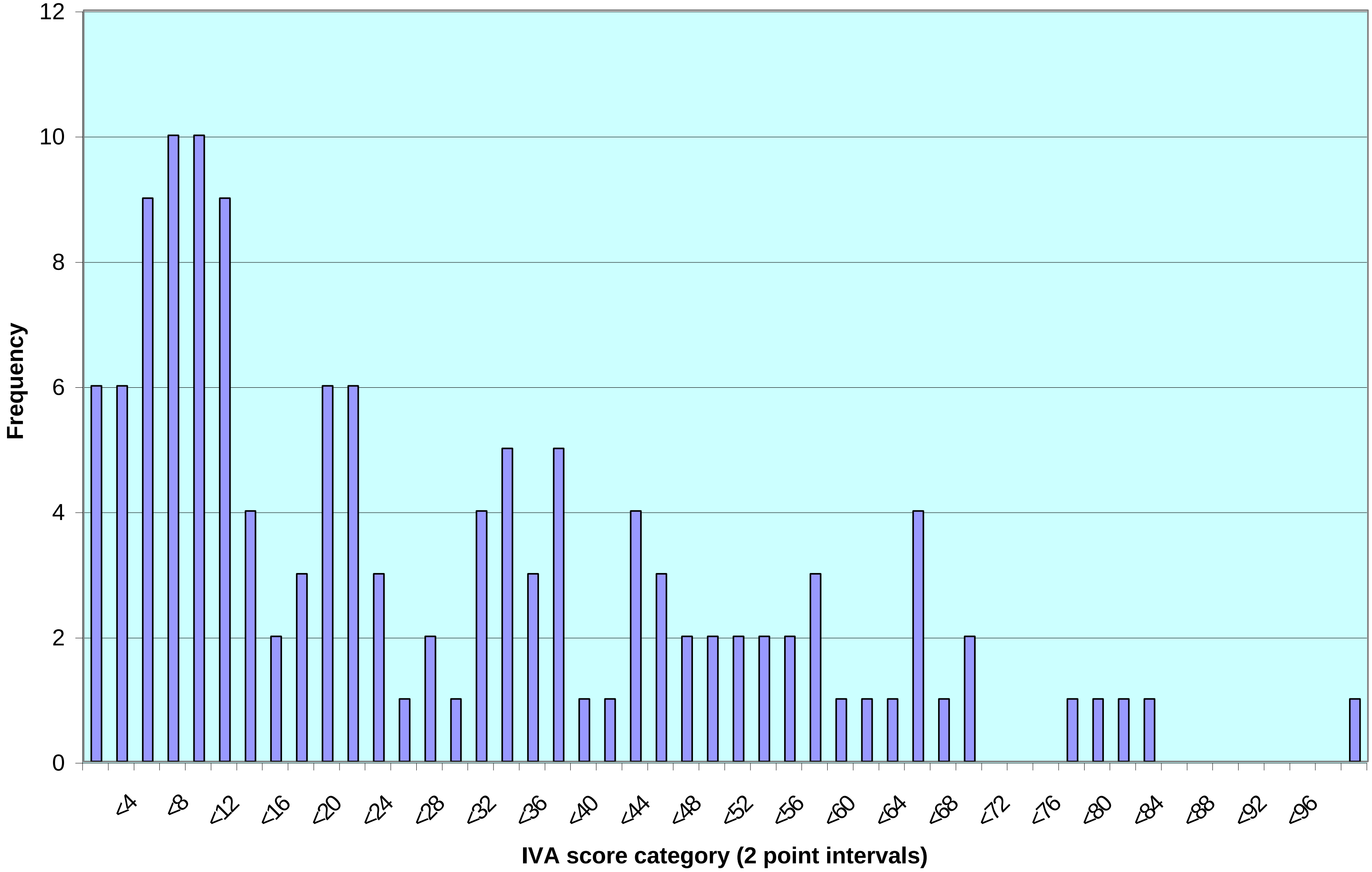


Figure 4.2 SEWIP AU IVA normalized score frequency distribution and habitat quality score categories: low (<16; n = 56), medium (16-42; n = 41), and high (>42; n = 34).

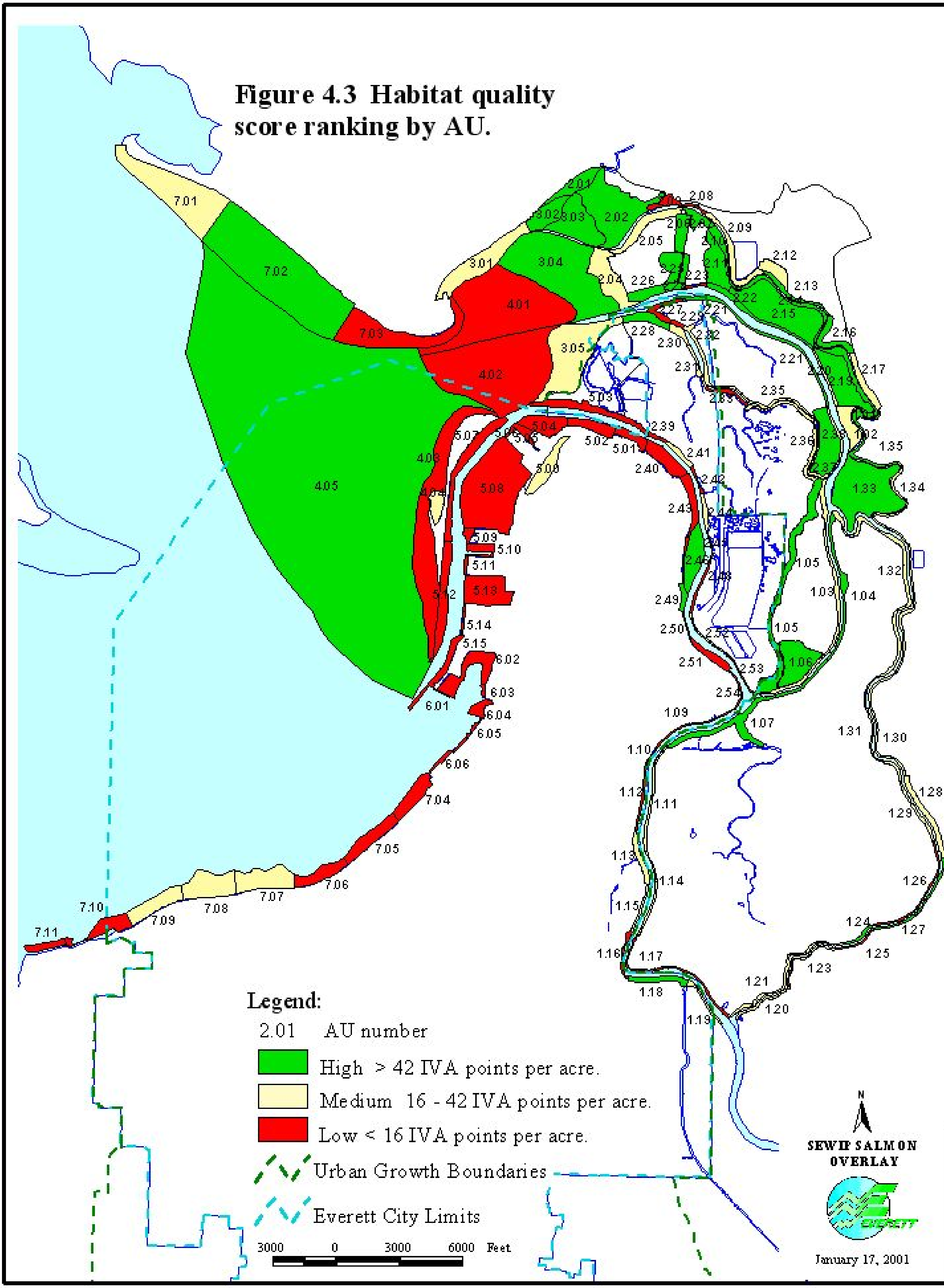


Figure 4.3 Habitat quality score ranking by AU.

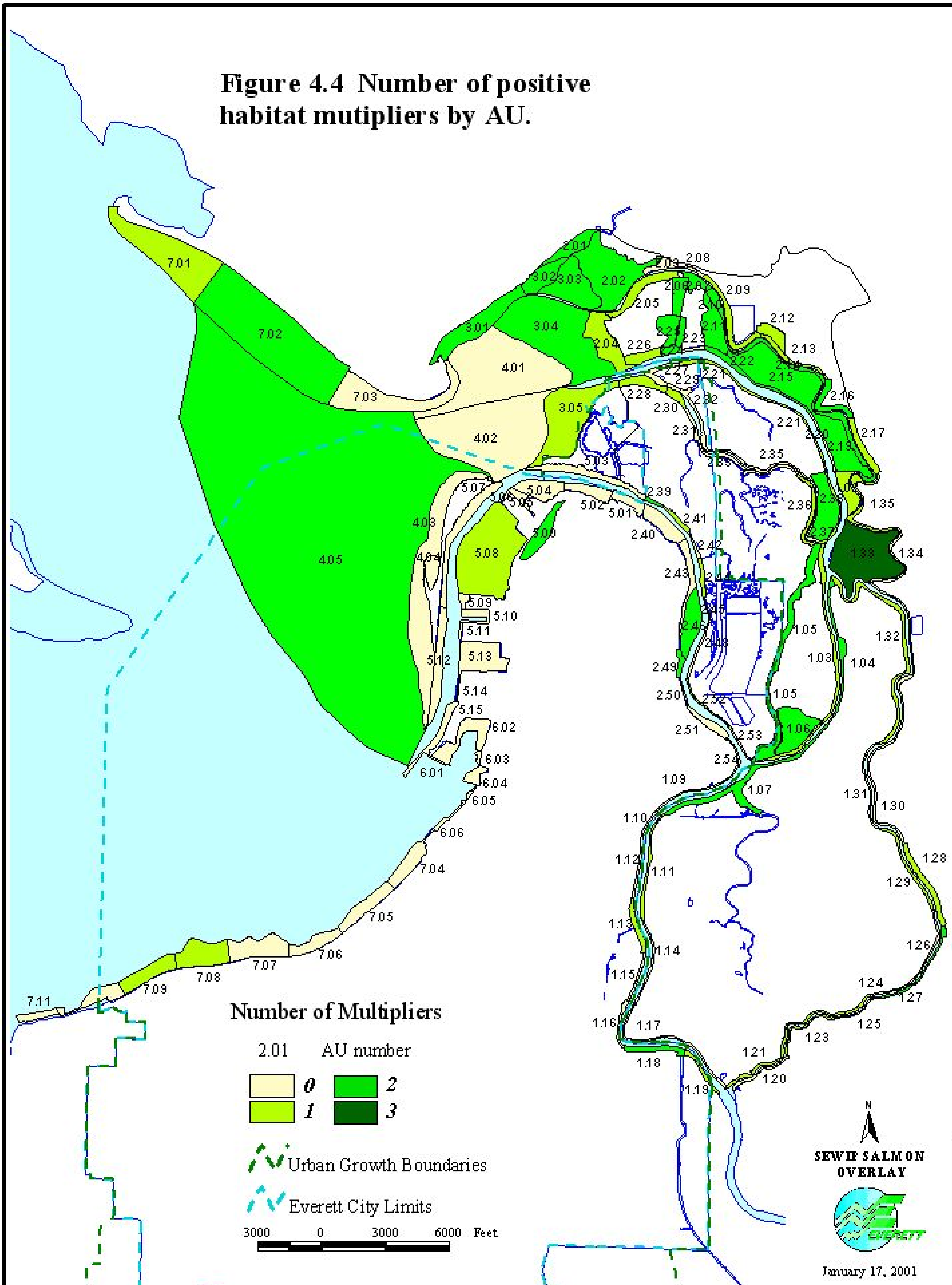
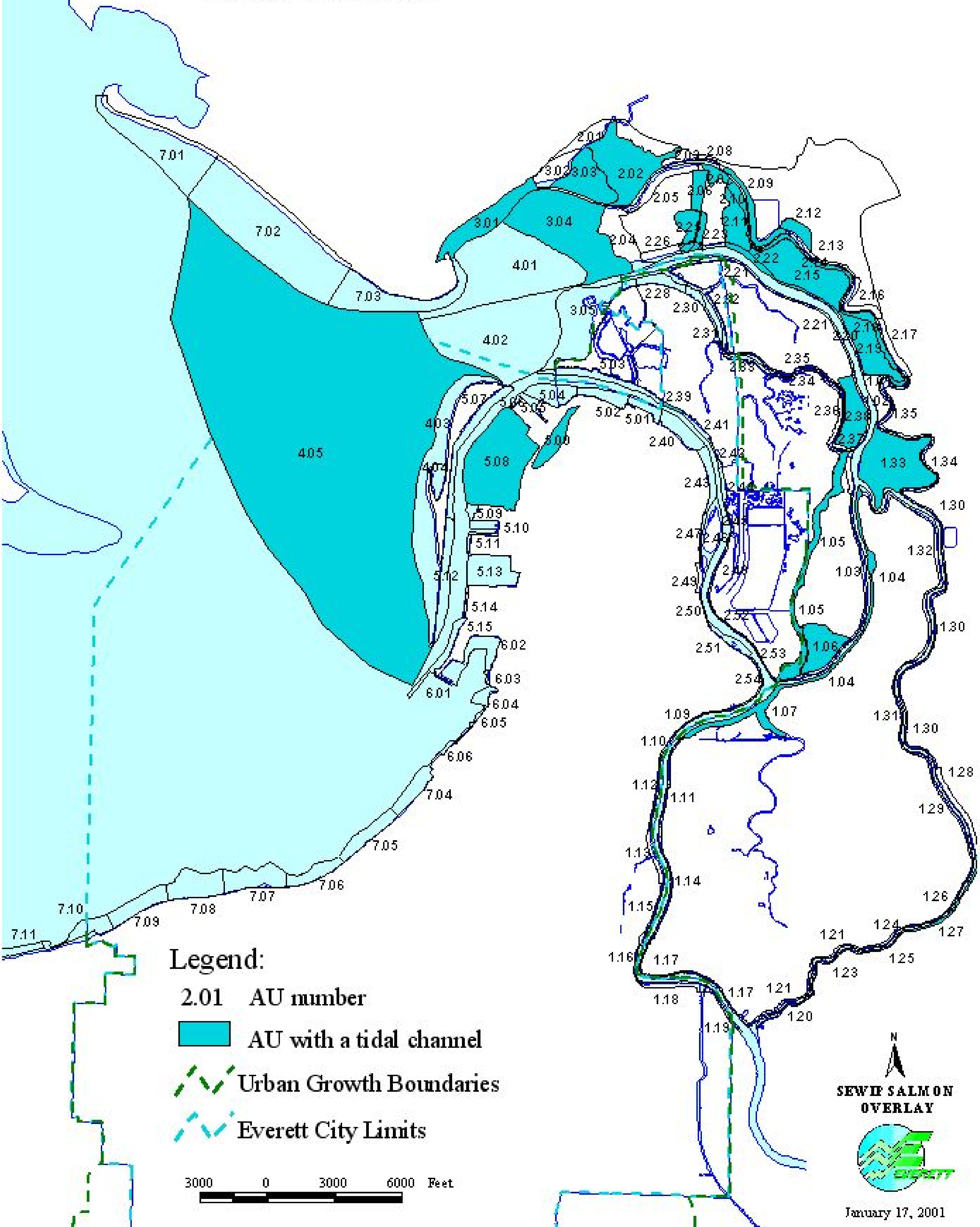


Figure 4.4 Number of positive habitat mutipliers by AU.

Figure 4.5 Assessment units containing a natural tidal channel wetted at MLLW.



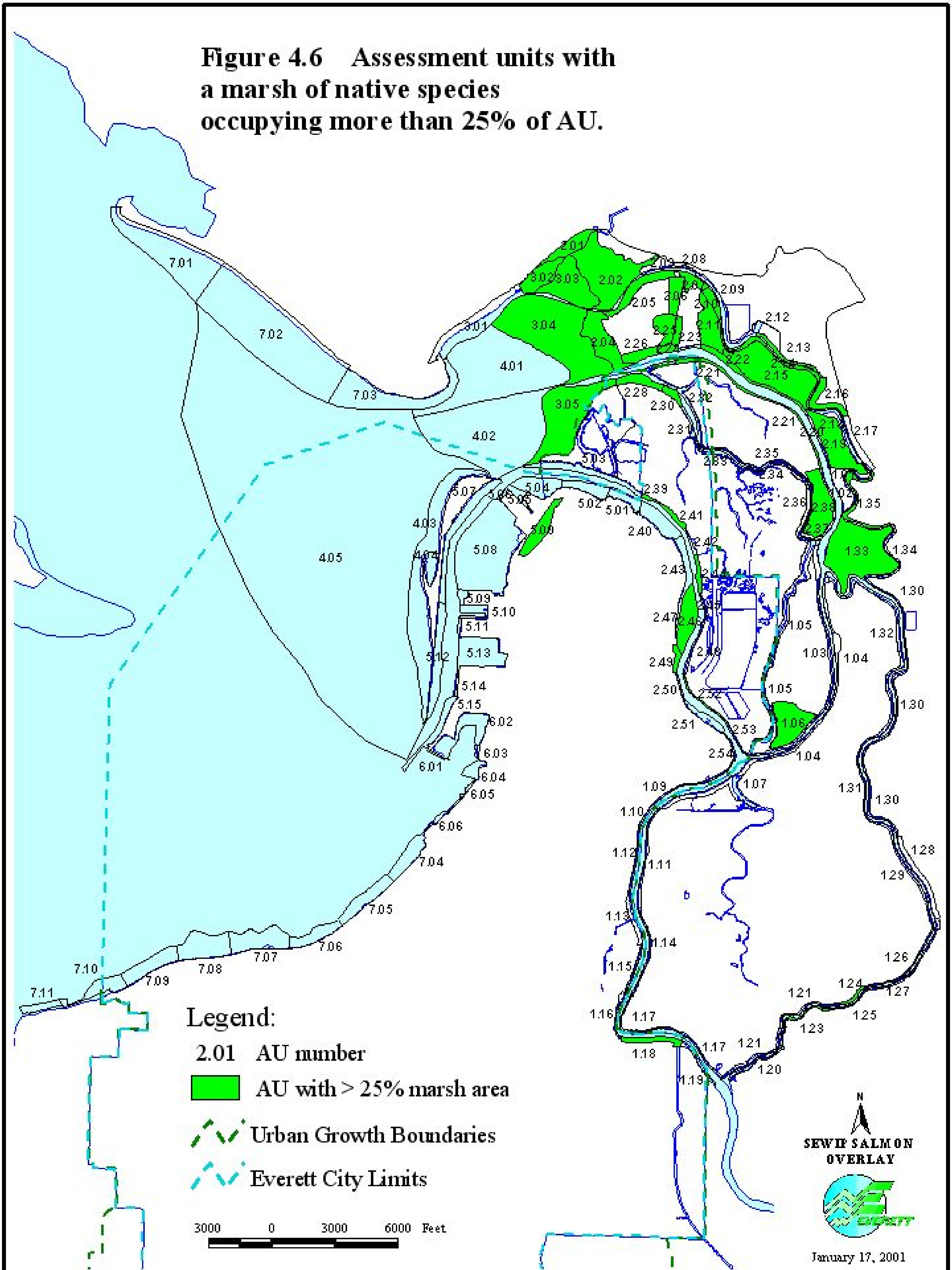


Figure 4.6 Assessment units with a marsh of native species occupying more than 25% of AU.

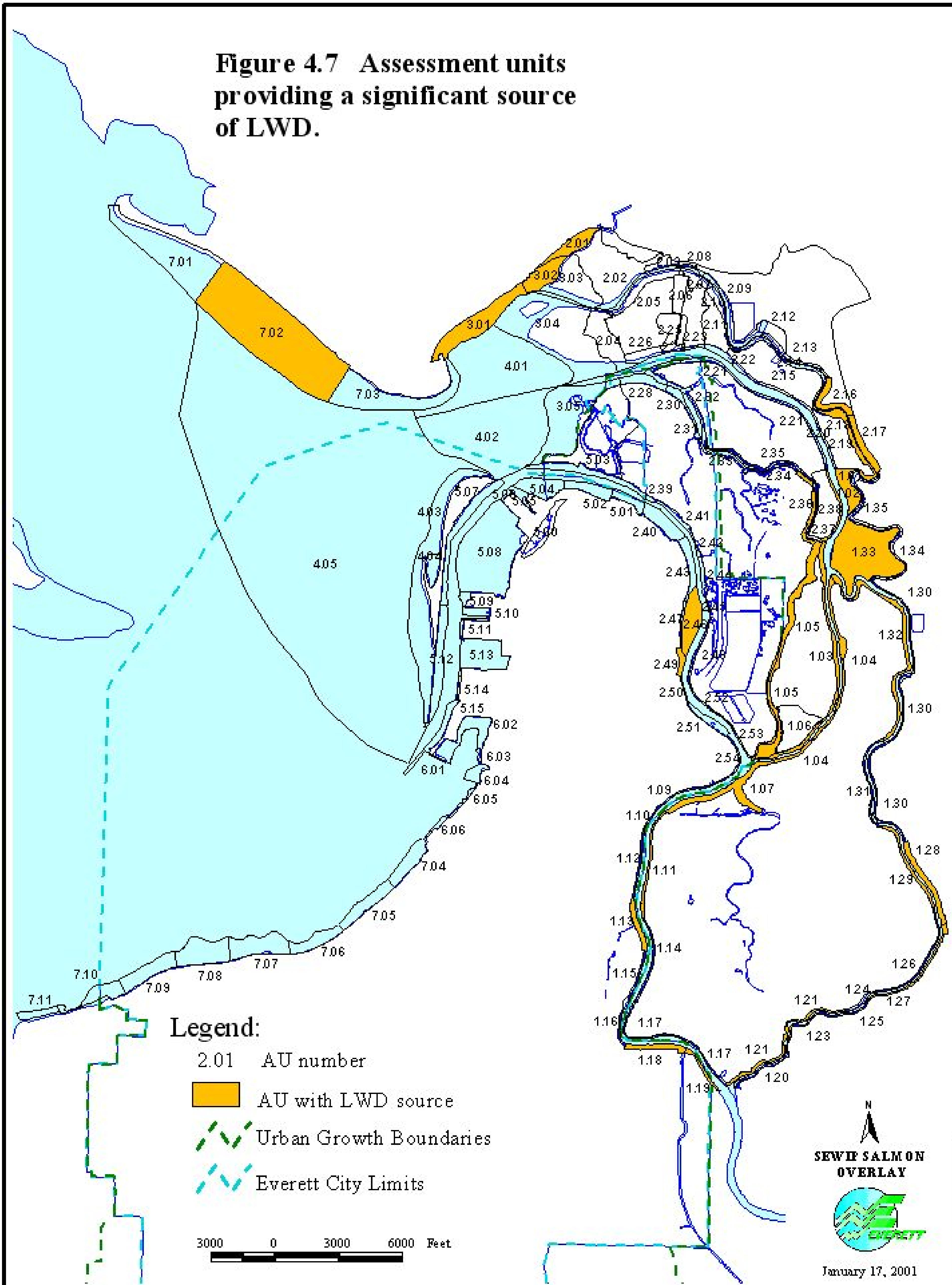


Figure 4.7 Assessment units providing a significant source of LWD.

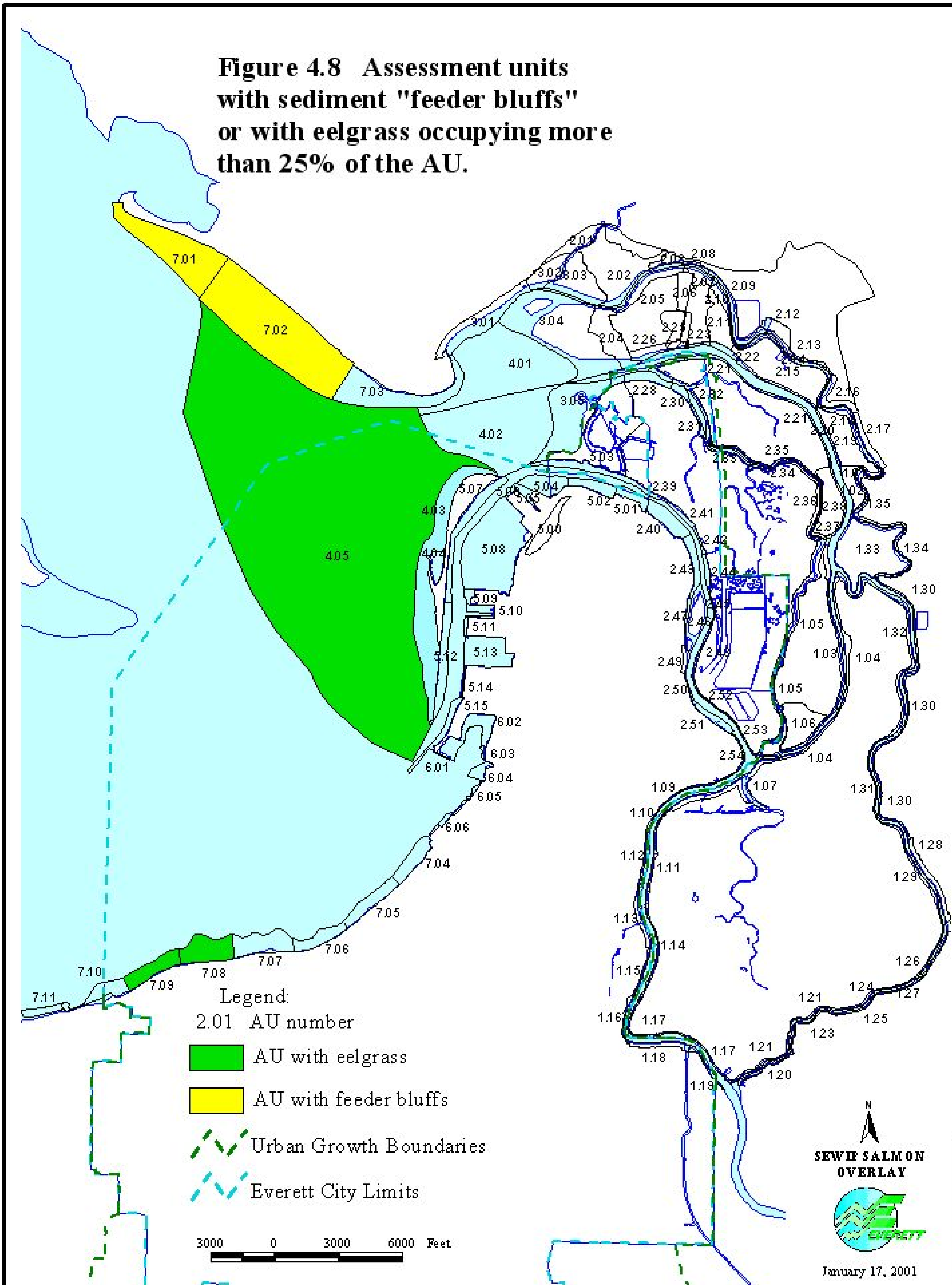
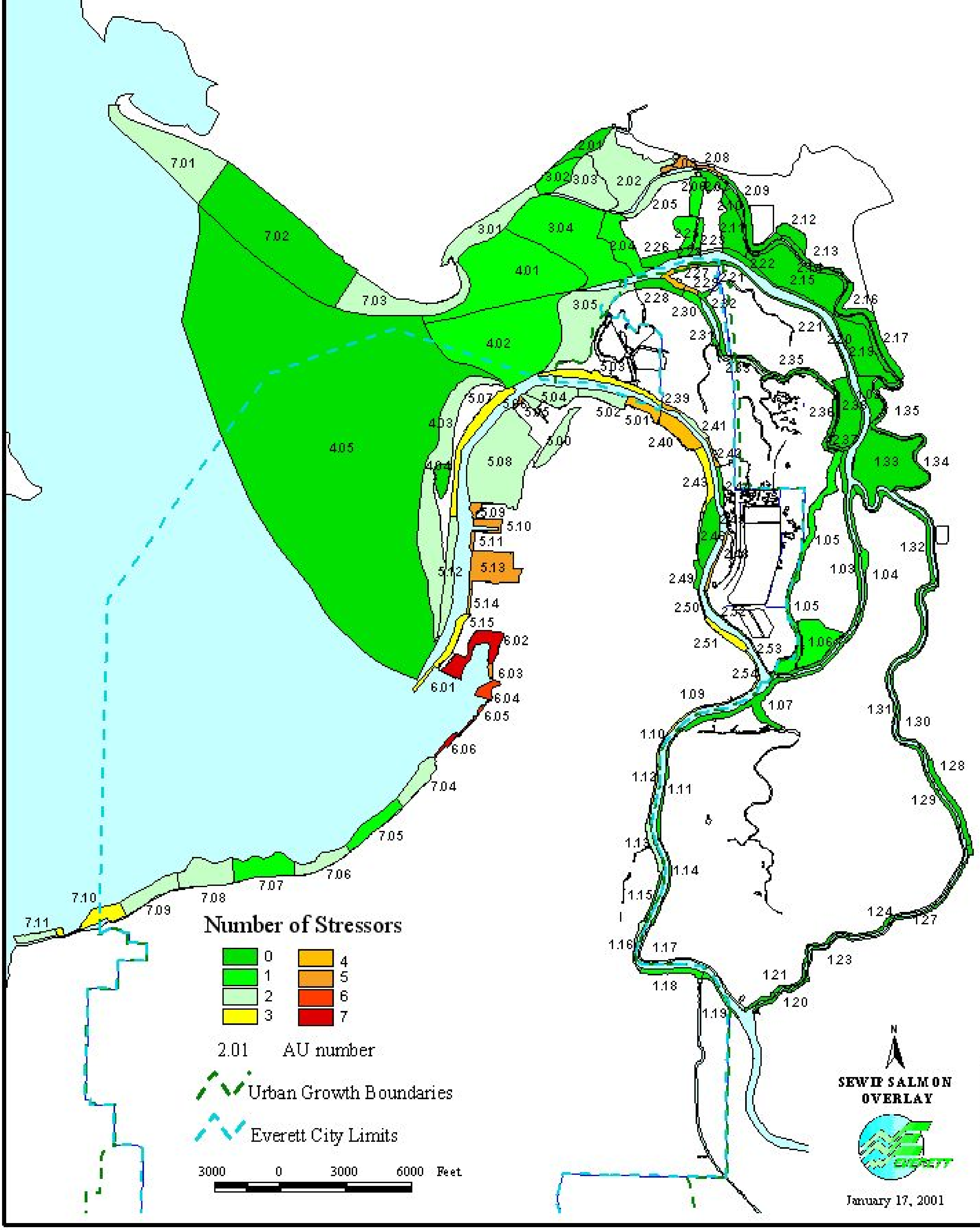


Figure 4.8 Assessment units
with sediment "feeder bluffs"
or with eelgrass occupying more
than 25% of the AU.
Legend:
2.01 AU number
AU with eelgrass
AU with feeder bluffs
Urban Growth Boundaries
Everett City Limits
3000 0 3000 6000 Feet
N
SEWIP SALMON
OVERLAY
January 17, 2001

Figure 4.9 Number of unique stressor indicators by AU.



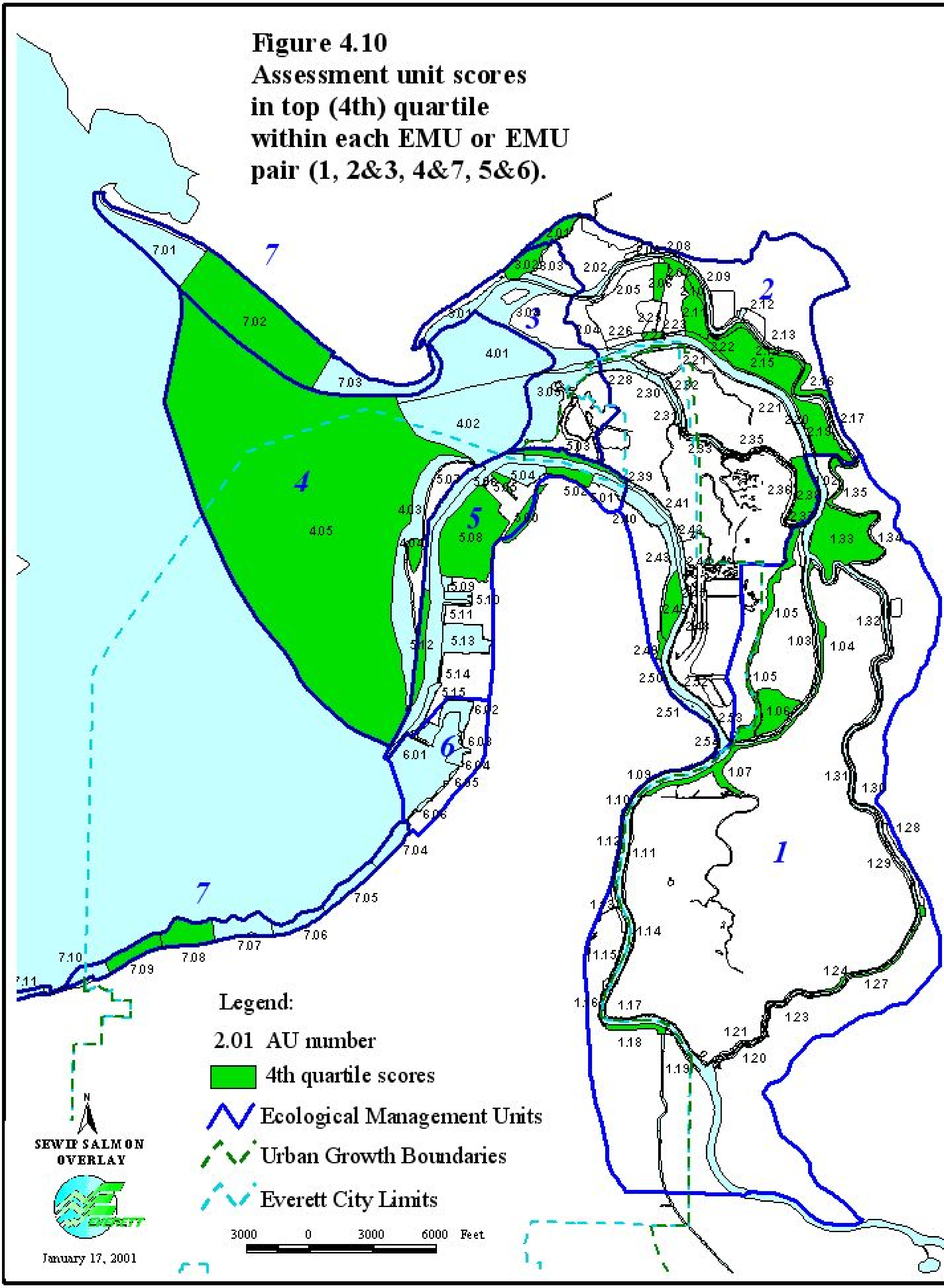


Figure 4.10
Assessment unit scores in top (4th) quartile within each EMU or EMU pair (1, 2&3, 4&7, 5&6).

Table 4.1 SEWIP Salmon Overlay Tidal Habitat Model question answer frequency.

Question No.	Question	Answer Frequency
1	AU has vernal or perennial freshwater stream or spring	12
2a	AU is depositional (slow currents, low wave action) over 25% of littoral area	18
2b	AU is depositional (slow currents, low wave action) over 50% of littoral area	90
3	AU has refuge from high velocities (e.g., during max. ebb)	96
4a	AU contains a natural tidal channel wetted at MLLW	28
4b	AU contains tidal channel wetted at MSL (i.e., shallow drainage)	20
5	Tidal channel is dendritic or highly sinuous	24
6a	Fresh water only (salinity <0.5 ppt)	41
6b	Oligohaline to Mesohaline (sal. variable: often 0.5 to 5 ppt, but can range to 18 ppt)	69
6c	Polyhaline (sal. typically 18 - 30 ppt)	20
7a	Temp/DO meet criteria for salmonid health during major use periods	16
7b	Temp/DO meet criteria for salmonid health at all times	116
8a	Ratio of length of MHHW boundary to width at MLLW >3 (include islands)	20
8b	Ratio of length of MHHW boundary to width at MLLW 1.2 to 3 (include islands)	34
8c	Ratio of length of MHHW boundary to width at MLLW <1.2 (include islands)	78
9	AU is sheltered from waves	115
10a	Slope of substrate in littoral zone >10h:1v (i.e., low gradient)	56
10b	Slope of substrate in littoral zone <10h:1v but >5h:1v (i.e., moderate)	23
10c	Slope of substrate in littoral zone <5h:1v but >2h:1v (i.e., steeper)	53
11a	>10% of AU is littoral (MHHW to -10 ft; use OHW if marsh veg. above MHHW)	6
11b	>25% of AU is littoral (MHHW to -10 ft; use OHW where vegetation indicates)	11
11c	>50% of AU is littoral (MHHW to -10 ft; use OHW where vegetation indicates)	114
12	Substrate in littoral zone - silty sand >25% of area	22
13	Substrate in littoral zone - mud or mixed fine 25 - 50% of area	85
14	Substrate in littoral zone - mud or mixed fine > 50% of area	109
15	Upper intertidal zone contains potential forage fish spawning habitat	5
16a	Buffer: marsh edge >10 ft wide over 50% of shoreline	31
16b	Marsh edge >5 ft wide over 50% of shoreline; or >10 ft wide over 25 - 50% of shoreline	15
16c	Marsh edge exists but <5 ft wide, or less than 25% (but >5%) of shoreline	15
16d	Marsh of native species occupies more than 25% of total AU	40
17a	Riparian scrub-shrub and/or forested >25 ft wide over 10 - 24% of shoreline	13
17b	Riparian scrub-shrub and/or forested >25 ft wide over 25 - 50% of shoreline	13
17c	Riparian scrub-shrub and/or forested >25 ft over 50% of shoreline	70
18	Riparian vegetation is dominated by native species	40
19	Riparian zone provides significant source of LWD recruitment	27
20a	AU has low- to moderate-gradient intertidal continuity with adjacent AU (one side)	43
20b	AU has low- to moderate-gradient intertidal continuity with adjacent AUs (both sides)	24
21a	1 piece/channel width, /30 m of shoreline, or /100 m² of AU whichever is greater	33
21b	0.5 piece/channel width, /30 m of shoreline, or /100 m² of AU whichever is greater	11
21c	0.2 piece/channel width, /30 m of shoreline, or /100 m² of AU whichever is greater	31
22	Algal cover over 10% of littoral area (during springtime)	17
23a	Eelgrass or kelp (laminarians) is present along 5 - 10% of low tide line of AU	3
23b	Eelgrass or kelp (laminarians) is present along 10 - 25% of low tide line of AU	1
23c	Eelgrass or kelp (laminarians) present along more than 25% of low tide line of AU	12
23d	Eelgrass or kelp (laminarians) occupies more than 25% of total AU	3
24	Do functioning feeder bluffs provide a significant source of sediment to the AU	2

continued

1997 SEWIP Wetland Complex Numbers

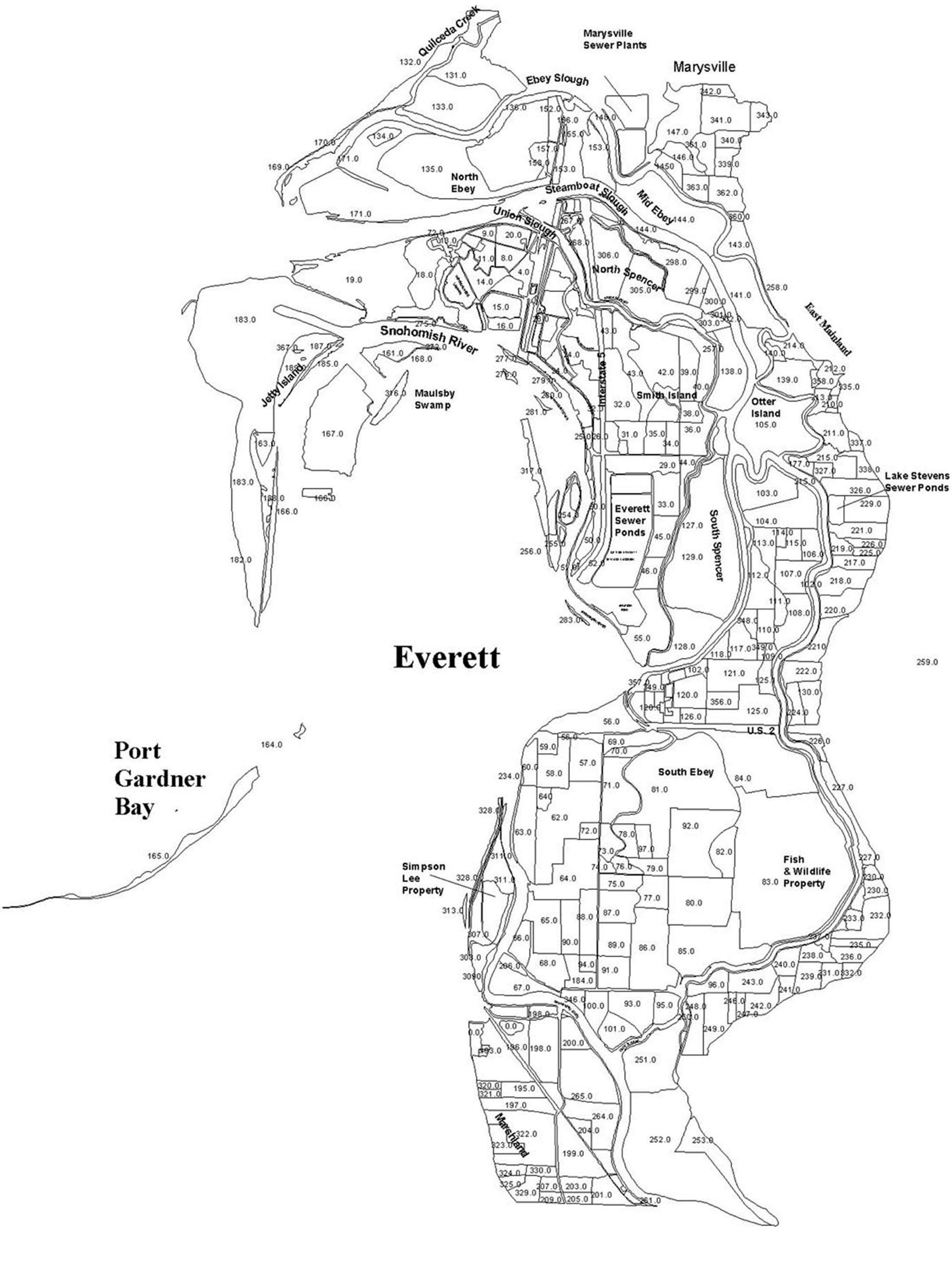


Table 4.1 (continued).

Question No.	Question	Answer Frequency
25a	Immigration/emigration restricted 25 to 50% of the time	2
25b	Immigration/emigration restricted 50 to 75% of the time	0
25c	Immigration/emigration restricted 75 to 90% of the time	2
26a	Wood debris present on the bottom 25 to 75% cover over AU	1
26b	Wood debris present on the bottom >75% over AU	0
27a	Log rafting affects 10 - 50% of AU on a recurring basis	15
27b	Log rafting affects over 50% of AU on a recurring basis	10
28a	Water col. conditions exceed salmonid thresholds during periods of high abundance	0
28b	Water col. conditions exceed salmonid thresholds during periods of low abundance	0
29a	Sediment chemical contam. present (>SQS over more than 25% of AU)	3
29b	Sediment chemical contam. present (>CSL over more than 25% of AU)	0
30a	Riprap or vertical bulkheads extend below MHHW for 10 - 50% of shore	20
30b	Riprap or vertical bulkheads extend below MHHW along >50% of shore	44
31	Majority of riprapped or bulkheaded shoreline extends below MSL (+6 ft MLLW)	46
32a	Finger pier or dock >8 ft wide	9
32b	Two or more finger piers or docks >8 ft wide; or single pier or dock >25 ft wide	18
33a	Overwater structures cover 10 to 30% of littoral area in AU	12
33b	Overwater structures cover 30 to 50% of littoral area in AU	2
33c	Overwater structures cover 50 to 75% of littoral area in AU	1
33d	Overwater structures cover >75% of littoral area in AU	3
34	Littoral benthic habitat routinely disturbed by prop wash, chronic oil spills, or dredging	32

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4.2 MANAGEMENT UNIT

AU IVA scores were also ranked within each EMU to identify the best-quality habitats available to listed salmonids in each EMU or ecological zone, within the continuum from tidal freshwater in EMU 1 to the largely marine shorelines in EMU 4 and 7. Because of the similarities in marine influence and habitats, and because of the limited number of AUs included, EMUs 4 and 7 were combined for this exercise. Additionally, freshwater/saltwater transition zone EMUs (2 and 3) were combined, as were the two relatively industrialized EMUs (5 and 6). The geographically larger EMU 1 was analyzed independently. Again, scores were normalized to 100 within each EMU or EMU pair, and the percentile distribution was calculated. The 35 AUs representing the top quartile of IVA scores in each EMU or EMU pair are shown in Figure 4.10.

4.3 SALMONID HABITAT AREA AND IVA-ACRE SCORES IN THE SNOHOMISH RIVER ESTUARY AND UGA

The entire SEWIP planning area (Figure 1.2) encompasses 20,262 acres, of which 42.4 percent (8,595 acres) comprises currently accessible salmonid habitat area (Table 4.2). This total includes both inwater habitat and riparian buffer habitat (up to 187 ft wide in some cases), and includes all of Otter Island. The functional quality score of each AU (IVA points per acre) was multiplied by the acreage within the AU to provide the estimate of function-area for each AU. These function-area values were then summed, to provide the estuarywide total of 506,609 IVA-acres. Table 4.2 shows the AU-acres and IVA-acres for the various geographic subareas within the estuary (e.g., EMUs, UGA).

It is noteworthy that EMU 1, which has the largest total area of any EMU, also has the smallest percentage of its total area (9.5 percent) that is salmonid habitat. The highest percentage of total area that is tidal is found in EMUs 4 and 7, which consist primarily of open-water and shoreline areas at the mouth of the estuary (Figure 3.1). It is also noteworthy that AU 4.05, the broad expanse of the Snohomish delta west of Jetty Island, contains 38.5 percent of the salmon habitat acreage in the entire planning area. Because of the presence of uniform sandy mudflats from about MLLW to -6 ft MLLW, and because of the extent of eelgrass coverage, this AU had

Table 4.2 Total salmon habitat area and functions in acres and IVA-acre points for SEWIP geographic, political, and ecological areas.

Geographic/Political Area	Area (acres) Total (tidal and uplands)	Tidal Habitat	Tidal Habitat as % of Total Area	% of Total Tidal Habitat Area	Functional Area (IVA-acres) IVA-acres	% of Total Habitat Function
EMU 1	8,117.0	772.3	9.5	9.0	57,846	11.4
EMU 2	4,336.0	1208.4	27.9	14.1	84,474	16.7
EMU 3	835.1	631.3	75.6	7.3	40,029	7.9
EMU 4	4,337.6	4245.1	97.9	49.4	251,347	49.6
EMU 5	1,161.4	606.3	52.2	7.1	9,061	1.8
EMU 6	417.8	74.4	17.8	0.9	214	0.0
EMU 7	1,057.4	1057.4	100.0	12.3	63,639	12.6
SEWIP Planning Area Total	20,262.3	8595.2	42.4	100.0	506,609	100.0
Everett UGA[1]		3909.0	19.3	45.5	203,600	40.2
Marysville UGA		217.0	1.1	2.5	16,307	3.2
AUs Considered in the HDS[2]		938.8	4.6	10.9	13,384	2.6

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[1] For AUs containing habitat both within the UGA and outside the UGA, only the area within the UGA boundary is included.

[2] Includes AUs in Everett and Mukilteo UGAs.

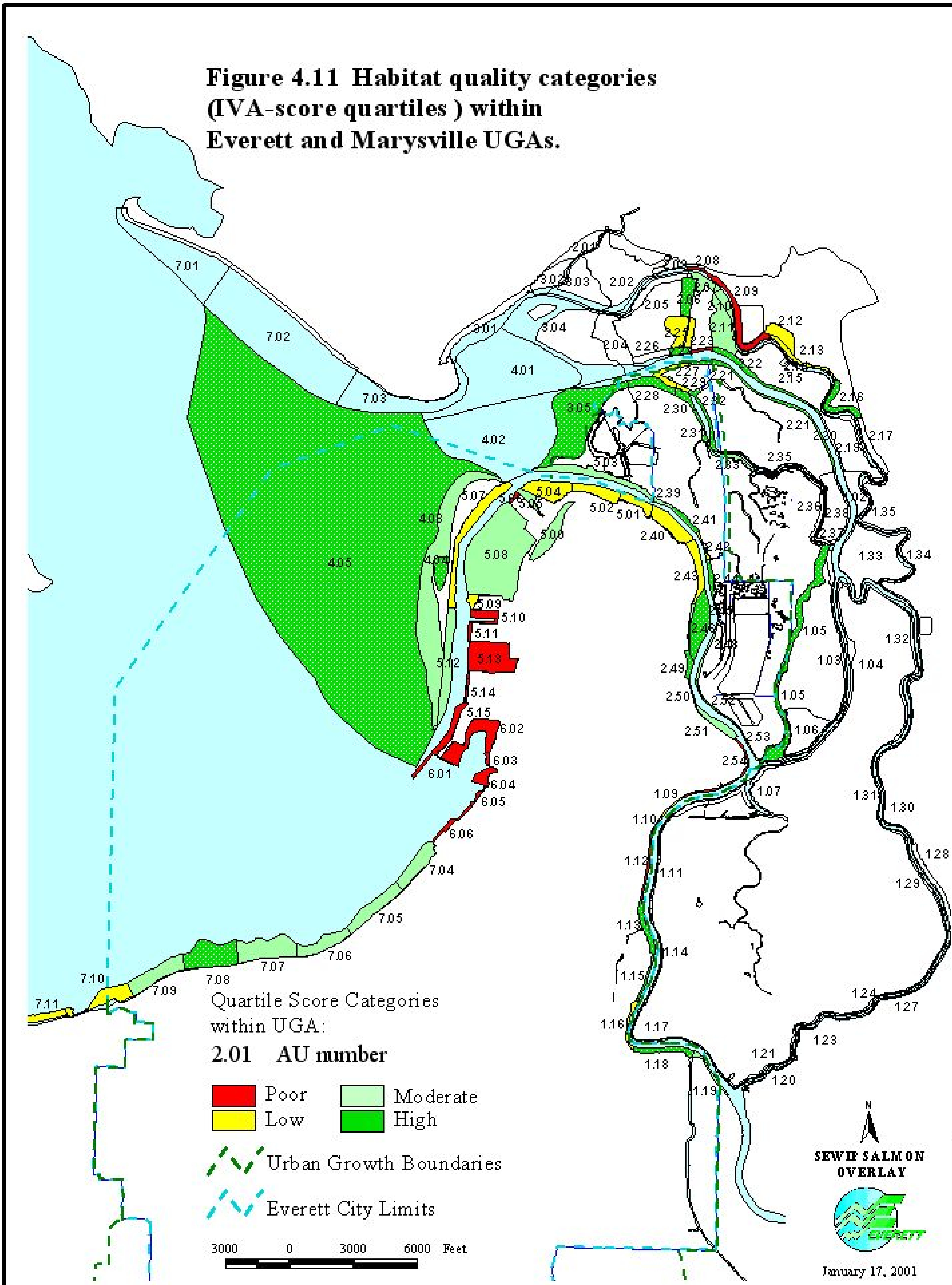


Figure 4.11 Habitat quality categories (IVA-score quartiles) within Everett and Marysville UGAs.

the second highest score in the marine EMUs (4 and 7). The combination of large area and high functional quality result in this single AU providing nearly 47 percent of all the existing salmon function-area (IVA-acres) in the planning area.

4.4 RANKING OF AUs IN THE UGAs OF EVERETT, MUKILTEO, AND MARYSVILLE

Sixty-eight AUs are located within the UGAs of the cities of Everett and Mukilteo. (For the purposes of ranking AUs in the nearshore environment of the UGA, we included two AUs that are partially [AU 7.10] or wholly [AU 7.11] contained within the City of Mukilteo UGA.) Contained within the combined UGA are 3,909 acres and 203,600 IVA-acres of salmonid habitat (Table 4.2). Note that where AUs lie across the UGA boundary, only that portion within the boundary is included in these totals. The 18 AUs with the highest habitat quality (4^{th} quartile of normalized IVA scores) are shown in Figure 4.11. Fourteen of these 18 AUs contained at least one habitat multiplier indicator (tidal channel, marsh area, LWD recruitment, eelgrass area; see Figures 4.5 through 4.8). Other AUs, classified as having poor-, low-, and medium-quality habitats (1^{st}, 2^{nd}, 3^{rd} quartile scores) are also shown. Most AUs within the combined UGA have experienced significant development to date. As a result, only 10 AUs (14 percent) contain no stressor indicators.

Thirteen AUs, all contained within EMU 2, are located within the City of Marysville UGA (Figure 4.11). There are 217 acres and 16,307 IVA-acres (points) of salmonid habitat contained within the Marysville UGA. The four AUs with the highest habitat quality are shown in Figure 4.11. These four AUs each contained two habitat multiplier indicators (a combination of marsh area, tidal channel, or LWD recruitment potential), and only one stressor indicator among the four AUs. Other AUs, classified as having poor-, low-, and medium-quality habitats are also shown in Figure 4.11.

4.5 HYPOTHETICAL DEVELOPMENT SCENARIO

The HDS was used to evaluate whether sufficient area is available in the estuary to provide compensatory mitigation for impacts to salmonid habitat under what is considered to be a realistic, maximum-development scenario.

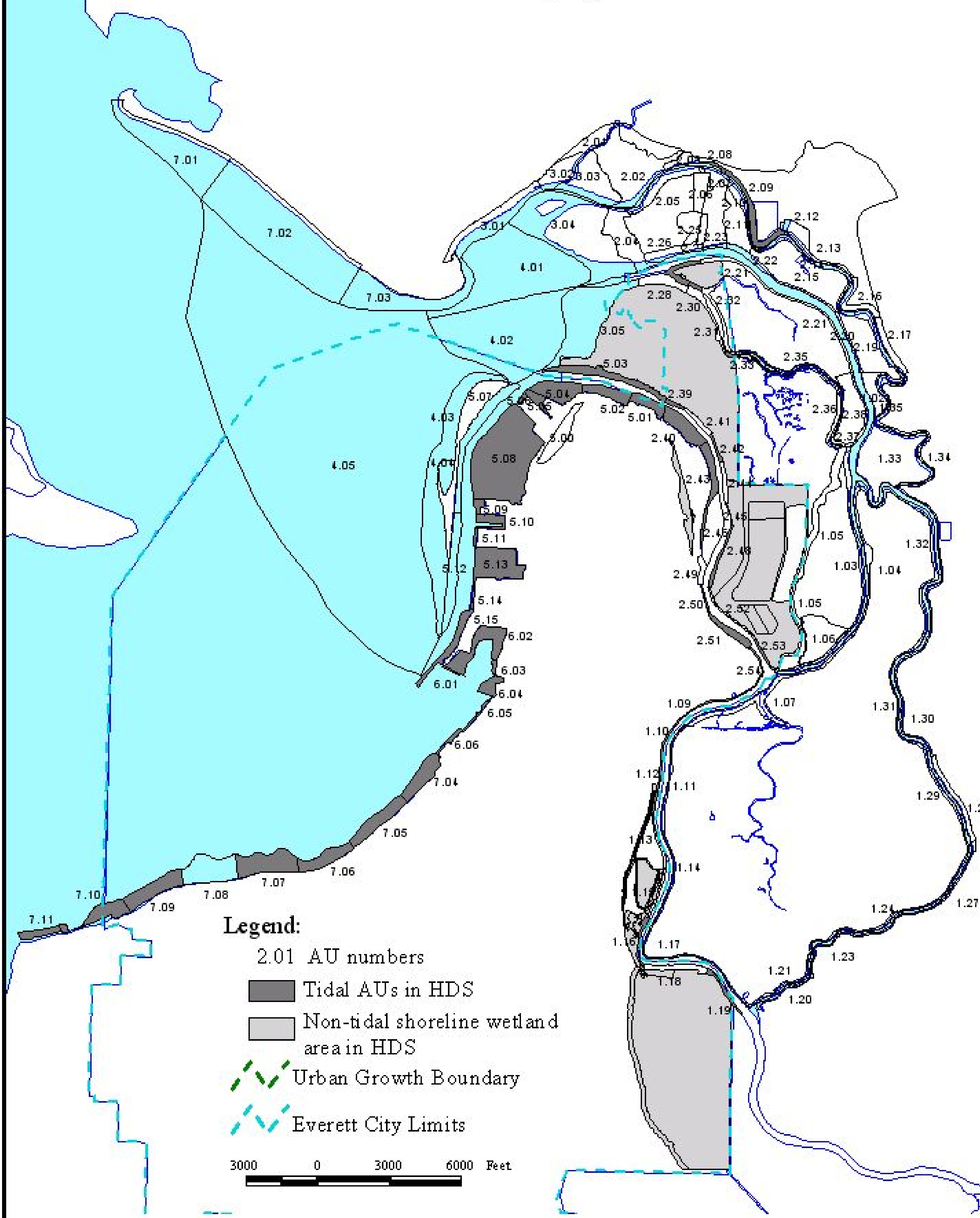
For purposes of the HDS, areas where shoreline and flood-plain development may occur within the SEWIP planning area were defined initially to include all AUs contained within the combined (Everett and Mukilteo) UGA (Figure 4.11), and an area outside the City of Everett UGA at Marshlands (AU 1.19). This potential development area, comprising 68 AUs, was modified to define the HDS by excluding from high-intensity development those AUs scoring in the top quartile of all AUs within the combined UGA. Additionally, AUs bordering Jetty Island (AUs 4.03, 5.07, and 5.12) were excluded from the HDS, as was the Maulsby Marsh (AU 5.00), because they have existing land uses, land-use designations, or logistical constraints that preclude development. This resulted in exclusion from the HDS of 21 AUs representing about 76 percent of the salmon habitat area and about 93 percent of the salmon habitat function within the UGA (Table 4.2). In total, these areas excluded from the HDS have been identified as having medium to high-quality salmonid habitat (Figure 4.3), and many of these AUs have previously been designated for shoreline use as Urban Conservancy.

In considering the maximum HDS, it was assumed that limited land uses (e.g., public access, habitat enhancement) might be permitted in AUs within the UGA which are excluded from the HDS, but that existing habitat area and functions (IVA-acres) for salmonids in these AUs would not be diminished compared to current (baseline) conditions. The remaining AUs considered in deriving the HDS comprised 46 AUs, containing 939 acres and 13,384 IVA-acres of salmonid habitat (Table 4.2; Figure 4.12). These AUs include about 11 percent of the total tidal habitat area (acres) in the SEWIP planning area but only about 2.6 percent of the salmon functional habitat (IVA-acres; Table 4.2). The HDS was developed from within only a portion of these AU, based on consideration of salmonid habitat conditions and functions only. Other land-use and resource issues will be used by the City of Everett in arriving at appropriate shoreline classifications within the City's Shoreline Master Program revisions (City of Everett 2000).

4.6 POTENTIAL DEVELOPMENT IMPACTS FROM THE HYPOTHETICAL DEVELOPMENT SCENARIO

The HDS assumes that land uses causing impacts to salmonid habitat are allowed, consistent with the City's Shoreline Master Program and the compensatory mitigation policies provided in

Figure 4.12 Tidal AU and flood-plain areas considered in developing the HDS.



Chapter 5. The proposed Master Program designates shoreline uses within the City of Everett UGA boundary (Draft City of Everett Shoreline Master Program 2000). To conservatively determine potential impacts to shoreline and palustrine wetlands that would result from the HDS, we assumed worst-case scenarios for the potential future development of those AUs within each shoreline land-use designation (Table 4.3A and Table 4.3B). Some of the AUs shown in Figure 4.12 do not appear likely to undergo development, despite their location within the UGA; for example, no development was assumed in AUs between the Pigeon Creek No. 1 delta (AU 7.04) and the Mukilteo tank farm (AU 7.10). Worst-case future development impacts to other shoreline areas are expected to arise from dredging and filling of nearshore or mudflat areas, hardening of littoral habitats, loss of marsh area below OHW, and loss of riparian areas (Table 4.3). In other cases, sites within AUs are scheduled to be developed pending regulatory approval, and impacts can be calculated based on actual development plans. Generally, impacts from development were assumed to reduce AU IVA scores and may reduce total AU area.

Impacts assumed to result from full development of lands under the HDS may include the following:

Tidal Habitat Impacts. Tidal habitat impacts that would result from full development of the HDS were evaluated using the Tidal Habitat Model. We evaluated potential impacts at locations in 10 AUs, and estimated potential full buildout at these locations, based on assumptions of the types of development that could occur (Table 4.3A). These impacts would reduce littoral area (as shown in Figure 4.13) and would be accompanied by a reduction in IVA score within these individual AUs. These impact assumptions are consistent with the types of development allowed within each shoreline land-use designation. The expected loss in littoral habitat acreage would be approximately 226 acres (Table 4.3A). (Note that approximately half of this loss of littoral area would be due to dredging that increased depths to greater than -10 ft MLLW, and thus would not be a loss of aquatic habitat or Waters of the State.) The expected loss in IVA-acres would be 4,942.

Isolated Palustrine Wetland Impacts. The HDS also considers potential development in nontidal areas within the Snohomish flood plain (lightly shaded areas on Figure 4.12). Isolated nontidal palustrine wetlands within diked areas may be filled or altered by development under the HDS. Alternatively, palustrine wetlands may be converted by tidal inundation where mitigation/restoration occurs to benefit anadromous salmonids. However, the Tidal Habitat Model does not calculate impacts and loss of function to isolated palustrine wetlands, which currently are not accessible to salmonids. Thus, loss of palustrine wetland function and area that would result from the hypothetical full buildout scenario, and the compensatory mitigation for this loss, was based on loss of area. Because the goals and objectives of estuarine restoration are to increase tidal habitat for anadromous salmonids, the policy preference (see Section 5, Policy P.4) is to mitigate the loss of palustrine wetlands with tidal habitat, especially where tidal inundation occurred historically. Thus, we assumed acre-for-acre replacement of lost palustrine wetlands by full buildout and an average 0.3-acre mitigation ratio for wetlands lost to tidal wetland conversion (Policy P.16).

To estimate the potential loss in acres of nontidal palustrine wetlands under the HDS, we identified those Wetland Complex Areas (WCAs) (from the original SEWIP, City of Everett et al. 1997) contained under the HDS, but excluded those WCAs that were immediately adjacent to tidally influenced areas (Figure 4.13). These areas, we assumed, have been captured in the Salmon Overlay AUs and have been evaluated previously with the Tidal Habitat Model. To conservatively estimate the wetland acreage contained within each WCA, we used the higher percentage of either seasonal or permanent open water observed within the WCA as scored in the SEWIP (City of Everett et al. 1997) Vegetated Complex IVA model. Because this wetland indicator was scored by category (e.g., 10 to 25 percent seasonal/permanent open water), we conservatively used the highest value of each category to represent wetland coverage within each WCA (Appendix Table 4.3B).

Next, we screened each WCA with the City of Everett Draft Shoreline Master Program Land Use Designations to estimate the level of impact and the loss of wetland acreage (Table 4.4). We assumed 100 percent of all wetlands in Urban Mixed-Use Industrial shoreline areas would be filled or lost due to full long-term buildout. In Urban Conservancy shoreline areas, we estimated palustrine wetland losses in each WCA on a case-by-case basis. For example, we estimated no losses would occur at Ferry Baker Island and Maulsby Swamp (areas removed from development under the HDS). In the Marshlands area, we assumed 50 percent of all wetlands would be lost to flood-plain development. In the WCA surrounding the Simpson Lee property, we assumed 25 percent of all palustrine wetlands would be lost or altered through redevelopment of roads, trails, railroad modification, and construction activities. In Urban Maritime shoreline areas we

Table 4.3A Potential development impact assumptions and calculations by AU (loss of tidal habitat and resulting mitigation IVA-acre debits).

	Existing Conditions				Postdevelopment Conditions				
AU	AU IVA Score	AU Acres	IVA Acres	Impact Acre Loss	AU Acres	IVA Score	IVA Acres	Mitigation Debit, IVA-Acres	Impact Assumptions
5.08	19.4	226.5	4,392.6	150.0	74.6	19.3	1,440.2	2,952.4	Fill and/or dredge 150 acres; 50% low slope shore; marsh fringe
2.28	64.0	19.9	1,273.0	7.0	12.9	18.8	242.0	1,031.0	Dredging for water dep. uses; dock <24 ft wide, loss of riparian
7.10	13.0	31.8	413.4	16.6	15.3	5.0	76.3	337.2	Dredging for marina, loss of shoreline area to riprap/bulkheads
5.04	11.2	37.6	420.8	21.1	16.5	9.5	156.9	263.8	Approximately 80% fill; 24 ft pier; mod. slope; marsh fringe
5.05	17.4	9.4	163.9	7.6	1.9	17.5	32.9	131.0	Approximately 80% fill; mod. slope; marsh fringe
5.10	6.7	14.6	96.9	11.9	2.7	5.9	15.8	81.2	Dredge all mudflat; construct marina, retain fringe habitats
7.04	13.4	34.3	460.6	6.0	28.3	13.4	380.5	80.1	Assume 6-acre fill, maintain shoreline conditions as is
5.01	10.0	16.9	168.8	1.2	15.7	8.2	128.8	40.0	Partial fill of remaining nonbulkhead area
6.04	4.2	13.1	54.5	2.0	11.0	3.5	38.6	15.9	Assume fill of Foss, slip even with existing modified shoreline
6.06	2.0	7.2	14.7	2.4	4.8	1.2	5.8	8.9	Fill across new marginal wharf, reduce littoral are <30 ft MLLW
Total		411.2	7,459.2	225.7	183.7		2,517.7	4,941.5	

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Table 4.3B **Wetland complex areas potentially affected by the Hypothetical Development Scenario (complexes as identified in the original SEWIP, City of Everett et al. 1997).**

Table 4.3B

Wetland Complex Number	Total Acres	Percent Wetland Category	Estimated Wetland Acres	Shoreline Land-Use Designation	Estimated Wetland Loss by Shoreline Designation (%)	Estimated Wetland Loss (acres)
29	48.03	25	12.01	Municipal Water Quality	100	12.01
52	29.31	75	21.98	Municipal Water Quality	100	21.98
54	7.09	25	1.77	Municipal Water Quality	100	1.77
55	75.61	75	56.71	Municipal Water Quality	100	56.71
33	41.11	75	30.83	Municipal Water Quality (Mitigation)	100	0.00
45	31.26	25	7.82	Municipal Water Quality (Mitigation)	100	0.00
46	22.40	25	5.60	Municipal Water Quality (Mitigation)	100	0.00
254	13.21	25	3.30	Urban Conservancy-Ferry Baker	0	0.00
255	2.25	10	0.23	Urban Conservancy-Ferry Baker	0	0.00
256	13.10	10	1.31	Urban Conservancy-Ferry Baker	0	0.00
282	5.95	0	0.00	Urban Conservancy-Ferry Baker	0	0.00
48	4.68	25	1.17	Urban Conservancy-Langus Park	25	0.29
49	2.50	75	1.88	Urban Conservancy-Langus Park	25	0.47
50	26.27	75	19.70	Urban Conservancy-Langus Park	25	4.93
51	1.54	25	0.39	Urban Conservancy-Langus Park	25	0.10
198	64.53	10	6.45	Urban Conservancy-Marshlands East	50	3.23
202	11.25	10	1.13	Urban Conservancy-Marshlands East	50	0.56
204	13.59	10	1.36	Urban Conservancy-Marshlands East	50	0.68
262	3.92	10	0.39	Urban Conservancy-Marshlands East	50	0.20
263	11.47	10	1.15	Urban Conservancy-Marshlands East	50	0.57
264	60.17	25	15.04	Urban Conservancy-Marshlands East	50	7.52
265	91.60	75	68.70	Urban Conservancy-Marshlands East	50	34.35
196	26.63	0	0.00	Urban Conservancy-Marshlands East	50	0.00
200	24.27	10	2.43	Urban Conservancy-Marshlands East	50	1.21
193	71.06	75	53.30	Urban Conservancy-Marshlands West	50	26.65
194	10.64	75	7.98	Urban Conservancy-Marshlands West	50	3.99
195	22.92	10	2.29	Urban Conservancy-Marshlands West	50	1.15
192	13.63	10	1.36	Urban Conservancy-Marshlands West	50	0.68
318	1.34	75	1.01	Urban Conservancy-Marshlands West	50	0.50
320	7.01	10	0.70	Urban Conservancy-Marshlands West	50	0.35
322	102.54	10	10.25	Urban Conservancy-Marshlands West	50	5.13
324	12.25	10	1.23	Urban Conservancy-Marshlands West	50	0.61
329	22.27	10	2.23	Urban Conservancy-Marshlands West	50	1.11
203	17.55	10	1.76	Urban Conservancy-Marshlands West	50	0.88
205	11.03	10	1.10	Urban Conservancy-Marshlands West	50	0.55
207	10.06	25	2.52	Urban Conservancy-Marshlands West	50	1.26
209	9.29	10	0.93	Urban Conservancy-Marshlands West	50	0.46
319	1.64	75	1.23	Urban Conservancy-Marshlands West	50	0.62
321	7.15	10	0.72	Urban Conservancy-Marshlands West	50	0.36
323	23.67	10	2.37	Urban Conservancy-Marshlands West	50	1.18
325	9.53	25	2.38	Urban Conservancy-Marshlands West	50	1.19
330	11.73	10	1.17	Urban Conservancy-Marshlands West	50	0.59
201	28.32	10	2.83	Urban Conservancy-Marshlands West	50	1.42
197	34.18	10	3.42	Urban Conservancy-Marshlands West	50	1.71

Table 4.3B **Wetland complex areas potentially affected by the Hypothetical Development Scenario (complexes as identified in the original SEWIP, City of Everett et al. 1997).**

Table 4.3B

Wetland Complex Number	Total Acres	Percent Wetland Category	Estimated Wetland Acres	Shoreline Land-Use Designation	Estimated Wetland Loss by Shoreline Designation (%)	Estimated Wetland Loss (acres)
						continued
199	65.58	25	16.40	Urban Conservancy-Marshlands West	50	8.20
316	18.45	25	4.61	Urban Conservancy-Maulsby Marsh	0	0.00
308	20.72	25	5.18	Urban Conservancy-Simpson Lee	25	1.30
310	4.38	0	0.00	Urban Conservancy-Simpson Lee	25	0.00
311	35.11	75	26.33	Urban Conservancy-Simpson Lee	0	0.00
312	8.18	25	2.05	Urban Conservancy-Simpson Lee	25	0.51
307	23.06	75	17.30	Urban Conservancy-Simpson Lee	0	0.00
317	31.27	75	23.45	Urban Industrial	100	23.45
162	0.60	25	0.15	Urban Maritime	100	0.15
3	6.82	25	1.71	Urban Mixed Use Industrial	100	1.71
1	5.11	10	0.51	Urban Mixed Use Industrial	100	0.51
24	31.99	10	3.20	Urban Mixed Use Industrial	100	3.20
25	5.20	25	1.30	Urban Mixed Use Industrial	100	1.30
26	9.10	10	0.91	Urban Mixed Use Industrial	100	0.91
27	5.95	75	4.46	Urban Mixed Use Industrial	100	4.46
28	19.15	10	1.92	Urban Mixed Use Industrial	100	1.92
30	11.35	10	1.14	Urban Mixed Use Industrial	100	1.14
159	1.26	10	0.13	Urban Mixed Use Industrial	100	0.13
160	0.69	10	0.07	Urban Mixed Use Industrial	100	0.07
267	3.37	10	0.34	Urban Mixed Use Industrial	100	0.34
291	4.98	10	0.50	Urban Mixed Use Industrial	100	0.50
23	12.70	25	3.18	Urban Mixed Use Industrial	100	3.18
13	10.00	10	1.00	Urban Mixed Use Industrial	100	1.00
15	29.06	0	0.00	Urban Mixed Use Industrial	100	0.00
16	14.15	0	0.00	Urban Mixed Use Industrial	100	0.00
17	9.11	0	0.00	Urban Mixed Use Industrial	100	0.00
21	11.87	25	2.97	Urban Mixed Use Industrial	100	2.97
23.1	11.97	0	0.00	Urban Mixed Use Industrial	100	0.00
2	5.22	10	0.52	Urban Mixed Use Industrial	100	0.52
5	2.03	25	0.51	Urban Mixed Use Industrial	100	0.51
4	18.77	25	4.69	Urban Mixed Use Industrial	100	4.69
6	2.09	0	0.00	Urban Mixed Use Industrial	100	0.00
7	2.41	10	0.24	Urban Mixed Use Industrial	100	0.24
8	20.03	75	15.02	Urban Mixed Use Industrial	100	15.02
9	9.45	10	0.95	Urban Mixed Use Industrial	100	0.95
10	5.98	75	4.49	Urban Mixed Use Industrial	100	4.49
11	17.33	25	4.33	Urban Mixed Use Industrial	100	4.33
12	5.04	25	1.26	Urban Mixed Use Industrial	100	1.26
14	34.77	25	8.69	Urban Mixed Use Industrial	100	8.69
20	23.20	25	5.80	Urban Mixed Use Industrial	100	5.80
22	13.24	10	1.32	Urban Mixed Use Industrial	100	1.32
269	2.77	10	0.28	Urban Mixed Use Industrial	100	0.28
270	4.21	75	3.16	Urban Mixed Use Industrial	100	3.16
271	0.88	75	0.66	Urban Mixed Use Industrial	100	0.66

Table 4.3B **Wetland complex areas potentially affected by the Hypothetical Development Scenario (complexes as identified in the original SEWIP, City of Everett et al. 1997).**

Table 4.3B

Wetland Complex Number	Total Acres	Percent Wetland Category	Estimated Wetland Acres	Shoreline Land-Use Designation	Estimated Wetland Loss by Shoreline Designation (%)	Estimated Wetland Loss (acres)
Totals	1638.15		532.79			305.79

SEWIP Complex Numbers

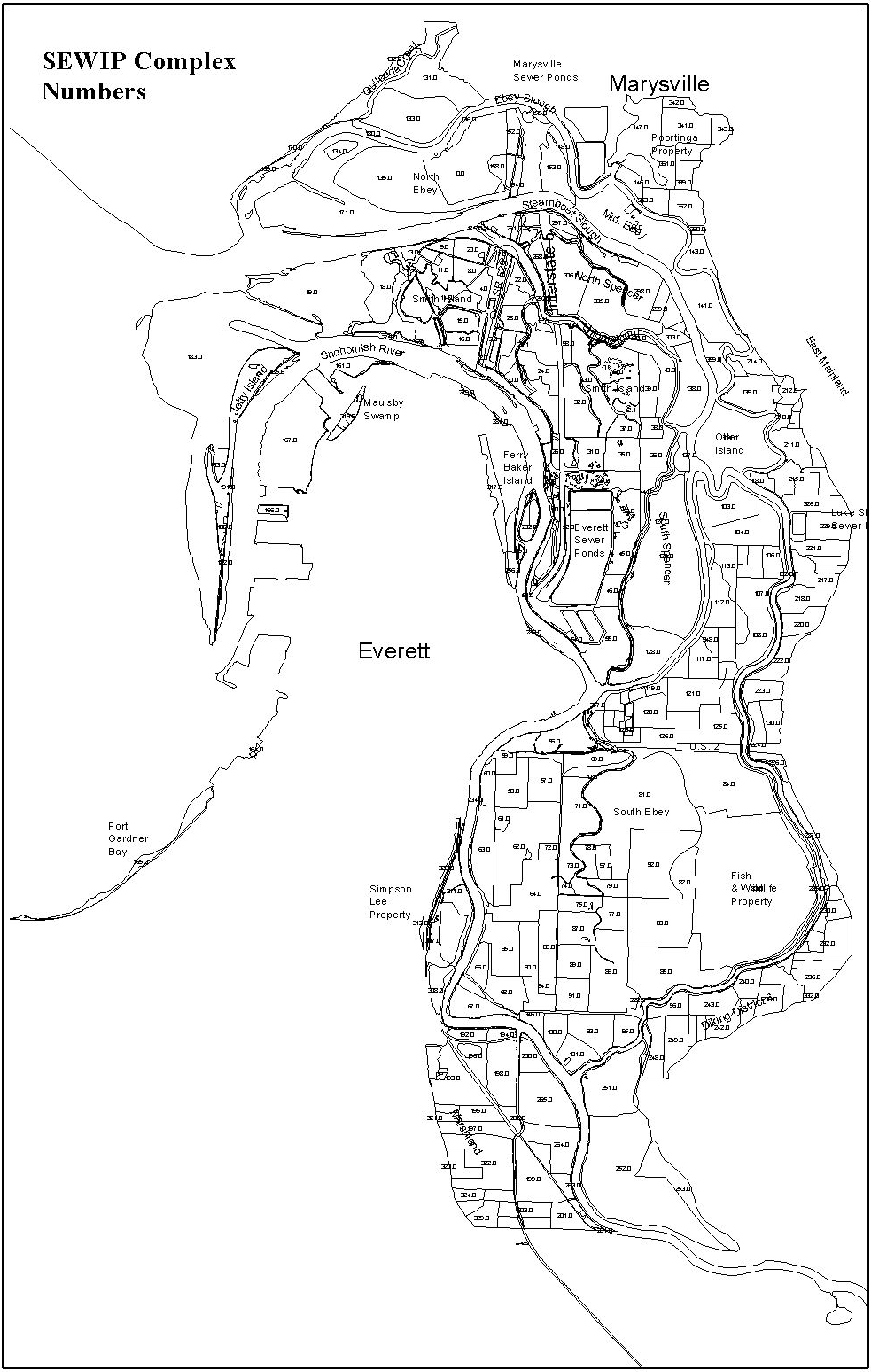

Figure 4.13 Potential development impacts to tidal and isolated wetland areas under the HDS.

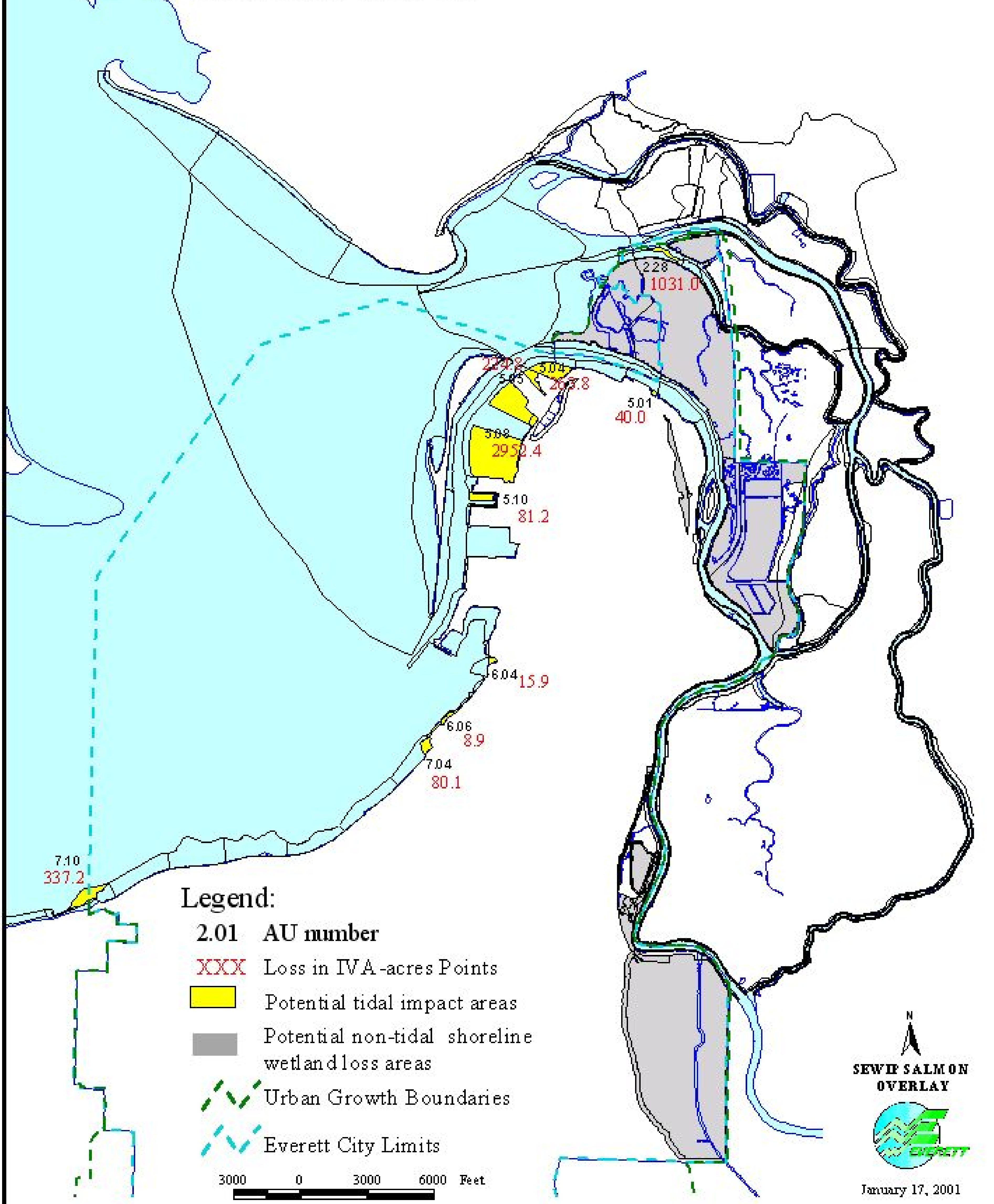

Table 4.4 City of Everett proposed Shoreline Master Program land-use designations, typical development, future impact assumptions, and the estimate of palustrine wetland losses based on these buildout assumptions.

Draft Shoreline Designations	Typical Development (draft Shoreline Master Program descriptions)	Impact Assumptions	Percent Wetland Loss	Estimated Isolated Palustrine Wetland Loss (acres)
Urban Deep Water Port	Water-dependent marine commerce, heavy industry, military use, and supporting activities	Dredging or fill of inwater areas less than 25 ft MLLW	100	0
Urban Maritime	Working waterfront, water-oriented commercial uses, public access, recreational uses, and supporting activities	Dredging or fill of inwater areas less than 11 ft MLLW, loss of palustrine wetlands and riparian habitats	100	0.15 (does not include mudflats)
Urban Industrial	Heavy manufacturing, heavy industry, water-dependent-related uses	Filling, dredging, bulkheading, loss of riparian habitats at navigation channel, riparian rehabilitation otherwise	100	23.5
Urban Mixed-Use Industrial	Economic development (especially adjacent to Snohomish River) and environmental restoration	Filling, dredging, bulkheading, loss of riparian habitats at navigation channel, restoration otherwise	100	75.2
Urban Multi-Use	Water-oriented public and commercial activities, recreational and residential uses, protection and restoration of ecology	Redevelopment of industrial areas, commerce, public access, riparian buffer enhancement	NA	0
Urban Conservancy	Public access and recreation, protection and rehabilitation of ecological resources, protection of steep slopes, agriculture	Public access and recreational opportunities, low-intensity agriculture, residences, and recreation	Variable	114.5
Municipal – Water Quality	Operation, maintenance, and expansion of the City's water pollution control facility, protection of public health, public access	Construction of overbuilt dike, trail maintenance or expansion	100	92.5
Aquatic	Preservation, restoration of natural resources; navigation, recreation, and commerce	Public access, overwater structures, limited dredging and filling	NA	NA

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Table 4.5 Potential mitigation/restoration sites and estimates of maximum and minimum IVA-acre credits under mitigation or restoration scenarios. Mitigation values are lightly shaded.

		Acreage			Potential IVA Scores		Restoration Potential			Mitigation Potential		
Site[1]	Restoration Site	Potential New	Setback Levee	Converted Wetlands	Min.	Max.	Acres[2]	Min. IVA-acres	Max. IVA-acres	Acres[3]	Min. IVA-acres	Max. IVA acres
Inside UGA												
7	Marshlands 1	368.7	14.3	29.0	32.2	85.2	354.4	11,412	30,196	325.4	10,479	27,727
9	Ferry Baker Island	5.6	- -	- -	127.5	127.5	5.6	714	714	- -	- -	- -
11	Simpson Lee Cat. I #311	35.0	- -	- -	30.2	73.8	35.0	1,057	2,583	- -	- -	- -
12	Smith Island Delta Front	154.0	10.9	4.6	36.7	77.6	143.1	5,252	11,105	138.5	5,082	10,746
14	Marshlands 2	502.3	26.0	35.2	28.1	59.6	476.3	13,383	28,385	441.1	12,395	26,289
18	Langus Park #50	26.3	- -	- -	27.7	63.7	26.3	729	1,675	- -	- -	- -
21	N. Smith Is., Union Slough	16.9	4.2	0.5	27.7	75.5	12.7	456	1,065	12.2	442	1,027
22	SR 529 Spencer	6.8	2.9	0.4	51.8	77.6	3.9	335	434	3.5	315	404
23	Smith Slough, Smith Island	17.0	10.3	3.3	39.8	79.7	6.7	267	534	3.4	135	271
24	Upper Union Slough	82.0	0.0	11.5	28.2	52.0	82.0	2,311	4,262	70.5	1,988	3,665
	Subtotal	1,214.6	68.7	84.4			1,145.9	35,915	80,952	994.6	30,836	70,128
Outside UGA												
1	North Tip, S. Ebey Island	423.1	5.0	20.9	66.2	103.7	418.0	29,088	44,764	397.2	27,706	42,600
2	Biringer Farm	347.3	7.6	13.6	32.1	85.0	339.8	11,626	29,600	326.2	11,191	28,448
3	Mid-Smith Island	499.1	15.1	37.7	31.0	75.5	484.0	15,448	36,985	446.3	14,279	34,138
4	S. Spencer Island WDFW	297.1	0.0	14.7	79.7	124.2	297.1	23,678	36,899	282.4	22,510	35,079
5	Poortinga Property	378.0	23.5	19.6	25.2	67.2	354.5	9,305	24,194	334.9	8,811	22,876
6	S. Ebey Island, SW Tip	44.3	- -	- -	25.6	32.8	44.3	1,134	1,453	- -	- -	- -
10	Deadwater Slough	655.4	34.4	32.6	29.8	58.0	620.9	18,504	36,015	588.3	17,531	34,122
8	Swan Slough	61.6	- -	- -	61.3	78.8	61.6	3,777	4,851	- -	- -	- -
15	Sunnyside South	341.4	20.2	43.0	32.1	85.0	321.2	10,911	27,903	278.2	9,531	24,250
13	Sunnyside North	196.5	14.3	13.3	35.0	81.6	182.3	6,527	15,020	169.0	6,062	13,937
16	Nyman Farm	50.0	0.0	4.2	94.8	127.3	50.0	5,857	7,483	45.9	5,463	6,954
17	S. Ebey Island, NW Corner	146.9	- -	- -	27.3	40.3	146.9	4,010	5,913	- -	- -	- -
19	S. Ebey Island, NE Corner	182.2	- -	- -	25.6	70.4	182.2	4,667	12,816	- -	- -	- -
20	Diking District 6	231.9	6.7	45.3	33.1	70.0	225.2	7,649	15,958	179.9	6,150	12,788
25	S. Ebey Island WDFW	532.0	15.1	39.9	62.1	62.1	516.8	32,801	32,801	476.9	30,323	30,323
	Subtotal	4,386.8	142.0	284.6			4,244.8	184,983	332,656	3,525.2	159,559	285,515
Totals		5,601		369			5,391	220,898	413,608			

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1 Site number corresponds with Figures 4.14 and 4.16. Numbers indicate ranking per Table 6.2.

2 Balance in acreage is calculated from GIS areal values less estimated setback levee footprint.

3 Balance in acreage is calculated from GIS areal values less estimated setback levee footprint and converted palustrine wetlands (Policy P.1).

- - indicates site was not included in mitigation use scenario.

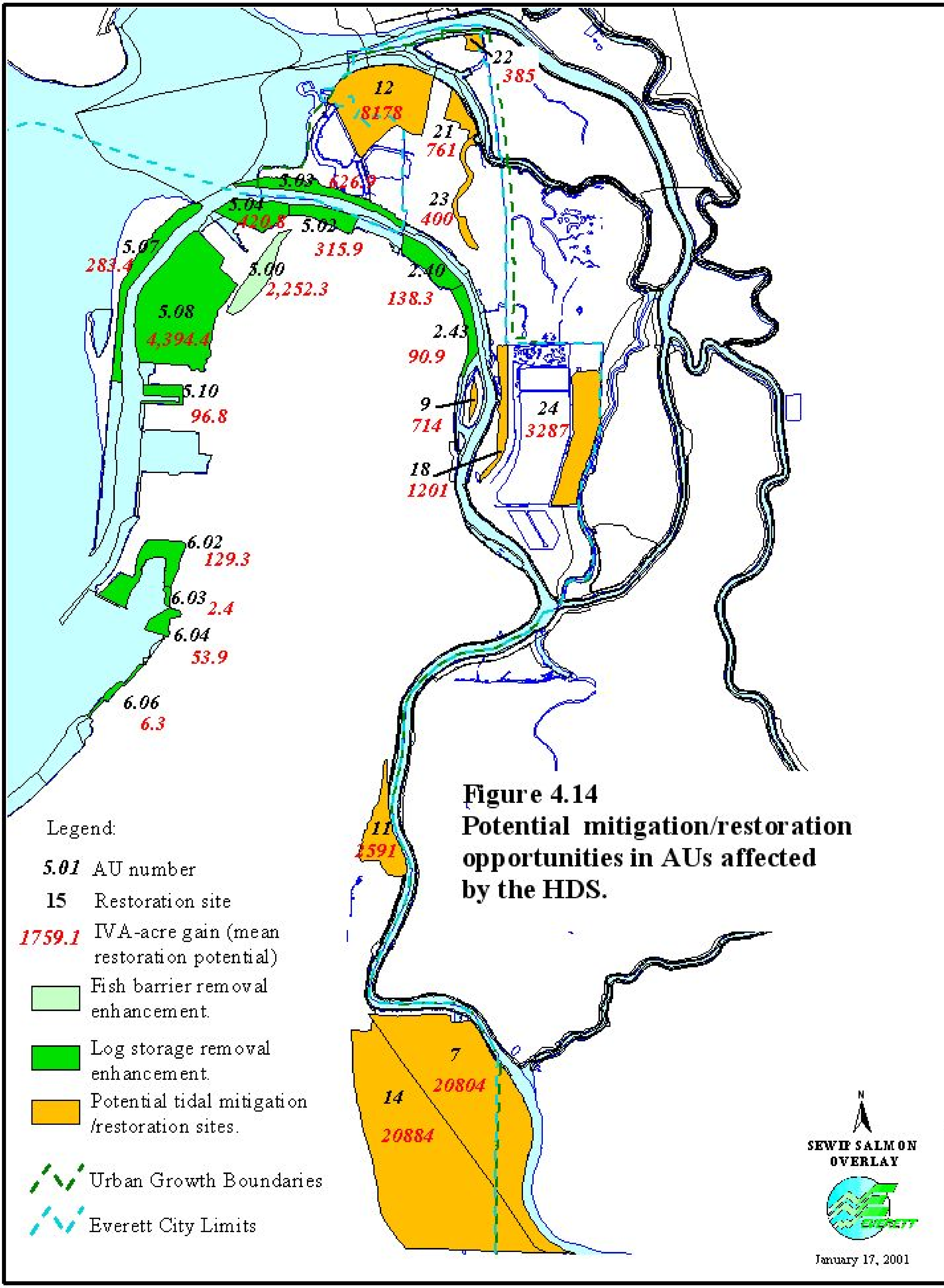
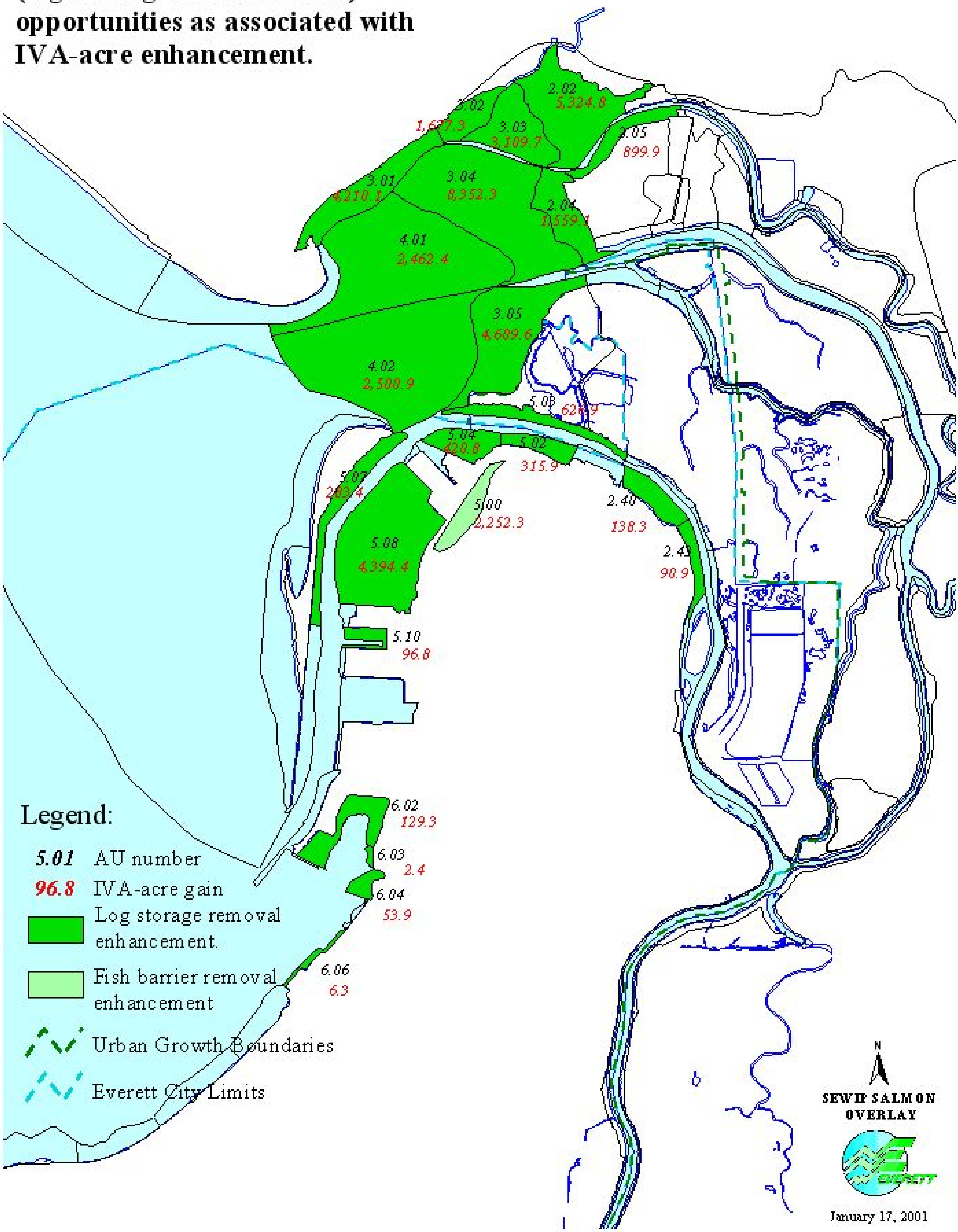


Figure 4.14
Potential mitigation/restoration opportunities in AUs affected by the HDS.

Figure 4.15 Potential stressor removal (log rafting and fish access) opportunities as associated with IVA-acre enhancement.



assumed 100 percent of palustrine wetland areas would be lost. This excludes losses of mudflat area and habitat function, which were evaluated using the Tidal Habitat Model (see above). In Municipal/Water Quality shoreline areas we assumed 100 percent of all wetlands would be lost to City of Everett Water Pollution Control Facility maintenance, future expansion, trail expansion, and future overbuilt dike construction. Additionally, we assumed that remaining palustrine wetlands east of the City sewer ponds will be altered by mitigation/restoration projects (see Section 4.7).

Based on these assumptions, total estimated loss (from development activities only) of isolated palustrine wetlands in the City of Everett UGA would be 306 acres (Appendix Table E.3). These areas have no direct present function as habitat for salmonids; however, this loss of acreage would need to be mitigated, preferably through tidal restoration (see Section 5, Policy P.4), on an acre-for-acre basis. This compensatory mitigation requirement was thus subtracted from the balance of mitigation credits (acres) at potential mitigation sites (acres and IVA-acres) identified in the following section. This acreage total does not include potential wetland areas converted to tidal inundation for mitigation credit (Section 4.7).

Loss of Restoration Opportunity. The loss of restoration opportunity represents the foreclosure of potential future restoration where impacts will occur if AUs considered under the HDS are developed. To calculate these impacts, the Tidal Habitat Model was used to score habitat indicators that could be realistically restored within the AU in the absence of development. These include tidal restoration, enhancement or establishment of vegetated riparian buffers, and removal of stressors (log raft storage, access restrictions) (Figures 4.14 and 4.15; Table 4.5). Note that some of these restoration options would not necessarily be foreclosed, and might be stimulated by some forms of redevelopment in the HDS. For example, the City of Everett typically requires buffer enhancement along redeveloped shorelines. The model was also used to score the increase in habitat area and ecological function that could be gained if tidal action were restored to certain AUs and to adjacent lowlands behind existing dikes. The potential increase in function (IVA points per acre) that would be gained by each of these restoration actions is shown in Figures 4.14 and 4.15 and tabulated in Tables 4.5 through 4.7. These scores represent potential increases in function that would be lost, in part, under the hypothetical full buildout scenario.

4.7 POTENTIAL COMPENSATORY MITIGATION/RESTORATION OPPORTUNITIES IN THE SNOHOMISH RIVER ESTUARY

Snohomish River Estuary compensatory mitigation/restoration opportunities fall under three main headings: tidal restoration, stressor removal, and riparian buffer enhancement. Only tidal restoration projects (compensatory mitigation or restoration) will contribute to the mitigation of lost acreage or can increase net salmon habitat acreage within the estuary. Riparian buffer enhancement and stressor removal can potentially improve habitat functions and therefore increase IVA-acre points or credits within individual AUs.

Tidal restoration will primarily occur, and has occurred in the estuary, by breaching dikes or levees. Areas behind dikes arguably have little or no present value to juvenile or adult salmon using the estuary, except where a habitat process, such as the recruitment of LWD, still occurs. The Tidal Habitat Model structure dictates in all cases that these areas behind dikes score 0 IVA points. With the restoration of tidal influence over a site, the habitat can immediately be scored with the model. The IVA scores we calculated for individual projects conservatively represent habitat restoration potential and IVA-acre credits that could be expected to be built into the project (e.g., tidal channels) or to develop within 5 years following construction (e.g., riparian marsh vegetation). Substantial additional benefits could be expected to accrue over the longer term through additional marsh development, improvements to riparian areas, and development of LWD recruitment potential.

Twenty-five potential tidal restoration sites were identified in the SEWIP study area (Figure 4.16). Fifteen of these sites have been previously described in the SEWIP plan (City of Everett et al. 1997) and by Haas and Collins (in press) for their restoration potential. Additional sites were identified as a result of the analyses in the previous sections and based on the personal knowledge of SSOTAC members. These sites do not represent the entire suite of sites where tidal restoration could occur in the estuary, nor do they imply an acceptance by the present landowner of that use. For example, WDFW has indicated that its present policy is to continue to manage Site 25 along Ebey Slough for its existing high values for waterfowl and wildlife. These potential restoration sites are prioritized following the restoration management goals and objectives in Chapter 6. Individual site plans and actions that support the restoration management goals and objectives are also described.

Table 4.6 **Assessment units with high potential for stressor removal and IVA-acre enhancement.**[1]

	Current IVA Score	Acres	IVA-acres	Restoration Action	Restoration IVA Score[2]	IVA-acre Enhancement	% IVA-acre Enhancement
AUs Considered Inside HDS							
5.00	28.3	34.1	965.3	improve access	94.3	2,252.2	233.3
5.08	19.4	226.5	4,392.6	log raft removal	38.8	4,394.4	100.0
5.03	13.3	38.5	513.0	log raft removal	29.6	626.9	122.2
5.04	11.2	37.6	420.8	log raft removal	22.4	420.8	100.0
5.02	13.2	23.9	315.9	log raft removal	26.4	315.9	100.0
2.40	9.9	32.7	322.9	log raft removal	14.1	138.3	42.8
6.02	2.7	47.7	129.2	log raft removal	5.4	129.3	100.0
5.10	6.7	14.6	96.9	log raft removal	13.3	96.8	99.9
2.43	10.2	20.8	212.2	log raft removal	14.6	90.9	42.9
6.04	4.2	13.1	54.5	log raft removal	8.3	53.9	98.9
6.06	2.0	7.2	14.7	log raft removal	2.9	6.3	42.7
6.03	2.1	2.7	5.6	log raft removal	3.0	2.4	42.7
Subtotal		499.3	7,443.6			8,528.3	114.6
AUs Considered Outside HDS							
3.04	71.5	274.1	19,603.8	log raft removal	102.0	8,352.3	42.6
2.02	62.7	144.5	9,066.5	log raft removal	99.6	5,324.8	58.7
3.05	51.7	151.9	7,848.7	log raft removal	82.0	4,609.6	58.7
3.01	39.3	87.6	3,441.8	log raft removal	87.4	4,210.1	122.3
3.03	66.0	79.8	5,265.1	log raft removal	105.0	3,109.7	59.1
4.02	15.4	378.9	5,835.4	log raft removal	22.0	2,500.9	42.9
4.01	17.5	328.3	5,745.6	log raft removal	25.0	2,462.4	42.9
3.02	101.9	38.0	3,869.3	log raft removal	146.0	1,677.3	43.3
2.04	57.4	63.4	3,638.0	log raft removal	82.0	1,559.1	42.9
2.05	45.4	33.8	1,532.3	log raft removal	72.0	899.9	58.7
5.07[3]	12.5	52.7	661.3	log raft removal	17.9	283.4	42.9
Subtotal		1,633.0	66,507.7			34,989.5	52.6
Total		2,132.3	73,951.4			43,517.8	58.8

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1 AUs are ordered by potential IVA-acre enhancement.

2 Where log transfer facilites are present, enhanced score includes cessation of both log transfer and storage.

3 Note that AU 5.07 is inside the UGA but not considered part of the HDS.

Table 4.7 Hypothetical development scenario potential riparian buffer enhancement and IVA-acre point credits.[1]

AU	Current IVA Score	Acres	IVA-acres	Enhanced IVA Score	Enhanced Acres[1]	IVA-acre Enhancement	% IVA-acre Enhancement
1.08	4.5	4.8	21.7	7.2	1.7	12.1	55.7
1.09	9.1	2.1	19.4	10.6	0.7	7.5	38.8
1.10	7.1	2.1	14.8	7.8	0.7	5.6	37.6
1.12	6.7	6.8	45.8	11.2	1.7	19.4	42.3
1.13	30.2	13.6	411.6	47.3	0.0	116.1	28.2
1.15	29.0	5.5	160.1	45.8	0.0	46.4	29.0
2.28	64.0	19.9	1,273.0	94.4	5.0	475.8	37.4
2.40	9.9	32.7	322.9	39.2	1.3	51.5	16.0
2.41	49.0	7.4	362.3	49.0	1.0	49.5	13.7
2.43	10.2	20.8	212.2	14.6	1.7	24.5	11.5
2.44	51.2	8.0	409.1	59.2	1.1	63.3	15.5
2.47	19.2	4.0	77.2	21.8	1.3	27.6	35.7
2.51	14.4	15.3	219.9	37.1	1.4	52.5	23.9
2.54	6.6	3.7	24.0	10.1	1.2	11.7	48.9
3.05	51.7	151.9	7,848.7	88.0	3.2	282.5	3.6
Totals			11,422.6		22.0	1,245.9	10.9

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1 Under the protocols used to define the upland boundary of each AU (Section 2.4), all areas would be increased by inclusion of a 25-ft-wide strip above ordinary high water where new riparian vegetation is provided.

Stressors in the Tidal Habitat Model, such as log rafting, riprap, and vertical bulkheads, fractionally reduce present habitat quality in many AUs. Thus, IVA scores and IVA-acres are significantly reduced. Stressors that reflect hardened infrastructure (vertical bulkheads, overwater structures) may be difficult or too expensive to physically remove or alter because of adjacent land uses. Other stressors, like log rafting or restricted fish access to existing habitats are more easily physically removed and may therefore represent the most likely means of increasing habitat function in some AUs. The removal of stressors may not increase available habitat area for salmonids, but habitat quality and IVA scores can be increased nonetheless. In other words, stressor removal represents potential habitat quality enhancement in the form of IVA-acres, but not necessarily as net habitat area.

Riparian buffer enhancement may occur in certain shoreline areas (Urban Industrial, Urban Multi-Use) designated for redevelopment. In these areas, where water-dependent commercial activities will not occur, 50- to 100-ft buffers will be restored in areas largely devoid of riparian vegetation. This long-term enhancement could potentially increase the IVA score in many AUs that did not have all the possible riparian function indicators scored in the model. This type of enhancement would comprise less than 6 percent of all enhancement opportunities and would require a long time to achieve the predicted IVA-acre gains.

4.7.1 Inside the UGA

Tidal Restoration. Several tidal mitigation/restoration opportunities exist inside the Everett/Mukilteo UGA on North Spencer Island, Smith Island, along the mainstem, and in the Marshlands. These opportunities include the reconnection of historical tidal channels at Smith Slough and the tidal channel and marshes on the delta front of Smith Island. Dike breaching of other sites could occur on Union Slough, Steamboat Slough, the Snohomish River, and Marshlands (Figure 4.14). These sites were evaluated for the IVA-acres that would be gained (Table 4.5) if the sites were restored instead of being developed.

Two tidal restoration scenarios were considered:

- First, we looked at the total IVA-acres that could be provided in each site if the site were simply restored and not used as a mitigation site.

- Second, we considered the case in which certain sites would be used for compensatory mitigation. In this case, the loss of palustrine wetlands (caused by tidal conversion or dike placement at mitigation sites) must be compensated. The compensation policies (Section 5, Policy P.16) require that these lost and/or converted wetlands be mitigated with tidal area at ratios ranging from 0.7 to 1, to 0.1 to 1, depending on wetland type; we used an average replacement ratio of 0.3 to 1. We conservatively estimated this area to be 85.5 acres (0.3 acre for each of the 285 total converted wetland acres). Therefore, the potential IVA-acre scores for tidal mitigation sites (Table 4.5) reflect the acreage and IVA-acre credits available after on-site compensatory mitigation for these palustrine wetland losses. However, these potential losses would necessarily be evaluated during the project design phase and would likely differ from the estimates provided here.

We also scored each tidal restoration site under two scenarios based on the level of function (IVA points) that might be gained:

- The minimum potential IVA score (Table 4.5) assumes only that the dikes are breached. The new tidal site was then scored for having a channel (low sinuosity), only if a channel already exists behind the dike; in some cases the site was scored as having a restricted access where elevations were high and where no channel exists. Credit was given for minimal marsh fringe and was only given for riparian vegetation that already exists along what would be the riparian border of the newly flooded site. Sites restored in this fashion would score in the moderate to high range among existing tidal AUs.

- The maximum potential IVA score (Table 4.5) projects a condition of a site that is actively reconfigured and managed after a prolonged period (10+ years). It assumes that a sinuous or dendritic tidal channel would be constructed before dike breaching, that fish can reach all parts of the site, that elevations would be modified so that riparian marsh would develop rapidly, and, in some cases, that the riparian zone would be enhanced and, at some sites, that LWD recruitment could be provided. Sites restored in this fashion would score in the moderate to high range among existing tidal AU (Table 4.5).

Inside the UGA we considered 10 potential restoration sites, which contain approximately 1,215 acres of historically tidally influenced or flooded areas (Table 4.5). The total habitat

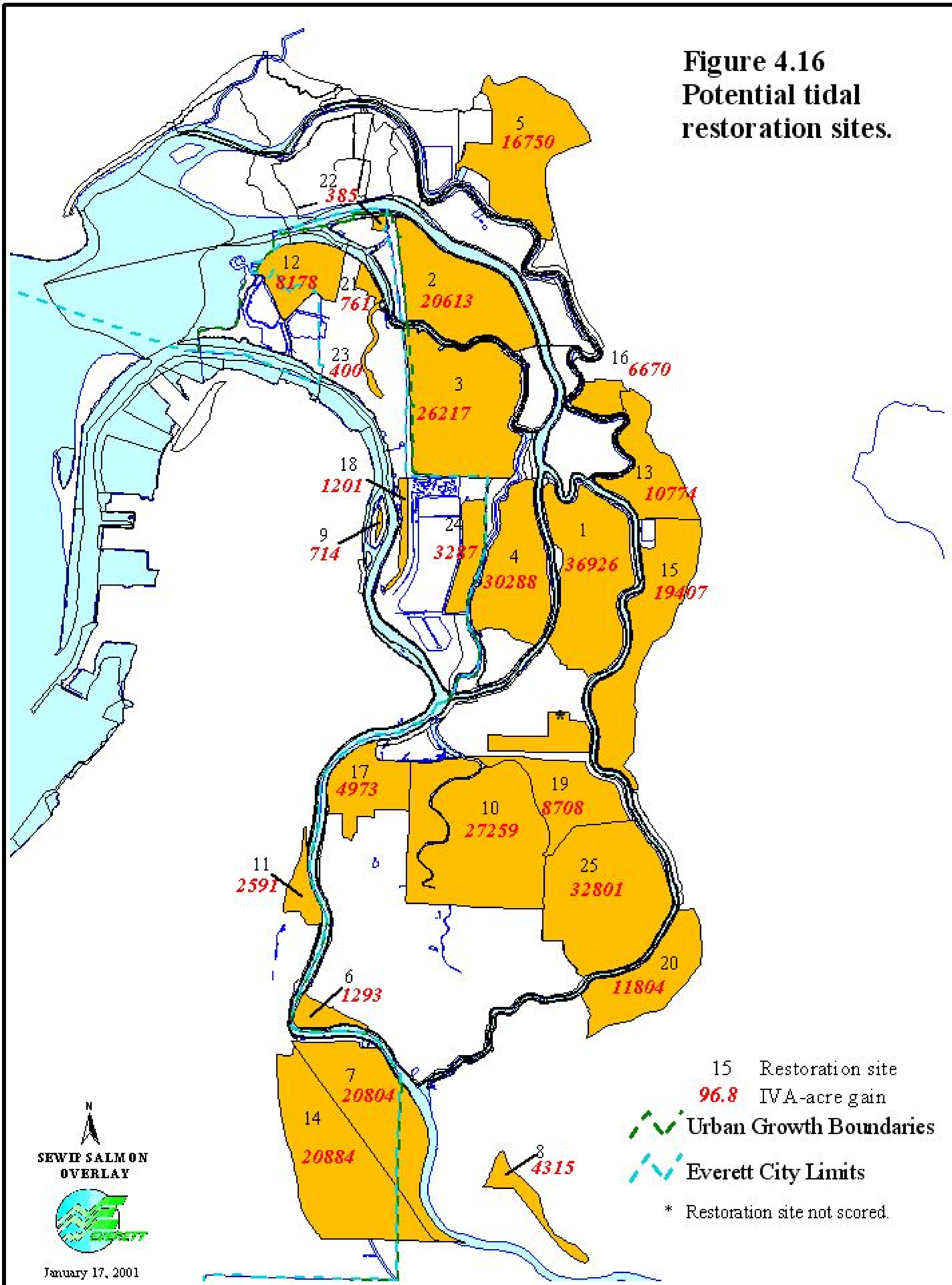

Figure 4.16 Potential tidal restoration sites.

mitigation potential is conservatively estimated to be 995 acres and 30,836 IVA-acres based on predicted restoration site habitat conditions (minimum scenario for elevation, riparian edge, tidal channels, marsh area; Table 4.5). This increase in IVA-acre points inside the HDS would represent a potential 15 percent increase in IVA-acre points within the composite UGA. The potential IVA-acre gain would be higher (up to 80,952 IVA-acre points; maximum scenario) if projects are conducted as restoration rather than compensatory mitigation (see Section 5, Policy P.3), and if projects achieve the maximum potential IVA score (Table 4.5). The actual acreage increase would be 25 percent above the total present salmonid habitat acreage in the composite UGA.

As noted above, these mitigation/restoration opportunities also represent the acreage (995 acres) and IVA-acres (minimum of 35,915 IVA-acres) where restoration might occur, that would be foreclosed, in the event of complete development within the UGA.

Stressor Removal. Log rafting impacts could be removed from 12 AUs in the estuary (Figure 4.15). The removal of these stressors represents a substantial increase in AU IVA scores that might be achieved in a minimum amount of time, and with no adverse effects (i.e., loss of palustrine wetlands, construction impacts, unanticipated impacts). However, alternative means of transporting and storing logs would need to be developed and implemented by the log handling industry. Development of these means would likely require construction of new shallow-draft (barge) berths elsewhere in the UGA. In AUs where log transfer facilities now operate, removal of these facilities was assumed to accompany cessation of log storage, thus changing the model scores for questions 26 and 34 (Appendix B). In addition to the removal of log rafting, the removal of the access barrier to Maulsby Marsh would potentially increase the IVA-acre point value of this AU by 2,546 points. The removal of these stressors in the 12 AUs represents an increase of 8,822 IVA-acre points (Table 4.6), although the potential IVA-acre points gained in the top four sites account for 65 percent of the total potential gain. No new or restored acreage would be gained.

Riparian Buffer Enhancement. The primary impediments to enhanced riparian buffers are conflicting shoreline land uses and the requirement to maintain the integrity of functioning dikes. Riverfront redevelopment will provide the opportunity to create riparian buffers, especially along the mainstem of the Snohomish River. Enhanced 50- to 100-ft buffers could run along the left bank of the Snohomish River from SR 529 south to Simpson Lee. Additionally, riparian buffer enhancement could occur (up to 200-ft buffers) on the north-facing side of Smith Island if setback levees were constructed. These riparian buffer enhancements represent potential increases of 1,246 IVA-acre points in these AUs, as habitat functions over the long term would be improved (Table 4.7). Actual area of tidal habitat as defined in Section 2.4 would be increased by 22 acres.

4.7.2 Outside the UGA

Tidal Restoration. Many potential tidal mitigation/restoration opportunities exist within the Snohomish River Estuary outside the UGA (Figure 4.16). These opportunities include the reconnection of historic tidal channels, the removal of dikes and levees, and the removal or reconfiguration of tide gates to create tidal mudflat or vegetated marsh areas. These sites are evaluated for their potential restored IVA score and IVA-acres that would result using the same four potential restoration scenarios covered in Section 4.7.1 (minimum and maximum IVA-acres, as mitigation and as restoration; Table 4.5).

Outside the UGA we considered 15 potential restoration sites, which could restore tidal hydrology to approximately 4,245 acres, providing up to 332,656 IVA-acres in the long-term (maximum) scenario, if all projects were constructed as restoration rather than as compensatory mitigation (Table 4.5). This maximum (optimally engineered and managed) scenario, including tidal restoration both inside and outside the UGA, over the long term, would result in an increase of 63 percent in the total salmonid habitat acreage in the estuary and an increase of 82 percent in the total IVA-acres in the estuary. These potential tidal restoration sites are ranked by their apparent suitability for restoration in Section 6.4.

Stressor Removal. Log rafting could be removed from 11 AUs not considered part of the HDS (Figure 4.15). The removal of these stressors represents the substantial increase in AU IVA score (up to 122 percent) that could be achieved in a minimum amount of time and with no adverse effects from the removal (i.e., construction impacts, dredge impacts, unanticipated impacts). However, as would be the case inside the UGA, alternative means of transporting and storing logs would need to be developed and implemented by the log handling industry. Again, new shallow-draft berths would likely be needed elsewhere in the HDS. In AUs where log transfer facilities now operate, removal of these facilities was again assumed to accompany cessation of log storage. The removal of these stressors in the 11 AUs represents an increase of 34,990 IVA-acres (Table 4.6). No new or restored acreage would be gained.

Riparian Buffer Enhancement. We did not evaluate or model the potential for riparian buffer enhancement outside the UGA. In most of these AUs, some riparian habitat within 25 ft of OHW already exists and will continue to improve in area and quality. Furthermore, these habitats are protected under local land-use ordinances and current land-use zoning would not allow for their impairment. However, there may be many individual opportunities to enhance riparian characteristics via nonregulatory projects.

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5.0 COMPENSATORY MITIGATION POLICIES AND PROCESS

5.1 GENERAL

SEWIP recognizes that a large proportion of tidal habitats that were once accessible to anadromous fish in the planning area was lost during the last century to urban, industrial, and agricultural uses (Section 3.1.2). SEWIP recognizes further that changing economic conditions (e.g., mill closures, reduced through-put of logs), implementation of environmental regulations (e.g., the Clean Water Act [CWA], the state Hydraulic Code), and natural and intentional breaching of some dikes have resulted in an overall trend of increasing habitat quality and area for salmonids in the estuary (Houghton et al. 1995). Even so, two anadromous salmonids have been listed as threatened with endangerment under the ESA. Nonetheless, to continue the trend toward increasing habitat area and quality for salmonids, compensatory mitigation policies recommended in SEWIP are designed to go beyond the heretofore-common goal of “no net loss” to require that a net gain in littoral habitat function (IVA-acres) for anadromous fish results from each permitted action. This will also ensure that the overall goals of restoration of salmonid habitat in the planning area (Section 6.1) are met.

The expected net gain in habitat function for salmonids will likely also provide a net gain in habitat function for certain other species (e.g., flatfish and shorebirds) but may degrade habitat for other species (e.g., waterfowl). However, other aquatic species were not directly evaluated with the Tidal Habitat Model. Also, the model does not address certain species of waterfowl, raptors, and other palustrine wetland species, existing habitat area and function that will be altered by conversion of currently nontidal areas back to their original tidal condition.

The recommended SEWIP mitigation policies endorse the concept of mitigation sequencing encompassed in CWA Section 404 (b)(1) and the state Hydraulic Code (WAC 220-110). Compensatory mitigation is only applied to offset unavoidable adverse impacts from water-dependent or water-related projects that have exhausted opportunities to avoid and minimize adverse impacts to tidal habitats.

The compensation policies described in this section are recommended for use in conjunction with the overall estuarine habitat restoration management plan set forth in Chapter 6. A development scenario has been derived (Section 4.5; Figure 4.12) that represents an assumed maximum development scenario in that portion of the SEWIP area within which the City of Everett, City of Mukilteo, City of Marysville, and Snohomish County GMA boundaries, shoreline master plans and land-use plans would allow development. Chapter 4 provides more detail on how the HDS was developed and how potential impacts were calculated based on appropriate levels of development, and identifies sites and actions that could be used as compensatory mitigation or for restoration. In Section 5.7, we calculate the mitigation that would be required for full buildout of that HDS.

5.2 APPLICABILITY

SEWIP recommends that these compensation policies be applied to any new development and redevelopment projects that meet the requirements of the SEWIP management plan (Chapter 6). Applicants filing for a permit will be required to follow current local, state, and federal permitting and habitat compensation policies and ESA requirements. However, it is recommended that permitting agencies approve use of the SEWIP model and policies to establish adequate compensation for the impacts predicted.

Because of the nature of the Tidal Habitat Model (focus on anadromous fish) and its limited sensitivity to small-scale changes in the environment, certain smaller projects, when viewed in the context of a large AU, may not trigger an assessment of a reduced ecological function. For example, within an area the size of a typical SEWIP AU, a small increase in some indicators (e.g., extent of overwater coverage), or decrease in others (e.g., impacts to a portion of a saltmarsh fringe), may not be of sufficient magnitude to change responses in the model. In such cases, dividing the AU into smaller areas (e.g., separating the area of project influence from surrounding, unimpacted areas) may improve the likelihood of triggering an assessment of a reduced ecological function.

If this approach does not adequately assess or address project impacts, smaller incremental impacts on habitat will still require mitigation on a local scale (consistent with local, state, and federal regulations). For example, mitigation of benthic productivity (potentially lost to shading from added overwater coverage), may be replaced by enhancement of benthic productivity elsewhere. These small-scale impacts and the actions necessary to compensate for the lost functions must be dealt with outside of the SEWIP process and must meet the mitigation requirements of WDFW and other regulatory agencies.

5.3 FOCUS OF COMPENSATORY MITIGATION

The compensatory mitigation policies listed in this section emphasize tidal restoration as the preferred mitigation action for impacts to freshwater palustrine habitats and for impacts to tidal habitats in the SEWIP planning area. This is consistent with the Initial Snohomish River Basin Chinook Salmon Conservation/Recovery Technical Work Plan (WRIA 7 Technical Committee 1999) and the SEWIP management plan (Chapter 6), both of which emphasize restoration of historic tidal habitat area and functions to increase habitat area available to anadromous salmonids, and to increase the quality of those habitats.

5.4 CONSTRAINTS

The compensatory mitigation policies described in this section (and the restoration policies and plans described in Chapter 6) recognize the constraints imposed on salmonid habitat restoration by existing, legal, permitted structures and alterations of the local landscape. For example, opportunities for restoration/enhancement of habitat quality or creation of new habitats in the commercial/industrial areas of EMUs 5 and 6 are limited, and the function of habitats that might be enhanced in those units often would be constrained further by adjacent developed areas or activities. Natural processes that create and maintain habitat (e.g., shoreline bluff erosion and natural sediment transport patterns) have been eliminated or highly modified in this area, in much of EMU 7 along the Everett to Mukilteo shoreline, and at the Priest Point and Mission Beach shorelines.

Essential anadromous fish functions provided in EMUs 5 and 6 are juvenile salmonid rearing and migration, adult migration, and saltwater/freshwater transition. Adult native char are also believed to feed in these areas. Because of the limited availability of habitats providing these functions, such habitats must be preserved to the extent that no additional hazards to successful rearing or migration are created, and that existing hazards are reduced wherever feasible. For the most part, enhancement of habitat quality in these areas can only be achieved through engineered solutions such as contaminant removal, log raft storage restrictions, reductions in bank slopes, and improved structural designs. Mitigation for unavoidable impacts in these highly modified habitats often can best be provided in EMUs (e.g., EMUs 2 and 3) where greater opportunities exist to significantly enhance salmonid habitat and habitat-forming processes, and where the greatest proportional loss of habitat has occurred. Regardless of the location of restored habitats, anadromous salmonids will continue to migrate through EMUs 5 and 6, and care must be taken to not locally diminish habitat functions to the extent that one life history trajectory is favored over another.

5.5 COMPENSATORY MITIGATION POLICIES

Compensating for unavoidable habitat impacts of development actions considered in the HDS by restoring historic tidal habitats and shorelines in the Snohomish River Estuary could result in a net loss of isolated palustrine wetland acreage (e.g., wetlands inside diked areas). In most instances, these palustrine wetlands have formed in areas that were formerly (i.e., before construction of dikes) connected to the major distributary channels and, hence, were once tidal. Thus, restoration of tidal influence in these areas is consistent with watershed restoration goals for salmonid habitat in the estuary and with an overall goal of restoring the estuary to a more nearly natural tidal ecosystem.

The compensation policies and ratios established in this section, and the restoration plan put forth in Chapter 6, are predicated on the expectation that restoration of tidal circulation carries with it a high probability of successful restoration of associated habitat functions for juvenile salmonid feeding and migration. While published reviews of mitigation actions nationwide (Race and Fonseca 1996, Zedler 1996) have painted a disappointing picture of limited success, in a large proportion of the cases cited, those failures have stemmed from the mitigation action simply not being taken, or from the project not being built to agreed-upon specifications. The SEWIP Salmon Overlay provides controls to ensure compliance with agreed-to mitigation requirements (Section 5.6).

Restoration projects completed and monitored in Pacific Northwest estuaries (Appendix Table C.1) have had a far better success rate at restoring salmonid habitat function than the success rates of nationwide projects described by Race and Fonseca (1996) at restoring other functions. Although tidal wetland restoration projects in general may not achieve full equivalency with natural reference marshes for a broad suite of ecological functions over the monitoring life of a project (5 to 10 years), most, if not all, of these regional created or restored habitats do provide habitat function for juvenile salmonids within 1 to 5 years of implementation. It is recognized that other estuarine functions (e.g., marsh and riparian zone productivity and diversity) may take much longer to reach levels comparable to those at natural or reference sites; however, because the focus of mitigation considered in this Overlay is on salmonids, the Overlay is justified in assuming a high potential for success. Moreover, where mitigation is provided to compensate for losses due to redevelopment projects in the urban estuaries of Puget Sound (e.g., in the UGA), often the impacted habitats for which compensation is needed are themselves already impacted to varying degrees. Therefore, the habitats being lost often are only providing moderate to low-quality littoral habitat function. The Salmon Overlay Tidal Habitat Model and policies provide a means of assessing the level of existing function at the proposed project site and of ensuring that those functions are adequately replaced at the mitigation site.

Tidal restoration projects in the Snohomish River Estuary were not included in the reviews by Race and Fonseca (1996), but they offer the best examples of the potential success of tidal habitat restoration in the SEWIP planning area. Four examples are described in some detail in Appendix F (Mid-Spencer Marsh on Union Slough [AU 2.36]; Marysville sewage treatment plant mitigation site on Ebey Slough [AU 2.12]; South Spencer Marsh between Union Slough and Steamboat Slough [AU 1.06]; and the Jetty Island berm [AU 4.04]). The first three of these are tidal mudflat/marsh complexes formed by breaching dikes, and the last (Jetty Island) resulted from a project that created a saltmarsh/mudflat complex on an exposed sandy beach.

Each of these projects has been subjected to some level of monitoring, and each (except Mid-Spencer, which was breached in a flood) has met or exceeded short- to mid-term (i.e., 5-year) ecological success criteria established before project construction. For salmonids, these goals generally included fish access and evidence of substantial epibenthic production. In most cases, long-term (i.e., 10+ years) restoration goals, objectives, and monitoring of the sustainability of the project have not yet been documented. However, as evidence of the long-term benefits of dike breaching in the estuary, juvenile salmonid use and invertebrate production in the Mid-Spencer Marsh (AU 2.36) was found to be high in 1992 (Pentec 1992b), some 30 years after the dike was breached. Visual observations and scoring in the SEWIP Tidal Habitat Model (Figure 4.1) have shown a high functional performance in all of these areas and in previously diked north Ebey Island, where dikes were breached in floods earlier in the last century (e.g., AU 2.15 and 2.19). In recognition of the need for longer-term monitoring of the success of restoration actions constructed as compensatory mitigation sites, the SEWIP includes guidance regarding establishment of restoration goals (Section 5.6.1), monitoring of progress toward meeting those goals (Section 5.6.2), and adaptive management (Section 5.6.3) to deal with unanticipated conditions.

The above-referenced projects have shown that breaching dikes in the lower Snohomish River Estuary is effective at restoring tidal hydrology. Moreover, soils inside the dikes differ little from the tidal soils present before diking (although elevations may have changed as a result of land-use practices), increasing the probability of successful reestablishment of tidal mudflat and marsh complexes when dikes are removed. Sampling in the Mid-Spencer Marsh (Pentec 1992b) and observations at the Mid-Ebey Marsh areas (AU 2.15, 2.19) have verified the long-term tendency of areas with restored tidal circulation to return to a near-natural, functioning mudflat and marsh complex. These areas scored greater than 69 IVA points per acre (normalized; Figure 4.1) and are ranked among the highest-quality AUs in the planning area (Figure 4.3). However, the SEWIP recognizes that uncertainties exist which could affect the long-term ecological performance of other mitigation/restoration projects or their usefulness to the target species. These uncertainties include:

- Uncertainty in the Tidal Habitat Model – As with any model, input variables and the relevance of assigned scores are limited by existing knowledge (see Appendix A); error estimates cannot be calculated around the IVA scores.

- Uncertainty in the spatial transferability of ecological functions – Although significant opportunities often exist to mitigate impacts to tidal habitat in a location off-site from the impact (i.e., in another EMU), this carries some uncertainty in the potential for disproportionate benefits to different life history trajectories. For example, smaller juvenile outmigrants may benefit more from tidal restoration projects in EMU 2 than would larger outmigrants that may have lost habitat lower in the estuary. The SEWIP has assumed that mitigation provided in the freshwater/saltwater transition zone of EMUs 2 and 3, which have lost the greatest proportion of their historical habitat area, will benefit all salmonid life history trajectories.

- Uncertainty in temporal loss of ecological function – Temporal loss may occur when a compensatory mitigation project is constructed concurrent with the impact and there is a lag between the time when the impact occurs and the time when the ecological performance of the mitigation action reaches a level equivalent to that lost. SEWIP policies require increased mitigation ratios for concurrent mitigation to compensate for this potential.

- Uncertainty in habitat function interchangeability – The Tidal Habitat Model calculates a single AU score that represents the quality of habitat for salmonids in each AU. This score integrates all salmonid functions (feeding, migration, predator avoidance, saltwater adaptation); however, one or more of these particular functions may disproportionately limit or enhance salmonid habitat quality within the AU. If the goal and objective of compensatory mitigation is to replace like function with like function (e.g., *Corophium* production with *Corophium* production – not possible with the model), then some uncertainty exists with respect to how well a specific function is replaced, even though the IVA AU score and IVA-acres, as calculated by the model, may be replaced.

- Uncertainty in compensatory mitigation project design, implementation, and outcome – There is some uncertainty associated with application of the model to an as-yet unbuilt mitigation/restoration site with respect to actual built condition of the project, and changes that may result over time from natural processes—especially erosion and accretion. The SEWIP recommends reevaluation of mitigation sites at fixed intervals and employs adaptive management to ensure that the functions required to compensate for project impacts have actually been provided.

In recognition of these potential uncertainties, and to minimize any adverse impacts of this approach on the landscape of salmonid habitat in the region (and to ensure that there is an overall net increase in habitat function and area for anadromous fish in the planning area), policies P.1 through P.16 are adopted as part of the plan.

Maulsby Mudflats: The compensation ratios in Policies 3, 6, and 7, however, will not apply to the Maulsby Mudflats due to the high natural resource value of the mudflats and the higher uncertainty of successfully mitigating impacts to this site. Compensation ratios for development at that site will be determined at the time a development is proposed based upon specific mitigation proposals and input from appropriate state and federal agencies.

Italicized text provides amplification of the rationale and intent underlying the policy.

- **P.1 – Unavoidable Impacts.** Unavoidable adverse impacts to tidal habitat functions that result from loss of littoral habitat functions or area in the Snohomish River Estuary (including Port Gardner) should be compensated by restoring or enhancing historic tidal aquatic habitat functions and littoral area in the estuary.

  Top priority is assigned to compensatory mitigation through tidal restoration in areas identified in the restoration plan (Section 6), and within the same EMU, where possible (Policy P.5). In cases where loss of function does not have an associated loss of littoral habitat area, mitigation can be provided in the form of restoration or enhancement of existing littoral habitat area, or by provision of new habitat area.

- **P.2 – Mitigation Timing.** Compensatory mitigation for unavoidable adverse impacts to tidal habitat functions should be provided, either in advance of the impact or concurrently with the actions resulting in impact. No temporal lag should occur between the time of loss of functions to the impact and the time when at least equivalent salmonid habitat functions are provided through mitigation actions.

- **P.3 – Minimum Compensation Requirements**. The minimum requirements for compensation should be:

  - 1 acre (or fraction thereof) of restored littoral habitat for each acre (or fraction thereof) of littoral habitat lost from diking, dredging, and/or filling. Littoral habitat includes all area from -10.0 ft MLLW to at least OHW (where discernible; otherwise MHHW); area of both impact and mitigation sites is extended landward to the extent of the riparian zone as defined in Section 2.4.

  - 1 acre (or fraction thereof) of tidal or palustrine habitat for each acre (or fraction thereof) of palustrine habitat lost to development (see also Policy P.16).

- 1.3 IVA-acres of habitat function for the limiting taxon (chinook or coho/bull trout) for each IVA-acre lost. This 30 percent increase in function accounts for uncertainty in the habitat assessments provided by the model as described above, and is intended to ensure that the SEWIP goal of a net increase in habitat function is achieved.

Minimum acreage compensation policies do not apply to habitat restoration and enhancement projects that are not used for compensatory mitigation. Note that loss of riparian function above OHW should be scored by the model, and should be compensated.

The original SEWIP technical advisory committee agreed that a minimum replacement ratio of 1:1 should be applied to situations where advanced mitigation is in place (e.g., Policy P.6). In the Salmon Overlay, a minimum ratio of 1.3:1 replacement of habitat function is recommended, even where advanced mitigation is provided, to ensure that a net gain in habitat function results from mitigation actions.

Some members of the SSOTAC have argued that the minimum functional replacement ratio should be set higher than 1.3 to 1, citing the uncertainties in the model's use as described above; for example, the model's inability to document specific ecological functions or individual factors that affect habitat quality (presence or absence of all indicators are reduced to a single numeric score for a given AU). They argue that the literature does not support the premise that full functional equivalency can be achieved over an equivalent mitigation area, and that, therefore, the proposed compensation policies would result in a net loss of habitat function.

SSOTAC members also cite a number of authors and agencies (e.g., Zedler 1996) who report that mitigation ratios of 2:1 or 4:1 are typically required. However, these authors and agencies, in virtually all cases, are referring to area ratios where functions have not been measured. The Tulalip Tribes has stated that the minimum replacement of tidal habitat area should be 1.5:1 and that the minimum replacement of habitat function should be 2:1. The City Planning Staff maintains, based on the field verification and a comparison of scores calculated for all AUs in the planning area, that the SEWIP model provides a reliable measure of habitat function and that the proposed ratios are *sufficiently conservative. In fact, an important purpose of developing the model was to allow functional assessments of habitat to replace simple acre-to-acre comparisons and ratios. The City Planning Staff maintains further that there is ample evidence of functional replacement of salmonid habitat in the several projects from Puget Sound and the Snohomish River Estuary described in Appendices C and F. The City Planning Staff notes that in most cases within the AUs included in the HDS, projects would be affecting AUs that currently have one or more negative stressors; mitigation in most, if not all, cases will be provided at mitigation sites designed to have a reduced number of stressors. As a result, most mitigation actions will end up being determined by the minimum acreage requirements of this policy. If higher-quality habitats are affected by development, the 1.3 minimum functional replacement ratio is intended to ensure that compensatory mitigation requirements are conservative.*

Consensus among the SSOTAC members was not reached regarding minimum mitigation requirements that should be included in this policy.

- **P.4 – Out-of-Kind Compensation.**

  - Development impacts to tidal or tidally influenced habitats should not be compensated for with palustrine wetland enhancement, restoration, or creation.

  - Development impacts to palustrine wetland habitats may be compensated for with tidal habitat restoration or creation on an acre-for-acre basis. If nontidal mitigation is proposed for loss of nontidal palustrine wetlands in the SEWIP planning area, it should be reviewed to ensure that opportunities to recover tidal function would not be foreclosed. To replace palustine wetland functions with palustrine wetland functions, the original SEWIP process and vegetated wetland model applies (City of Everett et al. 1997).

  - The Tidal Habitat Model should be used to ensure that adequate replacement of salmonid habitat function is provided (i.e., it is assumed that within the policies of SEWIP, the model will provide for replacement of habitat for salmonids, except that impacts to eelgrass will be evaluated and compensated for in accordance with WDFW mitigation policies).

- Out-of-kind compensation for the two watershed process-based functions identified in the Tidal Habitat Model (e.g., LWD recruitment, feeder bluffs) should not be allowed. An exception is made for cases where tree removal is required for maintenance of the integrity of functional dikes.

These watershed processes, where they persist in the SEWIP planning area, unlike other habitat indicators, cannot realistically be replaced in an acceptable time frame (e.g., less than 10 years); thus, impacts to these process-based indicators should be avoided.

To provide an incentive for restoration of the estuary to its natural tidal condition, any loss to development of isolated palustrine wetlands in the planning area may be compensated for by restoration of tidal functions to an equal area. This policy is consistent with the goal of increasing habitat area available to anadromous salmonids.

- **P.5 – Where Compensation Can Occur.**

- Compensation for impacts to vegetated palustrine wetlands may occur within any EMU, with either created, enhanced, or restored tidal habitat. However, to replace palustine wetland functions with palustrine wetland functions, the original SEWIP process and vegetated wetland model applies (City of Everett et al. 1997).

- Compensation for impacts to tidal (i.e., anadromous fish) habitats may occur with tidal habitat creation, enhancement, or restoration, preferably within the same EMU (Figure 3.1) or secondarily within the adjacent downstream EMU, with the following exceptions:

  - Because the nature of salmonid habitat functions provided by the salmonid habitat in EMU 7 (Port Gardner shoreline) is somewhat different from those provided in EMUs upstream in the estuary, impacts in EMU 7 should be compensated only in EMUs 4 or 7.

  - Opportunities for habitat restoration in the highly modified habitats in EMUs 5 and 6 are limited; therefore, impacts in EMUs 5 and 6 should be compensated in EMUs 2, 3, 4, 5, or 6. Because EMUs 1, 2, and 6 have the smallest proportions of their total acreage that is salmon habitat (Table 4.2) within their boundaries, further reduction of habitat area and function should be avoided.

- Impacts in EMU 3 may be compensated in EMUs 2, 3, or 4.

This policy recognizes the critical nature of the saltwater/freshwater transition zone (EMUs 2 and 3) for both juvenile and adult salmonids (Healy 1991; and Section 3.2.2), and the substantial habitat losses in this part of the estuary that have occurred in the last century (Haas and Collins, in press; and Section 3.1.2). Because of the presumption that juvenile salmonids impacted by projects in EMUs 5 and 6 have primarily migrated down the mainstem of the Snohomish River, applicants are encouraged to provide mitigation for impacts in these EMUs along the main Snohomish River channel, whenever possible. (Note that The Tulalip Tribes has indicated that mitigation should not occur in EMU 4; the City Planning Staff notes that there are opportunities for beneficial mitigation in EMU 4, such as elimination of log raft storage, that should be retained as options.)

- **P.6 – How Compensation is Calculated.** The SEWIP assumes that in all cases there will be no temporal loss of cumulative salmonid habitat function as calculated by the model. Where mitigation is provided in advance of project impacts (e.g., the performance standards established for Year 5 have been met at the mitigation site), the acreage of compensation should be calculated from the IVA function performance scores (Year 5) using the following ratio, provided that a minimum compensation requirement of 1:1 acres ("no net loss") of area is met and provided that the minimum functional replacement compensation requirement of Policy P.3 is met.

IVA score per acre function lost X acres lost* = *Acres of compensation
IVA score per acre function gained at the mitigation site

This policy is intended to provide incentive to developers for the creation of large habitat compensation banks. No additional multipliers for the compensatory uncertainties outlined above are included, because these uncertainties will be evaluated with the model directly after project construction. The advanced mitigation compensation site will *demonstrate through monitoring (Policy P.14) that habitat functions are performing as proposed in the compensatory mitigation plan at a level that fully replaces lost functions, at the time that the impact is incurred. This policy is applied to ensure that there is no temporal loss of habitat functions for listed salmonids. See example in Table 5.1.*

Consensus among the SSOTAC members was not reached regarding minimum mitigation ratios that should be included in this policy.

- **P.7 – How Compensation is Calculated (Concurrent Mitigation)**. The acreage of compensation for concurrent mitigation (mitigation that is constructed but may not be fully functioning at the time impact is incurred) should be calculated from the IVA function performance scores at the time of impact, provided that the minimum compensation requirements of Policy P.3 are met at all times (see Table 5.1 for example):

IVA score per acre function lost X 1.3 (acres lost) ***= Acres of compensation***
IVA score per acre function gained (at the time of impact)

This policy applies when the mitigation project is constructed concurrently with the impact and when mitigation credits per acre at the time of the impact are less than the impact debits per acre. The formula is intended to ensure that there is no temporal loss of habitat functions during the time required for the functions at the compensation site to approach the predicted level of performance. The 1.3 multiplier is included in this ratio calculation because, with concurrent impacts and mitigation, uncertainty exists regarding future development of the mitigation habitat (i.e., habitat quality in some cases could decline over time). Given that the minimum of full replacement of habitat functions (plus a 30 percent uncertainty factor) is met at that time of project impact, it may be that functional quality of the mitigation project will continue to increase over time, creating a significantly greater mitigation credit than has been lost at the impacted site. The project owner will have the right to present data to the SSOTAC and appropriate regulatory agencies that show that the function of the mitigation provided (as measured by the Tidal Habitat Model) has developed to the point where replacement functions exceed the *minimum of 1.3 IVA-acres for each IVA-acre lost to the project, and that there has been no temporal loss of function as assessed by repeated model evaluations. If this condition is verified, mitigation credits in excess of the minima provided in P.3 will be available for the owner to use as mitigation credits for unavoidable adverse effects of future projects or for transfer to another party.*

Consensus among the SSOTAC members was not reached regarding minimum mitigation ratios that should be included in this policy.

- **P.8 – Compensation Based on Limiting Function**. Under Policies P.6 and P.7, the acreage needed for compensation should be calculated separately for the chinook and coho/bull trout functions. Whichever function requires the greater acreage for compensation (i.e., which is the limiting function) will determine the required overall compensation acreage in order to ensure that the limiting function is adequately compensated for. Excess compensation acreage for the nonlimiting function should not be available as compensation for other habitat impacts.

- **P.9 – Use of Average Restoration Potential Per Acre**. An average restoration potential per acre should be used to establish the compensation requirements in cases where several AUs are restored simultaneously (as in a compensation bank) or where several individual project impacts are to be mitigated in a single restoration project. This average is calculated by summing the potential increase in IVA-acre points and dividing by the total acreage of the site. This average should then be used to determine the acres of compensation required according to Policies P.3 and P.6 or P.7.

Table 5.1 Mitigation example calculation.

Situation

Assume the following:

- A project proponent wished to fill 2 acres of existing littoral area on Smith Island (EMU 3) for a water dependant use.
- The existing functional rating for the AU in which the project occurs is 32 IVA points per acre for chinook salmon and 30 IVA points per acre for coho/bull trout (thus, chinook salmon habitat is the limiting function, i.e., the function that will require the greatest replacement per Policy P.8).
- The proponent proposes to mitigate for the unavoidable loss by breaching dikes to create tidal habitat along Steamboat Slough (EMU 2).
- The average IVA points per acre for chinook habitat function, when the mitigation site is fully functioning, is predicted to be 43 IVA points per acre for both chinook and coho/bull trout.

Calculation

Normally the calculations in Policies 6 and 7 below would be completed two times - once for chinook and once for coho/bull trout to determine the limiting function per Policy P.8. However, in this example, the mitigation site scores are the same for both species (43 IVA points per acre). Using the highest species function score at the impact site (32 IVA points per acre for chinook) will result in the need for the greatest replacement acreage.

Case 1 – Advance mitigation

The mitigation would be constructed and demonstrated by monitoring to be fully functioning in advance of the filling at the project; that is, the mitigation area meets its 5-year performance goals and provides 43 IVA points per acre, as scored by the Tidal Habitat Model.

Policy P.6 Calculation:
Required mitigation is calculated using the formula in P.6:

$$\frac{\text{IVA score per acre function lost}}{\text{IVA score per acre function gained}} \text{ x (acres lost) = Acres of compensation}$$

Using the numbers in the example above, the calculation would read:

32/43 X 2 acres = 1.49 acres of compensation

Policy P.3. Test:
Acreage Requirements of Policy P.3.
Based on the evaluation of the Tidal Habitat Model, this level of compensation (1.49 acres) would fully replace lost chinook salmon habitat function; however, it does not meet the minimum acreage criterion of Policy P.3. That policy requires a minimum of 2 acres of compensation for the 2 acres of tidal habitat lost, regardless of the greater function that may be provided at the mitigation site. Given that a minimum of 2 acres of compensatory mitigation will be required, the minimum functional replacement requirement ratio of 1.3 is next tested:

Function Requirements of Policy P.3.
The 2 acres of mitigation, at the time the impact is incurred, will provide 2 acres X 43 IVA-points/acre for a total of 86 IVA-acres. Thus, the loss of 2 acres X 32 IVA-points/acre (64 IVA-acres) will be replaced by 86 IVA-acres for an 86/64 = 1.34 replacement ratio, exceeding the minimum 1.3 functional replacement ratio.

Case 1 result: 2 acres of mitigation providing 86 IVA-acres of salmon functional habitat is required for the 2 acres of fill in project impact area which has lost a total of 64-IVA acres.

continued

Table 5.1 (continued).

Case 2 – Concurrent mitigation

The mitigation would be constructed concurrently with the filling at the project site invoking Policy P.7. Assume that at the time of project impact, the mitigation site will only be providing 25 IVA points per acre, but is expected to increase over time. Required initial mitigation would use the formula in P.7:

Policy P.7. Calculation at time of impact

IVA score per acre function lost / IVA score per acre function gain	x (1.3) x (acres lost) = Acres of compensation

It is calculated as follows:

32/25 x 1.3 x 2 acres = 3.33 acres of compensation

Based on the evaluation of the Tidal Habitat Model, this level of compensation would be required at the time of impact to replace lost chinook salmon habitat function. This acreage would also meet the minimum acreage criterion of Policy P.3.

Policy P.7. Calculation after 3 years::
After 3 years, the site is monitored and scored using the Tidal Habitat Model. Year 3 score reaches 43 IVA points per acre. Thus, the site is now providing mitigation functions in excess of those required to meet the P.7 minimum. Recalculation using the formula in P.7 is as follows:

32/43 X 1.3 X 2 acres = 1.93 acres of compensation

At Year 3, only 1.93 acres of the site are required to replace the functions lost at the impacted site plus provide a 30 percent uncertainty factor above those functions. The project owner would be allowed to petition the SSOTAC for release of excess mitigation provided in the 3.33 acres originally set aside.

Policy P.3. Calculation after 3 years:
However, P.3 mandates that a minimum of 2 acres be provided to compensate for the 2 acres of littoral habitat lost. Thus, the owner would be eligible to receive release to use 1.33 acres from the site (3.33 acres originally set aside minus the 2 acres of permanent mitigation requirement). This portion of the mitigation site would then be available as mitigation for unavoidable adverse impacts of other projects.

The 2 acres of mitigation, as it is shown to be functioning in 3 years, would provide 2 acres X 43 IVA-units/acre for a total of 86 IVA-acres.

Thus, the loss of 2 acres X 32 IVA-units/acre (64 IVA-acres) was replaced at Year 0 by 3.33 acres providing 83.2 IVA acres (83.2/64 = 1.3) and at Year 3 by 86 IVA-acres for a 86/64 = 1.34 replacement ratio, exceeding the minimum 1.3 functional replacement ratio.

Case 2 result at time of impact: 3.33 acres of mitigation providing 83.2 IVA-acres of salmon functional habitat is required

Case 2 result after 3 years: 2 acres of mitigation providing 86 IVA-acres is required. 1.33 acres is available for mitigation for other projects impacts.

continued

Table 5.1 (continued).

Case 3 – Advance mitigation (palustrine wetlands on mitigation site)

The mitigation would be constructed and demonstrated by monitoring to be fully functioning in advance of the filling at the project; that is, the mitigation area meets its 5-year performance goals and provides 43 IVA points per acre, as scored by the Tidal Habitat Model.

However, assume that the 10-acre mitigation site had 2 acres of moderate quality wetland and 5 acres of lowest quality wetland as determined by the original SEWIP model and shown on Figure 5.1.

As in Case 1, required project mitigation is calculated as 2 acres.

Policy P.16. Calculation
With the first use of the mitigation site, Policy P.16 requires that compensation be provided for existing wetlands on the site at a ratio of 0.5 acre per acre of moderate quality wetland and 0.1 acre per acre of lowest quality wetland.

Thus, in addition to the 2 acres required for project mitigation, an additional 2 x 0.5 = 1 acre must be set aside from the acreage available in the site to compensate for the loss of the 2 acres of moderate quality wetland, and 5 x 0.1 = 0.5 acres be set aside to compensate for the loss of lowest quality wetland. The 10-acre site restored would then have 10-2-1-0.5 = 6.5 acres of remaining, uncommitted mitigation credit.

Case 3 result: 3.5 acres of mitigation is required.

- **P.10 – Guidelines for Developing Compensatory Mitigation Plans**. Compensatory mitigation and monitoring plans (CMMPs) with applicable performance standards submitted under the SEWIP plan should follow the interagency "Guidelines for Developing Freshwater Wetlands Mitigation Plans and Proposals" (Department of Ecology Publication #94-29) and should be reviewed by the SSOTAC. Applicants should consider the overall restoration objectives set forth in Chapter 6.

Although the DOE guidelines were developed for freshwater wetlands, they also provide good guidance for developing plans for restoration of estuarine and nearshore tidal habitats.

- **P.11 – Performance Criteria.** Standards and performance criteria should be established for each mitigation action as described in Section 5.6 and stated in the CMMP.

- **P.12 – Monitoring Requirements**. Each compensation site should be monitored over a period of up to10 years as described in Section 5.6.

- **P.13 – Threatened, Endangered, or Commercially Important Species.** All tidal and associated riparian areas within the SEWIP planning area are designated critical habitat for chinook salmon and are likely to also constitute important habitat for coho salmon and anadromous native char. If areas in the UGA have other threatened, endangered or commercially important species, then the compensation plan should incorporate design measures to mitigate any impacts to these species and their habitats.

As part of the adaptive management process, the SSOTAC should periodically amend the Salmon Overlay to incorporate any new mapped areas of threatened, endangered, or commercially important species, and may develop new models to assess other species types (e.g., demersal or forage fish that are now candidate species).

- **P.14 – Use of Restoration Acreage in Lieu of Maintenance and Contingency Bond**. The restoration of additional habitat acreage may be used in lieu of a maintenance and contingency bond. The area of this in-kind maintenance and contingency bond should be equal to one-half the area required for compensation (1 additional acre of restoration for every 2 acres needed as compensation). Habitats that are restored/enhanced for the maintenance and contingency bond may be used or sold by the applicant to compensate for other impacts when all the 5-year performance standards established in the mitigation plan are met. Separate bonds may be required for monitoring.

- **P.15 – Projects with Impacts Outside of the Estuary Study Area.** Projects with impacts outside of the SEWIP study area may be compensated for within the SEWIP study area, consistent with the SEWIP restoration and/or enhancement goals and objectives.

- **P.16 – Loss of Palustine Wetlands.** Compensation is required where existing palustrine wetlands will be converted to tidal habitat for compensatory mitigation. The acreages calculated per this policy are set aside within the restored mitigation site and may not be considered as compensatory mitigation. However, to provide an incentive to developers to undertake tidal restoration as compensatory mitigation, while recognizing the range of functions provided by different types of isolated palustrine wetlands, the following ratios should apply for wetlands, based on existing scores from the SEWIP freshwater model (Figure 5.1). Alternatively, a project proponent may rescore the site using that model to reflect existing conditions:

- Fourth quartile (highest quality) – 0.75 acre for each acre lost
- Third quartile (moderate quality) – 0.5 acre for each acre lost
- Second quartile (fair quality) – 0.3 acre for each acre lost
- First quartile (lowest quality) – 0.1 acre for each acre lost

No compensation should be required for vegetated freshwater wetlands lost through restoration of tidal functions, if the restoration project is not used as compensatory mitigation.

Note that this policy will result in a net loss of palustrine wetlands in favor of restoration of tidal functions in areas where they historically occurred. The Tulalip Tribes has indicated a preference that the appropriate replacement for the fourth-quartile wetlands should be 1 acre for each acre lost, and that replacement for the third quartile should be

0.8 acre for each acre lost. The City Planning Staff disagrees and feels that this would create a disincentive for restoration of tidal functions.

5.6 MONITORING, ADAPTIVE MANAGEMENT, AND CONTINGENCY PLANS

5.6.1 Standards and Performance Criteria

This section provides guidance on design and implementation of CMMPs, establishment of performance criteria, and adaptive management for projects undertaken using the SEWIP Salmon Overlay recommendations and policies. SEWIP recommends that standards and performance criteria developed in the CMMP should be quantified and divided into two tiers as described by Ossinger (1999). It is expected that a CMMP will be prepared for approval by the appropriate regulatory agencies for each mitigation project undertaken under the SEWIP Tidal Habitat Model (Policies P.10 and P.12). The CMMPs may be used by SSOTAC to evaluate the success of the SEWIP Salmon Overlay mitigation and restoration policies. In cases where a project is established as a mitigation bank in accordance with Section 173-700 WAC, members of the SSOTAC may represent their organizations on the mitigation bank review team (MBRT) as per Washington Administrative Code (WAC) 173-700-732, and the CMMP may become a part of the instrument establishing that bank.

Tier 1. The first-tier standards are quantitative descriptions of the mitigation action implementation requirements and will include both area (acres) and performance criteria. For smaller projects (i.e., those affecting less than 0.25 acre and not involving creation or restoration of new tidal habitat), only Tier 1 implementation criteria may be required and associated monitoring can be adjusted accordingly. For example, where a new overwater structure is proposed that will change the shading within the AU from 35 percent to 55 percent, there would be an associated drop in the AU score based on changing the negative multiplier from 0.7 (for chinook) to 0.5. The resulting reduction in IVA-acres could be replaced by restriction of intertidal log raft storage over an area that provides adequate replacement of IVA-acres, consistent with the policies described above. There are adequate scientific data (Smith 1977) to provide confidence that elimination of intertidal log raft storage will indeed result in an increase in the desired ecological function—in this case, increased epibenthic zooplankton production.

Hence, the Tier 1 performance standard for such a mitigation action would simply be a demonstration that the log raft restrictions had indeed been implemented and enforced.

Larger projects may have more complex Tier 1 criteria (e.g., "tidal mudflat/emergent marsh will have at least 3 acres between elevations MLLW and +10 ft MLLW with a sinuous drainage channel"). These standards and performance criteria should be tied specifically, but not exclusively, to those habitat indicators assessed in the Tidal Habitat Model, in order to quantify and monitor the site in relation to the predicted IVA functional score. Submittal of surveyed as-built drawings or other documentation should be required for more complex projects, to document that the project has been constructed as approved.

Tier 2. The second-tier performance objectives describe functional criteria that will often be stated as testable null hypotheses (e.g., "site use by juvenile chinook salmon does not differ from the level [specified as abundance, density, residence time, and/or feeding and growth] found in the impacted area or in a specified reference area"). Tier 2 monitoring of larger projects should be designed and conducted to include verification of mitigation effectiveness external to the use of the model. Tier 2 monitoring may include biological refinements of a Tier 1 criterion (e.g., "native marsh vegetation will achieve 50 percent cover over 0.5 acre"). Each functional criterion should include a date by which the criterion must be met. Note that Tier 2 criteria may be compared against the impacted site or against a suitable reference site, if available.

Depending on the scale and complexity of a mitigation project, the following monitoring components (external to, or not directly reflected in the model) may be required as part of the Tier 2 performance standards for the mitigation site:

- Macroinvertebrate species density or diversity
- Botanical species cover or diversity
- Vertebrate species use or diversity
- Sediment flux (erosion/accretion)
- Water quality condition
- Exotic species presence or cover
- Marsh development or riparian condition

Benchmarks for criteria in each category should be established by the appropriate regulatory agencies based upon the nature of the criteria proposed, habitat type, and the availability of reference conditions (a reference site should be monitored). Data from monitoring should be used in the adaptive management process (Section 5.6.3) to refine the model, if needed, and to refine the design of mitigation and restoration projects.

5.6.2 Monitoring and Reporting Requirements

Tier 1. Mitigation projects that have only Tier 1 objectives (i.e., smaller enhancement projects) may only require documentation that the enhancement action has been taken, (e.g., existing shading structures have been removed, log raft restrictions have been implemented).

Tier 2. Tier 2 monitoring should occur over a period of 10 years; monitoring may not be required in each year, however. The CMMP will establish the monitoring schedule and a set of applicable performance standards. Additionally, the CMMP should include postproject assessment of the site using the Tidal Habitat Model to determine whether the projected increase in the IVA scores (mitigation goal) for the compensation site has been achieved. When the performance standards established for Year 5 are met (which may occur during any year of the monitoring period) and the increase in IVA points projected for the compensation site has occurred, then Policy P.6 may be applied.

Reporting. A monitoring report should be prepared for each mitigation action at the end of each year in which monitoring is required. The report should include a full description of project conditions, a statement of project performance objectives, monitoring required and completed, and results of monitoring to date. Current results should be compared against the performance criteria laid out in the CMMP. The monitoring report should be submitted to the appropriate permitting agencies for approval and submitted to the SSOTAC and The Tulalip Tribes for use in project tracking and adaptive management.

5.6.3 Adaptive Management

The SSOTAC will serve as the SEWIP adaptive management team. Adaptive management should be based in part on explicit testing of hypotheses associated with the goals, objectives, and assumptions of the SEWIP Salmon Overlay management plan. Results of site monitoring and corresponding performance measurements from individual CMMPs should be compared against predicted salmon habitat quality, based on the Tidal Habitat Model, as a means of testing and validating the model. The SSOTAC should evaluate model assumptions and determine whether the scoring reflects actual salmonid use, feeding, residence timing, etc. Field monitoring data may be used to modify scoring of indicators or to add or delete indicators from the model. Unavoidable adverse development impacts and mitigation monitoring should be examined to ensure that mitigation ratios are conservative, that individual projects do not result in a temporal reduction in salmonid habitat function (as IVA-acres), and that the overall effect of development and mitigation is to increase salmonid habitat area and function in the SEWIP planning area.

The SSOTAC will examine the results of monitoring of projects processed under the SEWIP umbrella, to determine if project performance criteria have been met. In the event that performance criteria are not met, the SSOTAC may advise regulatory agencies regarding appropriate actions. The SSOTAC may work with the project sponsor to evaluate monitoring data and factors that may have resulted in the condition observed. Recommendations may be forwarded to regulatory agencies and may include some or all of the following:

- Continued monitoring of the project to determine if criteria are met in a longer time frame.

- Additional measures to modify factors that are thought to be responsible for the project's failure to achieve its objectives.

- Modification of project objectives and establishment of additional mitigation requirements to replace those not achieved at the project in question. Additional mitigation required may be in the form of additional mitigation area to be committed out of an existing mitigation site, or creation of a new mitigation or enhancement action to meet the unfulfilled requirements.

If funding is available, the SSOTAC may establish an information base for the estuary in which an areawide accounting of projects is undertaken within the SEWIP framework. For each project an account should be kept of: the nature and location (EMU and AU) of the project and its associated compensatory mitigation; the nature of the mitigation planned, constructed, and realized; the results of monitoring and assessments with the Tidal Habitat Model; a plot of

IVA-acres at the impact and mitigation site over time; problems experienced in achieving Tier 1 implementation criteria; time to achieve Tier 2 performance criteria; and recommendations for improvements in future mitigation/restoration project designs.

If funding can be obtained, the SSOTAC or the WRIA 7 Technical Committee may develop and implement a monitoring plan for the entire SEWIP planning area. As many mitigation/restoration sites as possible should be incorporated into the monitoring plan, including some sites that are or become older than 10 years. It is extremely important to monitor over the longer term to understand the nature of functions provided. This can best be accomplished with consistent monitoring parameters and approaches among sites, and will allow reliable evaluation of the successes (or failures) of restoration/enhancement activities in the area and the areawide increases that are achieved in salmon habitat area and quality.

5.7 COMPENSATORY MITIGATION BALANCE

In this section, we evaluate the potential net effect on tidal salmonid habitat of the HDS for the Everett/Mukilteo UGA (Section 4.6), assuming implementation of concomitant compensatory mitigation requirements as defined in this section. The Tidal Habitat Model was first used to calculate the development "debits," based on the IVA-acre losses, of existing anadromous fish habitat that would result from full buildout of the HDS (Table 4.3; Figure 4.13). As summarized in Table 5.2, full buildout would result in the loss of about 226 acres of littoral habitat to deepening or filling and a loss of about 306 acres of isolated palustrine wetlands to filling or draining, for a total of 532 acres of loss equating to 4,942 IVA-acres of salmon habitat functional area.

Those debits were then compared to the "credits" that would be gained from required mitigation for those losses based on the compensatory mitigation policies in Section 5.5 to arrive at a predicted net increase in IVA-acres that would result from the HDS. We assumed that on average, mitigation sites, largely outside of the UGA, would have fewer stressors and a higher number of IVA points per acre than would impacted sites within the UGA. Hence, the minimum acreage policy (P.3) would dictate the acreage of mitigation required. Two scenarios were considered and are displayed on Tables 5.2 and 5.3.

Table 5.2 Mitigation balance for full development scenario in the UGA - Mitigation Scenario 1 (all mitigation through tidal restoration).

	Acres		IVA-acres	
	Credit	**Debit**	**Credit**	**Debit**
Existing Conditions - Salmon Habitat				
Snohomish Estuary SEWIP area (from Table 4.2)	8,595		506,609	
SEWIP area less AU 4.05	5,288		271,827	
AU in area considered for development (HDS, from Table 4.2)	939		13,384	
Hypothetical Development Scenario Impacts				
HDS impacts (from Table 4.3)		226		4,942
HDS palustrine wetland impacts (acres) (from Table E.3)		306		
Totals		532		4,942
Mitigation Requirements				
Minimum 1:1 (Policy P.3)		532		
Assume 200: acres palustrine wetlands on mitigation site				
Acres low quality at 0.1:1 (Policy P.16)	140	14		
Acres fair quality at 0.3:1	40	12		
Acres moderate quality at 0.5:1	20	10		
Total tidal acres required		568		
Assumed IVA-acres provided (Assumed nominal 40 IVA points per acre)			22,700	
Net increase in salmon habitat from development and mitigation	**342**	**acres**	**17,759**	**IVA-acres**
Percent increase in estuarywide salmon habitat from development and mitigation	4.0%		3.5%	
Percent increase in estuarywide salmon habitat from development and mitigation (excluding AU 4.05)	6.5%		6.5%	
Mitgation ratio provided by development scenario	**2.5**		**4.6**	

Table 5.3 Mitigation balance for full development scenario in the UGA - Mitigation Scenario 2 (100 acres of palustrine mitigation by tidal restoration; remainder per original SEWIP palustrine mitigation requirements).

	Acres		IVA-acres	
	Credit	**Debit**	**Credit**	**Debit**
Existing Conditions - Salmon Habitat				
Snohomish Estuary SEWIP area (from Table 4.2)	8,595		506,609	
SEWIP area less AU 4.05	5,288		271,827	
AU in area considered for development (HDS, from Table 4.2)	939		13,384	
Hypothetical Development Scenario Impacts				
HDS impacts (from Table 4.3)		226		4,942
HDS palustrine wetland impacts (acres) (from Table E.3)		100		
Totals		326		4,942
Mitigation Requirements				
Minimum 1:1 (Policy P.3)		326		
Assume 40: acres palustrine wetlands on mitigation site				
Acres low quality at 0.1:1 (Policy P.16)	20	2.0		
Acres fair quality at 0.3:1	12	3.6		
Acres moderate quality at 0.5:1	8	4.0		
Total tidal acres required		335		
Assumed IVA-acres provided (Assumed nominal 40 IVA-points per acre)			13,413	
Net increase in salmon habitat from development and mitigation	**110**	**acres**	**8,471**	**IVA-acres**
Percent increase in estuarywide salmon habitat from development and mitigation	1.3%		1.7%	
Percent increase in estuarywide salmon habitat from development and mitigation (excluding AU 4.05)	2.1%		3.1%	
Mitgation ratio provided by development scenario	**1.5**		**2.7**	

Under the first scenario the project proponent elects to compensate for both littoral habitat and palustrine wetland losses through tidal restoration (Policy P.4). Policy P.16 then will govern the amount of tidal restoration that will be required to offset the expected losses of palustrine wetlands on mitigation sites. To assess the habitat area and quality that would be provided by mitigation of the full buildout scenario, using the policies described in the preceding sections we have made the following assumptions and calculations:

- A minimum of 532 acres of tidal habitat would be required to compensate for the loss of 532 acres of littoral and palustrine wetlands affected by the HDS (Policy P.3; Table 5.2).

- Mitigation would be provided in EMU 2 and/or 3, in advance of impacts, through restoration of tidal hydrology in areas that are now diked; e.g., along lower Union Slough or Steamboat Slough (Policy P.5).

- Two hundred acres of the selected mitigation sites are delineated as existing palustrine wetlands (70 percent [140 acres] low quality (Figure 5.1), 20 percent [40 acres] fair quality, and 10 percent [20 acres] moderate quality) that must be compensated for using the ratios in Policy P.16. Compensation required will thus be (0.1 X 140) + (0.3 X 40) + (0.5 X 20) = 36 acres.

- A minimum of 532 + 36 = 568 acres will thus be required to compensate for the littoral habitat lost (226 acres) and the palustrine wetlands lost to development (306 acres) or converted to tidal habitat at the mitigation sites (36 acres).

- At the time of the impact, restored tidal wetlands in formerly diked mitigation areas provide an average of 40 IVA points per acre (e.g., Marysville sewage treatment plant mitigation site; AU 2.12 = 56 IVA points for chinook, 48.5 IVA points for coho/bull trout; Appendix Table E.1).

- Thus, the total mitigation provided would be 568 acres X 40 IVA points per acre, or 22,720 IVA-acres (Table 5.2). This is an increase of 17,759 IVA-acres and a functional replacement ratio of 4.6, exceeding the minimum functional replacement ratio of 1.3 (Policy P.3).

- Under this scenario, the assumed loss of 226 acres of littoral habitat would have been compensated for by restoration of tidal functions to 568 acres, for a net area increase of 342 acres of new salmonid habitat and a replacement ratio of 2.5 acres for each acre lost.

- If the mitigation required is viewed in the context of the entire planning area, this mitigation would result in a 4 percent increase in salmon habitat area and a 3.5 percent increase in salmon habitat function. If the AU (4.05) encompassing the Snohomish delta, in which no impacts or restoration will ever occur, is excluded from the calculation of "existing habitat," the mitigation scenario described in Table 5.2 would constitute an increase in both salmon habitat area and function of 6.5 percent.

This is considered the most probable scenario for compensatory mitigation in that the alternative choice under Policy P.4 would require a minimum of 1 acre of palustrine wetland be created and functioning for each acre of palustrine wetland lost to development. The increased certainty of meeting the minimum mitigation requirements through tidal restoration, and the requirement that more than 1 acre of palustrine wetland be provided under the original SEWIP and City Environmentally Sensitive Areas ordinances to mitigate for each acre lost, are expected to make tidal restoration by far the more attractive mitigation option.

Nonetheless, a second scenario was examined (Table 5.3) in which the various project proponents are assumed to elect to use tidal restoration to mitigate for only 100 of the 306 acres of palustrine wetlands lost to development. Under this scenario, the following assumptions were applied:

- A minimum of 326 acres of tidal habitat would be required to compensate for the loss of 226 acres of littoral habitat and 100 acres of the palustrine wetlands affected under the HDS (Policy P.3; Table 5.3).

- Mitigation through tidal restoration would be provided in EMU 2 and/or 3, in advance of impacts (Policy P.5).

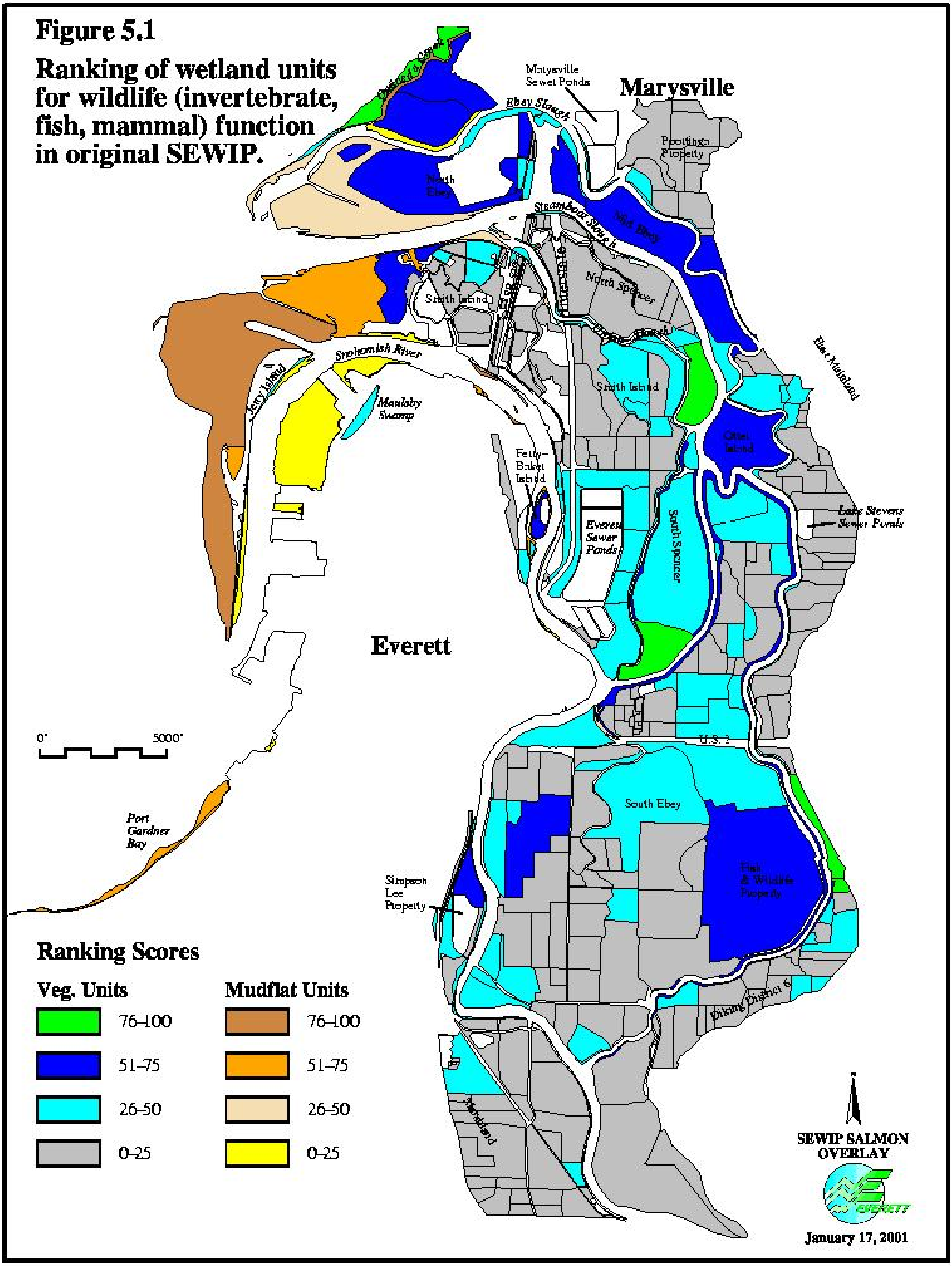

Figure 5.1

Ranking of wetland units for wildlife (invertebrate, fish, mammal) function in original SEWIP.

- Forty acres of the selected mitigation sites are delineated as existing palustrine wetlands (20 acres low-quality emergent, 12 acres fair quality, and 8 acres moderate quality [Figure 5.1]) that must be compensated for using the ratios in Policy P.16. Compensation required will thus be (0.1 X 20) + (0.3 X 12) + (0.5 X 8) = 9.6 acres.

- A minimum of 326 + 9.6 = 335 acres of tidal restoration will thus be required to compensate for the littoral habitat lost (226 acres) and the palustrine wetlands lost to development (100 acres) or converted to tidal habitat (9.6 acres).

- Restored tidal wetlands in formerly diked areas will provide an average of 40 IVA points per acre.

- Thus, the total tidal mitigation provided would be 335 acres X 40 IVA points per acre, or 13,413 IVA-acres (Table 5.3). This is an increase of 8,471 IVA-acres and a functional replacement ratio of 2.7, exceeding the minimum functional replacement ratio of 1.3 (Policy P.3).

- The loss of 226 acres of littoral habitat would have been compensated for by restoration of tidal functions to 335 acres, for an area increase of 110 acres of new salmon habitat and an area replacement ratio of 1.5:1 (Table 5.3).

This exercise demonstrates that, with the use of the proposed SEWIP mitigation policies, full buildout under the HDS would result in a significant net increase in salmonid habitat area and quality. A greater net increase is realized if the proponents elect to replace lost palustrine wetlands with tidal habitat accessible to salmonids (first scenario above). This scenario is considered to be the most probable of the two considered for the following reasons:

- The policies in this plan and in the original SEWIP for replacement of palustine wetlands at mitigation sites

- The uncertainties involved in creation of palustrine wetlands

- The relative cost of tidal restoration versus the cost of palustrine wetlands in the SEWIP planning area

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6.0 MANAGEMENT AND RESTORATION PLAN

6.1 OVERALL SALMONID HABITAT MANAGEMENT GOALS FOR THE ESTUARY

The ultimate goals of estuary management for recovery of listed salmonids are to preserve remaining natural ecosystem components and processes that provide for salmonid habitat productivity, and to restore and enhance those processes that have been lost or degraded to the extent necessary for recovery. This plan recognizes the critical location and function of the Snohomish River Estuary for the health and sustainability of all salmonid stocks in the Snohomish River system. Preserving existing high-quality habitats and increasing the area and quality of other habitats in the estuary will maximize the chances that native salmonid populations can achieve the abundance, geographic distribution, and life history diversity to be self-sustaining and productive into the future.

Salmonid habitat restoration within this plan emphasizes modification of existing and potential habitat areas within the estuary toward conditions extant in the pristine estuary (e.g., Haas and Collins, in press). These modifications also will affect habitats for other resources that will be modified to become more similar to precontact conditions. These changes will come at the expense of certain land uses (e.g., agricultural lands), habitats (e.g., palustrine wetlands), and resources (e.g., waterfowl, terrestrial wildlife) that now are present in the modified estuary. Emphasis on tidal habitat restoration over large areas of the estuary will displace existing land uses including palustrine habitats for freshwater wetland plants and wildlife.

This plan also recognizes that ecosystem protection, enhancement, and restoration must be balanced with the need for future economic development and redevelopment within appropriate sites in the UGAs of municipalities in the planning area. The Tidal Habitat Model was used to evaluate those potential future development impacts and the availability of compensatory mitigation opportunities (Section 5.7). Assuming the full development as described in the HDS, and assuming mitigation in accordance with the compensatory mitigation policies of Section 5.5, development and associated mitigation would result in small net increases in overall salmonid habitat area (about 4.0 percent) and function (about 3.5 percent) in the planning area. While these increases would be substantial and important, development and associated mitigation alone cannot be relied upon to effect salmon habitat recovery.

This section provides a recommended management and restoration component of the estuary management plan. The goals and objectives of salmon habitat restoration in the planning area are identified along with a prioritization of restoration opportunities and approaches that could be used to achieve those goals.

The SSOTAC has adopted the following overall management goals for the planning area (including Port Gardner):

Management Goal 1: Protect existing high-quality, undeveloped salmon habitat areas within the estuary, and preserve options for future restoration opportunities.

Management Goal 2: Enhance and restore the Snohomish River Estuary and the processes that create and maintain estuarine habitat for salmonids and other species to the maximum extent compatible with the GMA, Shoreline Master Program, and the Snohomish River basin chinook salmon recovery work plan (WRIA 7 Technical Committee 1999).

Management Goal 3: Achieve a net gain in salmonid habitat area, functions, and values for salmonids in the estuary that is reflective of and will support Snohomish basin salmonid recovery goals.

Management Goal 4: Achieve a balance between habitat protection, enhancement, and restoration, and continued economic and social activity within appropriate areas.

Management Goal 5: Provide an efficient permit review process that promotes consistency among applicable federal and state laws and regulations, including the federal Section 404 review process and ESA, and that provides development and environmental interests with a high degree of certainty as to the level of development permitted and the location, type, amount, benefits, and costs of required mitigation.

Management Goal 6: Compile detailed information for adaptive resource management and protection, as follows:

1. Map all palustrine wetland complexes and tidal AUs and assess their functions using the original wetland (City of Everett et al. 1997), and the revised Tidal Habitat Model (Chapter 4), respectively.

2. Review and summarize available biological, physical, and chemical data for the estuary (Chapter 3).

3. Monitor mitigation and restoration actions to provide information to guide future actions within the context of the Salmon Overlay. Monitoring data should also be used over time to test assumptions made in the Tidal Habitat Model. This is strongly related to adaptive management goals (Section 5.6.3).

Management Goal 7: Provide a level of certainty of implementation of the restoration plan that is acceptable to NMFS and USFWS. Certainty will come through adoption of the SEWIP Salmon Overlay as a component of the City of Everett's revised Shoreline Master Program and potentially, by acceptance of the Overlay by other entities (see Chapter 7).

6.2 HABITAT RECOVERY, RESTORATION, AND ENHANCEMENT GOALS

The following specific habitat recovery, restoration and enhancement goals are proposed, consistent with the goals of the Snohomish River basin chinook salmon recovery work plan (WRIA 7 Technical Committee 1999):

1. Protect existing high-quality salmonid habitat and migration corridors within the estuary and within the UGA (e.g., Sections 4.4 and 4.5).

2. Minimize further losses of and improve access to historically accessible habitats inside the UGA, including tidal areas and streams tributary to the estuary; ensure that existing tidal marshes and littoral areas remain hydrologically and functionally linked to main channels or marine areas.

3. Prevent further losses of, and improve access to historically accessible habitats outside of the UGA, including tidal areas and streams tributary to the estuary; ensure that existing tidal mudflats, marshes and littoral areas remain hydrologically and functionally linked to main channels or marine areas.

4. Restore tidal circulation and habitat structure by breaching dikes to reconnect intact, but isolated, formerly tidal habitats; breach dikes to create mudflat-marsh-channel complexes in areas historically providing such habitats.

5. Protect intact riparian zones and enhance and restore disturbed riparian zones adjacent to estuarine and nearshore areas; protect and restore historic flood-plain wetlands; provide for large wood and associated organic matter to enter the channel through natural processes.

6. Protect existing, functioning feeder bluffs and restore feeder bluff functions where possible.

7. Protect existing sources of LWD and restore LWD sources where possible.

8. Reduce or eliminate stressors to salmonids and to salmonid habitat functions through systematic actions (regulatory compliance, contaminant removal, elimination of intertidal log raft storage, reductions in shoreline armoring).

9. Over the next 15 years, achieve increases in salmonid habitat function, as defined by the Tidal Habitat Model, by 20 percent overall. This increase is considered an intermediate-term goal, not the ultimate goal of tidal habitat restoration in the planning area. It is not intended to be the end of restoration in the estuary. Clearly much more could be accomplished (e.g., Table 4.5 and Figure 4.16) and would be desirable if the funding and landowner cooperation can be obtained. As noted in Section 4.3, a very large percentage of the existing tidal habitat lies in EMU 4, specifically in AU 4.05. As shown on Table 6.5, if that single AU is considered a constant (little changed from its condition in 1850) and is removed from the equation, then the 20 percent overall increase in salmonid habitat function that is the suggested intermediate goal would provide a 38 percent increase in present habitat function (and a 25 percent increase in present habitat area) over

the remainder of the planning area. Because of the widely variant existing conditions in the several EMUs, it is expected and appropriate that the level of restoration and increase in existing functions will vary widely among EMUs (see Section 6.5).

6.3 ROLE OF THE TECHNICAL ADVISORY COMMITTEE

The SSOTAC included technical representatives from agencies and jurisdictions that may adopt or use the SEWIP Tidal Habitat Model and the Salmon Overlay. This plan recommends that the SSOTAC should continue to meet at least on an annual basis to review the success of implementation of the Salmon Overlay, and to review the results of applying the SEWIP Salmon Overlay and, where appropriate, the original SEWIP. It is anticipated that compliance with provisions of this Salmon Overlay may become a condition of permits issued for individual projects within the SEWIP planning area (e.g., hydrologic project approval, Section 10/404, Shoreline Substantial Development). The SSOTAC, if requested, may advise regulatory agencies in the appropriate use of the Salmon Overlay policies and the Tidal Habitat Model for assessment of mitigation requirements. The SSOTAC should act as a central clearinghouse to provide tracking of impact and compensation acreage created in the planning area. It is recommended that SSOTAC members represent their respective organizations as part of the MBRT for mitigation banks set up within the SEWIP planning area that use SEWIP policies in applying mitigation credits and the Tidal Habitat Model to calculate debits and credits.

The SSOTAC will meet at least once a year to review mitigation and restoration projects that have been completed in the estuary, upcoming projects, and the results of monitoring programs in progress. The potential role of the SSOTAC in adaptive management within the estuary is described in Section 5.6.3; additional discussion is included in Chapter 7.

6.4 OVERALL RESTORATION/ENHANCEMENT POTENTIAL

Over the last century, the Snohomish River Estuary has lost approximately 70 percent of the tidal mudflat, marsh, and forested wetland habitat that was historically present (Bortleson et al. 1980). Because much of this area was simply diked for agricultural use, the soils and topography behind the dikes are largely intact over large areas. Other reductions in habitat function have resulted from man-caused stressors such as log raft storage and sediment contamination, which can be reversed. Because of the nature of the losses in habitat area and function that have resulted from urban, industrial, and agricultural development over the last century, the Snohomish River Estuary has a substantial potential for restoration of salmonid habitat function.

In Chapter 4, we calculated the potential increase in habitat (IVA-acres) that would result from a suite of potential restoration actions that could be taken inside and outside the UGA (Tables 4.5 through 4.7; Figures 4.14 through 4.16). These are by no means the only restoration opportunities that exist in the planning area. For example, riparian buffer enhancement could be accomplished in many AUs not listed on Table 4.7 and opportunities for tidal habitat restoration occur in areas not shown on Figure 4.16. However, it must be reiterated that the potential restoration actions evaluated in Chapter 4 are not all necessarily feasible, practical, socially acceptable, or economically available. They are presented merely to demonstrate what is possible; further real estate and economic analysis would be necessary to refine a practical strategy for habitat restoration in the estuary.

The 25 potential tidal restoration sites identified in Chapter 4 and shown on Figure 4.16, if all were constructed and managed to maximize salmonid habitat functions, would increase the tidal existing habitat area in the estuary by nearly 5,400 acres, or 63 percent. Similarly, this scenario would result in an increase of about 66 percent in the total salmonid function (IVA-acres) in the estuary. If the exceptionally large Snohomish delta AU (AU 4.05), which is unlikely to be directly impacted or significantly enhanced by human activities, is eliminated from the definition of "existing conditions," then the completion of these 25 projects would increase existing salmon habitat acreage in the remaining planning area by over 100 percent.

Because it is unlikely that funding or the political will to implement tidal restoration at all 25 of these sites will be available in the near future, sites were ranked for their restoration potential using a simple mathematical model, constructed based on the following factors:

- Potential salmonid habitat function scores that would be achieved, as calculated by the Tidal Habitat Model

- Existing wildlife functions on the site as calculated by 1997 SEWIP vegetated freshwater wetlands

- Existing water quality functions on the site as calculated by 1997 SEWIP vegetated freshwater wetlands

- Potential technical difficulties associated with project construction (e.g., presence of roads or utilities; Table 6.1)

- The position of the site in the estuarine landscape; higher scores were given to sites in EMUs 2 and 3 and additional credit was given to sites on the mainstem of the Snohomish River (Table 6.1)

The ranking model is described in detail in Appendix D. Results of application of the ranking model (Table 6.2) should not be construed to mean that the top-ranked sites must be constructed before moving down the list. All projects on the list would provide significant habitat benefits, and factors not included in the model, such as existing land uses, owner willingness to sell, and cost, will have a major influence on project feasibility and the sequence of project completion.

The model examined two different ranking scenarios. Sites were first ranked based on the total score from the ranking model and are numbered in that order on Table 6.2 and in Figure 4.16. This view tends to provide a higher ranking for restoration sites of a larger size. Larger ecological units tend to facilitate the operation of critical habitat processes and biological interactions, which in turn improves the ability of a restoration site to be sustainable over the long term. Sites near the top of this ranking generally had a combination of high salmon habitat restoration potential (IVA-acres; associated with large size), moderate to low existing values for wildlife and water quality functions, and low technical difficulty. The importance of existing functions in determining site ranking can be seen by contrasting Site 1, North Tip, South Ebey Island, with Site 25, South Ebey, WDFW. These sites were ranked 1 and 2, respectively, based simply on salmon restoration potential; however, because it ranked last for having both the highest existing wildlife and the highest existing water quality scores, the South Ebey WDFW site ended up last in the overall ranking.

The second ranking (right-hand column on Table 6.2) is based on the subtotal ranking score obtained before inclusion of the technical difficulty factor in the model. This was examined to see if there were major differences in rankings which might suggest that ways should be sought to overcome the technical difficulties at some sites that otherwise would provide high salmon habitat benefits. This view of restoration site ranking had the effect of increasing the relative position of sites with higher potential difficulties (since they were not considered); for example, the Marshlands 1 site, which ranked 6 based on total score, moved up to be tied for number 2 in this view. The two sites that dropped the most (Site 7, SW tip South Ebey Island and Site 11, Simpson Lee Cat. I) were scored in "least degree of technical difficulty" category, and the two sites that increased the most in ranking (Site 21, North Smith Island, Union Slough and Site 23, Smith Slough, Smith Island) scored in the "highest degree of technical difficulty" category.

6.5 POSSIBLE RESTORATION SCENARIOS

In the previous section, we described what might be considered an unrealistic maximum tidal restoration scenario in which we assumed a high level of tidal restoration and no loss of restoration opportunities, even within the urban growth boundaries. The scenario described (tidal restoration in all 25 sites listed in Tables 4.5 and 6.2) would double the tidal habitat area available to salmonids and other estuarine species in the Snohomish River Estuary and increase salmon habitat function by 150 percent (excluding AU 4.05 on the Snohomish delta, where no change in existing functions is expected). In this section, we analyze somewhat more realistic scenarios. These scenarios combine development within the UGA as defined by the HDS with various restoration actions outside the UGA.

For purposes of analysis of two restoration scenarios, we have made the following assumptions:

- Full buildout under the HDS occurs as defined in Tables 4.3 and 4.4, and this buildout precludes all of the tidal restoration opportunity within the UGA as defined in Table 4.5. This assumption is conservative in that certain areas within the UGA will almost certainly be available for restoration.

- Impacts of full buildout are mitigated solely by tidal restoration as defined in Table 5.2, and this mitigation takes place entirely outside of the HDS.

Table 6.1 Landscape position and technical difficulty scoring for restoration sites.

	Landscape Position				Technical Difficulty				
Restoration Site	EMU No.	EMU Score	Main Stem Credit (2 if yes)	Land-scape Pos. Score	SEWIP 97 Acres	Est. Length of Dike Req'd (ft)	Linear ft Dike per Acre Restored	Narrative	Tech Diff. Score
Simpson Lee Cat. I #311	1	1	2	3	35.1		0.0	This Category 1 wetland to the north of the Simpson Lee site currently has limited tidal influence, with Bigelow Creek running through it. Restoration action would be to maximize tidal range in wetland. Need to investigate extent of diking necessary to protect adjacent railroad (if necessary).	4
South Spencer Island WDFW	1	1	0	1	298.3	0	0.0	Area managed for duck habitat by WDFW. Currently has dampened tidal action and salmonid use. Action would be to remove (or breach and bridge) cross dike that currently requires expensive maintenance.	5
SW Tip South Ebey Island	1	1	2	3	44.3	0	0.0	Some minor diking required to protect existing road and upgrade current setback dike.	5
Ferry Baker Island	2	3	2	5	5.6	0	0.0	Restoration action would be removal of significant amount of dredged material placed on island to create intertidal area; fill may include wood waste. Removal of fill would require protection of surrounding wetlands. Cost of removal is uncertain but could be high.	2
North Tip, South Ebey Island	1	1	0	1	399.2	2,200	5.5	Relatively short dike required across southern "neck" of area mapped.	4
Diking District 6	1	1	0	1	234.6	1,830	7.8	County feasibility study complete and restoration action underway. Scored at 3 due to difficult utility problems, but problems will likely be resolved within next year.	3
Mid-Smith Island	2	3	0	3	498.1	4,000	8.0	Large area fronts long reach on Union Slough. Dike would be required along Interstate 5 and along southern boundary.	4
Sunnyside South	1	1	0	1	283.8	2,500	8.8	Area is southern 2/3rds of Diking District 2. Area is long and narrow and protected by long dike along Ebey Slough. Site of dike failure last year. Restoration concept highly complicated by presence of Olympic Pipeline, which bisects the diking district, Lake Stevens sewer plant, and extensive area of unstable peat soils.	1
Sunnyside North	1	1	0	1	240.3	2,250	9.4	Area is northern 1/3rd of Diking district 2. Not constrained by Olympic Pipeline.	3
Poortinga Property	2	3	0	3	323.7	4,000	12.4	Restoration feasibility study currently underway. Will require dike to protect existing industrial development on west side of Allen Creek, plus likely dike improvements at Marysville WWTP.	4
Biringer Farm	2	3	0	3	319.5	4,000	12.5	Site has been targeted for restoration for many years. Would require relatively small protective dike along I-5.	4
Swan Slough	1	1	2	3	61.6	1,000	16.2	Restoration action would be to reconnect this wetland as a wall-based channel north along unmapped channel to Ebey Slough , and/or south to mainstem of the river. Would require some minor diking to protect the road. Landscape position score assumes upstream connection to main channel. Pump station to the north currently drains this area.	4

continued

Table 6.1 Landscape position and technical difficulty scoring for restoration sites.

	Landscape Position					Technical Difficulty				
Restoration Site	EMU No.	EMU Score	Main Stem Credit (2 if yes)	Land-scape Pos. Score		SEWIP 97 Acres	Est. Length of Dike Req'd (ft)	Linear ft Dike per Acre Restored	Narrative	Tech Diff. Score
South Ebey Island WDFW	1	1	0	1		545.6	10,000	18.3	Restoration of this forested wetland would require dikes around more than 50% of perimeter of WDFW ownership.	3
Marshlands 2	1	1	2	3		469.1	12,400	26.4	No present development in flood plain. Power line at Spaney Dairy, and rail road and Lowell Larimer road are on dike and protected from tidal flooding. Continued operation of Marshland pump station for drainage must be addressed.	1
Deadwater Slough	1	1	2	3		655.7	20,000	30.5	Extensive dikes required along 100% of perimeter of area. Action would include connection to mainstem of river.	3
Marshlands 1	1	1	2	3		240.8	8,000	33.2	No present development in flood plain. Power line, railroad and Lowell Larimer road are on dike and protected from tidal flooding. Continued operation of Marshland pump station for drainage must be addressed.	1
Upper Union Slough (Everett WWTP mitigation)	1	1	0	1		94.8	3,900	41.2	Existing sewer plant dike in place will require setback dike; technical issues involving this restoration have been resolved.	3
South Ebey Island, NE Corner	1	1	2	3		182.2	9,200	50.5	Similar to "South Ebey NW corner" but complicated by presence of Olympic Pipeline. City of Everett water line to the north.	1
Smith Island Delta Front	3	3	0	3		131.9	7,000	53.1	Existing Weyerhaeuser effluent ponds would require dike protection as would rail line to east.	2
South Ebey Island, NW Corner	1	1	2	3		146.9	8,000	54.5	Area is adjacent to mainstem of river; dikes would be required around 65% of area mapped. City of Everett water line to the north. Assumed connection to mainstem based on historic drainage patterns (in addition to Ebey Slough).	2
Nyman Farm	1	1	0	1		53.8	3,000	55.8	Dike around east side and north side to protect adjacent farmland (if not purchased or flood easement not obtained).	3
North Smith Island, Union Slough	2	3	0	3		13.2	2,400	181.3	Possible conflict with power lines. Relatively long dike for area restored. Highway would need protection. High dike cost relative to acres restored.	1
Langus Park #50	2	3	2	5		26.3	8,000	304.5	Wetland is an old channel to east of dredge disposal rehandling facility by Langus Park and to the west of I-5. Restoration action would be to connect channel back to mainstem of the river. Long dike would be required to protect highway and areas to the west of channel.	1
SR 529 Spencer	2	3	0	3		6.0	2,000	336.1	Site adjacent to I-5 and SR 529 to west. Both roads on bridges adjacent to dike. Internal dikes required to protect adjacent areas from flooding. Over half of site filled with considerable amount of concrete. Would require a level 1 analysis for contamination.	1
Smith Slough, Smith Island	2	3	0	3		12.0	9,200	768.6	Wetland restoration action would require a 9200 ft dike on outer edge of historic slough and removal of tide gate on Union Slough; dike placement would be restricted by surrounding industrial development.	1
						4988.82	124,880			

Notes:

See Appendix D for detail on ranking methodology.

Landscape Position Scoring: 3 = EMU 2 & 3; 2 = EMU 4-7; 1 = EMU 1; plus additional 2 points if on main channel of Snohomish River.

Technical Difficulty Scoring: 5 = no technical difficulties; 4 = minor; 3 = moderate to minor; 2 = moderate; 1 = significant

Table 6.2 Prioritization of potential restoration sites based on total IVA-acres per site, existing functions foregone, landscape, and technical difficulties anticipated.

Restoration Sites	Site No.[1]	New Tidal Habitat (acres[2])	Salmon Score Acre-Points[3]	Salmon Restora-ation Potential[4]	SEWIP 97 acres[5]	IVA Wildlife Acre-Points[5]	Normal-ized Wildlife Score[6]	IVA WQ Acre-Points[5]	Normal-ized WQ Score[6]	Land-scape Position[7]	Sub-total[8]	Tech. Diff.[9]	Total Score	Normalized Scores (based on) Total Score	Sub-total
North Tip, South Ebey Island	1	418	36,926	10.0	399	9,591	3.31	10,378	3.75	1	18.1	4	22.06	100	96
Biringer Farm	2	340	20,613	5.6	320	4,381	4.23	3,507	4.58	3	17.4	4	21.39	97	92
Mid-Smith Island	3	484	26,217	7.1	498	11,097	3.04	13,166	3.41	3	16.6	4	20.56	93	88
South Spencer Island WDFW	4	297	30,288	8.2	298	10,442	3.16	17,303	2.91	1	15.3	5	20.28	92	81
Poortinga Property	5	355	16,750	4.5	324	5,847	3.97	5,636	4.32	3	15.8	4	19.83	90	84
SW tip South Ebey Island	6	44	1,293	0.4	44	1,328	4.77	1,506	4.82	3	12.9	5	17.93	81	68
Marshlands 1	7	354	20,804	5.6	332	4,655	4.18	7,834	4.06	3	16.9	1	17.87	81	89
Swan Slough	8	62	4,315	1.2	62	1,109	4.80	3,265	4.61	3	13.6	4	17.58	80	72
Ferry Baker Island	9	6	714	0.2	6	0	5.00	0	5.00	5	15.2	2	17.19	78	80
Deadwater Slough	10	621	27,259	7.4	656	17,562	1.90	26,169	1.84	3	14.1	3	17.13	78	75
Simpson Lee Cat. I #311	11	35	2,591	0.7	35	2,142	4.62	2,984	4.64	3	13.0	4	16.96	77	69
Smith Island Delta Front	12	143	8,178	2.2	132	3,169	4.44	4,146	4.50	3	14.2	2	16.16	73	75
Sunnyside North	13	182	10,774	2.9	240	3,968	4.30	5,422	4.35	1	12.6	3	15.56	71	66
Marshlands 2	14	476	20,884	5.7	469	10,323	3.18	19,758	2.62	3	14.5	1	15.45	70	76
Sunnyside South	15	321	19,407	5.3	284	4,756	4.16	8,336	3.99	1	14.4	1	15.41	70	76
Nyman Farm	16	50	6,670	1.8	54	1,991	4.65	2,260	4.73	1	12.2	3	15.18	69	64
So. Ebey Island, NW Corner	17	147	4,973	1.3	147	3,236	4.43	5,744	4.31	3	13.1	2	15.08	68	69
Langus Park #50	18	26	1,201	0.3	26	709	4.87	11,103	3.66	5	13.9	1	14.86	67	73
So. Ebey Island, NE Corner	19	182	8,708	2.4	182	5,648	4.00	7,834	4.06	3	13.4	1	14.42	65	71
Diking District 6	20	225	11,804	3.2	235	6,289	3.89	14,942	3.20	1	11.3	3	14.29	65	60
N. Smith Is, Union Slough	21	13	761	0.2	13	212	4.96	132	4.98	3	13.2	1	14.15	64	70
SR 529 Spencer	22	4	385	0.1	6	89	4.98	161	4.98	3	13.1	1	14.07	64	69
Smith Slough, Smith Island	23	7	400	0.1	12	180	4.97	120	4.99	3	13.1	1	14.06	64	69
Upper Union Slough	24	82	3,287	0.9	95	3,282	4.42	3,504	4.58	1	10.9	3	13.89	63	58
South Ebey Island WDFW	25	517	32,801	8.9	546	28,371	0.00	41,465	0.00	1	9.9	3	12.88	58	52
Totals		5,391	318,003		5,414										

continued

Table 6.2 (continued).

Notes:

1. See Figure 4.16
2. Based on separate GIS based calculations of potential restored area (new tidal area created; in part shown on Table 4.5).
3. Mean of maximum and minimum restoration potential (IVA points per acre X salmon overlay acres; Table 4.5).
4. Salmonid restoration potential is based on IVA-acres. The top IVA score is divided into all the other scores and normalized so that the site with the greatest habitat function is scored a 10.
5. Data from original SEWIP (City of Everett et al. 1997). Acreage differences between "salmon overlay acres" column and "SEWIP 97 acres" column due to different acreage determination conventions between the 1997 SEWIP plan and the salmon overlay.
6. Normalized wildlife and WQ scores reflect existing values that would be altered by restoration; site with maximum existing value receives a score of 0.
7. Landscape Position: 3 = EMU 2 and 3; 2 = EMU 4-7; 1 = EMU 1; plus additional 2 points if site is on main channel of Snohomish River.
8. Subtotal: total of salmon, wildlife and water quality scores. Reflects relative prioritization without consideration of technical difficulty of site restoration.
9. Technical difficulties: 5 = No Tech Difficulties; 4 = Minor; 3 = Moderate to Minor; 2 = Moderate; 1 = Significant (based on Table 6.2).

Table 6.3 Minimum restoration scenario assuming full buildout of hypothetical development scenario and minimum development of 15 tidal restoration sites outside UGA.

	Area (acres)		Function (IVA-acres)	
Line	**Credit**	**Debit**	**Credit**	**Debit**
Existing conditions - salmon habitat				
1 Snohomish Estuary SEWIP planning area (from Table 4.2)	8,595		506,609	
2 AUs affected by hypothetical development scenario (HDS, from Table 4.2)	939		13,384	
Percent of planning area in AUs affected by HDS	11%		3%	
Development impact scenario (from Table 5.2)				
3 Total impact (palustrine and tidal acres; tidal functions)		532		4,942
4 Mitigation requirements	568		22,700	
5 Net increase in salmon habitat from development and mitigation	342		17,759	
6 Percent increase in estuarywide salmon habitat from development and mitigation (line 5 / line 1)	4.0%		3.5%	
Restoration potential				
7 Total tidal restoration potential (minimum from 15 sites outside UGA; Table 4.5)	4,245		184,983	
8 Tidal restoration remaining outside UGA after mitigation (line 7-line 4)	3,677		162,283	
9 Stressor removal potential inside UGA (from Table 4.6; AU 5.07 only[1])	–		283	
10 Stressor removal potential outside HDS (25% of total from Table 4.6)			8,747	
11 Total remaining restoration potential (line 8 + line 9 + line 10)	3,677		171,313	
12 Percent increase in estuarywide salmon habitat from restoration (line 11 / line 1)	43%		34%	
13 Total of gains due to restoration and to mitigation (lines 6 + line 12)	47%		37%	

1. Restoration potential in these AUs not precluded by development scenario.

Note: AU 5.07 is inside UGA but not considered in HDS.

Table 6.4 Maximum restoration scenario assuming full buildout of hypothetical development scenario and full development of 15 tidal restoration sites outside UGA.

Line		Area (acres)		Function (IVA-acres)	
		Credit	Debit	Credit	Debit
Existing conditions - salmon habitat					
1	Snohomish Estuary SEWIP planning area (from Table 4.2)	8,595		506,609	
2	AUs affected by hypothetical development scenario (HDS, from Table 4.2)	939		13,384	
	Percent of planning area in AUs affected by HDS	11%		3%	
Development impact scenario (from Table 5.2)					
3	Total impact (palustrine and tidal acres; tidal functions)		532		4,942
4	Mitigation requirements	568		22,700	
5	Net increase in salmon habitat from development and mitigation	342		17,759	
6	Percent increase in estuarywide salmon habitat from development and mitigation (line 5 / line 1)	4.0%		3.5%	
Restoration potential					
7	Total tidal restoration potential (maximum from 15 sites outside UGA; Table 4.5)	4,245		332,656	
8	Tidal restoration remaining outside UGA after mitigation (line 7-line 4)	3,677		309,956	
9	Stressor removal potential inside UGA (from Table 4.6; AU 2.40, 5.00, 5.07 only[1])	–		2,674	
10	Stressor removal potential outside HDS (75% of total from Table 4.6)			26,242	
11	Total remaining restoration potential (line 8 + line 9 + line 10)	3,677		338,871	
12	Percent increase in estuarywide salmon habitat from restoration (line 11 / line 1)	43%		67%	
13	Total of gains due to restoration and to mitigation (lines 6 + line 12)	47%		70%	

1. Restoration potential in these AUs not precluded by development scenario.
Note: AU 5.07 is inside UGA but not considered in HDS.

Table 6.5 Proposed restoration scenario (assuming full development under the HDS).

Line	Area (acres)		Function (IVA-acres)	
	Credit	Debit	Credit	Debit
Existing conditions - salmon habitat				
1 Snohomish Estuary SEWIP planning area (from Table 4.2)	8,595		506,609	
a. Planning area less AU 4.05, Snohomish delta platform	5,288		267,154	
2 Restoration goal in 15 years (20% of line 1)			101,322	
Development impact scenario (from Table 5.2)[1]				
3 Total impact (palustrine and tidal acres; tidal functions)		532		4,942
4 Mitigation requirements based on requirements of policies P.3, P.17		568		6,424
5 Mitigation actions (assumes median IVA points per acre in Table 4.5)				
a. Restore tidal circulation to Maulsby Marsh (AU 5.00; Table 4.6)	–		2,252	
b. Restrict log raft storage in AU 5.07 (northeast Jetty Is.; Table 4.6)	–		283	
c. Debit remaining acres in Port of Everett's Union Slough Mitigation site	8		440	
d. Restore tidal circulation to 200 acres at the Marshlands 1 (Site 6)	200		11,740	
e. Restore tidal circulation at Biringer Farm (Site 2)	340		19,895	
f. Debit remaining acreage at Upper Union Slough (Site 24)	20		802	
6 Total mitigation for full buildout under HDS	568		35,413	
7 Net gain in habitat acres from this impact/mitigation scenario (line 6 - line 4)	342		30,472	
8 Remaining restoration goal to reach 20% increase in planning area function (line 2 - line 7)			70,850	
Restoration actions (in approximate order of preference/probability)				
9 Restore tidal circulation: Poortinga Farm Site 5 (mitigation for Tulalip landfill)	354		16,355	
10 Restrict log raft storage in AU 2.40, 3.01, 4.01, 4.02 (Figure 4.15; Table 4.6)	–		9,312	
11 Restore tidal circulation to Diking District 6 (Site 20)	225		11,599	
12 Restore tidal circulation to north end of South Spencer Is. (Site 4)	297		30,289	
13 Restore tidal circulation to 100 acres of Deadwater Slough (Site 8)	100		4,390	
14 **Net gain under this plan (sum line 7 plus 9 through 13)**	**1,318**		**102,416**	
15 **Percent change from existing condition (line 14 / line 1)**	**15%**		**20%**	
16 **Percent change from existing condition (less AU 4.05; line 14 / line 1a)**	**25%**		**38%**	

1. Site numbers refer to Tables 4.5 and 6.2; Figures 4.14 and 4.16

- Mitigation credits required to offset full buildout impacts (Table 5.2) are deducted from the tidal restoration potential available outside of the HDS (Table 4.5) to show the remaining tidal restoration opportunities in the estuary (Tables 6.3 and 6.4, line 8). Again, this is conservative because a significant proportion of the required mitigation would certainly be provided within the UGA.

- Restoration credits that could be achieved by stressor removal within the HDS that would not be precluded by full development are included (Tables 6.3 and 6.4, line 9).

- Restoration credits that could be achieved by stressor removal outside the HDS are also included (Tables 6.3 and 6.4, line 10); under the maximum restoration scenario (Table 6.3), it is assumed that 75 percent of log raft storage stressors are removed; under the minimum restoration scenario (Table 6.4), it is assumed that 25 percent of log raft storage stressors are removed.

The remaining available restoration balance in acres and IVA-acre points under minimum and maximum tidal restoration potential scenarios are then calculated (Tables 6.3 and 6.4, line 11; see Section 4.7.1 for assumptions used in defining minimum and maximum restoration potential). Recall that the restoration sites considered in this analysis do not constitute all sites where restoration is possible, nor does the inclusion of a site in a restoration scenario imply consent of the landowner to that use.

Under the assumptions stated above, and assuming full development as defined by the HDS (and its concomitant mitigation), the restoration actions included in Tables 6.3 and 6.4, if implemented, would result in an increase of 47 percent in the habitat acreage available to salmonids in the SEWIP planning area. Under the minimum and maximum restoration scenarios, the increases in salmonid habitat function (IVA-acres) would be 37 percent and 70 percent, respectively.

Although both the minimum and maximum restoration scenarios described above assume that all 15 potential sites outside the UGA are constructed, they nonetheless have some conservatism. Some portion of the impact due to development will be compensated within the UGA; it is assumed that it all would occur outside the UGA and that only limited restoration (not precluded by full buildout) would occur within the UGA. Also, the scenarios do not include numerous additional smaller habitat gains that could be achieved by other forms of stressor reduction (contamination removal, slope reductions and slope softening, elimination of log transfer facilities, etc.), dike setbacks, and riparian zone enhancement. Each of these actions would result in an incremental improvement in some aspect of salmonid habitat and would therefore contribute to estuarywide habitat recovery. In some EMUs, these types of restoration actions may be the only opportunities to improve on existing habitat availability and quality. The estuarywide increase in salmonid habitat and quality that could be attained by these actions is probably no more than a few percent, however.

Other actions that can be expected to occur in the UGA will reduce environmental stresses that may be below thresholds detected in the Tidal Habitat Model. For example, stormwater management and cleanup efforts are underway through the urbanized portions of the planning area; also, the City of Everett is working to redirect effluents from its sewage treatment plant, along with those from one of the major dischargers to the East Waterway, into a common deepwater outfall well below the littoral zone. Although these efforts are clearly beneficial to the overall environmental health of the planning area, they do not count as a stressor reduction in the model because no direct effects of these discharges on salmonids have been identified.

6.6 PRELIMINARY ESTUARINE RECOVERY PLAN

Development of a habitat recovery plan for the Snohomish River Estuary and associated nearshore areas within the SEWIP planning area must include input from salmon habitat and population biologists from state and federal resource agencies, as well as from a variety of other stakeholders. The plan proposed in this section reflects consideration only of those aspects of habitat dealt with in the SEWIP Tidal Habitat Model and only the obvious existing land-use constraints. For example, tidal restoration carries with it a certainty that existing agricultural, commercial, transportation, and residential activities will be displaced. Certain formerly tidal areas that have been filled and are being actively used for economic activity are not considered as offering significant restoration potential.

As noted in Section 6.2, the proposed interim habitat recovery goal is to increase the salmon habitat function in the SEWIP planning area, as measured by the Tidal Habitat Model, by

20 percent in 15 years. In Table 6.5, we list a specific suite of mitigation/restoration actions that would achieve that goal. Some of these actions involve properties already wholly, or partially in public or tribal ownership and already intended as mitigation or restoration sites (e.g., Biringer Farms, Diking District 6); other actions listed would require property acquisition. No attempt has been made to evaluate the costs of these actions. From examination of Table 6.5, it can be seen that the mitigation and restoration actions are spread among EMUs 1 through 5, with the majority of the actions in EMUs 1 and 2, where historical analysis has shown high rates of past loss of tidal habitats (e.g., Table 4.2). Only minimal restoration potential has been identified in EMUs 6 and 7 (Figures 4.14 and 4.15) and none is assumed in this scenario.

This plan provides a suite of mitigation actions that would compensate for the full buildout scenario under the HDS and would result in an overall increase of 15 percent in salmon habitat area and 20 percent in salmon habitat function as measured by the Tidal Habitat Model. This is a realistic and achievable goal. Yet, substantially greater restoration opportunities exist in the planning area, and greater habitat benefits could be gained if the will and the funding exist.

7.0 IMPLEMENTATION OF THE SEWIP SALMON OVERLAY

7.1 HISTORICAL PERSPECTIVE

As noted in this report and in the original SEWIP (City of Everett et al. 1997), one purpose of the original SEWIP was to coordinate the sometimes cumbersome and complex regulatory framework governing development in or near water. The SEWIP provided a scientifically based management plan within the context of which various federal, state, and local agencies could base their respective regulatory decisions. The original work was to be used as the basis for an agreed-upon approach to management in the estuary. Sensitive resources were to be identified and a plan adopted by governments with appropriate jurisdiction to protect and provide opportunities to restore these resources.

With the listing of chinook salmon and bull trout as “threatened” under the ESA, the focus of SEWIP has shifted to providing a response for protection and restoration of habitat for these two species within the estuarine and nearshore environment of the lower Snohomish River and WRIA 7 – the Snohomish basin. While NMFS recovery efforts are focused on the so-called 4H strategy (habitat, harvest, hydrology, and hatcheries), local governments are responsible only for habitat where they have jurisdiction, and therefore have some potential liability for their actions. The revised SEWIP with the Salmon Overlay provides a scientific basis for salmon habitat protection and restoration activities in the study area.

7.2 WHAT THE SEWIP OVERLAY PROVIDES

The SEWIP Salmon Overlay is a tool to aid jurisdictions in responding to the specific needs presented by the ESA. The original plan provides significant baseline information on the estuary for a number of wetland and environmental characteristics. The Salmon Overlay provides additional information specific to the needs of chinook salmon and bull trout in the plan area (see Chapters 1-6). The Overlay includes:

1. A scientifically based Tidal Habitat Model that uses indicators of habitat structure that have been shown to affect salmon habitat functions within the study area, to characterize habitat quality for listed species.

2. An inventory, based on the Tidal Habitat Model, of the quality of habitats now available to listed species in the study area.

3. Identification of high value habitats that should be preserved within the UGA.

4. A process for comparing potential development impacts within the urban growth areas of Everett, Marysville and Mukilteo (part) with potential mitigation and restoration opportunities in the SEWIP study area.

5. Recommended mitigation and restoration/enhancement policies for development.

6. A listing and ranking of opportunities for restoration/enhancement of habitat within the planning area.

7. A restoration scenario that accommodates mitigation for the HDS and substantial increases in tidal habitat area and function for anadromous salmonids.

The SEWIP, as revised with this Salmon Overlay, has a number of applications for governments, technical and scientific interests studying fish resources and habitat, and property owners in or near the study area. These applications are outlined here as recommendations for consideration by policy makers, decision makers, advisors, technical experts, resource managers, and property owners.

7.3 LINK WITH WRIA 7 EFFORTS

The SEWIP planning area includes the lower 20,000 acres of the Snohomish River Estuary, and the nearshore areas in Port Gardner Bay/Puget Sound around the mouth of the river. This area is a sub-basin within the WRIA 7, the Snohomish basin. The SEWIP work represents important scientific inventory information for the WRIA that needs to be coordinated with other planning efforts. Members of the SSOTAC represent state and local resource agencies and have been providing important communication links to such agencies. The SEWIP Salmon Overlay work has been presented to the Fish Committee of the WRIA 7 technical group. It has also been presented to the NMFS Aquatic Habitat Assessment Workshop and the Marine Resources Advisory Committee reviewing Puget Sound concerns. The coordination of data and information is critical to further our understanding of habitat needs and to establishing baseline data for all reaches of the Snohomish River basin and the ESU.

The SEWIP is but one important piece of an incomplete puzzle. It identified seven different EMUs within the study area. The essential ecological functions provided to anadromous salmonids by habitats in the study area include feeding (rearing), migration, predator avoidance, and saltwater/freshwater adaptation. These functions were examined in relation to different points in the life cycle of the fish, juvenile, adult, etc. The life cycle needs of salmon in the estuary differ from their life cycle needs in other reaches of the river basin. However, how their needs may differ, and what factors may be impacting their life cycle and their survival in passing through and residing in the estuary, are not fully understood. Furthermore, the relationship of habitat protection to restoration goals is not well enough understood to draw direct cause-and-effect relationships or targets for recovery. That is why this work needs to be brought together with other scientific efforts to ensure that the best possible plan is being developed.

Recommendation: The SEWIP work needs to be communicated to other agencies responsible for habitat recovery efforts in WRIA 7 and the Puget Sound ESU. This work is underway and should continue. The responsibility for this continued effort should rest primarily with the government agencies represented on the SSOTAC (including The Tulalip Tribes). The SSOTAC members are in the best position to see that SEWIP efforts are appropriately communicated and coordinated with other planning and recovery efforts in WRIA 7 and the Puget Sound ESU. A permanent SSOTAC should be formed to meet at least on an annual basis to monitor results of applying the SEWIP Salmon Overlay and, where appropriate, the original SEWIP. The SSOTAC should serve as an advisory body to ensure that this work is considered as part of overall recovery planning and habitat protection.

7.4 IMPLEMENTATION OF THE SEWIP RESTORATION PLAN

While there is much to be learned regarding the habitat requirements and environmental tolerances of fish within the estuary, we have a relatively good working understanding of the basic habitat needs of fish and what good habitat characteristics would include. The SEWIP Salmon Overlay identifies a number of habitat improvements and restoration opportunities in the study area. Some of these relate to the removal of stressors for fish, such as log rafting or hydrologic barriers that prevent or limit access to habitat areas. Others relate to the preservation or restoration of natural tidal functions and riparian conditions. In either case, the SEWIP provides a basis for sustaining an overall trend of improvement in habitat conditions by implementing the plan for restoration, and it provides a means of scoring or weighting the various restoration efforts.

Recommendation: The SEWIP restoration plan needs to be implemented. In order to accomplish this, governments with jurisdiction in the study area need to work together to seek funding for restoration projects and to coordinate their regulatory activities to reduce or eliminate stressors on the resources. Funding for acquisition of properties with restoration potential, and the conversion of these properties to realize their potential, should be given high priority. Federal, state, and local funds could be dedicated to this effort, which could well produce the significant increase in salmon habitat that is desired for this subarea of the WRIA. Likewise, the coordination of policies and regulations to reduce or eliminate stressors will add to the quality and productivity of the habitat in the study area. Federal, state, and local governments need to address this issue, and the SEWIP Salmon Overlay provides a basis to accomplish this task. Some of the specifics to address the regulatory efforts are discussed in more detail in the remaining sections.

7.5 ADOPT OR INCORPORATE SEWIP INTO THE REGULATORY FRAMEWORK OF STATE AND LOCAL GOVERNMENTS

State and local governments did not adopt the original SEWIP as a part of their land-use or environmental regulatory frameworks. However, the SEWIP has been used as a technical tool for reviewing projects, developing mitigation plans, and assigning mitigation requirements for impacts associated with developments. Notably, the Port and the City, and state and federal regulatory agencies have applied the SEWIP to address impacts associated with Port development and have incorporated that information into environmental conditions on Port projects. Additionally, the City has used the SEWIP baseline information in the review of other projects and development of plans within the study area, including the recent draft of the Shoreline Master Program.

In response to the ESA, local governments are being required by the state to update their shoreline master plans and may also update their critical areas protection measures under the Shoreline Management Act and Growth Management Act, respectively. These requirements provide an excellent opportunity to incorporate the SEWIP work within their land-use and environmental regulations and to address the requirements of "best available science" incorporated in GMA. The City is currently considering a draft shoreline master program that does incorporate the SEWIP Salmon Overlay and that is designed to meet the requirements of DOE's newly adopted rules for shoreline master programs in response to the ESA, as well as new rules for best available science. For example, the rating of salmon habitat quality within the Snohomish River Estuary and associated nearshore areas using the Tidal Habitat Model (Chapter 4) is expected to satisfy the habitat inventory requirements of the DOE rules.

Recommendation: Local governments will be required to update their shoreline master programs in response to the ESA and to DOE's newly adopted rules for shoreline master programs. For those jurisdictions updating shoreline master programs (Cities of Everett, Marysville, Mukilteo, Lake Stevens, and Snohomish County), the SEWIP work should be incorporated into these efforts. This work can address significant portions of the new master plan requirements and can serve in substantial part to address the "best available science" requirements of GMA.

7.6 SEWIP AS A PART OF PROJECT REVIEW

Local governments will be called upon to respond to projects that may have impacts in the SEWIP study area. Some of these projects will be within the ultimately adopted development footprint and some may be outside of it. How a local jurisdiction responds to the project will depend in part on the status of their regulations and whether or not they have adopted the SEWIP process within their regulatory framework, or can include it within the framework of project review under the State Environmental Policy Act (SEPA). Given the consultation requirements (Section 7), take prohibitions (Section 4d), and third-party lawsuit provisions of the ESA, it is difficult to imagine a jurisdiction that would be legally able to or want to proceed with a project in or near the water that would not undergo some kind of ESA review. The SEWIP provides a basis for biological assessment or evaluation that is highly useful for Section 7 consultation with the federal services (NMFS and USFWS; e.g., Pentec 2000), and which can serve a similar purpose in review of projects not requiring federal review.

Recommendation: Local governments undertaking project reviews should use the SEWIP findings to address impacts associated with project proposals. Appreciating that there remain some differences of opinion on the application of the SEWIP for mitigation, and the appropriate mitigation ratios, the SEWIP is the best available tool for addressing impacts of development. The SEWIP was originally designed to accomplish this task. If a jurisdiction has adopted the SEWIP within its regulatory structure, it can apply the SEWIP as appropriate to the regulation(s). If, on the other hand, the SEWIP has not been incorporated into a jurisdiction's regulations, it can be incorporated on a case-by-case basis under SEPA. Using one process or the other, SEWIP should be applied to address impacts to habitat resulting from development projects.

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Appendix A— Tidal Habitat Model Rationale and Protocols

MANUAL FOR USE AND APPLICATION OF SEWIP TIDAL HABITAT MODEL

INTRODUCTION

BACKGROUND

The Snohomish Estuary Wetland Integration Program (SEWIP) Tidal Habitat Model (the model) is the result of substantial modifications to the anadromous fish portion of the Mudflat Model developed originally by an interagency technical advisory committee (City of Everett et al. 1997). The technical basis and applicability of the Mudflat Model to anadromous fish has been reviewed and modified as a result of the 1999 listing of several Puget Sound anadromous salmonids stocks as threatened with endangerment under the Endangered Species Act. The model modifications were focused on more accurately describing the quality of habitats in the estuary and adjacent nearshore areas for salmonids, with emphasis on chinook salmon, coho salmon, and bull trout. Ecological functions provided by habitats in the SEWIP area include feeding, migration, predator avoidance, and saltwater adaptation. The model provides the tool for inventory and mapping of salmon habitat function, and planning of salmon habitat restoration that is described in the SEWIP Salmon Overlay (City of Everett and Pentec 2001).

Modifications to the Mudflat Model were developed in a series of workshops involving an interagency SEWIP Salmon Overlay Technical Advisory Committee (SSOTAC) composed of biologists from the City of Everett, Snohomish County, the Washington State Department of Ecology (Ecology), the Washington Department of Fish and Wildlife (WDFW), and The Tulalip Tribes. Pentec Environmental biologists provided meeting facilitation and technical input. Although consensus was reached on the great majority of the features of the model, not all aspects of the model were unanimously agreed to by all the SSOTAC participants.

GENERAL APPROACH

The model follows the indicator value assessment (IVA) method of the original SEWIP model and is patterned after the approach of Hruby et al. (1995). The model assesses discrete units of habitat that are delineated by physical changes in habitat types or hydrological boundaries between units of habitat. These discrete units are termed assessment units (AUs). The model asks a series of "yes" or "no" questions about the hydrological, chemical, physical, geomorphological, biological, and landscape features (indicators) present within the AU. The SSOTAC developed these questions and assigned relative values for a positive response to each. Values were based on the degree to which each indicator was judged to be associated with the positive aspects of each function: indicators strongly associated with the function being assessed were assigned a value of 3; those moderately associated were assigned a value of 2; those weakly associated with the function were assigned a value of 1. Aspects of some indicators were judged to be disproportionately beneficial (e.g., large areas of native marsh) or adverse (e.g., severe hydromodification or chemical contamination) to such a degree that they were assigned positive or negative multipliers that are applied to the sum of the values from all the other indicators. Both the indicator value rankings of specific landscape features and the overall value multipliers were assigned metrics based upon evidence from the literature where available, or where literature was lacking, by the collective agreement of the expert panelists.

APPLICABILITY AND GENERAL ASSUMPTIONS

Although developed for use as part of the overall SEWIP, the model is also considered to be fully applicable to other estuary and nearshore conditions around the greater Puget Sound area. The model is designed to be relevant to both tidal estuarine habitats and nearshore environments. Some model questions may not be applicable for both estuarine and nearshore habitats; if the model question is not relevant (or the indicator is not present), the question is simply left as a nonaffirmative answer. In the nearshore, for example, no AU is expected to have a native plant marsh over more than 25 percent of its area; hence this question (16d) likely will never be scored in EMU 6. This will not diminish the model's ability to rate the relative quality of an AU within EMU 6, however. The model is focused only on indicators that are of direct or indirect relevance to anadromous salmonids. Moreover, the model focuses on existing or presumed indicator condition, not on the processes necessary to maintain those conditions. Although the model is clearly focused on the several important functions provided by estuarine and nearshore areas to juvenile salmonids, certain features of the model also serve to rate quality for adult salmon.

DOCUMENT PURPOSE

This document sets forth the underlying rationale and assumptions for each question and provides the model user with background information and protocols to assist in model application. The model is composed of 34 questions. To refine the model sensitivity to complexities and gradients in the environment, several questions include multiple subquestions, with only one subquestion to be answered under each question. This manual lists and describes the main questions. All questions and subquestions can be found in the field inventory sheet, Appendix B.

MAPPING METHODOLOGY

The AUs were first delineated on a series of 1998 aerial photographs obtained by Snohomish County from the Washington State Department of Natural Resources (DNR). This photo series included the County's hydromodification layer, indicating major categories of shoreline modification such as bulkheads, riprap, and dikes. These features were used in conjunction with major transitions in riparian condition or shoreline morphology in the initial delineation (done in the office) of AUs. This photo series was taken to the field and used as the base map and a primary data source for field assessment of each AU using the model. Some AU boundaries were adjusted on the basis of field observations of transitional conditions that were not evident in the photos alone.

Final AU boundaries were transferred onto a second series of 1996 aerial photographs available in the City's GIS system so that the area of each AU could be calculated.

In defining the specific AU boundaries in the waterward and landward directions, the following conventions were used:

1. Waterward Boundary

   - For nearshore AUs in EMU 4 through 7, the waterward boundary was set at -30 ft mean lower low water (MLLW), the approximate limit of productive vegetative growth that directly forms habitat for salmonids (e.g., beds of bull kelp, *Nereocystis luetkeana*).

   - In the mainstem Snohomish River, waterward boundary was set at the edge of the dredged navigation channel or at the -10 ft MLLW contour, where bathymetric data were available.

   - In other distributary channels and in the mainstem above the upper turning basin, the waterward boundary was set at 50 ft waterward of the lowest line of vegetation visible in aerial photos except where more extensive shallow sand or mud bars were evident in aerial photos or from the field surveys; in those cases, the boundary was drawn 50 ft waterward of the lowest edge of the visible shallow-water area.

2. Landward Boundary

- In AUs lacking riparian vegetation (e.g., riprapped or bulkheaded areas) the boundary was set at mean higher high water (MHHW).

- In AUs scored as having a riparian buffer (either above or below ordinary high water [OHW]), the landward boundary was set at 25 ft landward of OHW or to the top of any adjacent dike, whichever was least.

In AUs meeting the criterion for large woody debris (LWD) contribution, the boundary was set at one site potential tree height (187 ft) from OHW or to the limit of the trees that could contribute LWD, whichever was least. An exception was made for Otter Island; because of the forested wetland nature of the island and the presence of tidal channels penetrating well into the island, the entire island was considered part of the AU.

Several questions in the model are scored on the basis of portions of the AU that lie within the littoral zone. The littoral zone is defined as that area between MHHW (about +11.2 ft MLLW) to -10 ft MLLW, the area typically considered to be important habitat for juvenile anadromous fish during their early marine life history (e.g., McDonald et al. 1987). In areas where the upper beach is vegetated with water-dependent vegetation, the OHW line will be used to define the upper limit of the AU.

Along the major distributary channels of the Snohomish River, shoreline AUs will be defined and rated down to extreme low water (ELW) in the adjacent channel. This is done to focus assessment of habitat function on those attributes most important to juvenile salmonids. It is assumed that, while moving downstream in the water column of the center portion of the mainstem channels, juvenile salmonids are not dependent on shoreline features that are scored in the model (e.g., McDonald et al. 1987).

ASSUMPTIONS AND FIELD PROTOCOL

INDICATOR GROUP - HYDROLOGY

Question 1: Does AU have a vernal or perennial freshwater stream or spring?

Assumptions: This indicator addresses the feeding and osmoregulatory (saltwater adaptation) functions. Fresh water entering a tidal littoral habitat is assumed to provide increased ecological function by providing a range of small-scale salinity gradients that allow juvenile salmonids to select a salinity compatible with their stage of osmoregulatory adaptation (Thorpe 1994, Healey 1991, Rich 1920). Contributions of fresh water at the saltwater interface can also add diversity of plant and prey assemblages. For example, saltmarshes with freshwater input are more likely to support sedge assemblages that produce prey used by juvenile chinook (Pomeroy and Wiegert 1981). Freshwater streams and springs are especially useful for ocean-type chinook fry that outmigrate to estuary environments shortly after emergence from the gravel (Healey 1982).

Protocol: Answer "yes" if the AU has a freshwater stream or spring during the spring outmigration period. Spring or stream must be of sufficient flow to either modify the vegetative assemblages present or maintain a channel with sufficient depth to provide juvenile salmonids refuge during low tides. Freshwater inflow should be sufficient that salinity in the stream is lower than the ambient tidal water flowing by the AU. Note that presence of a channel is scored separately in Questions 4 and 5; thus, additional value is assumed if the channel is formed by freshwater rather than tidal flow.

Scoring can be done from maps or aerial photographs but may require field survey to verify that the water flow has significant freshwater inflow and does not consist merely of tidal drainage.

Question 2: Is littoral area of AU depositional (slow currents, low wave action)?

Assumptions: This indicator addresses the feeding function. Depositional areas are where settling of fine-grained sediments and organic particles occurs. Depositional areas in estuarine habitats have been shown to be more productive for epibenthic zooplankton prey of juvenile salmonids than are nondepositional areas (e.g., Sibert et al. 1977, Houghton and Gilmour 1997, Houghton et al. 1998).

Protocol: Subquestions are scored based on the percentage of the littoral portion of the AU area that displays depositional characteristics, i.e., fine-grained sediments or accumulations of organic debris. Vegetated marsh areas will almost always be depositional; areas with coarse sand or gravel will seldom be depositional in an estuarine or nearshore environment.

Percentage of AU that is depositional can be determined from maps or aerial photographs, but in many cases will require field verification of breaks in habitat (e.g., sediment) type.

Question 3: Does AU have refuge from high velocities (e.g., during maximum ebb tide)?

Assumptions: This indicator addresses the migration function and is relevant to estuarine AUs only (i.e., it will not be scored for most nearshore areas). Refuge from high velocities during river flooding or during maximum ebb tides allows juvenile salmonids to remain in the estuarine environment longer, potentially increasing the opportunities for feeding and growth before continued migration into the marine environment (Maser and Sedell 1994, Levy and Northcote 1981).

Protocol: Determination that refuge from high velocities is present in an AU may be possible from high-quality aerial photography, but field verification is usually necessary. Features providing this refuge include, but may not be limited to: LWD, large boulders or bedrock features, deep channel areas connected to main distributary channels, blind sloughs, and off-channel mudflat/marsh complexes with low tide refuge. In some cases, artificially constructed features such as wing walls, bridge piers, or riprap may also provide refuge from high velocities (e.g., Maser and Sedell 1994, CDFG 1995).

Question 4: Does AU contain a tidal channel?

Assumptions: This indicator addresses the predation/protection and feeding functions. Shallow tidal channels in marsh/mudflats provide low-tide refuge and feeding opportunities for juvenile salmonids (e.g., Levy and Northcote 1982, Levings 1982, Ryall and Levings 1987, Healey 1991). These functions are especially important for chinook fry (Congleton et al. 1981, Levy and Northcote 1982), as movement by this species into deeper water appears to be controlled by size (Thorpe 1994), probably as a manifestation of predator avoidance. Presence of a channel within an AU allows fish to remain within the AU during low-tide periods (Healey 1982) and prolongs the opportunities for fish to exploit food resources within the AU. Deeper channels and those that remain flooded at tides equal to or lower than MLLW provide additional benefits as deepwater refuge from certain types of predators (e.g., Levy and Northcote 1982). The habitat benefits to chinook of a deep tidal channel are sufficient that a natural, deep tidal channel (or a channel constructed to simulate and function as a natural channel) are given a positive multiplier of 1.5. Channel benefits for bull trout and coho are less well documented but are given a positive multiplier of 1.3. Shallower drainages (i.e., those that do not retain sufficient water for juvenile salmonid residence when the tide falls below mean sea level [MSL]) are still valuable but provide those values for only a portion of the tidal cycle. Constructed navigation channels that bisect an AU were considered to provide many of the functions provided by natural channels.

Protocol: Unless photos taken at different tide stages are available, scoring this indicator will require a site survey. An AU that lies along the margin of one of the major distributary channels of the river does not receive a positive answer for this question unless it has side channels that enter the distributary. "Yes" is the appropriate answer to Question 4a, if the channel is either deep enough (e.g., deeper than 0 ft MLLW) or contains enough runoff flow to provide habitat for juvenile salmonids during low tides. If a natural channel is present but it does not provide habitat below mean tide level, or if a dredged navigation channel is present, answer "yes" to Question 4b.

Question 5: Is tidal channel dendritic or highly sinuous?

Assumptions: This indicator addresses the predation-protection and feeding functions. Most natural unconfined stream channels are sinuous, and channels through broad natural mudflats are often also dendritic, with first-, second-, and third-order channels (Congleton et al. 1981). Increased length provided by channels that are either dendritic or highly sinuous provides increased low-tide refuge area and increased access to more of the AU at more tidal elevations. Healey (1982) also notes that sinuous channels increase trapping of detritus, increasing prey productivity.

Protocol: Channel morphology can be determined using aerial photographs or by site survey. A highly sinuous channel is defined as one that has sinuosity of greater than 1.5; i.e., where the channel length between two points is 1.5 times the straight line distance between the two points. A dendritic channel system within an AU must have multiple secondary channels; the secondary channels can be shallower than the main channel.

INDICATOR GROUP – WATER QUALITY

Question 6: What range of salinity is present in AU?

Assumptions: This indicator addresses the feeding and osmoregulatory (saltwater adaptation) functions. Presence of a range of salinities within the estuarine environment provides staging opportunities for outmigrant and returning salmonids to adjust physiologically between fresh and salt water. The range of salinities available within the estuary transition zone also affects the juvenile salmonid forage base by providing niches unavailable in fresh water only, and thereby a more diverse assemblage of food organisms (e.g., insects and crustaceans) (Pentec 1992). For the function of physiological transition (i.e., up- or down-regulation of gill ATPase activation for adjustment to changing NaCl concentrations), AUs with polyhaline salinities (marine conditions with >18 parts per thousand [ppt] salinity) are considered less important to salmonids than AUs with typically oligohaline or mesohaline salinities (variable salinity often ranging between 0.5 and 5 ppt but occasionally ranging as high as 18 ppt). This difference in importance is a result of the fact that most physiological changes that occur during smoltification occur at the lower salinities (Healey 1982). However, species that spend a greater portion of their early life history rearing in fresh water (e.g., coho, bull trout) may engage in extended rearing in an AU that has predominantly fresh water (almost always <0.5 ppt).

Protocol: The range of salinities within an AU may be based on location within the planning area, ascertained from previous monitoring efforts, or can be evaluated during field survey using either a hydrometer or refractometer. For example, areas in EMU 1 are by definition fresh water, although a deep-channel salt wedge may be present (answer "yes" to Question 6a). AUs in EMUs 4 through 7 are polyhaline (answer "yes" to Question 6c). In EMUs 2 and 3 efforts should be made to characterize the salinities over the tidal range experienced within the AU. This characterization need not require empirical testing, but if modeled, uncertainties should be minimized.

Question 7: Do temperature and dissolved oxygen meet criteria for salmonid health?

Assumptions: This indicator addresses the health and growth efficiency of salmonids in the AU. An AU will provide no function for salmonid rearing or refuge during periods when dissolved oxygen (DO) and/or temperature exceed thresholds of tolerance for the species. Threshold for temperature is considered to be 18^{o}C (64^{o}F) as a 24-hr average. Threshold for DO is considered to be greater than 8 mg/l in fresh water (EMU 1); greater than 6 mg/l in marine areas (EMUs 4 through 7); and greater than 7 mg/l in EMUs 2 and 3. Maximum habitat function is provided when the majority of an AU meets the temperature/DO thresholds at all times. However, if the majority of an AU does not meet temperature and/or DO criteria for salmonids at some times, e.g., mid-day in midsummer, it can still provide suitable habitat at other times, when temperature and/or DO are not limiting.

Protocol: Range of temperature and DO within an AU should be determined from previous monitoring efforts to the extent practicable. Alternatively, or additionally, these data can be collected during field visits with portable field probes. Efforts should be made to characterize the temperature/DO over the tidal and seasonal range experienced within the AU. This characterization could be modeled and need not require field measurement. Measurement of acceptable temperature and DO in an AU in the late spring or summer suggests that these water quality factors would be unlikely to limit salmonid use in the fall through early spring, when temperatures are lower and DOs higher.

INDICATOR GROUP – PHYSICAL FEATURES

Question 8: Shoreline complexity: What is the ratio of the AU high-water shoreline length at MHHW to its linear width at MLLW?

Assumptions: This indicator addresses the migration, predation/protection, and feeding functions. Higher shoreline complexity increases the “edge effect” by increasing the length of shoreline in close proximity to vegetation and the opportunity for fish to feed and find refuge from certain predators along the upper tide line. Shoreline vegetation provides direct shade, cover, and insect fall for juvenile salmonids (e.g., Spence et al. 1996; Cordell et al. 1997, 1998; Hetrick et al. 1998a,b) as well as indirect benefits from contribution of leaves and twigs to the detrital food base within the AU.

Protocol: Waterward edge width is the straight-line distance (e.g., at MLLW) between the boundary lines between the AU in question and the two adjacent AUs, measured parallel to the flow of the adjacent river channel (or parallel to the beach contour, in nearshore AUs; EMUs 4 through 7; see Figure 1). The high-water shoreline at MHHW is approximately the distance a fish migrating in shallow water would follow at high tide in transiting through the AU. In the estuary, this line may coincide with the transition from unvegetated mudflat to vegetated marsh. In a modified AU, the line may be along a dike edge or bulkhead. In nearshore areas, this line may be the high tide wrack line and may or may not be vegetated, or it may follow the MHHW line along a modified (e.g., riprapped) shoreline. If an island is present wholly within the AU, the distance around that island at MHHW is added to the length of the MHHW shoreline around the perimeter of the AU. This question is best answered using aerial photographs taken at low tide.

Question 9: Is AU sheltered from waves?

Assumptions: This indicator addresses the feeding and refuge functions. Shelter from wave action provides a stable sediment/water interface. This stability allows accumulation of fine organic detritus on the sediment surface and allows development of a productive microflora, primarily benthic diatoms. Both detritus and microflora are grazed by epibenthic zooplankters that are prey for juvenile salmonids (Healey 1982, 1991). Shelter from wave action also reduces suspension of sediment that can reduce feeding efficiency of juvenile salmonids For example, Bisson and Bilby (1982) showed that juvenile salmonid feeding efficiency was reduced in waters with turbidities greater than 70 to 100 NTU. (See Newcomb and Jensen 1996 for comprehensive review of suspended sediment effects.)

Protocol: This indicator is scored based on the geographic location and morphological configuration of the AU and surrounding uplands in relation to prevailing winds. Most AUs in EMUs 1 through 3 that are not along the main river channels are sheltered from waves. In some AUs, a portion of the area may be exposed to waves while the remainder is not; answer this question "yes" if more than 50 percent of the AU is sheltered.

Question 10: What is the predominant slope of the AU in the littoral zone?

Assumptions: This indicator addresses the feeding and predation/protection functions. Lower slopes in the littoral zone are presumed to provide small fish with shallow-water escape from certain types of predators such as piscivorous fish (Thorpe 1994). Shallower slopes also tend to be composed of finer sediments and provide a stable sediment/water interface for development of epibenthic zooplankton prey (CDFG 1995).

Protocol: Simple field measurements using a hand-held clinometer or visual observations can be used to score this question. The answer is based on the average slope over the majority of the littoral zone of the AU. For example, an AU with a riprapped margin between OHW and MSL, but with a broad mudflat from the toe of the riprap to the channel edge, would merit a "yes" on Question 10a. (The adverse effects of the riprap would be accounted for in several other questions in the model.)

Most mudflats or marshes are flatter than 10h:1v. Shoreline areas that are modified with riprap are often steeper than 2h:1v and thus would receive no score under this question. Detailed surveying may be needed to score areas with intermediate slopes, such as an AU along a distributary channel with a moderately sloped, diked shoreline.

Question 11: What range of depths is present in the AU?

Assumptions: This indicator addresses the feeding and predation/protection functions. Littoral areas between MHHW and -10 ft MLLW are typically considered to constitute the depth range wherein juvenile salmonids prefer to feed and migrate during their early marine life history (Thorpe 1994, CDFG 1995). This range encompasses the depths at which smaller juvenile salmonids feed primarily on epibenthic prey (e.g., amphipods, harpacticoid copepods, decapod larvae—see Healey 1982); larger smolts transition to a more pelagic lifestyle and feed predominantly on prey such as fish larvae in the water column (Kask and Parker 1972, Healey 1991, Thorpe 1994). Also, availability of shallow water provides alternatives for predator avoidance. Thus, an AU that has more of its area within the littoral depth range is considered to provide better functions for juvenile salmonids than an AU where much of the area is deeper or seldom inundated.

Protocol: Percentage of the AU within the preferred littoral range can be determined in the field or from available bathymetric surveys. Where native marsh vegetation extends above MHHW, the littoral area should be extended to OHW, since the high marsh also contributes to salmonid habitat quality.

INDICATOR GROUP – SEDIMENT TYPE

Questions 12 through 15: What sediment types are found in the littoral portion of the AU?

Assumptions: This indicator addresses the feeding function. Presence of finer-grained sediments, either as a silt or mud bottom or in a matrix of coarser gravel or cobble, is indicative of a more productive littoral environment for salmonid prey, primarily epibenthic crustaceans (CDFG 1995, Pentec 1996, Angell and Balcomb 1982, Simenstad et al. 1991, Sanders 1959).

Protocol: Note that Questions 12 through 15 can each be answered in the affirmative independent of other responses. If the littoral zone of an AU has 75 to 100 percent mud or mixed fine substrates, "yes" is the correct answer to Questions 13 and 14.

Question 12: Answer "yes" if the littoral zone of the AU has more than 25 percent of its bottom covered with silty sand.

Question 13: Answer "yes" if the littoral zone of the AU has 25 to 50 percent of its bottom covered with mud or mixed fine sediments.

Question 14: Answer "yes" if the littoral zone of the AU has more than 50 percent of its bottom covered with mud or mixed fine sediments.

Note: An AU with 80 percent mud or mixed fine substrate would score a "yes" for both Questions 13 and 14, for a total value of 5. Also, an AU with 30 percent silty sand, 40 percent mud, and 30 percent coarse sand or cobble would answer "yes" to Question 12 and "yes" on Question 13, for a total value of 3.

Question 15: Answer "yes" if the AU has spawning habitat for surf smelt or sand lance in the upper intertidal zone.

Surf smelt spawn in a coarse mixture of sand, pea gravel, and shell fragments at high-tide swash lines (Bargmann 1998, Eschmeyer and Herald 1983). Sand lance spawn in sand-gravel substrate in the upper intertidal zone between mean high tide and approximately + 5 ft

(Bargmann 1998). The WDFW baitfish unit in La Conner should be contacted regarding identified spawning areas in any particular AU.

INDICATOR GROUP – RIPARIAN ZONE

Two aspects of the nature of the riparian zone bordering estuarine and nearshore AUs are considered in the model: the extent of tidal marshes below OHW and the extent of riparian scrub-shrub and forest above OHW. It is recognized that the several functions of riparian buffers typically identified as applicable along streams higher in the watershed (e.g., Spence et al. 1996, Brosofske et al. 1997, Hetrick et al. 1998a,b) are not fully applicable in providing similar functions in the estuary and nearshore areas. Nonetheless, these riparian zones do affect the quality of these habitats for salmonids. Questions 16 through 19 address the feeding and refuge (predation/protection) functions.

Question 16: Is the vegetated edge below OHW?

Assumptions: Many tidal areas are bordered by intertidal marshes that serve several of the buffer functions typical in more fluvial systems. For example, the marsh may provide refuge (for juvenile salmonids that can swim in among the vegetation to avoid predators), food (e.g., insect production [Cordell et al. 1998]; amphipods [Levings 1990]), and a source of detrital energy to important food webs. Marshes are a principal foraging area for ocean-type chinook fry (Levings 1990, Thorpe 1994) and are extensively used by salmonids at night (CDFG 1995). The model assumes that juvenile salmonids utilize primarily the waterward edge of tidal marshes and do not penetrate more than a few feet into densely vegetated areas; thus, full functional value is given for an AU with saltmarsh around 50 percent of its shoreline that is greater than 10 ft in width. The additional indirect functions provided in AUs with a tidal marsh of native vegetation covering more than 25 percent of their area are recognized with a 2X multiplier in Question 16d.

Protocol: In most cases, width of the vegetated edge must be assessed from site survey of the AU, as aerial photography will not provide the accuracy to delineate the vegetated edge at the widths defined by the model. Also, assessment of species composition (i.e., non-native vs. native) is required to address the multiplier defined in 16d. Answer “yes” to Question 16d if native species occupy the vegetated edge over greater than 25 percent of the AU surface area below OHW.

Question 17: Is the vegetated edge above OHW?

Assumptions: If the marsh fringe is of sufficient width, the contribution of riparian forests at higher elevations (>OHW) is reduced, or, at the very least, effective only during the highest tides. For example, trees may provide shade along the edge of the high marsh that is seldom underwater; hence, shading will have little effect on water temperature. However, if the saltmarsh fringe is relatively narrow, riparian forests along the edge of the saltmarsh may provide highly effective shading over the water, and relatively increased contributions of organic components to support the detrital food web over that contributed by saltmarsh vegetation alone. Such conditions could be found particularly within the upper estuary. Riparian scrub-shrub and forests are assumed to begin providing significant functions in estuarine and nearshore areas at widths exceeding 25 ft or covering the waterward sides and tops of dikes. Credit is given under Question 17 even where the riparian vegetation is dominated by non-native species such as blackberry, on the assumption that this vegetation will still provide shading, insect fall, and litter fall to the aquatic environment. Additional credit is given under Question 18 if the vegetation is predominantly native species.

Protocol: Width and composition of the riparian forest is usually assessed from a site survey of the AU, as aerial photography may not provide the accuracy to delineate the riparian composition at the widths defined by the model. Answer "yes," as appropriate, among the three qualifiers (i.e., 17a,b,c) based upon field measurements or estimates of the width of the riparian zone above OHW and the extent of the AU high-water margin that has riparian scrub-shrub or forests greater than 25 ft in width. Credit can be given for vegetated widths less than 25 ft where the shoreline configuration supports riparian vegetation for the full width that may interact with the aquatic environment (e.g., the waterward slope and top of a dike).

Question 18: Is the riparian zone vegetation dominated by native species?

Assumptions: It is assumed that riparian vegetation that includes a mix of native species will provide a greater food resource to juvenile salmonids than will a riparian border of non-native species.

Protocol: If the riparian scrub-shrub or forest vegetation is dominated (>50 percent of the total cover) by native species, answer yes to Question 18.

Question 19: Does the riparian zone of the AU provide a significant source of LWD?

Assumptions: This indicator addresses the feeding and predator/protection functions. In general, the role of LWD in providing fish habitat within the estuary and nearshore is assumed to be of lesser importance than its role in freshwater fluvial conditions upstream. This is because of tidal water-level changes, which leave anchored wood submerged, or out of the water, a portion of the time, and because of the reduced importance of the pool-forming function of wood in estuaries where juvenile salmonid use is less than year-round. Late seral stands of riparian forest are necessary to recruit LWD into the active stream channel or marshes accessible to anadromous fish. Immature riparian forests do not provide LWD that will be retained for a long enough period of time in the channel to be considered important fish habitat elements. To be of direct habitat value to salmonids, LWD must be large enough to be retained in the channel and thereby provide hydraulic control, cover, and velocity refuge. Large wood also provides for organic contributions to the estuary and thereby supplements the detrital base (Maser and Sedell 1994).

Relatively smaller sizes of LWD can be retained in lower-energy, off-channel estuarine habitats and thus provide the same functions as larger LWD in more active channels. Mature trees considered for this purpose are those with diameter at breast height (dbh) of more than 0.3 m. Trees recruit to the estuary or nearshore from the adjacent riparian zone are assumed to have limbs and rootwads attached; thus, the criterion for recruitment is similar to that for inwater LWD with limbs or rootwads (Question 20).

Protocol: The state of maturity of a riparian stand can be evaluated from recent, high-quality, aerial photographs, or from field surveys. Answer "yes" to Question 19 if at least 50 percent of the riparian zone of the AU contains mature trees that meet the 0.3-m dbh size criterion, and if those trees have the potential to fall into areas accessible to juvenile salmonids, generally considered to be below MHHW. If the area between MHHW and OHW consists of a broad, vegetated marsh, trees that fall from the riparian forest will land in these vegetated areas and have little potential to provide the full function of LWD in stream or shoreline areas. Although such trees may still provide limited function, they would not be considered to be a significant source of LWD in the context of the model. Diameter at breast height should be considered from field measurements of at least six trees within the AU.

INDICATOR GROUP – LANDSCAPE/CONNECTIVITY

Question 20: Is AU connected to adjacent AU by low- to moderate-gradient littoral habitats?

Assumptions: This question addresses the migration and predator-avoidance functions. Free and safe movement of juvenile salmonids through the sequence of habitats available in the estuary is an important determinant of the overall functional quality of the estuary (Thorpe 1994). Therefore, availability of a safe migration pathway from one AU to the adjacent AU is considered to improve the function of both. A safe migration pathway is defined as a low-gradient, e.g., 5h:1v or flatter, transition from one AU to the next.

Protocol: The boundaries between AUs should be examined during field surveys to determine the nature of shorelines. Often, distinct breaks in shoreline type will be used to define the boundaries of adjacent AUs. If these breaks are the result of shoreline armoring, bulkheading, or deep water, then the two adjacent AUs would be judged to lack shallow-water connectivity. If one AU transitions into the next along a low- to moderate-gradient shoreline in one direction, answer "yes" to Question 20a. If it has low-gradient transitions into adjacent AU on both sides, answer "yes" to Question 20b.

INDICATOR GROUP – SPECIAL HABITAT FEATURES

Question 21: Does the AU contain significant densities of LWD?

Assumptions: This indicator addresses the feeding and predation/protection functions. The relative importance of LWD in providing physical habitat and hydraulic control in the estuary and marine nearshore areas is believed to be lower than in upstream reaches, but it is still important (e.g., Maser and Sedell 1994). Suitable criteria for wood-loading in estuaries and marine areas have not been established by quantitative research and likely would vary substantially over the gradient of conditions present.

The retention of wood in the channel is a function of channel width, wood size, and wood type, whereby wide channels retain proportionately less wood per unit channel length than narrower channels. Most of the wood recruited into estuaries and nearshore areas is derived from upstream sources, not from riparian stands immediately adjacent to AUs within the estuary. For purposes of this model, LWD is defined to include the following:

- logs with length >10 m and diameter >0.6 m
- logs/trees with rootwad and/or branches, length >10 m, and diameter >0.3 m
- stumps with diameter >1 m

Wood-loading densities proposed for the estuary and nearshore reflect a reduced ecological function of LWD in estuary and nearshore areas compared with densities suggested by DNR as needed to rank as "good" loading levels in streams. The inchannel densities assumed in the model to provide full ecological function would rate as "fair" under the Washington State Forest Practices Board (WFPB 1994) watershed analysis protocols for channel widths less than 20 m in streams. This rating is justified on the basis of the reduced functionality of LWD in the estuarine environment (for salmonid habitat), and the "channel widths" found in the estuary that often exceed 20 m. The suggested model LWD assessment values would be within the range considered "good" by Ralph et al. (1991) for Washington streams with channel widths less than 20 m in unmanaged forests (range reported: 0.46 to 3.95 pieces per channel width). LWD criteria have typically been based on number of pieces per linear distance of stream channel, reflecting the derivation of those values. LWD densities (number of pieces per 100 m^2) are also proposed for broader marsh and mudflat areas that are prevalent in estuarine areas, although no field measurements are available upon which to base these levels.

Protocol: Wood loadings within a channel edge or nearshore AU must be assessed by field survey of the AU. Number of pieces by size class along the edge of the MHHW line should be counted along with those visible at lower water levels. In a broader marsh or mudflat AU, the number of pieces of LWD visible between MLLW and MHHW is counted and divided by the area of the AU between the same boundaries.

Question 22: Does the AU support macroalgal coverage over more than 10 percent of the littoral area during the spring outmigration period?

Assumptions: This question addresses the feeding and predator-avoidance functions. Macroalgae, especially where represented by several species, provide a substrate for growth of diatoms and for grazing by epibenthic crustaceans that constitute an important prey of juvenile salmonids (Northcote et al. 1979, Healey 1982, Levings 1990). In nearshore areas, macroalgae such as rockweed (*Fucus gardneri*) and laminarians (e.g., *Laminaria saccharina*) also provide vertical structure above the bottom that can provide refuge for juvenile salmonids from piscivores.

Protocol: This question may be scored based on high-quality color or color-infrared photographs; if such photographs are not available, a springtime field survey will be required. Area of coverage within the littoral zone will be visually estimated.

Question 23: Does the AU support eelgrass along the lower intertidal edge?

Assumptions: This question addresses the feeding and predator-avoidance functions. Eelgrass (*Zostera marina*) has been demonstrated to provide high-quality feeding and refuge habitat for juvenile salmonids (e.g., Simenstad and Wissmar 1985, Levings 1990, Thorpe 1994). Harpacticoid copepods in particular may be highly abundant on eelgrass blades. Eelgrass also provides a substrate for spawning by herring and may also provide structure for predator avoidance (e.g., Thom et al. 1994). Eelgrass may be found between about +2 ft and -18 ft MLLW, depending on water clarity.

Note: While the importance of eelgrass in overall AU function for juvenile salmonids is reflected in the SEWIP Model, the model and SEWIP management policies cannot be used as the sole means of addressing eelgrass impacts and mitigation requirements from a development proposal. Actions that might affect eelgrass beds must also comply with WDFW policies and the state Hydraulic Code (WAC 220-110).

Protocol: This question may be scored based on high-quality color or color-infrared photographs; if such photographs are not available, field surveys will be required. Field surveys should be conducted between late spring and early fall by diver, underwater video, or by extreme low-tide foot or boat surveys.

Question 23a: Answer "yes" if eelgrass is present along 5 to 10 percent of the low-tide shoreline of the AU.

Question 23b: Answer "yes" if eelgrass is present along more than 25 percent of the low-tide shoreline of the AU.

Question 23c: Answer "yes" if eelgrass is present along 10 to 25 percent of the low-tide shoreline of the AU.

Question 23d: Answer "yes" if eelgrass is present over more than 25 percent of the entire area of the AU.

This question (23d) results in a multiplier of 2 times the entire score for the AU and reflects the high importance placed on eelgrass for juvenile salmonids and for overall nearshore ecosystem function.

Question 24: Do functioning feeder bluffs provide a significant source of sediment to the AU?

Assumptions: This question addresses the feeding function. Erosion of gravel feeder bluffs along the shorelines of Puget Sound is a major contributor to the maintenance of certain types of shoreline habitat (e.g., Canning and Shipman 1995), including areas that support spawning by important forage fish species (Bargmann 1998, Eschmeyer and Herald 1983). In many areas of Puget Sound, feeder bluffs have been isolated from erosion by shoreline hardening (see Question 30) increasing the relative importance of remaining bluffs.

Protocol: This question is best scored during a field visit. Answer "yes" if a feeder bluff is present that is not cut off at its base from wave erosion and longshore sediment transport, and if the bluff appears to provide a significant sediment source to the associated beach.

INDICATOR GROUP – STRESSORS

Question 25: Is access to the AU by anadromous fish limited?

Assumptions: Artificial (man-made) barriers to immigration and emigration limit habitat use by salmonids for rearing, and thereby may reduce the overall carrying capacity of the estuarine environment for salmonid production. Any AU with access restricted by an artificial barrier over 90 percent of the time is considered to provide no function for salmonids, and the model score for such an AU would be zero (i.e., no value). Many portions of estuarine habitats will be naturally restrictive at certain times of the year because of high water temperatures or tidal conditions; such natural restrictions to habitat use are not penalized under this protocol.

Freshwater and estuarine habitat restrictions may represent the singlemost important element to reducing the ability of a system to support salmonids. Variable stressor penalties recognize that not all barriers are complete; that is, some habitat may be accessible under some tidal conditions and not others. Stressor penalties increase with increasing access restrictions to habitat. Artificial barriers restricting estuarine use include diking, ditching, dredging, and impassable or restrictive tide-gated culverts (Beechie et al. 1994).

Protocol: To answer this question, the assessor must examine the AU for the presence/ absence of culverts and/or dikes. If these are present within the AU, they pose a potential restriction to tidal circulation and immigration/emigration for salmonids. Culverts should be evaluated for length, slope, presence/absence of tide gates, and tide-gate functionality (if present). If present, the assessor should address tide-gate functionality at both low and high tide. The assessor will determine if the potential exists to strand salmonids within the AU on the basis of the evaluation of the tide-gate function. Culvert slope and length will be evaluated for their ability to pass juvenile salmonids upstream on an ebb tide by virtue of the velocity and depth gradients established. Criteria for juvenile salmonid passage will follow those reported by Powers (1997). Dikes or storm berms that totally isolate an AU from salmon-accessible waters on all but flood or extreme tides (e.g., AU accessible less than 10 percent of the time) dictate that it is inappropriate to score the AU for salmon in its present state.

The lowest penalty (Question 25a) recognizes that an AU with partially restricted access (i.e., is inaccessible 25 to 50 percent of the time) may still provide important habitat for salmonids. A barrier restriction that exists 50 to 75 percent of the time (Question 25b) carries a greater risk of stranding or isolation of fish within the AU, thereby resulting in increased mortality. An AU that is only accessible between 10 and 25 percent of the time is considered to provide limited habitat for juvenile salmonids and is assigned the lowest decimal multiplier.

Question 26: Does the AU contain accumulations of wood debris (e.g., bark) over the bottom?

Assumptions: This question addresses the feeding function. Small to moderate accumulation of wood debris on the bottom (up to 40 percent by volume) can have a stimulatory effect on benthic assemblages (Kathman et al. 1984, Schaumberg and Walker 1973). However, dense accumulations of wood debris that smother the bottom (i.e., reach 100 percent cover of the bottom) have been shown to have a strongly negative effect on benthic infauna and to result in significant changes to epibenthos (e.g., Conlan and Ellis 1979, Jackson 1986, Freese and O'Clair 1987).

Protocol: Two levels of wood debris accumulation are reflected by Questions 26a and 26b. For AUs that are largely intertidal, this question can be answered by a field reconnaissance during low tide. Subtidal areas where wood debris accumulations can be expected must be surveyed by some combination of grab sampling, video observations, or diver observations.

Question 27: Does intertidal log raft storage occur in the AU?

Assumptions: This question addresses the feeding function. Grounding of log rafts at low tide can affect the benthic community by compacting sediments, smothering organisms, and precluding access to the underlying sediments. Zegers (1979) found an 88 to 95 percent reduction in benthic organism populations in Coos Bay, Oregon, due to grounding of logs. Smith (1977) found that the only benthic organism not affected by grounding of logs in the Snohomish River Estuary was the epibenthic amphipod *Anisogammarus*. (These animals, which are a preferred prey species of juvenile salmonids, may have been attracted to the log rafts.) This question is scored based on the percentage of the AU affected by log raft storage on a recurring basis (i.e., more than once a quarter), because the effects of log raft grounding on epibenthic prey of juvenile salmonids diminish rapidly with time since the last storage (e.g., Cheney 1989).

Protocol: Answer "yes" to Question 27a if log rafts have affected 10 to 50 percent of the AU in the last 3 months. Answer "yes" to Question 27b if log rafts have affected more than 50 percent of the AU in the same time period.

Question 28: Do water column contaminant concentrations exceed salmonid thresholds for health or survival?

Assumption: This question addresses the feeding and health functions. Toxicants within the water column could cause direct mortality, preclude the use of habitat, or cause sublethal toxicity to salmonids during periods of exposure within an AU. For example, outmigrant juvenile salmonids passing through a PCB- and PAH-contaminated portion of the Duwamish River Estuary were found to exhibit reduced disease resistance relative to unexposed control group fish (Arkoosh et al. 1998). The impact from such exposures to the overall salmonid population within a WRIA is assumed to be proportional to the relative percentage of the population exposed to those conditions when such thresholds are exceeded. Thus, if water column thresholds are exceeded during periods of high abundance, then the impact could be significant; if thresholds are exceeded during low abundance periods, the impact from the stressor would be less significant. The SEWIP stressor multipliers reflect this proportionality difference, by assigning multipliers of 0.3 and 0.7 to the total score during periods of high and low salmonid abundance, respectively. It is assumed that exceedance of existing water quality toxicant standards within an AU would equate to a potentially stressful condition for salmonids, and such exceedances, if present over a significant portion of the AU, would warrant the application of one of the above stressor multipliers; stressors present in a limited, permitted, mixing zone within the AU would not warrant a positive response to these questions. It is also assumed that these stressor multipliers would be assigned to anthropogenic toxicants only. Conventional water quality parameters (temperature and DO) are not evaluated under the stressor categories (see Question 7).

Protocol: Evaluation of water column pollutants within an AU can be conducted by review of relevant and applicable data from the site or from a nearby location that could be construed to exhibit similar conditions based upon site history. If there were no historical record of industrial activity on or near the site, it would be unlikely that toxicant exceedances in the water column would exist. Should field reconnaissance suggest that water quality is locally impaired within the AU, then field sampling should be conducted and samples submitted to a qualified laboratory to define the extent and significance of impairment. Field observations of odd color, odor, sheen, or unusual biological indicators (e.g., dead fish, dead algae, etc.) would be indicators to the assessor that water samples should be collected and submitted for analysis. If water samples are collected, site conditions will dictate whether simple grab samples or depth-integrated sampling is warranted. Standard water sampling protocols will be followed in accordance with laboratory procedures (APHA et al. 1995).

Question 29: Do AU sediments contain contamination at levels that may affect salmonid health or prey base?

Assumptions: This question addresses the feeding and health functions. Toxicants within sediment may serve as a source of bioavailable contaminants to which salmonids could be exposed within an AU. Contaminated sediments could preclude the use of habitat or cause sublethal toxicity to salmonids during periods of exposure within an AU. They could also affect the species abundance and distribution of critical salmonid food organisms. The direct impact from contaminated sediment exposures to the overall salmonid population within a WRIA is proportional to the total area affected, and the concentrations of the contaminants within the area contaminated as defined by the state sediment quality standards (SQS) or cleanup screening levels (CSLs). The SQS and CSLs are biological criteria based on benthic infaunal taxa not directly trophically linked to salmonids. Since salmonids do not depend heavily on food webs based on infauna, it is assumed that the adverse effects of sediment contamination on salmonids are less severe than those of water column contamination.

Protocol: Existing data will be used to evaluate sediment conditions within an AU, to the extent possible. Should there be no foreseeable source of contamination to the site (e.g., no on-site or adjacent industry, or recent history of such) then it will be assumed that the sediment would meet salmonid use thresholds. If review of the site history indicates otherwise and no sediment evaluations have been conducted, then sediment sampling will be considered. Existing sediment sampling protocols will be followed in accordance with local jurisdiction requirements. Thus, sampling may involve grab samples for surficial sediments or sediment coring. Site-specific protocols will be developed for each evaluation in conjunction with regulatory authorities.

Thus, if SQS thresholds are exceeded over more than 25 percent of the AU, a multiplier of 0.8 is applied to the total SEWIP score, whereas if the higher CSL levels are exceeded over the same aerial extent, a multiplier of 0.6 is applied. Similar to the water column evaluations of toxicants, it is also assumed that these sediment-stressor multipliers would be assigned to anthropogenic toxicants only; thus, conventional sediment quality parameters (e.g., grain size, total organic carbon) are evaluated.

Question 30: Does AU shoreline include riprap or vertical bulkheads extending below MHHW?

Assumptions: This question addresses the feeding, migration, and predator-avoidance functions, as well as shoreline sediment source and transport processes, and reflects the horizontal extent of shoreline hardening. It is widely assumed that juvenile salmonids encountering vertical bulkheads or steep riprap as they migrate along estuarine or marine shorelines are more vulnerable to predation than they are as they migrate along gradually sloping beaches (e.g., Heiser and Finn 1970, Thom et al. 1994). Smaller fish (e.g., pinks, chums, and ocean-type chinook) are considered to be more vulnerable to predation along a vertical bulkhead than larger fish such as stream-type chinook, coho, and bull trout. Limited observations of predation along bulkheads and riprap in the Everett Harbor area (Pentec 1997) found that larger salmonids (possibly bull or cutthroat trout) were the primary predators on smaller salmonids. Thus, vertical bulkheads result in a lesser reduction of habitat function (a higher decimal multiplier) for bull trout and coho than for chinook. Vertical bulkheads also provide less shallow-water surface area for generation of epibenthic prey favored by smaller juvenile salmonids and may force fish to switch to pelagic prey.

Riprapping or bulkheading of shorelines also interferes with normal shoreline sediment erosion and deposition processes (e.g., Canning and Shipman 1995). Thus, bulkheads or riprap at any slope that limits natural shoreline processes is scored under this question.

Protocol: This question can be answered either through site photographs of sufficient detail or through a site visit. Answer "yes" to Question 30a if the AU high-water shoreline has 10 to 50 percent riprap or vertical bulkheads, or "yes" to Question 30b if more than 50 percent of the shoreline is hardened.

Question 31: Do riprap or bulkheads extend below MSL over the majority of the hardened AU shoreline?

Assumptions: This question addresses the feeding, migration, and predator-avoidance functions and reflects the vertical extent of shoreline hardening. The tidal nature of littoral habitat is recognized along with the fact that riprap or bulkheading can eliminate a large proportion of the intertidal habitat that would normally be available to juvenile salmonids. AUs in which the majority of the shoreline hardening extends below MSL (about +6 ft MLLW) will lack essential natural features of upper intertidal habitat and will be reduced in overall area. Migrating fish will encounter the hardened shoreline over 50 percent of the time. Therefore, this condition is scored with an additional decimal multiplier.

Protocol: This question can be answered either through site photographs of sufficient detail or through a site visit. Answer "yes" to Question 31 if shoreline hardening extends below MSL over a major portion (e.g., more than 25 percent) of AU shoreline scored as hardened in Question 30.

Question 32: Does the AU have one or more finger piers or marginal wharfs?

Assumptions: This question addresses the predator-avoidance function. Limited studies and observations have shown that a portion of shoreline-migrating juvenile salmonids, upon encountering a large overwater structure in marine areas, may either delay further shoreline movement for a time or move waterward along the margin of the wharf (e.g., Pentec 1997, Heiser and Finn 1970). It is presumed that those fish that move into deeper water or farther from shore may become more vulnerable to certain types of predation than they would be had they not encountered the wharf, although there is little information in the literature to document this predation (Pentec 1997, Simenstad et al. 1999). The degree of light penetration under the structure is considered to be important in determining the degree of interruption of migration induced by a wharf, but Ratte and Salo (1985) found no significant difference in the numbers of juvenile salmonids captured under a wharf in Tacoma between periods when the under-wharf area was artificially lighted and when it was unlit.

Protocol: This question can be answered either through site photographs or through a site visit. Answer "yes" to Question 32a if the AU has one finger pier, dock, or wharf greater than

8 ft wide, or “yes” to Question 32b if the AU has either two or more docks that are 8 to 25 ft wide or a single structure that is more than 25 ft wide.

Question 33: Is more than 10 percent of the AU littoral area covered with overwater structures that are more than 8 ft wide?

Assumptions: This question addresses the feeding, migration, and predator-avoidance functions. Shading of littoral area bottoms can reduce or eliminate benthic primary productivity. The effect is seen between elevations of about +8 ft MLLW (on most substrates; OHW in a marsh area) and -10 to -25 ft MLLW (depending on water clarity). Above +8 ft MLLW, there is little primary production on most substrates and rates of production are more limited by high light and desiccation; reduced light levels (e.g., partial shading by a narrow dock) can actually increase primary productivity at higher elevations. Overwater structures such as marina floats, while they may produce substantial epibenthic prey (e.g., Kozloff 1987), can create a maze that surface-oriented juvenile salmonids can follow in random directions, potentially delaying their progress along a given reach of shoreline. Overwater structures, like finger piers, can also lead fish into deeper water where they may be more vulnerable to certain types of predation than they would be in shallower waters. However, Cardwell et al. (1980) found that abundance of chinook and coho salmon, as well as herring, were higher inside the Skyline Marina than outside, and they noted a scarcity of fish and avian predators on juvenile salmonids within the marina. They also reported that prey favored by chinook and coho juveniles were more abundant in the marina than in nearby Burrows Bay.

Protocol: This question can be answered by scale drawings, aerial photographs, or by on-site measurements. Areas with light-transmissive grating or other material should be subtracted from the area of coverage before scoring this question. Answer “yes” to Question 33a if the AU has a total overwater coverage of 10 to 30 percent of its total littoral area; “yes” to Question 33b if overwater coverage is between 30 and 50 percent; “yes” to Question 33c if overwater coverage is between 50 and 75 percent; and “yes” to Question 33d if overwater coverage is greater than 75 percent.

Question 34: Is littoral area in the AU routinely disturbed by propeller scour, oil spills, or dredging?

Assumptions: This question addresses the feeding and salmonid health functions. Routine or recurring disturbances of the benthic environment that reduce the productivity or health of epibenthic prey of salmonids degrade the quality of the habitat. Propeller scour can resuspend finer and more richly organic surficial sediments that provide habitat for epibenthic zooplankters. Chronic oil releases can leave the epibenthos in a constant state of early recovery from an oiling event and could result in increased bioaccumulation of PAHs in salmon via a sediment-to-epibenthos pathway (e.g., Arkoosh et al. 1998). Dredging will eliminate less mobile existing benthos from an area and may result in a postdredging bottom that is less rich in organic matter, and which serves as a basis for epibenthic food webs upon which juvenile salmonids are dependent (e.g., Healey 1982). However, recovery of benthos, and especially of epibenthos, is expected to be rapid (e.g., McCauley et al. 1977, Richardson et al. 1977, Romberg et al. 1995.)

Protocol: Answer "yes" to Question 34 if any one of the following is applicable:

1. AU is sufficiently shallow to be scoured by vessel propeller wash over 25 percent of the littoral portion of the AU on a recurring basis.

2. The nature of use of the AU or adjacent areas is such that oil sheens are frequently visible on the water surface along the shoreline and can be assumed to affect at least 25 percent of the AU on a recurring basis.

3. The AU contains areas that are dredged for maintenance of navigation depths on a recurring basis; e.g., more than once every 6 years.

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Appendix B—
Field Inventory Sheet

Appendix B SEWIP Salmon Overlay Field Inventory Sheet.

SEWIP IVA for Estuarine or Marine Habitat					
(This model assumes source of water is tidal fresh, brackish, or marine)	* BT-bull trout, CH-chinook, CO-coho, F-feeding, H-health/toxicity, M-migration, O-osmoregulatory, P-predator avoidance				
Date **Surveyors** **On Site or Off Site? Circle**					
AU # **Supplement w/Aerials?** **Date and Type?**	Y/N	CH*	CO/BT*	Functions Addressed*	Comments
Hydrology				F, M, O	
1 AU has vernal or perennial freshwater stream or spring		3	3	F, O	
2a AU is depositional (slow currents, low wave action) over 25% of littoral area		2	2	F	
2b AU is depositional (slow currents, low wave action) over 50% of littoral area		3	3	F	
3 AU has refuge from high velocities (e.g., during max. ebb)		3	3	M, P	
4a AU contains a natural tidal channel wetted at MLLW		X1.5	X1.3	F, P	
4b AU contains tidal channel wetted at MSL (i.e., shallow drainage)		2	2	F, P	
5 Tidal channel is dendritic or highly sinuous		3	3	F, P	
Water Quality					
6a Fresh water only (salinity <0.5 ppt)		1	3	F	
6b Oligohaline to Mesohaline (sal. variable: often 0.5 to 5 ppt, but can range to 18 ppt)		3	3	F, O	
6c Polyhaline (sal. typically 18 to 30 ppt)		1	1	F, O	
7a Temp/DO meet criteria for salmonid health during major use periods		2	2	H	
7b Temp/DO meet criteria for salmonid health at all times		3	3	H	
Physical Features					
Vascular plant/mud (or sand) flat boundary (vegetated/unvegetated boundary)					
Shoreline complexity					
8a Ratio of length of MHHW boundary to width at MLLW >3 (include islands)		3	3	F, P	
8b Ratio of length of MHHW boundary to width at MLLW 1.2 to 3 (include islands)		2	2	F, P	
8c Ratio of length of MHHW boundary to width at MLLW <1.2 (include islands)		1	1	F, P	
Exposure					
9 AU is sheltered from waves		2	2	F	
Slope					
10a Slope of substrate in littoral zone >10h:1v (i.e., low gradient)		3	3	F, P	
10b Slope of substrate in littoral zone <10h:1v but >5h:1v (i.e., moderate)		2	2	F, P	
10c Slope of substrate in littoral zone <5h:1v but >2h:1v (i.e., steeper)		1	1	F, P	

Appendix B SEWIP Salmon Overlay Field Inventory Sheet.

AU # Date Surveyors	Y/N	CH	CO/BT	Address	Comments
Range of Depths					
11a >10% of AU is littoral (MHHW to -10 ft; use OHW if marsh veg. above MHHW)		1	1	F, P	
11b >25% of AU is littoral (MHHW to -10 ft; use OHW where vegetation indicates)		2	2	F, P	
11c >50% of AU is littoral (MHHW to -10 ft; use OHW where vegetation indicates)		3	3	F, P	
Sediments (surficial only)					
12 Substrate in littoral zone - silty sand >25% of area		1	1	F	
13 Substrate in littoral zone - mud or mixed fine 25 - 50% of area		2	2	F	
14 Substrate in littoral zone - mud or mixed fine >50% of area		3	3	F	
15 Upper intertidal zone contains potential forage fish spawning habitat		3	3	F	
Vegetated Edge					
Below OHW					
16a Buffer: marsh edge >10 ft wide over 50% of shoreline		3	3	F, P	
16b Marsh edge >5 ft wide over 50% of shoreline; or >10 ft wide over 25-50% of shoreline		2	2	F, P	
16c Marsh edge exists but <5 ft wide, or less than 25% (but >5%) of shoreline		1	1	F, P	
16d Marsh of native species occupies more than 25% of total AU		X 2	X 2	F	
Above OHW (riparian zone)					
17a Riparian scrub-shrub and/or forested >25 ft wide over 10 to 24% of shoreline		1	1	F, P	
17b Riparian scrub-shrub and/or forested >25 ft wide over 25 to 50% of shoreline		2	2	F, P	
17c Riparian scrub-shrub and/or forested >25 ft over 50% of shoreline		3	3	F, P	
18 Riparian vegetation is dominated by native species		1	1	F	
19 Riparian zone provides significant source of LWD recruitment		X1.5	X1.5	F, P	
Landscape					
20a AU has low- to moderate-gradient intertidal continuity with adjacent AU (one side)		1	1	M, P	
20b AU has low- to moderate-gradient intertidal continuity with adjacent AUs (both sides)		3	3	M, P	
Special Habitat Features					
LWD Density (LWD must be in the IT zone below MHHW)					
21a 1.0 piece/channel width, /30 m of shoreline, or /100 m² of AU whichever is greater		3	3	P	
21b 0.5 piece/channel width, /30 m of shoreline, or /100 m² of AU whichever is greater		2	2	P	
21c 0.2 piece/channel width, /30 m of shoreline, or /100 m² of AU whichever is greater		1	1	P	

Appendix B SEWIP Salmon Overlay Field Inventory Sheet.

AU # Date Surveyors	Y/N	CH	CO/BT	Address	Comments
Submerged Vegetation (note provisions with regard to impacts to macrovegetation)					
22 Algal cover over 10% of littoral area (during springtime)		1	1	F, P	
23a Eelgrass or kelp (laminarians) is present along 5 - 10% of low tide line of AU		1	1	F, P	
23b Eelgrass or kelp (laminarians) is present along 10 - 25% of low tide line of AU		2	2	F, P	
23c Eelgrass is or kelp (laminarians) present along more than 25% of low tide line of AU		3	3	F, P	
23d Eelgrass or kelp (laminarians) occupies more than 25% of total area of AU		X 2	X 2	F, P	
24 Do functioning feeder bluffs provide a significant source of sediment to the AU?		X 2	X 2	F	
Stressors					
25a Immigration/emigration restricted 25 to 50% of the time		X 0.8	X 0.8	M	
25b Immigration/emigration restricted 50 to 75% of the time		X 0.5	X 0.5	M	
25c Immigration/emigration restricted 75 to 90% of the time		X 0.3	X 0.3	M	
26a Wood debris present on the bottom 25% to 75% cover over AU		X 0.7	X 0.7	F	
26b Wood debris present on the bottom >75% over AU		X 0.5	X 0.5	F	
27a Log rafting affects 10 - 50% of AU on a recurring basis		X 0.7	X 0.7	F	
27b Log rafting affects over 50% of AU on a recurring basis		X 0.5	X 0.5	F	
28a Water col. conditions exceed salmonid thresholds during periods of high abundance		X 0.3	X 0.3	H	
28b Water col. conditions exceed salmonid thresholds during periods of low abundance		X 0.7	X 0.7	H	
29a Sediment chemical contam. present (>SQS over more than 25% of AU)		X 0.8	X 0.8	F, H	
29b Sediment chemical contam. present (>CSL over more than 25% of AU)		X 0.6	X 0.6	F, H	
30a Riprap or vertical bulkheads extend below MHHW for 10 - 50% of shore		X 0.8	X 0.9	P,M,F	
30b Riprap or vertical bulkheads extend below MHHW along >50% of shore		X 0.7	X 0.8	P,M,F	
31 Majority of riprapped or bulkheaded shoreline extends below MSL (+6 ft MLLW)		X 0.8	X 0.9	P,M,F	
32a Finger pier or dock >8 ft wide		X 0.9	–	P	
32b Two or more finger piers or docks >8 ft wide; or single pier or dock >25 ft wide		X 0.8	X 0.9	P	
33a Overwater structures cover 10 to 30% of littoral area in AU		X 0.8	X 0.9	P,M,F	
33b Overwater structures cover 30 to 50% of littoral area in AU		X 0.7	X 0.8	P,M,F	
33c Overwater structures cover 50 to 75% of littoral area in AU		X 0.5	X 0.7	P,M,F	
33d Overwater structures cover >75% of littoral area in AU		X 0.4	X 0.5	P,M,F	
34 Littoral benthic habitat routinely disturbed by prop wash, chronic oil spills, or dredging		X 0.9	X 0.9	H, F	

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Appendix C— Success of Estuarine and Shoreline Restoration Projects

Appendix Table C.1 Summary of the relative success of Puget Sound and coastal estuarine and nearshore restoration/mitigation projects.

Project Name	Location	Size (acres)	Restoration (R) or Mitigation (M)	Monitoring (No. of Years) Salmon	Epibenthos	Other	Results[1]	Success Index[2]	Authors
Demonstration of beneficial use of dredged material	Jetty Is. Port Gardner	30	R	2 (Years 0, 2, 4)	2 (Years 0, 2, 4)	Birds (Years 0, 5); saltmarsh veg. (Years 3, 5)	5-yr goals of salmonid use and epibenthic zooplankton production met; 4,000% increase in salmonid habitat as measured by project-specific model; no significant difference in saltmarsh vegetation between planted area and ref. marsh.	3	Pentec 1996
Slip 1 Mitigation Beach, 1984	Blair Waterway	0.2	M	3	5	Vegetation	Epibenthic densities much greater than Nanaimo River Estuary; <u>inconsistent numbers of juvenile salmon--large numbers in 1988, but few in 1989 and 1990</u>; diatom growth typical of flora of nearshore areas in Puget Sound.	2	FishPro 1990
Gog-Li-Hi-Te Wetland Construction	Puyallup River	9.6	M	5	5	Birds and Carex (Years 0.5, 1.5, 2.5, 3.5, 4.5)	Highly selective foraging behavior by juvenile salmon and long residence times indicate a beneficial foraging area, although results are preliminary and no comparisons to other wetlands have been made; 10- to 20-fold increase in epibenthos by Year 2; 112 species of birds documented by 1990; 70% of which observed during first year. <u>Atypically high sedimentation rates a concern.</u>	2 or 3	Shreffler et al. 1990, 1992; Simenstad and Thom 1996
Terminal 91 Port of Seattle	Terminal 91	1.2	M	2	2		Numbers of epibenthic invertebrates were highly variable and in the same range as reference sites; juvenile chum and chinook preyed upon epibenthic fauna. <u>Salmonid numbers and comparisons to reference were not available.</u>	2?	Williams 1990 (not available)
Tacoma Kraft Mill	Puyallup River	17	M	< 10	8	Benthic 10	Salmon found to be present in numbers equal to adjacent areas; benthic and epibenthic communities commonly equaled or exceeded reference stations.	3	Parametrix 1990-1998

continued

Appendix Table C.1 Summary of the relative success of Puget Sound and coastal estuarine and nearshore restoration/mitigation projects.

Project Name	Location	Size (acres)	Restoration (R) or Mitigation (M)	Monitoring (No. of Years) Salmon	Epibenthos	Other	Results[1]	Success Index[2]	Authors
Slip 5 Mitigation Area, 1988	Commence-ment Bay	2.5	M	4	4		Chinook, chum, and pink salmon were present at generally higher numbers than reference beach between Sitcum and Milwaukee waterways; epibenthic abundance equaled or exceeded reference beaches for most periods.	3	Jones & Stokes 1991a,b, 1992, 1995
Chehalis River, 1990	Chehalis River	1.6	M	2		Salmon stomach fullness - 2 years	Juvenile chinook residence and emigration times comparable with reference; taxonomic composition of stomach contents in juvenile chinook and coho similar to reference; significantly lower stomach fullness for both species in the constructed habitat.	2 or 3	Miller and Simenstad 1997
Middle Waterway Marsh, 1994	Commence-ment Bay	5	M	3		Saltmarsh plants - 3 years	Juvenile salmon showed only small numbers, apparently due to high tidal elevation and lack of lower intertidal connection to deeper water; most saltmarsh plants develop slowly; marginal success for transplants.	1	Parametrix 1996-1998
Sitcum Waterway Remediation Project, 1995	Commence-ment Bay	18.5	M		Benthos - ?	Birds (4 surveys in 1996/97; macroalgae 1996)	27 species of birds were observed in the constructed habitat; all saltmarsh plants were destroyed by geese; benthos: lower number of taxa and mean abundance at the constructed site.	0	Parametrix 1996-1998a,b
ASARCO Pilot Cap, 1997	Commence-ment Bay	0.67	M		3 benthic surveys in 1 year		Benthic species - 40% of reference at 3 months, 50% at 6 months, 78-95% at 12 months; benthic abundance - 25% of reference at 3 months, 25% at six months, 100% at 12 months.	3 (limited number of targeted benefits; salmonids not monitored)	Parametrix 1999

continued

Appendix Table C.1 Summary of the relative success of Puget Sound and coastal estuarine and nearshore restoration/mitigation projects.

				Monitoring (No. of Years)					
Project Name	Location	Size (acres)	Restoration (R) or Mitigation (M)	Salmon	Epibenthos	Other	Results[1]	Success Index[2]	Authors
Marysville Wastewater Treatment Facility Wetland Mitigation Site	Ebey Slough	13.7	M	5		Vegetation, wildlife, water, substrate elevation - 5 years	Wetland vegetation increased from 9 species after Year 1 to 14 species at Year 5 (max. 17 species Year 4) with a maximum coverage of 80%. Juvenile salmonids were sampled in 4 of 5 years in modest numbers (4 to 51 individual salmonids). Substantial increases in the number of birds associated with wetlands compared to adjacent areas with preproject conditions. Primary uses are as migrant and wintering habitat, rather than breeding habitat.	3	Jones & Stokes 1996; 1999a,b,c
Spencer Island Breach-Dike Wetland, 1994	Snohomish River		R	2		Benthic - 2	Sampling consistency of juvenile chinook and chum salmon across the sampling period suggests regular use of the breached restoration area; 5 times as many salmonids were caught in 1998 than in 1997, although differences may be due to more efficient sampling methods; benthic community is dominated by taxa that can dominate freshwater as well as estuarine habitats; salinity data indicates that the wetland does not experience regular saltwater intrusions.	3	Cordell et al. 1998, 1999
Fraser River Estuary Sites, 1985-1989	Fraser River		?	?	?	?	<u>Abundance of chinook and chum fry were similar at transplant, reference, and disturbed areas;</u> <u>chinook and sockeye smolt abundance were highest at disturbed sites</u>. Chum residence time was similar among all sampling areas; three of the four transplant sites had plant biomass similar to reference sites; abundance and number of insect taxa at transplant sites similar to reference but higher than disturbed sites.	2	Levings and Nishimura 1997

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[1] Underlined factors caused decrease in Success Index.

[2] Success Index:

3 = High Success - All (>75%) of targeted habitat benefits and objectives achieved.

2 = Moderate Success - 25 to 75% of targeted habitat benefits and objectives achieved.

1 = Low Success - <25% of targeted habitat benefits and objectives achieved.

0 = Failure - few to none of anticipated habitat benefits gained.

Appendix Table C.1 (continued).

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Project name	Results*	Success Index**	Authors
Demonstration of beneficial use of dredged material	5-yr goals of salmonid use and epibenthic zooplankton production met; 4000 % increase in salmonid habitat as measured by project specific model; no significant difference in saltmarsh vegetation between planted area and ref. marsh.	3	Pentec 1996
Slip 1 Mitigation Beach, 1984	Epibenthic densities much greater than Nanaimo River Estuary; inconsistent numbers of juvenile salmon--large numbers in 1988, but few in 1989 and 1990; diatom growth typical of flora of nearshore areas in Puget Sound.	2	FishPro 1990
Gog-Li-Hi-Te Wetland Construction	Highly selective foraging behavior by juvenile salmon along with long residence times indicate a beneficial foraging area, although results are preliminary and no comparisons to other wetlands have been made; 10-20 fold increase in epibenthos by year 2; 112 species of birds documented by 1990; 70 percent of which observed during first year. Atypically high sedimentation rates a concern.	2 or 3	Shreffler et al. 1990 and 1992; Simenstad and Thom 1996
Terminal 91 Port of Seattle	Numbers of epibenthic invertebrates were highly variable and in the same range as reference sites; juvenile chum and chinook preyed upon epibenthic fauna. Salmonid numbers and comparisons to reference were not available.	2	Williams 1990 (not available)
Tacoma Kraft Mill	Salmon found to be present in numbers equal to adjacent areas; benthic and epibenthic communities commonly equaled or exceeded reference stations.	3	Parametrix 1990-1998
Slip 5 Mitigation Area, 1988	Chinook, chum, and pink salmon were present at generally higher numbers than reference beach between Sitcum and Milwaukee Waterways; epibenthic abundance equaled or exceeded reference beaches for most periods.	3	Jones and Stokes 1991a, 1991b, 1992, 1995
Chehalis River, 1990	Juvenile chinook residence and emigration times comparable with reference; taxonomic composition of stomach contents in juvenile chinook and coho similar to reference; significantly lower stomach fullness for both species in the constructed habitat.	2 or 3	Miller and Simenstad 1997
Middle Waterway Marsh, 1994	Juvenile salmon showed only small numbers, apparently due to high tidal elevation and lack of lower intertidal connection to deeper water; most saltmarsh plants develop slowly, marginal success for transplants.	1	Parametrix 1996-1998
Marysville Wastewater Treatment Facility Wetland Mitigation Site	Wetland vegetation increased from 9 species after Year 1 to 14 species at Year 5 (max. 17 species Year 4) with a maximum coverage of 80 percent. Juvenile salmonids were sampled in 4 of 5 years in modest numbers (4 to 51 individual salmonids). Substantial increases in the number of birds associated with wetlands compared to adjacent areas with pre-project conditions. Primary uses are as migrant and wintering habitat, rather than breeding habitat.	3	Jones and Stokes 1996; 1999a,b,c
Spencer Island Breach-Dike Wetland, 1994	Sampling consistency of juvenile chinook and chum salmon across the sampling period suggests regular use of the breached restoration area; 5 times as many salmonids were caught in 1998 than in 1997, although differences may be due to more efficient sampling methods; benthic community is dominated by taxa that can dominate freshwater as well as estuarine habitats; salinity data indicates that the wetland does not experience regular salt water intrusions.	3	Cordell et al 1998, 1999
Fraser River Estuary Sites, 1985-1989	Abundance of chinook and chum fry were similar at transplant, reference, and disturbed areas; chinook and sockeye smolt abundance were highest at disturbed sites. Chum residence time was similar among all sampling areas; three of the four transplant sites had plant biomass similar to reference sites; Abundance and number of insect taxa at transplant sites similar to reference but higher than disturbed sites.	2	Levings and Nishimura 1997
	No. of restoration projects	**11**	
	No. of highly successful restoration projects	**5**	
	No. of moderately successful restoration projects	**5**	
	No. of unsuccessful restoration projects	**1**	

Appendix D—Methods for Ranking Potential Restoration Sites

METHODS FOR RANKING POTENTIAL RESTORATION SITES:

By Erik Stockdale and Stephen Stanley, Department of Ecology

SUMMARY OF RANKING EQUATION

A total of 27 sites within the entire SEWIP planning area inside and outside the hypothetical development footprint (HDF) were ranked for their tidal restoration potential, using a simple mathematical model. This model primarily relied on potential salmonid habitat function scores that would be achieved, as calculated by the Tidal Habitat Model (Section 2.3), and on the existing wildlife and water quality functions on the site as calculated by 1997 SEWIP model for vegetated freshwater wetlands. The ranking model was based on the following five variables:

A. The Tidal Habitat Model salmonid score (mean of minimum and maximum potential IVA points per acre; see Section 4.7 and Table 4.5); scores were normalized to a maximum value of 10 to represent the relative potential salmonid habitat function of each site following tidal restoration.

B. The inverse of the SEWIP 1997 wildlife score, normalized to 5: Actual normalized model score was subtracted from 5 so that the site with the highest existing function scored the lowest for restoration potential.

C. The inverse of the SEWIP 1997 wildlife score, normalized to 5: Actual normalized model score was subtracted from 5 so that the site with the highest existing function scored the lowest for restoration potential.

D. The degree of technical difficulty in restoring the proposed site; sites with lower technical difficulty scored higher for restoration potential.

E. The position of the proposed site within the estuary landscape; sites in the freshwater/saltwater transition zone and those connected to the mainstem Snohomish River scored highest.

Using the variable “letters” presented above, the restoration ranking equation is:

Total Ranking Score = A+B+C+D+E

All variables where normalized for a score range from 0 to 5 except for the salmon habitat function variable, which was normalized for a range from 0 to 10.

TIDAL HABITAT MODEL SCORE VARIABLE (A)

The “value” for this variable was calculated as follows: The salmon scores that could be expected to be achieved in each of the 27 potential restoration sites in IVA-acres (a measure that combines quality and quantity of ecological function) are listed in Table 6.1. The scores used correspond to the mean of the maximum and minimum restoration potential score as described in Section 2.7.2. The site with the greatest restoration potential (in IVA acres) was given a score of 10 and the remaining sites normalized to that value.

$$A = 10 \times \frac{\text{Potential salmon function in IVA-acres for specific site}}{\text{Highest potential salmon score in IVA-acres}}$$

As noted above, the salmon score was given greater weighting than the other variables, because it was the conclusion of the technical committee that the ranking should emphasize the restoration of tidal salmon habitat function within the Snohomish River Estuary.

WILDLIFE SCORE VARIABLE

The value for this variable was calculated as follows: The wildlife scores from the 1997 SEWIP study in IVA-acres for all of the isolated freshwater wetland AUs in each of the 28 potential restoration sites were summed and normalized by dividing the highest IVA-acre total into the scores for the other sites and subtracting this value from 1. The result was multiplied by 5 to derive a score on a scale from 0 to 5; sites with highest existing wildlife functions have the lowest contribution to the ranking model.

B = [1 - (Wildlife score for specific site/highest wildlife score)] X 5

Because restoration emphasis is placed on sites that are degraded (primarily from clearing of native vegetation and agricultural activities), potential restoration sites that score “high” for existing wildlife functions have a “low” value entered for this variable, and vice versa.

WATER QUALITY SCORE VARIABLE

The value for this variable was calculated as follows: The water quality scores from the 1997 SEWIP study in IVA-acres for all of the isolated freshwater wetland AUs in each of the 28 potential restoration sites were summed and normalized by dividing the highest IVA-acre total into the scores for the other sites and subtracting this normalized value from 1. The result was multiplied by 5 to derive a score on a scale from 0 to 5; sites with highest existing wildlife functions have the lowest contribution to the ranking model.

C = [1 - (Water quality score for specific site/Highest water quality score)] X 5

Because the restoration emphasis is placed on sites that are degraded (primarily from clearing of native vegetation and agricultural activities), potential restoration sites that score “high” for existing water quality function have a “low” value entered for this variable, and vice versa.

TECHNICAL DIFFICULTY VARIABLE

The purpose of this variable was to rank each site, from 1 to 5, on the degree of technical difficulty involved in restoring the site. A ranking of 5 represents a site with minimal technical difficulties and a ranking of 1 represents a site with significant technical difficulties. The main criterion used to rank sites was the length of dike required for each acre restored (ratio of dike length to acres restored). The estimated length of “cross” or protective diking was measured for each restoration site and entered into a spreadsheet along with the restoration acreage (Figure D.1).

Other criteria used included the number of other technical requirements (e.g., relocating utilities, protecting roads) present on the site. In general, potential restoration sites that had a low “length of dike-to-acres ratio” (i.e., less than 20; Figure D.1) were scored low for technical difficulty and those with a high ratio (i.e., greater than 20) were scored high for technical difficulty. The exceptions were when a site had two or more major technical issues (e.g., presence of Olympic pipeline in Sunnyside South). Further definitions of the rankings are provided below:

5 = No technical difficulties. The site would require no construction for restoration other than removal of existing dike areas. For example, restoration would require removing several sections of dike and plugging old agricultural ditches. It would not require constructing extensive cross dikes (length of dike-to-acres ratio would be very low), relocating utilities, or removing fill and/or existing structures. The restoration would be self-sustaining and require no ongoing maintenance.

4 = Minor technical difficulties. The site would require some construction but length of dike-to-acres ratio would be low (less than 20) and, at most, there would be only one major technical issue. In cases where design/technical issues have been resolved, then the site considered to have minor technical issues. The restoration would be self-sustaining and require minimal ongoing maintenance.

3 = Moderate to minor technical difficulties. The length of dike-to-acres ratio would still be low (less than 20). Technical difficulties would still involve only one issue but are judged to fall in-between those described for 2 and 4.

2 = Moderate technical difficulties. The length of dike-to-acres ratio would be high (greater than 20). The site would require construction that involves major issues, typically more than one (e.g., removal of a major power line and protection of a transportation corridor, or construction of a cross or protective dike). The restoration may require ongoing dike maintenance.

1 = Significant technical difficulties. The length of dike-to-acres ratio would be high (greater than 20) and in many cases very high (greater than 100). Site would require construction that involves several major issues (e.g., removal/relocation of a major power line, protection of a transportation corridor, or construction of a cross or protective dike around more than 50 percent of site perimeter). If the site involves a major issue that is particularly difficult because of the presence of hazardous materials (e.g., Olympic pipeline) then it would be scored a 1. Sites also included within this scoring involve circumstances where construction of protective dikes would be infeasible because of proximity of surrounding development and/or an existing high-value wetland would have to be filled within the restoration site. The restoration would probably require substantial ongoing dike maintenance.

LANDSCAPE POSITION VARIABLE

The purpose of this variable is to rank the potential restoration sites for their contributions to the overall food chain support function and role in providing for the life needs of salmonids. For example, potential restoration sites within EMUs 2 and 3 were considered to have a significant role in the food chain support function given the higher level of primary productivity in brackish marshes. Primary productivity is exported as detritus, which supports a wide variety and number of organisms in the base of the estuary food chain. Many of these organisms are an important food source for salmonid species, such as epibethic organisms on eelgrass in subtidal habitat, which receive this detrital material. Upstream areas (EMU 1) were scored lower because they have lower levels of productivity relative to EMUs 2 and 3. These EMUs were also ranked higher because their position in the estuary is associated with a gradient of salinities ranging from near fresh to moderately saline (oligohaline to mesohaline), which allows salmonids to select salinity regimes that are optimal for their stage in osmoregulatory adjustment between the freshwater and marine environments. While these factors are considered in the scoring of each AU with the Tidal Habitat Model, this ranking variable adds emphasis to their importance in the landscape context.

This ranking variable also considers the location of the potential restoration site relative to the estuary channels where the highest level of salmonid use has been observed. Beach-seine surveys conducted by the Tulalip Tribes (Beauchamp 1986, Beauchamp et al. 1987) indicates that the mainstem of the Snohomish River has the greatest salmonid use (highest catch per unit of effort) of the several distributary channels (Figure D.2). For potential restoration sites that would be directly on or linked to the mainstem of the Snohomish River, an additional two points were added to the rating for the site.

The ranking scheme is as follows for a site that is located in the EMUs as noted below:

3 = EMUs 2 and 3
2 = EMUs 4 to 7
1 = EMU 1
and to the ranking score above add:
2 = If directly on or connected to the mainstem of Snohomish River

SUMMARY

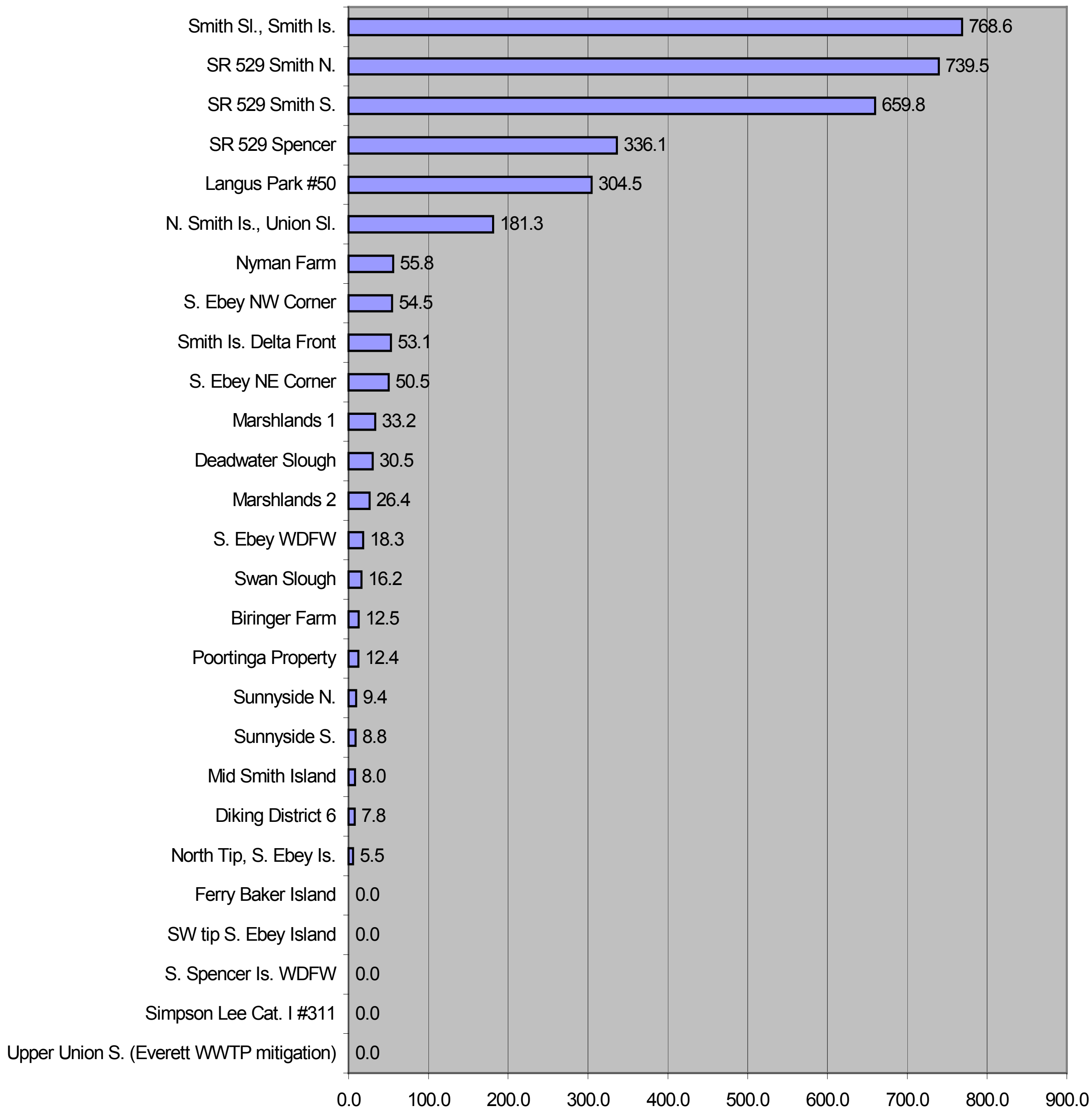
A summary of the results of ranking on the basis of the total number of IVA-acre points that would be gained in each site is displayed on Figure D.3. If the technical difficulty factor is excluded from the ranking formula, a somewhat different view is presented (Figure D.4). However, because higher technical difficulty is related to higher costs, the ranking shown in Figure D.3 is incorporated as the ranking used in the body of the text (Table 4.5 and Figure 4.16).

REFERENCES

Beauchamp, D.A. 1986. Snohomish River juvenile salmon outmigration study 1986. Report of the Tulalip Tribes, Marysville, Washington, and R. W. Beck and Associates, Seattle, Washington, prepared for the US Department of the Navy under contract N62474-86-C-0991.

Beauchamp, D.A., D.E. Pflug, and G. Lucchetti. 1987. Snohomish River juvenile salmon outmigration study 1987. Prepared by Northwest Enviro-Metric Sciences, Vashon, Washington, and the Tulalip Tribes, Marysville, Washington, for the US Department of the Navy.

Figure D.1
Linear Feet of Dike per Acre Restored



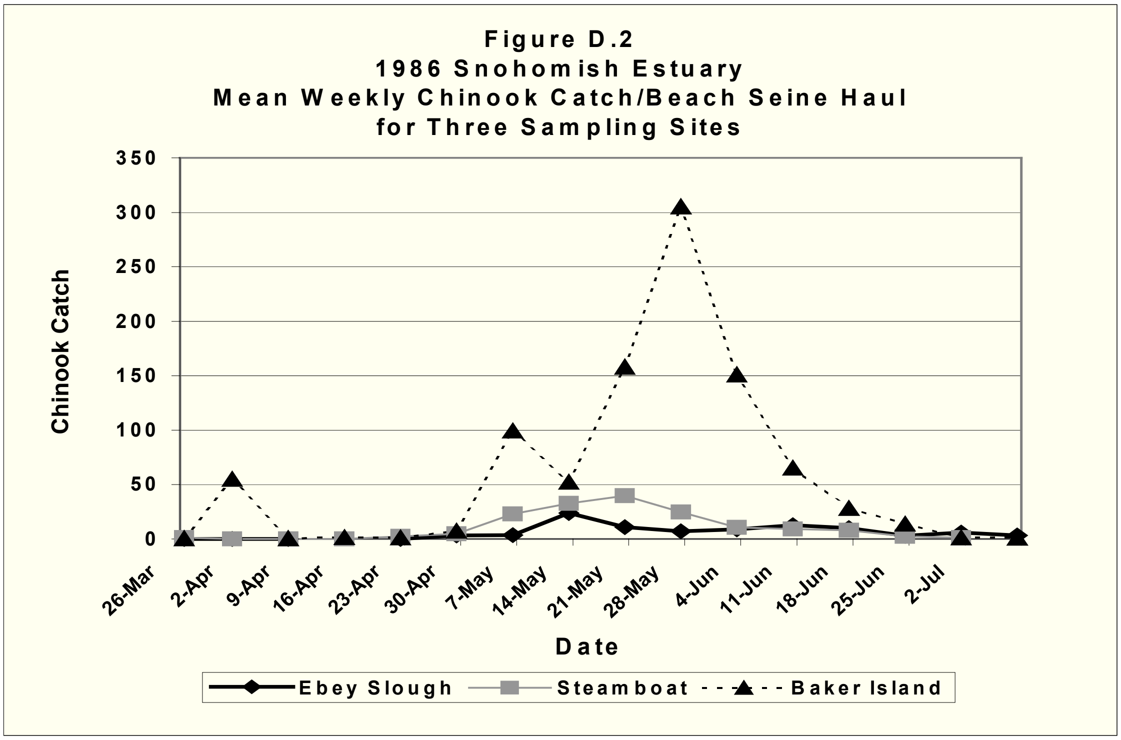


Figure D.2
1986 Snohomish Estuary
Mean Weekly Chinook Catch/Beach Seine Haul
for Three Sampling Sites
Chinook Catch
350
300
250
200
150
100
50
0
26-Mar
2-Apr
9-Apr
16-Apr
23-Apr
30-Apr
7-May
14-May
21-May
28-May
4-Jun
11-Jun
18-Jun
25-Jun
2-Jul
Date
Ebey Slough
Steamboat
Baker Island

Figure D.3
Final Ranking Based on Total IVA Acre Points per Site

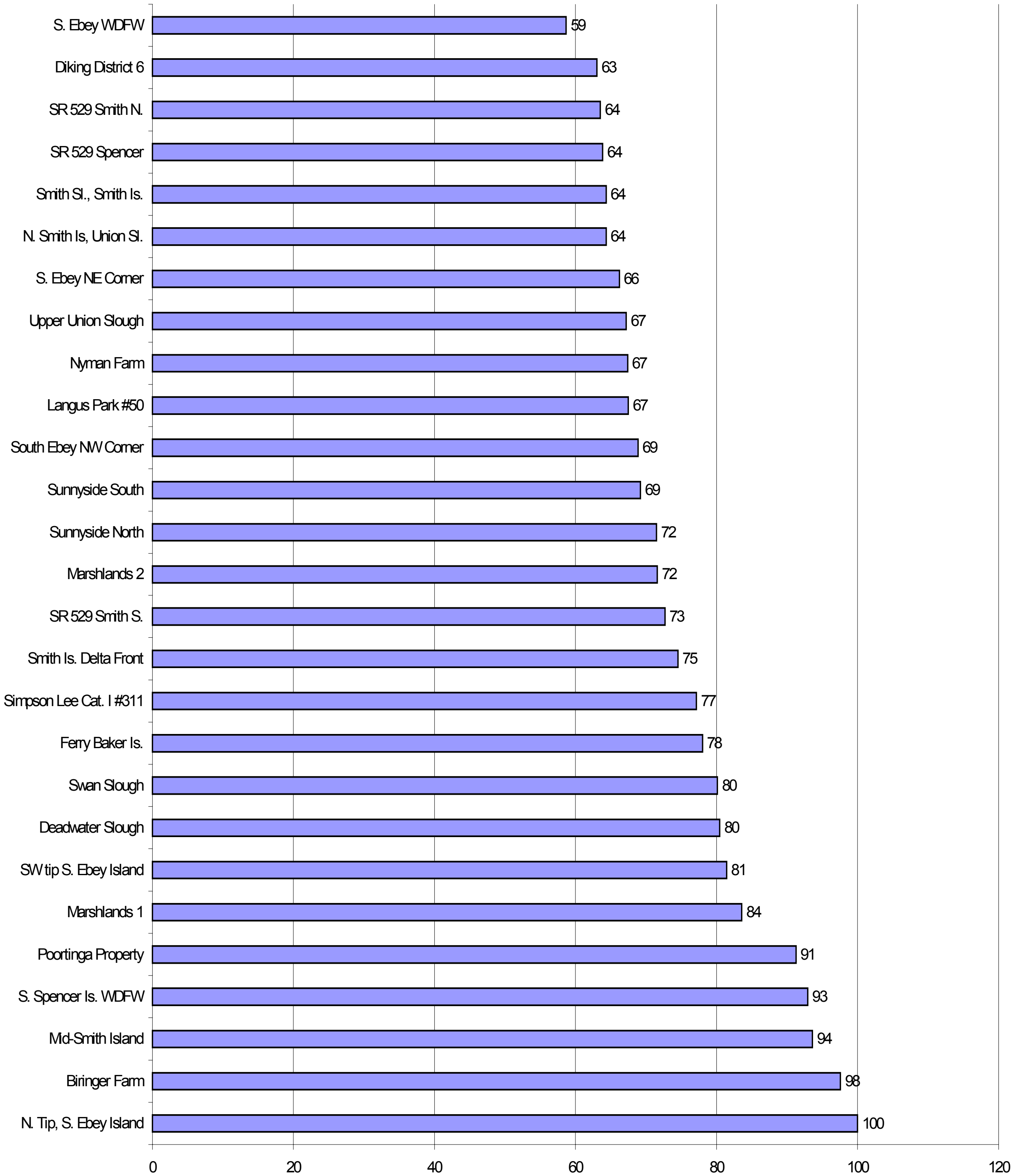
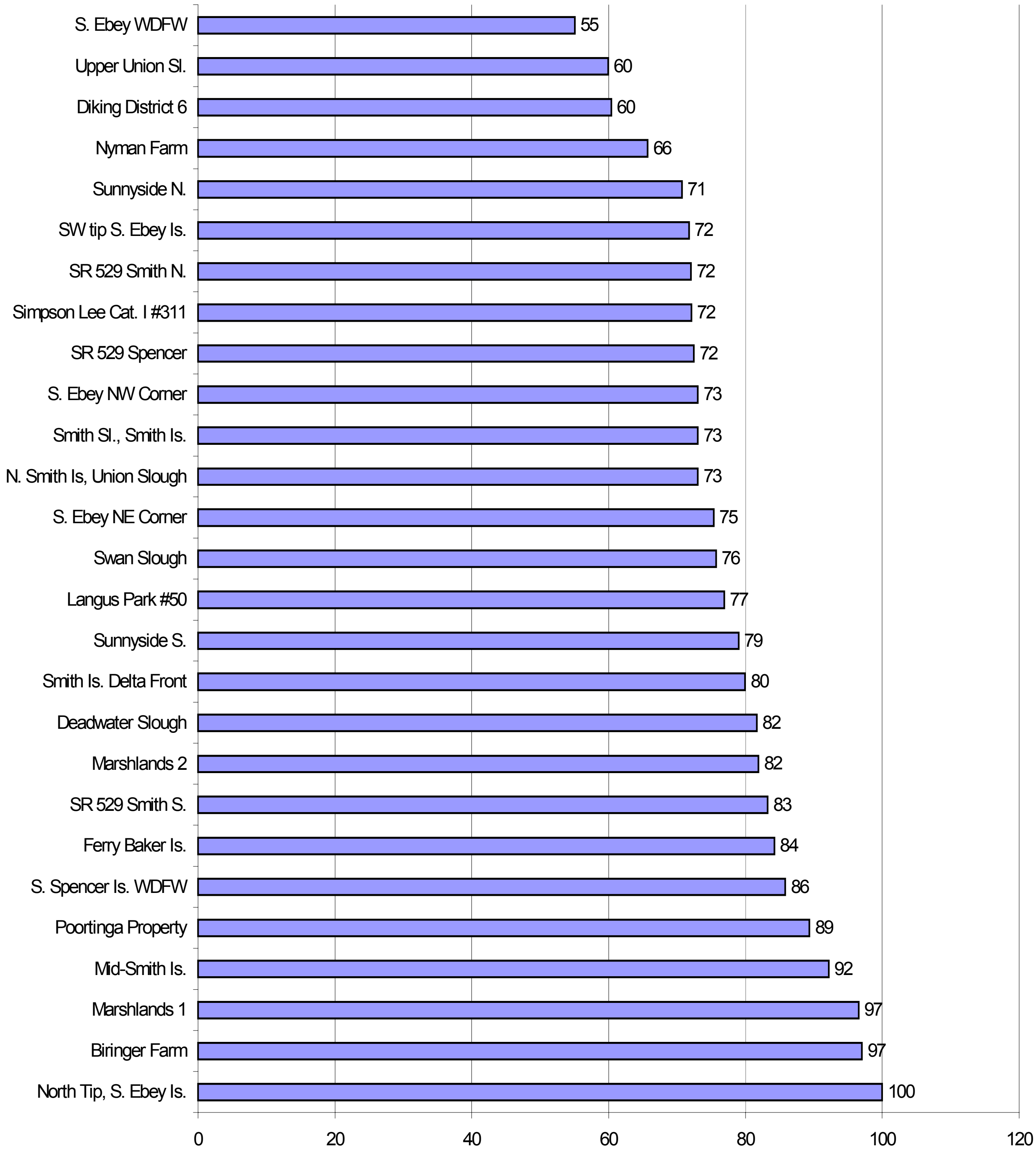


Figure D.4
Final Ranking Based on Total IVA-Acre Points per Site
Without Technical Difficulty Variable Included



Appendix E— Tidal Habitat Model Results

Appendix Table E.1 Existing AU scores by EMU and assessment species.

Chinook Salmon					Coho Salmon/Bull Trout				
EMU AU Number	Raw Score	Pos. Int. Score[1]	Neg. Mult.[2]	Final Score[3]	EMU AU Number	Raw Score	Pos. Int. Score[1]	Neg. Mult.[2]	Final Score[3]
1.01	36.5	54.8	1.00	54.8	1.01	36.5	54.8	1.00	54.8
1.02	33.5	50.3	1.00	50.3	1.02	33.5	50.3	1.00	50.3
1.03	35.5	53.3	1.00	53.3	1.03	37.5	56.3	1.00	56.3
1.04	35.0	78.8	0.80	63.0	1.04	36.8	71.8	0.90	64.6
1.05	33.0	74.3	0.90	66.8	1.05	34.8	67.9	1.00	67.9
1.06	35.5	106.5	0.90	95.9	1.06	37.3	97.0	1.00	97.0
1.07	39.0	87.8	1.00	87.8	1.07	40.8	79.6	1.00	79.6
1.08	14.0	14.0	0.32	4.5	1.08	16.0	16.0	0.52	8.4
1.09	18.0	18.0	0.50	9.1	1.09	20.0	20.0	0.72	14.4
1.10	14.0	14.0	0.50	7.1	1.10	16.0	16.0	0.65	10.4
1.11	28.5	42.8	1.00	42.8	1.11	30.5	45.8	1.00	45.8
1.12	19.0	19.0	0.35	6.7	1.12	21.0	21.0	0.45	9.5
1.13	31.5	47.3	0.64	30.2	1.13	33.5	50.3	0.81	40.7
1.14	27.0	27.0	1.00	27.0	1.14	29.0	29.0	1.00	29.0
1.15	29.0	29.0	1.00	29.0	1.15	31.0	31.0	1.00	31.0
1.16	17.0	17.0	0.56	9.5	1.16	19.0	19.0	0.72	13.7
1.17	25.0	25.0	0.56	14.0	1.17	27.0	27.0	0.72	19.4
1.18	32.5	97.5	0.90	87.8	1.18	34.5	103.5	1.00	103.5
1.19	22.5	33.8	0.80	27.0	1.19	24.5	36.8	0.90	33.1
1.20	31.0	31.0	1.00	31.0	1.20	33.0	33.0	1.00	33.0
1.21	35.5	53.3	1.00	53.3	1.21	37.5	56.3	1.00	56.3
1.22	21.5	32.3	0.64	20.6	1.22	23.5	35.3	0.81	28.6
1.23	30.0	60.0	1.00	60.0	1.23	32.0	64.0	1.00	64.0
1.24	34.0	68.0	1.00	68.0	1.24	36.0	72.0	1.00	72.0
1.25	24.0	24.0	0.64	15.4	1.25	26.0	26.0	0.81	21.1
1.26	25.0	25.0	0.64	16.0	1.26	27.0	27.0	0.81	21.9
1.27	37.0	83.3	1.00	83.3	1.27	38.8	75.7	1.00	75.7
1.28	30.5	45.8	1.00	45.8	1.28	32.5	48.8	1.00	48.8
1.29	32.5	48.8	1.00	48.8	1.29	34.5	51.8	1.00	51.8
1.30	30.0	30.0	1.00	30.0	1.30	32.0	32.0	1.00	32.0
1.31	28.0	28.0	0.90	25.2	1.31	30.0	30.0	1.00	30.0
1.32	29.5	44.3	1.00	44.3	1.32	31.5	47.3	1.00	47.3
1.33	36.0	162.0	1.00	162.0	1.33	37.8	147.4	1.00	147.4
1.34	34.0	34.0	1.00	34.0	1.34	36.0	36.0	1.00	36.0
1.35	39.0	78.0	1.00	78.0	1.35	41.0	82.0	1.00	82.0
2.01	39.5	118.5	1.00	118.5	2.01	39.5	118.5	1.00	118.5
2.02	38.5	115.5	0.63	72.8	2.02	38.3	99.6	0.63	62.7
2.03	23.0	23.0	0.20	4.6	2.03	23.0	23.0	0.29	6.7
2.04	41.0	82.0	0.70	57.4	2.04	41.0	82.0	0.70	57.4
2.05	36.0	72.0	0.63	45.4	2.05	36.0	72.0	0.63	45.4
2.06	36.5	109.5	0.80	87.6	2.06	36.3	94.4	0.90	84.9
2.07	32.5	97.5	1.00	97.5	2.07	32.3	84.0	1.00	84.0
2.08	28.0	28.0	0.32	9.0	2.08	28.0	28.0	0.52	14.7
2.09	35.5	53.3	1.00	53.3	2.09	35.3	45.9	1.00	45.9
2.10	31.5	94.5	1.00	94.5	2.10	31.3	81.4	1.00	81.4

continued

Appendix Table E.1 Existing AU scores by EMU and assessment species.

Chinook Salmon					Coho Salmon/Bull Trout				
EMU AU Number	Raw Score	Pos. Int. Score[1]	Neg. Mult.[2]	Final Score[3]	EMU AU Number	Raw Score	Pos. Int. Score[1]	Neg. Mult.[2]	Final Score[3]
2.11	32.5	97.5	1.00	97.5	2.11	32.3	84.0	1.00	84.0
2.12	37.5	56.3	1.00	56.3	2.12	37.3	48.5	1.00	48.5
2.13	33.0	66.0	1.00	66.0	2.13	33.0	66.0	1.00	66.0
2.14	36.5	109.5	1.00	109.5	2.14	36.3	94.4	1.00	94.4
2.15	37.5	112.5	1.00	112.5	2.15	37.3	97.0	1.00	97.0
2.16	37.5	112.5	1.00	112.5	2.16	39.5	118.5	1.00	118.5
2.17	35.5	53.3	1.00	53.3	2.17	37.5	56.3	1.00	56.3
2.18	37.0	83.3	1.00	83.3	2.18	38.8	75.7	1.00	75.7
2.19	35.5	106.5	1.00	106.5	2.19	37.3	97.0	1.00	97.0
2.20	39.0	39.0	1.00	39.0	2.20	39.0	39.0	1.00	39.0
2.21	32.0	64.0	1.00	64.0	2.21	32.0	64.0	1.00	64.0
2.22	34.5	103.5	1.00	103.5	2.22	34.3	89.2	1.00	89.2
2.23	27.0	27.0	0.64	17.3	2.23	27.0	27.0	0.81	21.9
2.24	35.5	106.5	1.00	106.5	2.24	35.3	91.8	1.00	91.8
2.25	38.5	115.5	0.70	80.9	2.25	38.3	99.6	0.80	79.7
2.26	34.0	68.0	1.00	68.0	2.26	34.0	68.0	1.00	68.0
2.27	27.0	27.0	0.46	12.4	2.27	27.0	27.0	0.66	17.7
2.28	32.0	64.0	1.00	64.0	2.28	32.0	64.0	1.00	64.0
2.29	25.0	25.0	0.41	10.2	2.29	25.0	25.0	0.58	14.6
2.30	35.0	70.0	0.80	56.0	2.30	35.0	70.0	0.90	63.0
2.31	34.0	34.0	1.00	34.0	2.31	34.0	34.0	1.00	34.0
2.32	32.0	32.0	1.00	32.0	2.32	32.0	32.0	1.00	32.0
2.33	32.0	32.0	0.45	14.4	2.33	32.0	32.0	0.45	14.4
2.34	29.0	29.0	1.00	29.0	2.34	29.0	29.0	1.00	29.0
2.35	30.0	30.0	1.00	30.0	2.35	30.0	30.0	1.00	30.0
2.36	32.5	48.8	1.00	48.8	2.36	32.5	48.8	1.00	48.8
2.37	32.0	32.0	1.00	32.0	2.37	32.0	32.0	1.00	32.0
2.38	38.5	115.5	1.00	115.5	2.38	38.3	99.6	1.00	99.6
2.39	35.5	106.5	0.17	18.4	2.39	35.3	91.8	0.22	20.1
2.40	28.0	28.0	0.35	9.9	2.40	28.0	28.0	0.50	14.1
2.41	34.0	68.0	0.72	49.0	2.41	34.0	68.0	0.90	61.2
2.42	24.0	24.0	0.46	11.1	2.42	24.0	24.0	0.66	15.7
2.43	26.0	26.0	0.39	10.2	2.43	26.0	26.0	0.50	13.1
2.44	32.0	64.0	0.80	51.2	2.44	32.0	64.0	0.90	57.6
2.45	11.0	11.0	0.56	6.2	2.45	11.0	11.0	0.72	7.9
2.46	40.5	121.5	1.00	121.5	2.46	40.5	121.5	1.00	121.5
2.47	30.0	30.0	0.64	19.2	2.47	30.0	30.0	0.81	24.3
2.48	29.0	29.0	0.46	13.4	2.48	29.0	29.0	0.66	19.0
2.49	33.5	100.5	1.00	100.5	2.49	33.5	100.5	1.00	100.5
2.50	20.0	20.0	0.56	11.2	2.50	20.0	20.0	0.72	14.4
2.51	25.0	25.0	0.58	14.4	2.51	27.0	27.0	0.73	19.7
2.52	25.0	50.0	1.00	50.0	2.52	27.0	54.0	1.00	54.0
2.53	14.0	14.0	0.56	7.8	2.53	16.0	16.0	0.72	11.5
2.54	13.0	13.0	0.50	6.6	2.54	15.0	15.0	0.65	9.7

continued

Appendix Table E.1 Existing AU scores by EMU and assessment species.

Chinook Salmon					Coho Salmon/Bull Trout				
EMU AU Number	Raw Score	Pos. Int. Score[1]	Neg. Mult.[2]	Final Score[3]	EMU AU Number	Raw Score	Pos. Int. Score[1]	Neg. Mult.[2]	Final Score[3]
3.01	45.0	101.3	0.45	45.6	3.01	44.8	87.4	0.45	39.3
3.02	48.5	145.5	0.70	101.9	3.02	48.5	145.5	0.70	101.9
3.03	40.5	121.5	0.63	76.5	3.03	40.3	104.8	0.63	66.0
3.04	39.5	118.5	0.70	83.0	3.04	39.3	102.2	0.70	71.5
3.05	41.0	82.0	0.63	51.7	3.05	41.0	82.0	0.63	51.7
4.01	25.0	25.0	0.70	17.5	4.01	25.0	25.0	0.70	17.5
4.02	22.0	22.0	0.70	15.4	4.02	22.0	22.0	0.70	15.4
4.03	32.0	32.0	0.64	20.5	4.03	32.0	32.0	0.81	25.9
4.04	37.0	37.0	1.00	37.0	4.04	37.0	37.0	1.00	37.0
4.05	27.5	82.5	1.00	82.5	4.05	27.3	71.0	1.00	71.0
5.00	40.5	121.5	0.24	29.2	5.00	40.3	104.8	0.27	28.3
5.01	22.0	22.0	0.45	10.0	5.01	22.0	22.0	0.65	14.3
5.02	33.0	33.0	0.40	13.2	5.02	33.0	33.0	0.45	14.9
5.03	37.0	37.0	0.36	13.3	5.03	37.0	37.0	0.41	15.0
5.04	32.0	32.0	0.35	11.2	5.04	32.0	32.0	0.40	12.8
5.05	31.0	31.0	0.56	17.4	5.05	31.0	31.0	0.72	22.3
5.06	20.0	20.0	0.32	6.5	5.06	20.0	20.0	0.52	10.5
5.07	32.0	32.0	0.39	12.5	5.07	32.0	32.0	0.45	14.3
5.08	37.5	56.3	0.35	19.7	5.08	37.3	48.5	0.40	19.4
5.09	22.0	22.0	0.32	7.1	5.09	22.0	22.0	0.52	11.5
5.10	33.0	33.0	0.20	6.7	5.10	33.0	33.0	0.29	9.6
5.11	11.0	11.0	0.32	3.5	5.11	11.0	11.0	0.52	5.8
5.12	30.0	30.0	0.56	16.8	5.12	30.0	30.0	0.72	21.6
5.13	20.0	20.0	0.28	5.6	5.13	20.0	20.0	0.47	9.3
5.14	11.0	11.0	0.20	2.2	5.14	11.0	11.0	0.32	3.6
5.15	8.0	8.0	0.50	4.0	5.15	8.0	8.0	0.65	5.2
6.01	14.0	14.0	0.16	2.3	6.01	14.0	14.0	0.29	4.1
6.02	24.0	24.0	0.11	2.7	6.02	24.0	24.0	0.16	3.9
6.03	15.0	15.0	0.14	2.1	6.03	15.0	15.0	0.23	3.4
6.04	23.0	23.0	0.18	4.2	6.04	23.0	23.0	0.29	6.7
6.05	12.0	12.0	0.23	2.7	6.05	12.0	12.0	0.37	4.5
6.06	18.0	18.0	0.11	2.0	6.06	18.0	18.0	0.23	4.1
7.01	23.0	46.0	0.56	25.8	7.01	23.0	46.0	0.72	33.1
7.02	38.5	115.5	1.00	115.5	7.02	38.5	115.5	1.00	115.5
7.03	28.0	28.0	0.56	15.7	7.03	28.0	28.0	0.72	20.2
7.04	24.0	24.0	0.56	13.4	7.04	24.0	24.0	0.72	17.3
7.05	32.0	32.0	0.70	22.4	7.05	32.0	32.0	0.80	25.6
7.06	28.0	28.0	0.56	15.7	7.06	28.0	28.0	0.72	20.2
7.07	34.0	34.0	0.70	23.8	7.07	34.0	34.0	0.80	27.2
7.08	30.0	60.0	0.56	33.6	7.08	30.0	60.0	0.72	43.2
7.09	24.0	48.0	0.56	26.9	7.09	24.0	48.0	0.72	34.6
7.10	29.0	29.0	0.45	13.0	7.10	29.0	29.0	0.65	18.8
7.11	15.0	15.0	0.56	8.4	7.11	15.0	15.0	0.72	10.8

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[1] Positive Intermediate Score is the product of Raw Score and all positive multipliers (those >1).
[2] Negative multiplier is the product of all negative multipliers (those <1).
[3] Final Score is the product of Positive Intermediate Score and all negative multipliers (those <1).

Appendix Table E.2 Existing AU scores, AU acreage, normalized scores, and IVA-acre points, by limiting species.

EMU AU Number	AU Acreage	Limiting Species[1]	Raw Score	Pos. Int. Score[2]	Neg. Mult.[3]	Final Score[4]	IVA-acre Points	Normalized Score
2.12	19.72	CO/BT	37.30	48.5	1.00	48.5	956.2	32.9
2.13	13.10	CH	33.00	66.0	1.00	66.0	864.6	44.8
2.14	19.39	CO/BT	36.30	94.4	1.00	94.4	1,830.0	64.0
2.15	134.31	CO/BT	37.30	97.0	1.00	97.0	13,025.4	65.8
2.16	19.84	CH	37.50	112.5	1.00	112.5	2,232.0	76.3
2.17	19.79	CH	35.50	53.3	1.00	53.3	1,053.8	36.1
2.18	24.67	CO/BT	38.80	75.7	1.00	75.7	1,866.5	51.3
2.19	74.32	CO/BT	37.30	97.0	1.00	97.0	7,207.6	65.8
2.20	7.17	CH	39.00	39.0	1.00	39.0	279.6	26.5
2.21	24.83	CH	32.00	64.0	1.00	64.0	1,589.1	43.4
2.22	21.89	CO/BT	34.30	89.2	1.00	89.2	1,952.2	60.5
2.23	3.00	CH	27.00	27.0	0.64	17.3	51.8	11.7
2.24	7.78	CO/BT	35.30	91.8	1.00	91.8	714.0	62.3
2.25	35.17	CO/BT	38.30	99.6	0.80	79.7	2,801.8	54.0
2.26	18.40	CH	34.00	68.0	1.00	68.0	1,251.2	46.1
2.27	12.45	CH	27.00	27.0	0.46	12.4	154.9	8.4
2.28	19.89	CH	32.00	64.0	1.00	64.0	1,273.0	43.4
2.29	2.64	CH	25.00	25.0	0.41	10.2	27.0	6.9
2.30	8.80	CH	35.00	70.0	0.80	56.0	492.8	38.0
2.31	6.57	CH	34.00	34.0	1.00	34.0	223.4	23.1
2.32	13.52	CH	32.00	32.0	1.00	32.0	432.6	21.7
2.33	7.39	CH	32.00	32.0	0.45	14.4	106.4	9.8
2.34	7.31	CH	29.00	29.0	1.00	29.0	212.0	19.7
2.35	11.98	CH	30.00	30.0	1.00	30.0	359.4	20.4
2.36	14.81	CH	32.50	48.8	1.00	48.8	722.0	33.1
2.37	6.39	CH	32.00	32.0	1.00	32.0	204.5	21.7
2.38	64.22	CO/BT	38.30	99.6	1.00	99.6	6,395.0	67.5
2.39	3.38	CH	35.50	106.5	0.17	18.4	62.2	12.5
2.40	32.69	CH	28.00	28.0	0.35	9.9	322.9	6.7
2.41	7.40	CH	34.00	68.0	0.72	49.0	362.3	33.2
2.42	3.68	CH	24.00	24.0	0.46	11.1	40.7	7.5
2.43	20.82	CH	26.00	26.0	0.39	10.2	212.2	6.9
2.44	7.99	CH	32.00	64.0	0.80	51.2	409.1	34.7
2.45	1.20	CH	11.00	11.0	0.56	6.2	7.4	4.2
2.46	45.52	CH	40.50	121.5	1.00	121.5	5,530.7	82.4
2.47	4.02	CH	30.00	30.0	0.64	19.2	77.2	13.0
2.48	7.09	CH	29.00	29.0	0.46	13.4	94.7	9.1
2.49	7.66	CH	33.50	100.5	1.00	100.5	769.8	68.2
2.50	1.69	CH	20.00	20.0	0.56	11.2	18.9	7.6
2.51	15.27	CH	25.00	25.0	0.58	14.4	219.9	9.8
2.52	5.72	CH	25.00	50.0	1.00	50.0	286.0	33.9
2.53	3.16	CH	14.00	14.0	0.56	7.8	24.8	5.3
2.54	3.66	CH	13.00	13.0	0.50	6.6	24.0	4.4
3.01	87.55	CO/BT	44.80	87.4	0.45	39.3	3,441.8	26.7
3.02	37.99	CH	48.50	145.5	0.70	101.9	3,869.3	69.1

continued

Appendix Table E.2 Existing AU scores, AU acreage, normalized scores, and IVA-acre points, by limiting species.

EMU AU Number	AU Acreage	Limiting Species[1]	Raw Score	Pos. Int. Score[2]	Neg. Mult.[3]	Final Score[4]	IVA-acre Points	Normalized Score
3.03	79.76	CO/BT	40.30	104.8	0.63	66.0	5,265.1	44.8
3.04	274.08	CO/BT	39.30	102.2	0.70	71.5	19,603.8	48.5
3.05	151.93	CH	41.00	82.0	0.63	51.7	7,848.7	35.0
4.01	328.32	CH	25.00	25.0	0.70	17.5	5,745.6	11.9
4.02	378.92	CH	22.00	22.0	0.70	15.4	5,835.4	10.4
4.03	211.88	CH	32.00	32.0	0.64	20.5	4,339.3	13.9
4.04	19.20	CH	37.00	37.0	1.00	37.0	710.4	25.1
4.05	3306.79	CO/BT	27.30	71.0	1.00	71.0	234,716.0	48.2
5.00	34.12	CO/BT	40.50	121.5	0.24	28.3	965.3	19.2
5.01	16.92	CH	22.00	22.0	0.45	10.0	168.8	6.8
5.02	23.93	CH	33.00	33.0	0.40	13.2	315.9	9.0
5.03	38.51	CH	37.00	37.0	0.36	13.3	513.0	9.0
5.04	37.57	CH	32.00	32.0	0.35	11.2	420.8	7.6
5.05	9.44	CH	31.00	31.0	0.56	17.4	163.9	11.8
5.06	2.55	CH	20.00	20.0	0.32	6.5	16.5	4.4
5.07	52.72	CH	32.00	32.0	0.39	12.5	661.3	8.5
5.08	226.47	CO/BT	37.30	48.5	0.40	19.4	4,392.6	13.2
5.09	5.86	CH	22.00	22.0	0.32	7.1	41.6	4.8
5.10	14.57	CH	33.00	33.0	0.20	6.7	96.9	4.5
5.11	2.76	CH	11.00	11.0	0.32	3.5	9.8	2.4
5.12	48.97	CH	30.00	30.0	0.56	16.8	822.7	11.4
5.13	65.85	CH	20.00	20.0	0.28	5.6	371.7	3.8
5.14	2.31	CH	11.00	11.0	0.20	2.2	5.1	1.5
5.15	23.70	CH	8.00	8.0	0.50	4.0	95.6	2.7
6.01	1.30	CH	14.00	14.0	0.16	2.3	2.9	1.5
6.02	47.70	CH	24.00	24.0	0.11	2.7	129.2	1.8
6.03	2.66	CH	15.00	15.0	0.14	2.1	5.6	1.4
6.04	13.07	CH	23.00	23.0	0.18	4.2	54.5	2.8
6.05	2.43	CH	12.00	12.0	0.23	2.7	6.6	1.8
6.06	7.22	CH	18.00	18.0	0.11	2.0	14.7	1.4
7.01	181.76	CH	23.00	46.0	0.56	25.8	4,682.1	17.5
7.02	432.45	CH	38.50	115.5	1.00	115.5	49,948.0	78.3
7.03	130.23	CH	28.00	28.0	0.56	15.7	2,042.0	10.6
7.04	34.27	CH	24.00	24.0	0.56	13.4	460.6	9.1
7.05	37.62	CH	32.00	32.0	0.70	22.4	842.7	15.2
7.06	31.33	CH	28.00	28.0	0.56	15.7	491.3	10.6
7.07	58.83	CH	34.00	34.0	0.70	23.8	1,400.2	16.1
7.08	61.81	CH	30.00	60.0	0.56	33.6	2,076.8	22.8
7.09	43.35	CH	24.00	48.0	0.56	26.9	1,165.2	18.2
7.10	31.82	CH	29.00	29.0	0.45	13.0	413.4	8.8
7.11	13.93	CH	15.00	15.0	0.56	8.4	117.0	5.7

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[1] CH - chinook, CO/BT - coho/bull trout

[2] Positive Intermediate Score is the product of Raw Score and all positive multipliers (those >1).

[3] Negative multiplier is the product of all negative multipliers (those <1).

[4] Final Score is the product of Positive Intermediate Score and all negative multipliers (those <1).

Appendix F—
Summary of Snohomish Estuary Restoration Projects

SUMMARY OF SNOHOMISH ESTUARY RESTORATION PROJECTS

NORTH SPENCER ISLAND, BREACHED-DIKE WETLAND

Various studies have provided information on this tidal marsh adjacent to Union Slough (AU 2.36) that was naturally restored after a dike was breached during a flood in the late 1960s. The area of the Mid-Spencer Marsh was diked in the late 1800s and was one of the earliest successful diking projects in the Snohomish River Estuary (Pentec 1992a, Shapiro and Associates 1979). Between 1955 and 1963, North Spencer Island was cut off from South Spencer Island when a channel was dredged to connect Union Slough and Steamboat Slough (Shapiro & Associates 1979). Although the year that the Mid-Spencer dike was breached is uncertain, aerial photographs indicate the breach occurred between 1965 and 1970 (Cunningham and Polayes-Wien 1995).

In their review of the Mid-Spencer Marsh, Cunningham and Polayes-Wien (1995) cite various studies that have alluded to the high functional values of intertidal, brackish marsh on Mid-Spencer Island. The US Army Corps of Engineers' (Corps) Snohomish Estuary Wetlands Study (Shapiro & Associates 1979) designated the Mid-Spencer Marsh an "area of importance" based on its biological functions, ecosystem support, floodwater storage, and water purification functions. The Snohomish River Wetlands Management Plan, prepared for Snohomish County (Shapiro & Associates 1989), also noted the highly productive marsh habitat of Mid-Spencer Marsh. Marsh vegetation interspersed with open-water channels and ponds, and forest along the dikes, provide habitat for waterfowl, shorebirds, raptors, songbirds, and small animals (Cunningham and Polayes-Wien 1995). The original SEWIP (City of Everett et al. 1997) rated Mid-Spencer Island high for both wildlife and water quality improvement attributes.

The Mid-Spencer Marsh is also important as a potential reference site for other restoration projects in the Snohomish River Estuary (Cunningham and Polayes-Wien 1995). Located within the fluvial brackish-water portion of the estuary (Pentec 1992a), the marsh could provide valuable baseline information for similarly situated sites, such as the Port of Everett's mitigation site on Union Slough and the potential mitigation bank at Biringer Farm. The Port plans to restore these sites by regrading existing agricultural lands and isolated freshwater wetlands, and breaching the dikes. The intent is to promote recolonization of brackish marsh vegetation and ultimately restore high-quality habitat for fish and wildlife (Pentec 1992a, 1996).

Evidence of the potential for restoring fish habitat on North Spencer Island and other restoration sites in the Snohomish River Estuary is provided by fish sampling data collected by Pentec from 1991 to 1992 (Pentec 1992b). During the peak of the migration, catches of juvenile chum salmon were higher at the Mid-Spencer Marsh than at the other off-channel habitats sampled, including nearby Ebey Marsh, which in comparison to the Mid-Spencer Marsh has historically experienced less disturbance. Epibenthic zooplankton sampling and fish stomach analyses also indicated that this restored marsh was providing good rearing opportunities for juvenile salmonids (Pentec 1992b).

SOUTH SPENCER ISLAND, BREACHED-DIKE WETLAND

The South Spencer Island, Breached Dike Wetland Project is located off the main channel of the Snohomish River at about river mile 3.8 (AU 1.06). The project area lies between Steamboat and Union sloughs, tidal distributaries of the Snohomish River. Prior to 1994, the perimeter of Spencer Island had been diked since the early 1900s to allow agricultural development. Because tidal brackish and other marshes have been greatly decreased in the Snohomish River Estuary, and because they provide direct support for fish and wildlife, Spencer Island was chosen as a pilot wetland restoration site under the Puget Sound Water Quality Management Plan, element W-8.1 (PSWQA 1990). In 1994, the exterior dike surrounding the southern portion of South Spencer Island was breached in three places, allowing natural tidal inundation of approximately 50 acres of the southern section of the island (Cordell et al. 1998, 1999).

The objectives of the South Spencer Island wetland project are to re-establish estuarine wetland conditions and allow the access of juvenile anadromous salmonids, which would use the restored area as a juvenile nursery before outmigrating to the ocean. The wetland is monitored for the following (Cordell et al. 1998, 1999):

- Benthic invertebrates and fallout of insects known to be important juvenile salmon prey in different strata (i.e., mudflat, wetland vegetation, and wooded edge) at the breached dike, the restored marsh site, and reference sites.

- Juvenile salmon access to the restoration site.

- Diets of juvenile salmon captured within the restoration site.

Specific project goals and objectives are as follows (Cordell et al. 1998, 1999):

- Allow juvenile salmon access to the inner portion of South Spencer Island.
- Provide juvenile salmon productive and varied nursery habitat that contain prey resources typical of those found in juvenile salmon diets.

By 1998 (second sampling year), sampling data indicated that access to the wetland and subsequent use by juvenile salmon had been achieved. Six sampling events between early April and mid-June collected nearly 400 juvenile salmon, of which over 300 were chinook and chum (Cordell et al. 1999), the two salmonids most dependent upon estuaries (Aitkin 1998). The benthic community was dominated by taxa tolerant of both freshwater and low-salinity estuarine conditions. However, dietary analysis of chinook and chum juveniles collected in the restored area showed diets similar to those in other restored and natural habitats in the Pacific Northwest (Cordell et al. 1999).

Monitoring results of 1997 and 1998 indicate that the restored area has achieved the stated goals and objectives (Cordell et al. 1998, 1999). Significant numbers of juvenile salmonids have access to the restoration site, and the site provides suitable nursery habitat before juveniles outmigrate to the ocean. Monitoring has also shown that the restoration site contains suitable prey resources and is being used by juvenile salmon.

MARYSVILLE SEWAGE TREATMENT FACILITIES IMPROVEMENTS PROJECT

In 1994, the City of Marysville completed construction of improvements at its existing wastewater treatment facility, adjacent to Ebey Slough in the Snohomish River Estuary. Permitting for the project was conditioned upon the construction and monitoring of a wetland mitigation site located east of the treatment plant and adjacent to Ebey Slough (AU 2.12). In 1994, in an effort to restore estuarine wetland conditions, about 400 lineal feet of flood-control dike was breached to provide tidal inundation of 13.7 acres of wet pasture. Breaching the dike restored tidal flow from Ebey Slough to the mitigation site such that the area is now inundated by tides higher than 8.1 ft (Jones & Stokes 1996).

The objective of the mitigation action was to provide a viable estuarine wetland in 10 years. The wetland is monitored for the following (Jones & Stokes 1996):

- Wetland vegetation community
- Wildlife community (primarily birds)
- Fish community
- Salinity and temperature
- Substrate elevation

Specific project goals and objectives are as follows (Jones & Stokes 1996):

- Presence of emergent plant seedlings in the estuarine wetland in Year 1
- Viable estuarine wetland in Year 10
- Removal and control of invasive and exotic species to an abundance of less than 10 percent
- 50 percent vegetative cover in areas above mean higher high water by Year 3, and thereafter
- 80 percent survivability of planted trees and shrubs by Year 5

Since the dike was breached, 5 years of monitoring data have been collected. These data indicate that wetland vegetation, water-associated bird species, and fish have colonized the mitigation area. Wetland vegetation has increased from 9 species after Year 1 to 14 species at Year 5. Up to 17 wetland plant species have been observed (Year 4). Coverage has increased most years, with a maximum of 80 percent in Year 4. In Year 5, 75 percent coverage was observed. The planted shrubs and trees in the buffer zone have had survival rates of 100 percent and continue to show healthy growth. Salinities have ranged from 0 to 16.5 parts per thousand. Substantial increases in the number of birds associated with wetlands have been observed compared to adjacent areas where preproject conditions are present. Breeding has been limited; the highest use consists of migrant resting and forage areas and overwintering habitats (Jones & Stokes 1996, 1999a,b,c).

Yearly fish sampling has occurred during May, and small to modest numbers of juvenile salmon have been collected. Between 4 and 51 juvenile salmon have been collected in 4 of the 5 years of monitoring. A gradual increase in the number of salmonids has not been observed. The dominant fish species sampled in the mitigation area is the peamouth chub (Jones & Stokes 1996, 1999a,b,c).

Monitoring indicates that the primary goals of the mitigation project are being met (Jones & Stokes 1996, 1999a,b,c). However, juvenile salmonid use of the wetland has not been measured to the same degree as in other wetland mitigation or restoration sites. The yearly May fish sampling event does not provide an overall picture of the extent that the wetland is used by juvenile salmonids.

JETTY ISLAND BERM PROJECT

The Port of Everett and the Corps created a 15-acre sand berm on an existing island in the winter of 1989 and 1990. The berm was constructed with approximately 323,000 cubic yards (cy) of clean dredged material and formed a protected mudflat covering 19 acres. Four objectives were established for testing project success after 5 years:

1. To balance erosion losses on the exposed west side of the island.

2. To create additional dunegrass habitat.

3. To create a protected embayment that would be naturally colonized by marine invertebrates.

4. To demonstrate a beneficial use of clean dredged material. Development of the protected embayment was expected to increase productivity and invertebrate biomass, thereby improving habitat for juvenile salmonids, other fish, shorebirds, and waterfowl.

It was anticipated and accepted by the technical advisory committee (TAC), that the berm would not be a permanent feature; rather, a decision would be made following the receipt of monitoring results whether to renourish the berm to extend its life and retain any benefits achieved.

Experimental planting of six saltmarsh species conducted in the spring of 1990 showed limited survival overall, but demonstrated that upper portions of the embayment (above +9 ft mean lower low water [MLLW]) would support these species. A second planting of *Jaumea*, *Salicornia,* and *Distichlis* in this area in 1991 has flourished and achieved over 100 percent cover in some areas by 1993. Subsequent natural colonization of 15 to 20 salt-tolerant upland species has occurred above +12 ft MLLW. Monitoring from 1990 through 1995 demonstrated the following results:

- Epibenthic zooplankton sampling in the spring of 1992 and 1994 showed higher abundance of juvenile salmonid prey species inside the depositional mudflat formed by the berm than at comparable elevations on the clean sandy shoreline along the remainder of the island.

- Beach seining in 1992 and 1994 (Pentec 1993, 1994) demonstrated that juvenile salmon and other fish, especially juvenile surf smelt, use the embayment during high tides. Surf smelt were about 150 times more abundant within the lagoon than on exposed sandy beaches outside the lagoon (Pentec 1994).

- The protected mudflat is intensively used by migrating dunlin, dowitchers, plovers, other sandpipers, and bald eagles. Data from 1995 sampling demonstrated that the project met all pre-established criteria for success and increased juvenile salmonid habitat by over 4,000 percent (Pentec 1996).

These data have been reported in detail in a series of monitoring reports (Pentec 1993, 1994, 1996). Upon reviewing these data, the TAC concluded that the project was a success. Based on this conclusion, additional nourishment (81,000 cy maintenance dredged material) was added to the berm in 1998 to maintain its physical integrity and to preserve the ecological benefits it provides. Observations of conditions along and within the berm noted that in 1997, overtopping of the natural spit that had formed at the end of the berm had eliminated an area of saltmarsh vegetation that had colonized the area inside the spit.

Although quantitative monitoring has not been conducted since 1995, the benefits provided by the project have continued to increase. The area of saltmarsh has continued to expand along the upper intertidal fringe on the inside of the berm, and along the sheltered shoreline of Jetty Island itself; this latter area was planted, but plant growth was inhibited for several years by unstable shoreline sands. Productivity of the mudflats appears to be increasing, the channel system within the lagoon is maturing and provides low-tide refuge for large numbers of small fish and invertebrates. The spit at the end of the berm has elongated, with longshore transport of sediment placed with the 1998 renourishment, to the point where it now provides additional wave protection for the area inside the lagoon and an expanded supralittoral sand-spit refuge for shorebirds and eagles.

Because erosion continues, as expected, along the outer third of the berm, further nourishment is required to preserve the benefits that have been achieved. Without renourishment, the Corps has predicted that the main portion of the berm could be breached in the winter of 2000-2001. Should that occur, the substantial increases in salmonid, forage fish, and avian habitat that have been provided by the berm will be lost. Renourishment was planned in 2000 to add material to sustain the berm and to expand the area of protected mudflat, thus increasing the habitat benefits achieved. However, this nourishment was not accomplished due to objections of the US Fish and Wildlife Service, citing concerns about adverse impacts of renourishment on native char.

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Attachment— City's Response to Comments

Letter from DOE

December 22, 2000

Mr. Paul Roberts, Planning Director
City of Everett
2930 Wetmore Avenue, Suite 8-A
Everett, WA 98201

Mr. Jon Houghton
Pentec Environmental
120 Third Avenue South, Suite 110
Edmonds, WA 98020

RE: **December 20, 2000 Final Draft, SEWIP Salmon Overlay**

Dear Paul and Jon:

Thank you for the opportunity to comment on the December 20, 2000 final draft of the SEWIP Salmon Overlay. The development of a management plan for the lower Snohomish estuary has been a long and rewarding process and I have personally enjoyed working with both of you as well as other members of the committee. I think the final product will greatly enhance the management of resources in the lower estuary.

Given my vacation schedule I have to send you some rather quick comments. My main comment, as you both undoubtedly suspect, centers on the proposed land use policy and use designations for the Maulsby mudflat. Other minor comments follow. We have commented on this matter previously with respect to the City's draft Shoreline Master Program, and offer the narrative below to supplement that record.

Maulsby Mudflat

We continue to recommend that the City remove the Maulsby mudflat from what is considered in the report as a "reasonable development" footprint. We do not consider the mudflat to be a "reasonable" development location given the critical and intrinsic habitat value the mudflat provides for chinook and bull trout and other salmonid species, as well as shorebirds and waterfowl.

Response 1. *In the SEWIP Salmon Overlay, the mudflat was left in the area considered for a reasonable (but hypothetical) worst-case development scenario (the HDS) because it did not fall within the top quartile of AUs in the UGA. The approach (Section 2.5) taken was to look at all AUs within the UGA, normalize them against the highest scoring AU in the UGA, and remove the top quartile as high-quality habitats worthy of* *protection. As an exercise (not included in the Overlay), the AUs within the UGA were ranked and plotted in a score-frequency histogram, as in Figure 4.2. The major break occurs within the lower third of the fourth quartile. If this break were adopted, six fewer AUs, mostly in EMUs 1 and 2, would be excluded from the HDS. A less distinct break occurs about one-third of the way down into the third quartile. If this break were adopted, three additional AUs (1.19, 7.09, and 5.00) would be excluded from the HDS. None of these three has any assumed impact under the HDS (Table 4.3); thus, there would be no change in the outcome described with respect to the position of Maulsby Mudflat. As noted in the Overlay, this merely leaves it in the HDS.*

The mudflat is an irreplaceable estuarine habitat due to the habitat connectivity it provides along the Snohomish mainstem shoreline and nearshore environment, and critical estuarine food chain support. In fact, the mudflat is the single largest remaining contiguous block of mudflat habitat along the main stem of the Snohomish River, and represents approximately 90 percent of the remaining habitat for this EMU. Pentec (1992a) estimated that historical intertidal mudflats in EMU 5 have been reduced by approximately 50 percent.

<u>Response 2.</u> The Maulsby Mudflat (AU 5.08) does indeed provide a high percentage of the remaining littoral habitat in EMU 5 (37.4 percent of the acreage, and 48.5 [not 90] percent of the functional habitat; Tables 4.2 and E.2 in Appendix E).

Mudflats provide important feeding and resting areas for juvenile salmonids, as well as refuge from predators. The 1997 SEWIP report identified the significant shorebird and waterfowl habitat functions provided by the mudflat. The observed heavy shorebird use on the mudflat indicates that invertebrate production on the flats is high, despite the log rafting stressors. These invertebrates provide food chain support for a variety of estuarine-dependent fish and wildlife species.

<u>Response 3.</u> The Maulsby Mudflat has been shown in systematic surveys to have high use by shorebirds and waterfowl (Pentec 1996c). Epibenthic zooplankton production is high along the margins of the mudflat but low to moderate in the central portion of the mudflat (relative to other sampling along the lower Snohomish channel; Pentec 1991). Juvenile salmonid use of the mudflat is consistent during the spring: Pentec (1996c), in beach-seining and round-haul sampling across the mudflats, was unable to capture juvenile salmonids in the central region of the flats despite consistent catches along the channel edge at low tide and along the upland shoreline at high tide. This suggests that fish use the edges much more intensely than they use the central portion of the mudflats and that

the important aspect of the mudflat for juvenile salmonids is the shallow sloping shoreline, not the broad central area of the flat.

It is also interesting to review the derivation of the Maulsby Mudflat. According to early mapping in the estuary, the area of the mudflat was a continuation of the shoreline extending east from Mukilteo. It was exposed to a broad fetch to the west and north and likely consisted of sandy substrates much like the present west shore of Jetty Island. Coring conducted in the area of the Maulsby and 12th Street mudflats indicates that surficial materials are somewhat coarser than the subsurface (native) beach, which was predominantly silty sand with some gravel inclusions. It was also the only shoreline between the Everett to Mukilteo shoreline and the Priest Point to Mission Beach shoreline for small fish to follow as they left the river mouth.

Studies by Pentec (1996b) have shown that productivity of the shallow, wave-swept, sandy habitats on the west side of Jetty Island is very low compared to that of shorelines on the east side of the island (Pentec 1996c) and on the mudflat itself (Pentec 1991). Given these probable conditions, it is likely that the area did not become a mudflat at all until the construction of the jetty around 1900 provided the shelter from waves that allowed deposition of finer-grained materials. Construction of the jetty and subsequent construction of the navigation channel and Jetty Island created a second potentially productive mudflat on the east side of the jetty along with an exposed sandy shoreline (like that which occupied the mudflat location) on the west side of Jetty Island. Thus, while some 50 percent of the former sandflats along the Everett shoreline south of Preston Point has been lost due to fill, a substantial area (100 acres) of new littoral mudflat has been created along the inside of Jetty Island.

The SEWIP model suggests that the impacts at the mudflat can be readily mitigated. In fact, one of the policies in the plan (P5) indicates that impacts in EMU 5 can be mitigated upstream as far as EMU 2.

<u>Response 4.</u> *The City Planning Staff notes that this provision in Policy P.5 is similar to a provision that was endorsed by Ecology in the original SEWIP and now, as then, is justified by the perceived need to restore habitats in EMUs 2 and 3 to the maximum extent practicable. This freshwater/saltwater transition zone is of high importance to juvenile salmonids for feeding and osmoregulatory adjustment before they enter the more saline waters of EMUs 4 through 7. EMUs 2 and 3 have been heavily impacted by diking and filling over the past century, much more than have the more marine EMUs; thus, assuming that the natural runs of salmon were fully adjusted to and dependent on the natural proportions and landscape of habitat in the pristine estuary, the landscape*

approach to restoration would favor actions that are most effective at restoring the balance of habitats.

The City Planning Staff recognizes that the Maulsby Mudflat was not in the development footprint approved by the original SETAC.

A closer look at the "impact" and "mitigation" assessment units reveals several shortcomings of this conclusion. First, the model makes several assumptions about the interchangeability of assessment units. Based on the model results, the overlay report fails to account for landscape position and accompanying processes that would dictate the type of habitat present over the long term. The model assumes that the Maulsby mudflat can be replaced by a vegetated wetland on Ebey Slough despite different processes present at each location. This proposed exchange would be the permanent loss of a significant area of remaining mudflat with the estuary as a whole and a critical element of habitat connectivity. The mudflat and the farm are not interchangeable in their landscape positions. They occur on different river channels, are in different fluvial environments, and therefore provide different, albeit important, functions. Thus, the problem with this assumption is that the net result is the loss of habitat connectivity along the main stem, the elimination of the remaining mudflat habitat, and its replacement with a vegetated wetland.

Because the Maulsby mudflat has existed as a mudflat for a considerable length of time, it indicates that there are landscape-scale processes at work that support that habitat type. The proposed mitigation site at Biringer, however, does not appear to have the same landscape-scale processes present which would support a persistent mudflat habitat. The fluvial processes present on Ebey Slough at the Biringer reach are very different from those along the mainstem at Maulsby. At Biringer, predominant water flows are lower in volume and velocity, in addition to a muted tidal action, resulting in greater sediment deposition (relative to Maulsby).

The processes at Maulsby, however, have created an equilibrium in the deposition and removal rates of sediment, thereby maintaining a stable substrate elevation. A look at adjacent areas restored through inadvertent dike breaches (mid-Ebey Island wetland opposite the Biringer farm on Ebey Island, and mid-Spencer immediately to the south) clearly suggests that the Biringer farm will revert to a vegetated emergent wetland over the long term. It will not persist as a mudflat. Granted, a restored emergent wetland on the farm is a desirable restoration action, but it will not replace the functions lost at the mudflat.

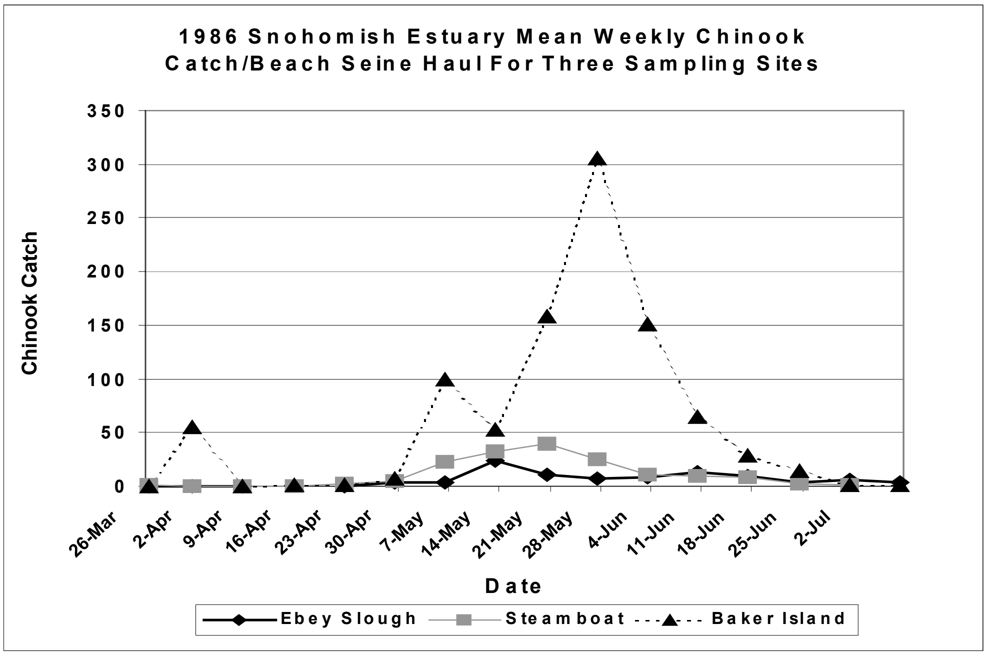
Response 5. *A minor point: Biringer Farm is on North Spencer Island, between Steamboat and Union sloughs, and nowhere is that site identified as the only site which might be considered as mitigation for development on the Maulsby Mudflat. The City Planning Staff notes that under the 1997 SEWIP policies, mitigation of impacts along the lower Snohomish channel in the vicinity of the mudflats would be allowed at Biringer Farm under Policy M.1. As noted in the 1997 SEWIP, diked areas in the estuary can be expected to have undergone substantial subsidence since diking. This makes it likely that simple dike breaching (without substantial regrading) will create large areas of mudflat. At the Marysville sewage treatment plant site, Jones & Stokes has reported an increase in elevation of about 0.1 ft per year due to sediment accumulation and (possibly) rebound. Thus, as noted by Ecology, over the long term (decades), accretion in breached areas protected from wave action by dikes is expected to lead to establishment of predominantly a marsh habitat. More, and longer-lasting mudflat could be preserved by removing more of the existing dikes to increase wave action on a restoration site.*

An ability to create mudflats in the lower estuary has been demonstrated in the Port's Jetty Island berm project. This project created a 19-acre mudflat that has been shown (Pentec 1996b) to provide excellent mudflat habitat for juvenile salmonids and shorebirds. The drawback of this type of project is that it does require periodic renourishment with dredged material.

Other actions could be taken to mitigate for impacts in EMU 5 within EMU 5. Mudflat functions can be improved in the lower Snohomish channel by restrictions on log raft storage. The restricted entrance channel to the Maulsby Marsh could be opened up – thus greatly improving the function of the marsh and the adjacent mudflats. Shoreline and riparian enhancements could be included in any development proposals for these mudflats to enhance the function of those remaining areas.

Development of an AU such as the Maulsby Mudflat in EMU 5 may not require that the total area of littoral habitat in the AU be lost. For example, the HDS assumes approximately 200 acres of littoral habitat loss in EMU 5 (Table 4.3) or about one-third of the total littoral acreage in the EMU (Table 4.2). Of this 200 acres, about half of the loss was assumed to be to dredging to depths deeper than -10 ft MLLW; so this area would remain as Waters of the State but would require acre-for-acre mitigation per Policy P.3.

Perhaps most important from a salmonid perspective is the fact that there is a differential use of the main channel of the river when compared to Ebey or Steamboat sloughs. The chart below, provided by Kurt Nelson (Tulalip Tribes) shows that outmigrating chinook salmon use the main channel disproportionately more than the others. The juvenile chinook that use Maulsby will not use the restored Biringer site during their outward migration and attendant estuarine residence.



<u>Response 6.</u> *Beach-seine catch rate is highly dependent on the nature of the site selected for seining and is not necessarily an indicator of absolute fish abundance, of habitat quality, or of duration of fish use and benefits derived. For example, there are other data sets (e.g., Pentec 1992b) that found higher beach-seine catch rates at sites in Steamboat, Union, and Ebey sloughs than at a site in the mainstem (for chinook and coho salmon; chum catch rate was highest at the mainstem site).*

While it is probable that a high proportion of fish moving down the right-hand shoreline of the mainstem spend some time on the Maulsby Mudflat, fish following the right-hand shoreline out of Union or Steamboat sloughs at anything other than a low tide also may access the mudflats via the pass at the north end of Jetty Island.

The second problem with the model is the way it scales the impacts of log rafting as compared to other stressors. During the restoration ranking exercise we conducted, Stephen Stanley and I began to question whether the removal of log rafting, given its temporary nature, should receive the same level of restoration credits as wetlands that have alterations of historic hydrology.

The log rafting studies referenced in the report imply that areas stressed by log rafting activities quickly recover when such activities cease, which is not the case with permanent wetland impacts (e.g., fill). We suggest that project-specific projects revisit the specifics of this element of the model and weigh the stressors accordingly.

Response 7. *The model has been used to score the present, instantaneous condition of habitat; log raft storage has been practiced for many years in various AUs in the study area and its effects on habitat function have been well documented (e.g., Smith 1977). The model can be used repeatedly over time on a site that is evolving from a condition of higher stress to one of lower stress. In the case of log raft storage removal, as cited by Ecology, recovery is relatively rapid. In this case, the model would indicate an immediate increase in function as soon as the rafting is removed, although the actual full recovery to prerafting conditions may take a few months. Note that removal of log rafts cannot be used to replace required mitigation area, but only function.*

In the case of a restored wetland, where tidal hydrology has been restored by breaching dikes, the Overlay (Section 5.6.3) calls for monitoring over a 10-year period, with repeated assessments using the model. In this case, the model would be expected to record a slow increase in score as various indicators develop toward relatively stable conditions. Examples of indicators expected to become established to increasing degrees over time are tidal channels, marsh vegetation, and riparian vegetation. The mitigation site would not be scored as having these indicators until they meet the thresholds of the model (Appendix A).

The model does raise, however, questions about the liability under the Endangered Species Act for the physical damage to mudflat habitats from log rafting activities.

Response 8. *Noted.*

I trust the City and the Port will hear a similar level of concern regarding impacts to the Maulsby mudflat from the Corps of Engineers, the US Fish & Wildlife Service, and the National Marine Fisheries Service, particularly in light of the ESA, when such a proposal goes through the Section 404 permitting process.

Other Minor Comments

1. Appendix Table C.3 (now 4.3B) still refers to “development footprint wetland complex areas”.

Response 9. *This error has been corrected.*

2. Table 4.5 refers to restoration sites that have been slightly renamed. For example, site 25 used to be called "Fish and Wildlife property". We renamed it as "S. Ebey WDFW" to distinguish it from "S. Spencer Island WDFW", which we renamed from "South Spencer Island". You may also want to remove the old map numbers from the table.

   Response 10. *These errors have been corrected.*

3. Will you have time to correct the mapping of the emergent wetland at AU 3.05, per Stephen's comments during the last meeting?

   Response 11. *This error has been corrected.*

Once again, thank you for the opportunity to comment. I look forward to discussing this further at our next meeting.

Sincerely,

Erik Stockdale
Wetlands Specialist
Shorelands & Environmental Assistance Program

cc: Stephen Stanley
Jeannie Summerhays
Bob Fritzen
Ann Garrett, NMFS
Members of the SEWIP Oversight Committee

Letter from Snohomish County

January 8, 2001

Mr. Paul A. Roberts, Director
City of Everett
Planning and Community Development
2930 Wetmore Avenue, Suite 100
Everett, WA 98201-4044

Subject: SEWIP Salmon Overlay Report, Review Draft – December 20, 2000

Dear Mr. Roberts:

Thank you for the opportunity to review the December 20, 2000, final draft Snohomish Estuary Wetland Integration Plan (SEWIP) Salmon Overlay report. I appreciate the City's efforts to involve other SEWIP Technical Committee members and me in the review of products leading up to this report. Consistent with the purpose of the Committee, this letter offers my comments as technical staff regarding how to place this report and its outcomes on a stronger technical foundation. Some of my comments will be familiar because they were discussed in committee meetings while the committee schedule prevented other issues from being addressed. Although my comments outline areas of disagreement on technical approaches and outcomes, I share the SEWIP Salmon Overlay's stated goal: "to preserve remaining natural ecosystem components and processes that provide for salmonid habitat productivity and to restore and enhance those processes that have been lost or degraded to the extent necessary for recovery" (p. 76). I hope my comments will assist the City and its SEWIP overlay in achieving this goal.

GENERAL COMMENTS

1. Uncertainty associated with model

Numerous sources of uncertainty associated with the IVA model have not been addressed or acknowledged through the compensation policies. As a result, I am concerned that an over reliance on the model may jeopardize salmon recovery in the Snohomish Basin.

The IVA model indicators are only a subset out of the universe of potential functions provided to fish by estuary and nearshore habitat. Because no IVA model error rate has been calculated, it is unknown to what degree the final IVA scores are reflective of and related to actual habitat functions provided. Without knowing or testing the importance of other functions, the methodology assumes there is a direct correlation between the subset of indicators and the full suite of conditions necessary to fulfill the habitat requirements of the target species.

<u>Response 1</u>. *It is unclear which functions out of the universe of potential functions provided to fish were not addressed. We spent the first several of the SSOTAC meetings listing all the functions we thought important to salmonids and the indicators (environmental attributes) that determine the quality of habitat for providing functions for juvenile salmonids. It was recognized from the outset that this type of model has no "error rate" and can only be tested by use and informed examination of the results. See also additional text at the end of Section 2.3. The City Planning Staff notes that the County reviewer was not present for the first two SSOTAC sessions in which the underlying approach and assumptions of the IVA model were discussed. Many of the comments in this section regarding the nature of the model and its limitations were discussed in some detail at those meetings.*

Observer bias has not been acknowledged and tested. If someone else scored the AUs, would he/she assign comparable scores? This is particularly an issue with the scoring of habitat under hypothetical restoration scenarios, and was a significant concern during a field outing by the technical committee.

<u>Response 2.</u> *Observer bias was tested in the SSOTAC field "calibration" trip on April 5, 2000, and the model was modified to accommodate changes warranted by the field effort. Observer bias was also addressed in the first full day of fieldwork by having three biologists confer and agree on the appropriate scoring. In ideal application, the field scoring should be done by a minimum team of two biologists with full knowledge of the model rationales and protocols. This recommendation has been added to the text (Section 2.3).*

Model is not validated or calibrated with real data of fish abundance and distribution. The importance of an AU to fish may be independent of the AU score.

<u>Response 3.</u> *This model is not a fish production model; it is a habitat model. It is also not a statistical model that can be quantitatively "verified." Please see new text at the end of Section 2.3. If the importance of an AU to fish is really independent of (i.e., not related to) the AU score, then we have grossly wasted the last year. However, it is true that the importance of areas to fish may depend on additional landscape features that are not represented in the model (the SSOTAC spent some time trying to figure out how to better reflect landscape features in the model). These aspects are dealt with in the restoration prioritization score and can be addressed in the policies if that is the decision of the implementing entity. While the model may*

not fit our expectations of habitat quality perfectly in all cases, the City Planning Staff firmly believes that it clearly distinguishes good habitat from mediocre habitat, from poor habitat, thus meeting one test for validation of a scientific model (e.g., Mobrand Biometrics unpublished).

Example: Is the habitat on Otter Island really 3X as valuable to fish per acre as the marsh at the mouth of Quilceda Creek as the model suggests?

Response 4. *There is much that could be debated about this. In the final scoring of the sites at the mouth of Quilceda Creek, the normalized scores ranged from 42.6 to 80.4, normalized to 100 for Otter Island. Thus, at a maximum, AU 2.02 at the mouth of Quilceda Creek is calculated by the model to be about 43 percent as good as Otter Island, while AU 2.01 is calculated to be about 80 percent as good.*

Both Otter Island and the Quilceda Creek mouth AUs have tidal channels and both scored as having marsh over 25 percent of their area. Juvenile salmonids can access only a limited portion of each AU along the edges of these tidal channels and marsh vegetation. Some AUs at the mouth of Quilceda (e.g., 2.02, 3.01, 3.02, 3.03) have log rafts persistently stored on their mudflats; there is good local science (Smith 1977) which indicates that this is bad for benthos, and this negative influence is reflected in the negative multiplier applied to the score. Otter Island is also a source of LWD, which the SSOTAC agreed merits a positive multiplier. Based on these considerations, the City Planning Staff would submit that Otter Island arguably does provide better habitat than the AU at the mouth of Quilceda. Moreover, it is also one of the few remaining forested tidal wetlands in the estuary and has a great many of those benefits to nonsalmonids and nonfish species about which the County Surface Water Management Staff has expressed much concern. Certainly there are differences in the detail of how fish may use the two areas, and Pentec's work (1992b) has shown that the nature of the prey base available for juvenile salmonids changes between EMUs 1 and 2 or 3.

Example: Beauchamp et al. (1986) had a significantly higher catch of chinook in the main-stem than at sites along the distributary sloughs. This data doesn't appear to be consistent with IVA scoring.

Response 5. *Beach-seine catch rate is highly dependent on the nature of the site selected for seining and is not necessarily an indicator of absolute fish abundance, of habitat quality, or of duration of fish use and benefits derived. For example, there are other data sets (e.g., Pentec 1992b) that found higher beach-seine catch rates at* *sites in Steamboat, Union, and Ebey sloughs than at a site in the mainstem (for chinook and coho salmon; chum catch rate was highest at a mainstem site).*

If indeed more fish go down the main channel, it is because it is bigger, not because it provides better littoral habitat along the way. As is evident (and reflected in the model results), the shorelines of Ebey or Steamboat sloughs indeed offer better habitat quality for juvenile salmonids than does the majority of the shoreline of the mainstem downstream of US 2. This example does not reflect a model deficiency but rather a landscape feature that could be addressed through policy in model application. For example, the restoration site prioritization strategy gives extra emphasis to sites on the mainstem (see new Appendix D and Chapter 6).

Model scores habitat indicators for functions, which may be important in one EMU but not in another. Since scores are not normalized within EMUs, this results in certain AUs being scored lower relative to other AUs because they lack certain functions (i.e., wood recruitment potential within emergent marsh) that would not be expected to be present even under pristine conditions. As a result, the model fails to recognize the value of the suite of habitat conditions available in the estuary, which accommodate multiple life history strategies, life history stages and species diversity.

Examples: protection from waves, eelgrass, salinity, wood recruitment, feeder bluffs.

Response 6. *Please note that Figure 4.10 identifies the top (fourth) quartile of AUs within each EMU or EMU pair.* Also, *wood recruitment does occur within emergent marshes and was scored in some AUs with marshes (Figure 4.7). Obviously, no AU has all indicators. It is unclear why this is considered to be a fault in the model. The IVA approach is predicated on assignment of the highest-quality rating to the AU with the most indicators present. It is unclear what significant habitat conditions or indicators important to any life history trajectory are not represented in the model.*

Functions are weighted in overly simplistic manner.

Examples: no assessment of limiting function (i.e., temperature). No assessment of synergistic relationships among functions.

Response 7. *Models by their very nature attempt to simplify complex natural phenomena and to simulate the essential features of the model subject. It is unclear which functions are simplistically rated in the Tidal Habitat Model. Based on the examples given, it seems the reviewer is referring to indicators, not functions*; *the IVA* *approach could be considered "simplistic" in the sense that absence of an indicator receives no score and presence receives a score of 1, 2, or 3, depending on the importance of the indicator in defining habitat function. In some other models (e.g., the hydrogeomorphic model, HGM), the indicator, or attribute, may be scored on a scale of 0 to 1, as rated against a reference condition of "as good as it gets." In the HGM, the scoring is based on field measurements, which are costly and time consuming when a great many AUs must be assessed. In the Tidal Habitat Model, field observations of the presence or absence of many indicators are substituted for field measurements of fewer attributes. The end product of either approach is a number that represents the quality of habitat for performance of certain functions. The City Planning Staff believes that the Tidal Habitat Model is an efficient way to assess the habitat function of AUs for salmonids.*

If temperature is limiting in an AU, it receives a negative score. It is unclear what synergisms among functions (?) or indicators should be addressed. As noted above, all indicators are weighted on a scale of 1 to 3, if present, based on the expert panel (SSOTAC) decision on the relative importance of that indicator; exceptions are made for indicators that the SSOTAC believed to have an overridingly positive or negative influence on habitat quality.

Some functions are not readily observable at a macroscopic level, and thus are not included in the model.

Example: primary production, above and below ground plant biomass.

<u>Response 8.</u> *The model is not intended to address all metrics one could measure in an estuary; the intent is to rate habitat quality based on characteristics or indicators that are readily discernible without extensive or intensive field measurement. Likewise, the model clearly is not intended to address all functions that occur in the estuary – only those that are recognized to affect salmon habitat quality (see Appendix A). Nonetheless, several model questions address primary production. Plant biomass is covered, to the extent that it affects salmonid habitat quality, through questions on extent of marsh, eelgrass, and riparian vegetation.*

Critical threshold determinations in the scoring (e.g., 0-25%, 25-50%) are not biologically meaningful or based on hard data. The thresholds have a huge impact on the IVA scoring.

Example: if eelgrass is present over 25 percent of the AU, the AU is scored a 2X multiplier. If it is present over 24 percent it does not receive the multiplier. This makes a 50 percent difference in the overall score for the AU. What data supports this break that so dramatically changes the score?

Response 9. *Actually, the difference would be somewhat less extreme in that the 24 percent total coverage probably would have scored a "yes" on Question 23c, thus receiving a +3 rather than a X2. In reality, the field investigators can exercise scientific judgment if they feel that the AU warrants the 2X multiplier. A dense bed covering 22 percent of an AU might be of more value than a sparse bed covering 30 percent.*

The SSOTAC was well aware that, following the IVA model approach (e.g., Hruby et al. 1995), we were trying to categorize continuous variables by ranges of condition, and that this results necessarily in break points between conditions. We know that large areas of eelgrass are of great importance to coastal ecosystems (and to salmon). In the IVA model, this (like saltmarsh) would certainly qualify as an indicator that warrants a positive multiplier.

Model does not provide for habitat functions contributed from >25 ft landward of the OHW. This misses numerous factors that influence habitat and is inconsistent with salmonid critical habitat designations (i.e., Snohomish County Administrative Rule).

Examples: microclimate effects, shading, water quality controls.

Response 10. *The model does indeed cover functions provided beyond 25 ft from OHW. Where larger trees (an LWD source) are present the AU boundary was extended to 1 SPT height for calculation of AU area. (See discussion of the Landward Boundary of the EMUs in Section 2.4.) The importance of riparian microclimate on estuarine waters is highly debatable; microclimate effects on fish are negligible. The shading and sediment delivery attenuation functions of riparian vegetation and their effects on water quality in the estuary are likewise less important in tidal areas compared to their importance along streams. Nonetheless, an AU that has a vegetated riparian zone with large trees receives a riparian score (Q 17 and 18) and a positive multiplier (Q 19).*

Model discounts area for functions. For species dependent on the detritus-based food web, area itself is a function.

Response 11. *It is unclear what the comment addresses. The IVA score reflects quality of habitat per unit area; when multiplied by AU area in acres, the IVA-acre score represents both function and area. Thus, an AU of limited functional score* *(low IVA points per acre) can have a high function (high number of IVA-acres), if it has a large tidal area.*

2. Application of the model

The model underscores development sites and overscores mitigation sites. Much of this arises from the scoring of log rafting. The benefits gained from log raft removal are overstated. Log raft storage (a transient and "soft" habitat impact) is given the same fractional stressor value as dikes and fill, which are of a more permanent nature and do not allow for the trophic support of fish even while the impact is occurring.

Response 12. The SSOTAC was in agreement over the negative multipliers assigned to log raft storage, which were based on Snohomish Estuary data by Smith (1977). The negative multiplier reflects both loss of trophic support resulting from log rafts grounding in the intertidal zone and the exclusion of fish from water areas occupied by rafts. The model scores dikes and fill as a loss of area, a change in shoreline slope, a loss of riparian function, and often a change in shoreline armoring.

Since log rafting occurs at many of the sites that are proposed for development, they are scored lower. In contrast, restoration sites are scored higher than is justified because the scoring does not take into account the impact of subsidence of areas behind dikes.

Response 13. Consistent with impact/mitigation policies in effect for many years and in use in various regulatory programs, the SSOTAC agreed that the basis for assessment of existing habitat conditions is the present condition. Restoration potential is calculated for areas that would be developed under the HDS so that the mitigation potential that would be lost is known; the City Planning Staff is unaware of a legal precedent for requiring mitigation for that lost potential. All areas with log raft storage are scored lower; many are outside of the UGA (see Figure 4.15). The last sentence of the above comment implies that a mudflat at +4 ft MLLW is less valuable than a mudflat at +6 ft MLLW. If that is the intent, the City Planning Staff respectfully disagrees. Model application should reflect actual conditions expected with dike removal; regardless of subsidence or fill, the area behind the dikes can be graded to any desired elevations before breaching. Tidal mudflats, with associated channels, surrounded by marsh area are expected to provide excellent habitat for juvenile salmonids, habitat that is similar to what is provided in the "near natural" marshes in EMU 3. Moreover, it is expected that in the long term (over several decades), natural deposition will transform most created mudflats behind remnant *dikes into a tidal marsh/channel complex like those that have developed in the Mid-Spencer Marsh.*

Normalization of AU scores across the planning area fails to recognize the value of diverse habitats across the estuary. For example, marsh habitat in lower Quilceda Creek/Ebey Slough will never achieve habitat conditions like those that exist on Otter Island, the highest ranking AU. Under natural conditions, these areas provide different habitat. Therefore it is misrepresentative to indicate that these habitats function at a fraction of the function provided by Otter Island. A more effective approach for represent the habitat functions of these AUs for fish with changing life history needs is to normalize and rank sites within EMUs. This approach would remove the uncertainty of functional inter-changeability among EMUs.

Response 14. *This was much discussed in the SSOTAC meetings – in EMUs with few AUs this seems to be a pointless exercise. One approach would be to delineate more AUs within an EMU – i.e., break the EMU into smaller pieces – which could be done. This would, however, be something of a diversion from our original basis for defining AUs as areas with biologically significant boundaries. As noted above, Figure 4-10 identifies the top (fourth) quartile of AUs within each EMU or EMU pair.*

3. Inadequate mitigation policies

The SEWIP Salmon Overlay's use of the functions and values approach should not be used as a substitute for mitigation ratios. The SEWIP Salmon Overlay says that its mitigation policies go beyond "no net loss" of function toward restoration. I strongly disagree. This claim is based on a mitigation ratio of 1:1.3 for concurrent mitigation and an assumption that non-tidal wetlands lost through development will be mitigated for through the restoration of tidal wetlands – [**This is not required by the policies**].

Response 15. *As noted in the discussion that accompanies Policy P.3 (Section 5.5), the City Planning Staff recognizes that consensus was not reached regarding minimum mitigation ratios and provides its rationale for adopting 1.3:1 functional replacement as a minimum to ensure there will be a net increase in function. Level of increase that might be expected to result from the HDS under two different assumptions is provided in Tables 6.3 and 6.4. The fact that policies do indeed go beyond no net loss of tidal habitat is guaranteed by the requirement that any loss of palustrine wetland at a tidal restoration mitigation site be replaced with tidal habitat (Policy P.16).*

On page 60 the plan says that the 1:1.3 ratio accounts for uncertainty. In the next sentence, it states that this same 30 percent increase in function is intended to ensure an increase in habitat function.

<u>Response 16.</u> *If we believed the model was 100 percent accurate, a 1.01:1 ratio would ensure an increase in habitat function; since we chose to recognize that the model may be less than 100 percent accurate, we mandated a 30 percent increase in habitat function as determined by the model, to provide the assurance that there will be a gain in function. Note that this is not saying we are providing for a 30 percent increase in habitat function – rather the increase is in habitat function as measured in the model.*

On page 64 it says that the 1.3 multiplier is to account for the temporal loss. How can it be all of these things?

<u>Response 17.</u> *The 1.3 multiplier in Policy P.7 is not the same as the minimum 1.3 ratio for habitat function. This multiplier is applied to up-front acreage required in the case where mitigation is provided concurrently with the impact, and is intended to ensure that there is no temporal loss in function. The different uses of these similar factors are illustrated in Table 5.1.*

It is also important to note that the less than one to one mitigation ratio for non-tidal wetlands mitigation with tidal mitigation results in an overall net loss of wetland area in the estuary, if developers choose this approach.

<u>Response 18.</u> *The SEWIP policies are recognized and intended to result in a net increase in tidal habitat area at the expense of a loss of palustrine wetlands.*

I believe that the approach in SEWIP doesn't account for all the sources of uncertainty, and consequently will result in a "net loss" of salmon habitat. In order to ensure "no net loss," the SEWIP compensation approach must account for the following sources of uncertainty:

> **Uncertainty with the model** (applies to mitigation in advance of impacts as well as concurrent mitigation) (see above).
>
> **Uncertainty in habitat function interchangeability** (applies to mitigation in advance of impacts and concurrent mitigation): The SEWIP Salmon Overlay uses the functions and values approach to justify a low (or in most cases no) mitigation ratio and even assign restoration credit at this level of compensation, yet the Tidal Habitat Model does not and cannot be used to replace like functions with like functions. The

Tidal Habitat Model calculates a single IVA score to represent the habitat quality in each AU. This IVA score is simply the sum total of the scores for each indicator multiplied by the multipliers and stressors. This total IVA score is used to calculate mitigation "debits" and "credits." Unique function or functions within an AU that may disproportionately limit or enhance salmonid habitat quality are lost in the summation of the scores. Therefore, critical and unique functions could be lost in one location and replaced with different functions in another location as long as the total score adds up to an equal or greater value.

Response 19. *The City Planning Staff cannot envision an example where use of the model and mitigation policies as described would result in loss of a disproportionate loss of a single function, or where critical and unique functions could be lost in one location and replaced with different functions in another location.*

Spatial uncertainty (applies to mitigation in advance of impact as well as concurrent mitigation): Diversity of habitat is not valued in the model or addressed in the mitigation policies, despite strong objections from the majority of technical committee members.

Response 20. *It is unclear what is meant by "diversity of habitat" or what strong objections are referred to. Policy P.5 does recognize the somewhat different functions of tidal habitats in different EMUs and provides requirements for where compensation can occur. For example, it states that impacts in EMU 7 should only be mitigated in EMUs 4 or 7.*

There is no mechanism built into the policies to require that the full range of habitat functions provided by the estuary are preserved or even an incentive to do so (i.e., a higher mitigation ratio for mitigating outside the EMU where the development impact will occur).

Response 21. *This was discussed in the SSOTAC meetings and concurrence was reached that we wished to focus mitigation and enhancement actions in EMUs 2 and 3 (to relieve the so-called "estuarine bottleneck").*

Under the policies of this plan as written, all remaining accessible habitats within an entire EMU could be developed.

Response 22. *It is unclear where this could happen. Only in EMU 6, where shorelines are 100 percent altered, could development affect all AUs. Such development would be expected to leave the shoreline (the remaining accessible* *habitat) much as it is today. In other EMUs only a fraction of the AUs are included in the HDS, and in those AUs, not all accessible habitat area was assumed to be developed under the HDS.*

The current draft (December 18, 2000) of the City's Shoreline Master Program designates all of the aquatic areas that ranked highest in Figure 4.11, all the aquatic areas except Maulsby Mudflats and Au 5.03 that ranked highest in Figure 4.10, and the entire nearshore area between the Mukilteo tank farm and the Port's South Terminal as "Aquatic Conservancy." Modification of these areas is highly restricted under the policies and regulations of the draft Shoreline Master Program. In addition, regulations for adjacent uplands include:

- *Restrictions on water-dependent uses that would require significant dredging or piers to gain access to the water*
- *Requirements to construct setback dikes when feasible, to allow the outer dikes to revert to more mature vegetation*

Each AU and each EMU provide unique functions and values. Different areas provide different functions for estuary processes, life history stages, life history strategies and various species. The full range of habitats needs to be represented. The following questions illustrate some of the potential implications of this shortcoming on salmon production:

- What percent of outmigrants go down the main stem and what percent go down the sloughs?
- Does an outmigrant traveling down the left bank of the main stem ever find high quality habitat areas on the other side of the estuary?
- How does habitat fragmentation affect fish use and distribution?

Response 23. All are excellent questions that remain data gaps.

Temporal impacts (applies only to concurrent mitigation): For concurrent mitigation there is a lag time between when the impact at the development site begins and the completion of the mitigation project. There is also a lag time between completion of the mitigation project and the achievement of functional equivalency at the mitigation site to the loss that has occurred at the development site.

<u>Response 24.</u> This is accounted for in Policy P.7. No temporal loss (as calculated by the model) is allowed. A 1.3:1 acreage factor (different from the minimum 1.3:1 functional replacement requirement) is applied to concurrent mitigation to ensure that this is the case. See Table 5.1 for an example. We apologize that this was not included in the information for your final review. Note that this requires that the mitigation must be at least partially functioning before any impact occurs at the impact site.

Uncertainty of outcome (applies primarily to concurrent mitigation, with the exception of uncertainty associated with long-term project success):

- What is the probability of success?

  <u>Response 25.</u> See Appendices C and F (in final document; appendices have been given new designations).

- Will a mitigation that occurs after the project impact ever be constructed?

  <u>Response 26.</u> This situation is not allowed by Policy P.7.

- Will the project be constructed as designed?

  <u>Response 27.</u> Covered in Section 5.6 Tier 1.

- Was the project design flawed, and thus not sustainable over the long term?

  <u>Response 28.</u> Because the SSOTAC does not have regulatory authority, this situation would need to be covered as a permit condition.

- What corrective measures will be taken if a site doesn't meet its performance targets?

  <u>Response 29.</u> Because the SSOTAC does not have regulatory authority, this situation would need to be covered as a permit condition. The City requires performance bonds be posted by private parties to guarantee mitigation performance.

- Will mitigation sites continue on a trajectory toward full recovery after 5-year performance standards are met?

Response 30. *Per Section 5.6.2, monitoring would be required over 10 years and the project would be rescored using the model after 5 and 10 years. Data from these exercises would be used in the adaptive management process to refine the model and the design of mitigation/restoration projects. The expectation, based on the Mid-Spencer Marsh example (new Appendix F), is that, once tidal influence is restored, the site will evolve toward a functioning tidal system, the nature of which is dictated by elevations present, location in the estuary, and hydrology of the adjacent river distributary.*

- How will the significant subsidence that has occurred affect the outcome of restoration?

Response 31. *The 1997 SEWIP, on pages 5-9 through 5-11, includes a discussion on the effect of elevation on goals for individual restoration sites. It is probable that areas behind dikes have subsided since diking. Elevations behind the dikes can be changed by excavation or fill if desired, before dikes are breached; this has been done at the Port of Everett's Union Slough mitigation site. Once tidal influence is restored, the site will evolve toward a functioning tidal system, the nature of which will be dictated by elevations present, location in the estuary, and hydrology of the adjacent river distributary. Elevations of the area behind the dike will dictate the percentage of the area that will be mudflat and the percentage that will become marsh or riparian. Elevations can be expected to change over time depending on rates of sedimentation and erosion, rebound, and even geologic events such as earthquakes.*

4. Characterization of the role of the committee and best available science in the creation of the document

I am troubled by how the role of the SSOTAC in creation of this report is represented (p. 6, p. 12, and numerous other locations throughout the document). The committee discussed how best to represent its role and opinions and I feel that the current text is not a fair representation of that agreement. The text should clearly state that the committee reviewed and commented on issues and draft sections of the report but that there was not committee consensus on the report's content. Therefore the report does not represent the opinions of all committee members or their respective organizations. The report was developed by the City and their consultant and comments were requested from the Technical Committee but the City is responsible for the report's final content. A statement such as this should be made on the page that lists the Technical Committee members and elsewhere in the document where the committee's role is discussed. In the report as a whole, conclusions and recommendations should not imply Committee endorsement or consensus if there was none. If these changes to the text are made, I would feel more comfortable that the agreements on representation of the Committee's role and opinions have been honored.

Response 32. Text has been modified to address these concerns (Sections 2.1 and 5.5).

5. Failure to view the ecosystem holistically either from an ecological or geomorphic perspective

The focus of the SEWIP Salmon Overlay plan on compensatory mitigation for loss of functions important to salmonids doesn't fully account for the importance of restoring the suite of ecosystem processes (hydrological, geo-chemical, and biological) and functions which are important not only to salmonids but other organisms integral to the function of the watershed as a whole. Where impacts occur to existing tidal and or isolated palustrine wetland habitats, only those habitat indicators and functions in the IVA model that are deemed important to fish are required to be replaced and monitored over time. Furthermore, the final success of a project will be evaluated only in terms of the salmon IVA model. Other habitat indicators (e.g., above and below ground vegetative biomass, sediment organic content) of functions which have not been evaluated or were not deemed to be important to salmonid fishes may also be lost with development impacts.

Response 33. The Tidal Habitat Model addresses (gives credit for) restoration of tidal hydrology, tidal marshes, riparian zones, eelgrass beds, and feeder bluffs. All of these are processes believed to be important to forming salmonid habitat. Other processes are scored in the model based on the result of their action (e.g., sedimentation, circulation, surface water delivery). It is unclear what other processes are not accounted for. The last sentence of this comment implies an expectation that tidal marshes will be impacted by development; in general, that is not considered likely in the HDS evaluated. Vegetated biomass and sediment TOC are legitimate parameters that could be considered in Tier 2 monitoring per Section 5.6.2.

However, due to the focus on compensatory mitigation for salmonid fishes, those lost functions will be both unknown and not replaced at the mitigation site. This approach is inconsistent with watershed assessment, watershed planning, and the maintenance and restoration of watershed processes, which act to naturally create those habitats important to salmonids and other ecosystem components. This suggests that a functional equivalency approach to compensatory mitigation is misguided if it is, in fact focused on one guild of secondary consumers.

Response 34. *In cases where other nonsalmonid ecosystem functions are of agency concern, they can certainly be reflected in stipulations on permits issued by the appropriate regulatory agencies. This document is a salmon overlay and is not intended to cover all species or ecosystem functions. Other species and functions are addressed in the 1997 SEWIP.*

6. Inadequate restoration plan

As illustrated by its position at the end of the document, the management and restoration plan chapter is an afterthought of the SEWIP Salmon Overlay. It does not meet the definition of a plan because it does not outline a course of action or a means to achieving its stated goals. Instead, Chapter 6 lists management and restoration goals, identifies potential restoration sites and presents "restoration scenarios." Two of my greatest concerns are that the restoration target is too low to relieve the bottleneck to chinook production in the estuary (Haas and Collins 2000), and no strategy is outlined for the restoration of any habitat in the estuary.

Response 35. *The City Planning Staff disagrees that restoration is an afterthought. The restoration plan (Chapter 6) builds on the preceding chapters, which are prerequisite to developing the restoration plan. Recommendations in Chapter 7 provide a strategy for implementation. It is unfortunate that the County Surface Water Management Staff was not able to attend the last two SSOTAC meetings, when these chapters were discussed. Recall that restoration of large tracts of privately owned land requires two basic things: funding and a willing landowner. Thus, the 20 percent, 15-year goal is an interim target that may be achievable. It is not intended to be the end of restoration in the estuary. Clearly, much more could be accomplished if the funding and landowner cooperation can be obtained. The City Planning Staff is committed to working with the County and The Tulalip Tribes to accomplish restoration in the SEWIP planning area.*

Equally troubling, the scenarios are based on mitigation for development but are labeled as restoration scenarios, therefore blurring the distinction between restoration and mitigation.

Response 36. *The restoration scenarios (Tables 6.3 and 6.4) are not "based on mitigation"; they are intended to describe a "reasonable worst case" which recognizes that development may occur within the UGA. Thus, the mitigation requirements for this development (the HDS) are "deducted out" of the pool of available restoration sites using the compensatory mitigation policies established in Chapter 5. Implementation of the development scenarios would result in some restoration of (a net increase in) tidal habitat; the gains from potential restoration actions are added to that. A maximum tidal* *restoration scenario (no development) can be inferred from Table 4.5, in which a suite of tidal restoration projects both inside and outside the UGA are described.*

The scenarios also are primarily built upon the premise that impacts to non-tidal restoration will be mitigated with tidal restoration, a policy that is not required in the SEWIP Salmon Overlay.

Response 37. *While not mandated, the City Planning Staff believes that this approach will be the approach of choice. This belief is based on economics, because it is generally much less expensive to restore tidal action to wetlands by breaching dikes than it is to construct a new wetland inland, where sufficient hydrology is more difficult to ensure and substantial planting is required. The City's present Environmentally Sensitive Areas requirements (EMC 19.37) require from 1.25:1 (Category IV and emergent) to 6:1 (Category I) replacement compared to 1:1 replacement for any category if replaced with tidal habitat within SEWIP. Mitigation ratios may be decreased to a minimum of 1:1 when the findings of a wetlands mitigation plan (such as one based on the Salmon Overlay) demonstrate that no net loss of wetland functional values will result from the decreased ratio.*

Furthermore, I disagree with the ranking because it does not take into account production potential or look at restoration sites from a historical and holistic perspective (although I do agree with the identified restoration sites). As a result, the inclusion of water quality and wildlife scores from the original SEWIP (SEWIP 1997) pits functions against each other. This will result in the estuary being sliced into a pie with different management goals parcel by parcel. Another element that is lacking from the plan is a policy or strategy that would prevent full buildout of entire EMUs. EMUs were delineated because they contain conditions that are unique within the estuary. Finally, it should be noted that the proposed restoration scenarios result in an overall net loss in wetlands area of several hundred acres overall.

Response 38. *The ranking system (new Appendix D) and the restoration potential (Section 4.7) both address the issues of landscape and production potential. Any restoration action, anywhere, will result in tradeoffs of existing functions for new and different functions that we perceive to be of greater value. Using the 1997 SEWIP wetland and wildlife scores assigns the highest restoration priority to sites with the least to lose in terms of existing functions. Different restoration projects may indeed have different goals. For example, one might seek maximum tidal restoration while another may seek to retain some existing forested or palustrine wetland values. It is true that either scenario considered does result in a net loss of palustrine wetlands and a net loss of tidal plus palustrine wetland acreage. This is a necessary requirement of tidal* *restoration and necessary to ameliorate the so-called estuary bottleneck for chinook (and other species) production. Full buildout of entire EMUs within the City's urban growth boundary cannot occur under the City's proposed Shoreline Master Program, except for EMU 6.*

SPECIFIC COMMENTS

Chapter 1

1.2 (p. 2) – It is misleading to state that NMFS staff supports the concepts and technical approach embodied within the SEWIP. What specific staff? What are the concepts and technical approaches they support?

Response 39. Conversations have been held with Mr. Robert Donnelly of NMFS beginning in 1999. Presentations have been made to NMFS and other agencies (June 28, 2000) and the NMFS Technical Review Team (November 13-14, 2000). Generally favorable, albeit informal, reviews of the model and the approach taken in the Salmon Overlay to deal with salmon habitat restoration were received.

1.3 (p. 2) – The passive voice makes the statement unclear. Who sees the SEWIP as a component of the basin-wide management strategy for recovery of listed species? The City of Everett or the technical committee?

Response 40. The City Planning Staff and a portion of the members of the SSOTAC see the SEWIP as a component of the basinwide management strategy.

1.3 (p. 3) – I don't think that this document provides guidance that incorporates the needs of multiple species as states at the top of the page. It is salmon focused. It does not take a look at the estuary as a complete ecosystem or from a natural process approach.

Response 41. Changed text to read "…multiple salmonid species."

1.4 (p. 4) – The final product is not strictly a scientifically based management plan. Many policy-based decisions are made throughout this document (i.e., mitigation policies, restoration target).

Response 42. The County Surface Water Management Staff's view is noted. The City Planning Staff holds that the Salmon Overlay is indeed "scientifically based."

1.5 (p. 5) – The compensation policies were developed by the City of Everett, Port of Everett and their hired consultant. They were not developed by the SSOTAC. Most other committee members disagreed with the technical assumptions and outcomes.

Response 43. The policies were drafted by the City Planning Staff and modified substantially as a result of SSOTAC input. The majority of the remaining disagreement over the policies relates to the minimum mitigation ratios necessary to ensure a net gain in salmonid habitat function results from any development action. Text has been modified to reflect the County Surface Water Management Staff's concern.

Chapter 2

2.1 (p. 6) – It should be made crystal clear that the document and its policies are products of the City of Everett and their hired consultant, not a consensus document developed by the SSOTAC. The way this is written implies that there was consensus among technical staff on the committee, despite many of my comments and the comments of other committee members not being addressed and incorporated.

Response 44. A disclaimer has been added to Sections 2.1 and 5.5.

2.3 (p. 8) – The model does not include consideration of all aspects of estuarine and nearshore habitats that affect the quality of that habitat for performance of essential functions as stated. It examines only aspects that impact salmonids and ignores factors that cannot be visibly estimated (i.e., primary production).

Response 45. See Response 1, above. The intent of the Salmon Overlay and the Tidal Habitat Model is to address salmonid habitat.

2.4 (p. 9) – When will a more detailed application of the model be undertaken? Who will score the AUs? What are the checks and balances?

Response 46. It is uncertain when a more detailed application of the model will be undertaken. It is anticipated that geographically localized applications will occur within a short time as the value of the model for assessing project impacts and mitigation needs is recognized. It is expected that a field team of two or more biologists familiar with the model rationales and protocols would do any future rescoring (e.g., for project-specific applications). Checks and balances are provided by regulatory agency review. A more detailed scoring of the entire estuary may be an appropriate WRIA 7 activity at some point in the future.

2.4 (p. 10) – The landward boundary should be one site potential tree height on all AUs. If the area is impacted by a hydromodification, riparian removal or development, then it should be scored as a stressor.

Response 47. The City Planning Staff respectfully disagrees. Setting the landward boundary at one site potential tree height on all AUs would require such features as paved parking lots, buildings, outdoor storage, areas of industrial activity, etc., to be considered as salmon habitat. Areas with shoreline hydromodifications or lacking in riparian vegetation do receive low scores in the model.

2.5 (p. 11) – The exclusion of the top 25 percent from the development scenario is an arbitrary decision.

Response 48. True.

2.5 (p. 11) – Why is the word "footprint" replaced with "scenario"?

Response 49. This was an outgrowth of SSOTAC discussions on November 27 and December 11, 2000 (not attended by County representatives). The intent was to eliminate implication of approval of development in these areas by any regulatory body.

2.5 (p. 11) – Why have you crossed out the section, which states that the top quartile within each EMU will be excluded from the footprint? Without EMU-specific protective measures, all habitat within specific EMUs that is unique within the estuary could be lost.

Response 50. This is included as an alternative that will be evaluated in the City's proposed Shoreline Master Program revisions. As noted above, all habitat within any specific EMU would not be lost under the HDS. Except for the Maulsby Mudflats, which has a long history of industrial use, and AU 5.03, the December 18, 2000, draft update of the Shoreline Master Program designated the areas that scored in the top quartile in Figures 4.10 and 4.11 as "Aquatic Conservancy." In addition, all of the nearshore areas between the Mukilteo tank farm site and the Port's South Terminal were designated "Aquatic Conservancy." The Shoreline Master Program regulations severely limit modifications to these areas.

2.5 (p. 11 to 12) – The HDS may consider salmonid habitat conditions, but it does not take into account an analysis of the habitat necessary to allow recovery of ESA listed species to occur.

Response 51. *This analysis (calculation of the habitat necessary to allow recovery of ESA-listed species) has not been completed to the City Planning Staff's's knowledge. Once those goals are established, the model and framework of the Salmon Overlay would be a useful tool in exploring how to reach those goals.*

2.6 (p. 12) – The compensatory mitigation policies were not developed by the current SSOTAC. The process and policies were modified to ensure a net improvement and no net loss of habitat as calculated by the model.

Response 52. *The compensatory mitigation policies in the Salmon Overlay were highly modified from those in the original SEWIP by the City Planning Staff, with substantial input from the SSOTAC.*

2.6 (p. 12) – It should be made very clear that the overall net gain in habitat that is projected is based entirely on an assumption that non-tidal wetlands that will be lost through development will be replaced with tidal wetlands. This is not a fair assumption because no policy in this document requires that this will occur. In many cases it would be easier and cheaper for the developer to restore non-tidal wetlands. For example, the owner of Biringer Farms could mitigate for development that affects non-tidal wetlands at another location in the estuary simply by turning off the pump-station that keeps the property drained artificially. This would satisfy the policy as written and would be much cheaper than breaching a dike and constructing a new cross-dike to protect I-5. Not only would this not create salmon habitat, but it would eliminate an opportunity to restore tidal function. In fact, a developer could even mitigate in phases on the same site. First they could turn off the pump to mitigate for one development. At a later date they could breach a dike at the same site as mitigation for another development.

Response 53. *The mandated net gain in habitat function is based on the mitigation policies in Chapter 5 and does not explicitly require that nontidal wetlands lost to development be mitigated through tidal restoration. The City Planning Staff believes that the minimum 1.3:1 replacement of habitat function is sufficient to ensure a net gain in habitat function. The requirement that palustrine wetlands lost to tidal restoration for compensatory mitigation be replaced at some ratio with tidal restoration (p.16) will ensure a net gain in tidal habitat. The expectation that the majority of loss of nontidal wetlands affected by the HDS would be compensated for by tidal restoration, while not mandated by the SEWIP policies, is considered highly likely based on the economics of land and restoration opportunity in the planning area, and on the City Planning Staff's's replacement ratios described above.*

Permitting agencies would be unlikely to allow the same mitigation area to be used as mitigation for two different projects without full replacement of all habitat function and area lost in both projects.

2.7 (p. 12) – The amount of mitigation required should be calculated from the raw score not including reductions in score due to log rafting. The policy as written does not make a distinction between temporary (i.e., log rafts) and more permanent stressors (i.e., fill). Therefore the impact of a development that involves fill or bank armoring, and thus the amount of mitigation required, is undercalculated.

Response 54. *Consistent with impact/mitigation policies in effect for many years and now in use in various regulatory programs, the SSOTAC agreed that the basis for assessment of impact is change from the present condition. Projects that include fill or bank armoring will be scored as having a net loss of function and, in the case of fill, a net loss in area. Both would be scored by the model as mitigation debits that require offsetting credits. Also, hypothetically, a proposal to add log raft storage to an area would be scored as having a debit to be mitigated for. The County Surface Water Management Staff's proposal would apparently not consider new log raft storage to be an impact requiring mitigation.*

2.7.1 (p. 13) – Change to "credits" that may be gained from required mitigation for those losses if the project is constructed in a timely fashion and as planned.

Response 55. *This qualifier is implicit in the mitigation polices referenced in Chapter 5. Because SEWIP does not have regulatory status, additional emphasis to ensure mitigation project performance must be in the form of permit conditions.*

2.7.2 (p. 13) – The use of the 1997 SEWIP document is not appropriate because it has not been revisited by the SSOTAC in light of ESA listings. Numerous policies and goal statements in the original document are in conflict with the recovery of ESA listed species and a holistic framework for estuary management.

Response 56. *The mission and focus of the Salmon Overlay was to revisit the 1997 SEWIP document in light of ESA listings (Section 1.3). The City Planning Staff believes that the 1997 SEWIP is very much a holistic framework and that, as modified in the Salmon Overlay, is very much compatible with salmon habitat recovery.*

2.7.3 (p. 14) – The listing of goals and investigation of one potential scenario, which is not supported by any policies, does not constitute a restoration plan. The estuary has loss at least 50 percent of its production capacity for chinook based on habitat quantity and it is currently a bottleneck to production. A 20 percent increase in habitat quality doesn't allow for recovery.

<u>Response 57.</u> *The County Surface Water Management Staff's view is noted. The City Planning Staff is not aware of scientific data that identify a direct proportionality between estuarine habitat area and quality, and chinook run sizes. The City Planning Staff notes that salmon habitat area and quality are considerably improved now from the area availability and conditions in the 1940 through 1970 time frame, when chinook numbers were substantially higher, and surmises that other factors must also be limiting run sizes. The City Planning Staff agrees that a higher level of restoration would be preferable, but feels that the 20 percent increase in habitat is attainable over the next 15 years. Also, the City Planning Staff notes that the 20-year goal is an interim goal, and that if sufficient funding is available and willing landowners can be found, much higher levels of restoration can be achieved (e.g., Table 4.5 and Figure 4.16).*

Chapter 3 -- (did not have time to review)

<u>Response 58.</u> *No response needed.*

Chapter 4

4.1 (p. 37) – Normalization of scores is fundamentally flawed in terms of ranking habitat quality across the planning area. For example, no AU in EMUs 3 and 4 could naturally attain the habitat functions provided by Otter Island as scored by this IVA model. However, the normalization process defines AUs as having only a fraction of the habitat quality of Otter Island, and therefore lower value no matter their position on the landscape. AUs should only be normalized and evaluated within EMUs or EMU pairs as described in Chapter 4. This will better describe and protect the best habitats currently available to juvenile salmonids as their life history requirements change through the SEWIP planning area. To ignore salmonid life history requirements and assume AU or habitat function interchangeability will inevitably contribute to the persistence or worsening of production bottlenecks.

<u>Response 59.</u> *See Responses 6 and 14 above.*

4.3 (p. 39) – AU 4.05 is highlighted as having 46 percent of the total salmon habitat function area in the estuary. This simple result is based on habitat function interchangeability and an indifference to changing salmonid life history requirements throughout the planning area, and may (WE DO NOT KNOW) completely misrepresent the habitat requirements and distribution of migrating fish. The ranking and scores of

AUs should not be confused with our uncertainty of which AUs or migration pathways are most important to fish. SEWIP has not endeavored to include any index of relative importance of these AUs for fish (even with the uncertainty it brings), so it is unsupportable to assume the IVA scores are representative of the importance of those areas to fish. Hence the approach in considering or assigning the "value" of any AU must be very conservative.

<u>Response 60.</u> The disproportionate size and calculated habitat quality of AU 4.05 is recognized in the development scenarios described in Sections 6.4 and 6.5. Given that this AU has not been directly affected by human actions, and the fact that it is not included in the HDS, the model predictions of relative restoration that is feasible are provided both with and without inclusion of AU 4.05.

The City Planning Staff is rather surprised by the County Surface Water Management Staff's assertion that "SEWIP has not endeavored to include any index of relative importance of these AUs for fish (even with the uncertainty it brings), so it is unsupportable to assume the IVA scores are representative of the importance of those areas to fish." At the initial SSOTAC meetings, the Tidal Habitat Model was built by repeatedly asking the question: "What are the factors in the tidal environment that dictate habitat quality for salmonids?" That is, "What makes these areas important for salmonids?"

4.4 (p. 40) – AUs within the UGA are ranked by score and distributed by habitat quality based on quartile ranking. There is no biologically meaningful reasoning associated with this arbitrary quartile ranking. In Figure 4.2, all AUs were ranked and habitat categories were broken out based on the apparent distribution of habitat quality – why was this approach to ranking AU not mirrored within the UGA? These results of habitat quality ranking do not support a goal of habitat restoration. Next, the top quartile scores were removed from the threat of development. However, there is no biologically meaningful way of knowing whether the top ranked site in the third quartile is any different from the lowest ranked site in the 4th quartile. Next, four additional AUs were removed which are clearly not the next highest scoring AUs. Why is Maulsby Marsh AU 5.00 removed and Maulsby Mudflat AU 5.08 not removed? There is no reasoning provided.

<u>Response 61.</u> The County Surface Water Management Staff seems to first say that there is no scientific basis for ranking AUs within the UGA by quartile and then asks that the City Planning Staff do just that within EMU pairs. The approach taken is to define a hypothetical development scenario; i.e., to identify areas within the UGA that are the best of the existing habitat, and hypothetically say that no development would be allowed in those areas. This is tantamount to protecting the best remaining habitats, which is a

cornerstone of salmon habitat restoration planning. This exercise is provided to allow evaluation of restoration opportunities available to compensate for the losses that would result from the HDS. As was discussed in the last two SSOTAC meetings (not attended by the County Surface Water Management Staff), there is no implication that the SSOTAC approved development of these areas, identified in Figure 4.12, or that they will, in fact, be developed.

Prioritization of AUs by normalization within EMU pairs is an alternative approach to identification of AUs that should be considered for removal from the development footprint. The Salmon Overlay makes no judgment on which AUs will be removed by appropriate regulatory authority.

As an exercise, the AUs within the UGA were ranked and plotted in a score-frequency histogram, as in Figure 4.2 (attached). The major break occurs within the lower third of the fourth quartile. If this break were adopted, six fewer AUs, mostly in EMUs 1 and 2, would be excluded from the HDS. A less distinct break occurs about one-third of the way down into the third quartile. If this break were adopted, three additional AUs (1.19, 7.09, and 5.00) would be excluded from the HDS. None of these three has any assumed impact under the HDS (Table 4.3); thus, there would be no change in the outcome described. The four additional AUs that were removed from the HDS were removed because they have existing land uses or designations that preclude development.

The alternative PDF/HDS, which incorporated Figure 4.10 the ranking of AUs within EMUs, should be reinstated over the current top quartile AUs within the UGA. This approach is the only way of protecting baseline habitat functions, which currently are available to fish as they migrate from one EMU to the next. The argument for removal of Figure 4.10 says EMU pairs unfairly weight results. However, AU ranking is the same in EMU 5 whether EMU 6 is considered or not. Considering EMU 5 alone, additional AUs protected will be 5.05 and 5.08, based on current AU scoring provided in Appendix Tables. The argument that AU 5.08 is significant habitat only for shorebirds is ignoring the present SEWIP salmon overlay results. The salmon overlay was conducted because the original SEWIP was apparently deemed inadequate to characterize habitat functions for fish, thus the citation of shorebirds is illogical in the face of the present results which show AU 5.08 as being important habitat for salmonids, especially within EMU 5. Furthermore if AU 5.08 is developed to the degree indicated, it will result in a nearly 25 percent loss of existing habitat area and a 33 percent loss in habitat functions within the EMU. No EMU should sustain such losses when mitigation at Marshland or Biringer farm cannot replace mudflat functions and fish requirements at this juncture in their life history. AUs 5.05 and 5.08 should be removed from the development footprint.

<u>Response 62.</u> The evaluation of AUs where future development should be restricted is a matter under consideration of the City and the Department of Ecology as part of the City's Shoreline Master Program revisions. The City Planning Staff notes that restoration of mudflats in areas currently behind dikes in EMU 3 and lower EMU 2 is highly probable, especially if diked farmlands have subsided as suggested by the County Surface Water Management Staff.

4.6 (p. 43) – Tidal Habitat impacts should be much greater than 4,942 IVA acres because log rafting should not be considered as great an impact as it presently is. It presently artificially reduces the scores of AUs in the development footprint and makes them appear less important ecologically.

<u>Response 63.</u> The City Planning Staff disagrees, as noted in Response 54.

The acreage impacts to isolated palustrine wetlands should be recalculated based on concerns Steven Stanley raised regarding the inconsistency between wetland identification and assumptions made in the original SEWIP and those calculations and assumptions made under the present plan. All indications are that wetland acreage is significantly underestimated in the present plan. With full buildout this potential wetland loss could be as high as 1,800 acres, not 300 acres (Appendix Table D.3). The conservative value should be used.

<u>Response 64.</u> The approach used to derive the 306-acre estimate is defined in Section 4.6 and Appendix Table E.3 (new designations). This approach makes reasonable assumptions based on the existing and available data. When sites are proposed as development or mitigation sites, they would require a formal wetland delineation, and mitigation requirements would be adjusted accordingly. To assume a larger number of acres of palustrine wetlands would actually be less conservative in that the scenario would then show a greater area of required tidal restoration.

The loss of restoration opportunity and the loss of those IVA-acres with full buildout are never addressed in terms of mitigation compensation of the loss of restoration potential. If this is not going to be considered in any development scenario equation it should be dropped, as it is misleading.

<u>Response 65.</u> As noted above, restoration potential is calculated for areas within the HDS so that lost potential is known; the City Planning Staff is unaware of a legal precedent for requiring mitigation for lost restoration potential (see Response 54).

4.7 (p. 46) – The model does not adequately capture those processes (especially elevation differences and sedimentation processes), which would be present at a mitigation/ restoration site that likely will compromise the AU scoring over a period of 10 years. Habitat conditions at Mid-Spencer Marsh and Mid-Ebey Island have evolved over approximately 50 years and the prevailing conditions in no way represent "natural" or restored state. They may potentially be in disequilibrium for decades. Minimal AU IVA restoration scores should be similar to Marysville STP mitigation site. They will likely not score among the higher-ranking AU scores.

<u>Response 66.</u> As noted above, the model allows prediction of habitat quality that can be achieved by dike breaching and is a tool to aid in prebreaching design of the site in a manner that will maximize the desired habitat characteristics (elevations, channels, riparian areas). The City Planning Staff agrees that the goal is to design and construct projects that will be self-sustaining through natural processes and that will resemble natural environments which were present at a given location in the estuary. The City Planning Staff notes that the Mid-Spencer and Mid-Ebey marshes appear to be functioning much as would "natural" habitats at those locations (e.g., Pentec 1992b, Cunningham and Polayes-Wien 1995) and score very high in the model (60 to 70 IVA points, normalized to Otter Island at 100; Figure 4.1). The Mid-Spencer Marsh was cited as early as 1978 (Shapiro and Associates 1979) as an area of importance based on its biologic functions, ecosystem support, floodwater storage, and water purification functions. This was only 10 to 15 years after the natural dike breaching. The Marysville STP mitigation site (32.9 IVA points, normalized) was used to estimate model score in the first few years of a maximally engineered mitigation site per the scenarios described in Section 4.7.1.

Although the approach of Table 6.2 is to integrate original SEWIP results with salmon overlay results, the approach essentially pits the value of one resource against another, and does not adequately view the entire estuary within a watershed/landscape perspective and is contrary to many principles of the restoration of natural habitat forming processes. The table indicates that fish habitat, water quality and wildlife habitat are mutually exclusive and that we cannot manage for all of these resources on the same site. This approach will continue to protect artificially created ecological isolated habitat conditions at the expense of a naturally formed landscape that provides important, albeit different, habitat conditions for salmon, wildlife, water quality, water fowl, flood control, and passive recreation.

<u>Response 67.</u> The approach of Appendix D (new; results shown in Table 6.2) to ranking potential restoration sites seeks to balance benefits of tidal restoration against existing wetland functions. There are recognized tradeoffs involved in tidal restoration of areas

that have been diked and allowed to develop isolated wetland characteristics. The SEWIP restoration plan seeks to restore tidal circulation to areas where it historically existed and to allow restored habitats to evolve at the mercy of natural processes toward productive tidal habitats, as has occurred at the Mid-Spencer Marsh.

Figure 4.2 – this same frequency distribution representation should be applied to the UGA area to develop habitat quality categories based upon the real distribution of habitat condition rather than a biologically meaningless partitioning of AUs based on quartile score distribution.

Response 68. *As an exercise, the AUs within the UGA were ranked and plotted in a score-frequency histogram (attached), as in Figure 4.2. The major break in this distribution occurs within the lower third of the fourth quartile. If this break were adopted, six fewer AUs, mostly in EMUs 1 and 2, would be excluded from the HDS. A less distinct break occurs about one-third of the way down into the third quartile. If this break were adopted, three additional AUs (1.19, 7.09, and 5.00) would be excluded from the HDS. None of these three has any assumed impact under the HDS (Table 4.3); thus, there would be no change in the outcome described and included in the scenario.*

Table 4.2 – there is an unjustifiable over-weighting/over-representation of fish habitat function in EMU 4, especially in AU 4.05. Especially in light of no IVA model validation, we need to critically examine any and all data regarding fish distribution in the lower estuary. Work by Beauchamp and others in the lower estuary and in Port Gardner indicate fish use shoreline areas north and south of AU 4.05 and the mainstem Snohomish River disproportionately. And fish residence in the neritic zone may be less than residence time in estuarine marsh habitats. These are highly questionable results without independent verification.

Response 69. *The disproportionate size and calculated habitat quality of AU 4.05 is recognized in the development scenarios described in Sections 6.4 and 6.5. Given that this AU has not been directly affected by human actions, and the fact that it is not included in the HDS, the model predictions of relative restoration that is feasible are provided both with and without inclusion of AU 4.05. The City Planning Staff is unaware of sampling directly within AU 4.05 (which has no shoreline), but generally agrees that salmon use is likely to be greater along the shorelines than in the offshore water over the central part of the delta; i.e., in AU 4.05.*

Appendix Table C2 – model scoring results are fundamentally flawed in terms of representation of fish habitat function. For example, AU 4.05 apparently contains nearly 50 percent of all “functional” habitat for salmonids in the entire study area. This is mistaken from a fish life history perspective. The functions provided by habitats in upper Ebey Slough or the mainstem Snohomish are fundamentally different from those functions provided in neritic habitats and are not comparable. In addition, the distribution patterns of salmonid smolts as indicated by available data and the literature in general would suggest nearshore habitats north and south of AU 4.05 are more heavily used by migrating smolts than is the broad mudflat west of Jetty Island.

Response 70. Noted. See Response 69 above.

In addition, scoring Maulsby Marsh higher than Maulsby Mudflat for fish habitat functions is highly dubious given that fish cannot access the site (see Table 4.6). And we do not know how much of the area fish could access if even some of the area were partially available. Therefore it is inappropriate to integrate "fish functions" and the score across the entire site, when fish clearly are able to access the entire Maulsby Mudflat except for the 25-ft fringe).

Response 71. Maulsby Marsh is a remnant of a high saltmarsh with channels; this is a habitat type believed to be of high value to juvenile salmonids. In its present condition, it retains many of the characteristics of high saltmarsh (dendritic channel, good riparian zone, high marsh cover) that the SSOTAC has deemed to be important indicators of habitat quality. Fish access to the marsh is possible, but restricted by the culvert under Marine View Drive. The restricted access does not limit the contribution of organic matter from the marsh to the mudflat and river, however. The marsh scored as having stressors of restricted access and riprap (cumulative negative multiplier of 0.24); the mudflat had stressors of log raft storage and riprap (cumulative negative multiplier of 0.4). While the marsh scored higher in the model than the mudflat, it has fewer IVA-acres than the mudflat because of its size (965.3 IVA-acres vs. 4392.6 IVA-acres). Both have a high potential for restoration by removal of those stressors (Figure 4.14). Interestingly, Pentec (1996c), in beach seining and round haul sampling across the mudflats, was unable to capture juvenile salmonids in the central region of the flats. This suggests that fish use of the mudflats may be similar to that speculated above for the delta of AU 4.05; i.e., that they use the edges much more intensely than they use the central portion.

Chapter 5

5.1 (p. 52) – SEWIP fails to acknowledge that the Snohomish estuary is a bottleneck to chinook production and that reversing a significant component of the loss that has occurred due past development is critical for recovery.

<u>Response 72.</u> The City Planning Staff respectfully disagrees. The first sentence of Section 5.1 recognizes the loss that has occurred, and the subsequent policies stress the need to restore area and function of tidal habitats in the lower estuary.

5.1 (p. 52) – I strongly disagree that the policies in SEWIP go beyond "no net loss" (see section critique of compensation policies).

<u>Response 73.</u> See Response 53 above.

5.1 (p. 52) – Other examples of species that may lose out under SEWIP policies include bald eagle, Dungeness crab, and bivalves.

<u>Response 74.</u> Noted. However, it is difficult to see how these species will lose out by increased tidal habitat in the lower estuary.

5.2 (p. 54) – Who re-slices the pie? Who rescores the new AUs? The applicant?

<u>Response 75.</u> Redefinition of AU boundaries and scoring of AUs would need to be accomplished by a team of knowledgeable biologists familiar with the rationales and protocols of Appendix A with review by the SSOTAC and appropriate regulatory agencies.

5.3 (p. 54) – It should be clarified in the first sentence that the plan does not require tidal restoration. Otherwise this statement is very misleading.

<u>Response 76.</u> The Salmon Overlay does indeed emphasize tidal restoration and requires it for losses of littoral habitat.

5.4 (p. 54) – The fact that mitigation for impacts within EMUs 5 and 6 is limited is used as a justification to mitigate somewhere else (at a 1:1 mitigation ratio). The flip side of the argument would be that since only a few high quality habitat areas exist within this EMU (i.e., Maulsby Mudflat), they should be protected.

<u>Response 77.</u> Noted. The City Planning Staff is currently discussing these issues with the Department of Ecology and others. While the City Planning Staff recognizes that Maulsby Mudflat provides high- quality habitat for salmonids and other species, the City Planning Staff also recognizes that the area has been modified, is not in pristine condition, and is located within the City's traditional harbor area. Minimum mitigation is set at 1:1 replacement of lost littoral acreage and 1.3:1 replacement of lost function as measured by the Tidal Habitat Model.

5.4 (p. 55) – Natural processes that create and maintain habitat have not been "largely eliminated" within EMU 7. Specific natural processes such as the delivery and routing of sediment and wood have been substantially modified.

<u>Response 78.</u> Text revised.

5.4 (p. 55) – The last statement in this section is not supported by the policies in this document.

<u>Response 79.</u> Noted. Text revised.

5.5 (p. 56) – The second two sentences of the second paragraph are not supported in the literature.

<u>Response 80.</u> The City Planning Staff respectfully disagrees. See following discussion (Responses 82 and 83) and the new Appendices C and F.

5.5 (p. 56) – Low quality littoral habitat, if it is the only habitat available, may be extremely important. Also it is important to make a distinction between habitat that is degraded by soft impacts (boat props, contamination, log rafts) and more permanent and total losses resulting from armoring and fill.

<u>Response 81.</u> The City Planning Staff agrees that migratory corridors must be maintained through EMUs 5 and 6, but disagrees with regard to the need to distinguish between "soft" and "permanent" losses in defining compensatory mitigation requirements.

5.5 (p. 56 to 57) – Four examples are given of successful restoration projects in the Snohomish, yet the criteria used to show that these projects are successful are not identified. What is the standard? I am aware of several problems related to these restoration projects. For example:

> **Mid-Spencer Marsh** - This area was historically forested. The restored marsh is non-forested, and consequently, fully exposed to the sun. In the same report referenced (Pentec 1992b), temperatures were documented during the outmigration within this marsh at levels that are lethal to salmon.
>
> *<u>Response 82.</u> While this specific location may have once been forested, the marsh that is now present is a highly functioning tidal brackish marsh, as illustrated by fish use, epibenthic prey production, and extent of channel and marsh habitats. Excessive*

temperatures are common on natural mudflats and marshes at low tide and result in movement of fish into refuge channels or back into cooler mainstem habitats. This does not mean that the marshes do not provide high-quality habitat. Potential problems with the recording thermographs used in the Pentec (1992b) study are discussed in that report. The shallow Mid-Spencer thermograph likely was exposed to the air during low tides (Figure 13 in Pentec 1992b). Data taken with manual thermometers during field sampling efforts show no temperatures in excess of 20^{o}C (Table 5 in Pentec 1992b). (See also Appendix F.)

Marysville Sewage Treatment plant mitigation site – It is largely still a mudflat, the dike along Ebey Slough was not removed, and the constructed channel is oriented at an unnatural angle to the tidal flow that is not observed in nature. This raises doubt that it would be sustainable over the long term.

Response 83. These characteristics were scored in the model. In 2000, the mudflat was becoming increasingly vegetated with low marsh species. The dike, at present, provides significant riparian function but may ultimately breach naturally. Such a breach would improve access of fish and sediment to the site.

South Spencer Marsh – yes fish are using the site, but is at comparable levels to natural sites? Very few salmonids have been captured in the forested part of the site.

Response 84. See Appendix F.

Jetty Island Berm – This project is not sustainable over the long term. New dredge spoils will have to be added to sustain it.

Response 85. This project was never expected to be self-sustaining. See Appendix F.

5.5 (p. 59) – Why have all the "shalls" been changed to "shoulds"?

Response 86. This change was the result of discussions during the last two meetings of the SSOTAC (not attended by the County Surface Water Management Staff) and reflect the fact that the Salmon Overlay is not a regulatory document. Agencies choosing to adopt SEWIP as a regulatory document may change the "shoulds" to "shalls."

5.5 (p. 59) – It says that top priority is assigned to compensatory mitigation actions through tidal restoration in areas identified in the restoration plan, but there is no policy, which makes this a top priority. Is it a voluntary top priority?

<u>Response 87.</u> Policy P.1 is a policy and mandates that impacts to tidal habitats be mitigated by restoration or creation of tidal habitats. It is recommended (not mandated) that the restoration actions be selected from those identified in the restoration plan; an applicant is left the option of choosing other appropriate sites.

5.5 (p. 60) – How can the 30 percent increase in function account for all sources or uncertainty, as well as ensure a net increase in habitat function? In another location the document says that this 30 percent increase is to account for the temporal impact.

<u>Response 88.</u> See Responses 15 through 17.

5.5 (p. 60) – The "minority" opinion is not captured. The minority opinion should not contain a rebuttal of its points.

<u>Response 89.</u> Noted. Text has been modified to state that consensus was not reached on mitigation ratios.

5.5 (p. 62) – The first italicized section at the top of the page is erroneous. Providing an option for mitigation for impacts to non-tidal wetlands with tidal-wetlands is not an incentive for restoration of the estuary and it is not consistent with a goal of increasing habitat area available to salmonids. An increase in habitat area may or may not result in an increase in habitat area available to anadromous salmonids.

<u>Response 90.</u> Noted. Allowing out-of-kind mitigation at 1 acre of tidal habitat for 1 acre of nontidal habitat lost to development is considered to be an incentive. It is an incentive because the alternative of mitigation for nontidal wetland loss with nontidal wetland creation or enhancement involves higher ratios of replacement under City of Everett's Environmentally Sensitive Areas ordinance. It also would usually require establishment of appropriate hydrology on the site.

5.5 (p. 62) – I am uncomfortable with the use of the original SEWIP document since it has not been revisited by the SSOTAC to ensure that it does not result in harm or foreclosed opportunities to recover listed species. Many policies within the original document are in conflict with restoration of a natural tidal estuary and with salmon recovery.

<u>Response 91.</u> Noted.

5.5 (p. 62) – EMUs 5 and 6 are not artificially created habitats. They are highly altered habitats.

<u>Response 92.</u> The City Planning Staff sees this as a matter of semantics but has modified the text to address the County Surface Water Management Staff's concern.

5.5 (p. 62) – It says that further reduction in habitat in the EMU with the smallest proportion of habitat area and function should be avoided. No policy in the document supports this statement.

<u>Response 93. That language is part of Policy P.5</u>.

5.5 P.6 (p. 63) – A 1:1 mitigation ratio is inadequate for upfront mitigation because there is still uncertainty with the model, uncertainty with function interchangeability, spatial uncertainty, and uncertainty regarding the long-term success of the mitigation (see above). The incentive for upfront mitigation is that the developer does not also have to account for the temporal impact and thus the mitigation ratio should be lower (for example, 2:1 instead of 3:1 for concurrent mitigation).

<u>Response 94.</u> The incentive for upfront mitigation is a lower ratio (minimum 1:1 for acreage vs. 1.3:1). See additional response to comments above. The text has been revised to reflect the lack of SSOTAC consensus on this point.

5.5 P.7 (p. 63) – Sites where the mitigation credits per acre at the time of impact that are less that the debits should not be exempt from the higher mitigation ratio for concurrent mitigation.

<u>Response 95.</u> Noted. The City Planning Staff does not believe that this is the case. See Table 5.1 for an example of calculating the ratios for concurrent mitigation. The higher mitigation ratio would still apply.

5.5 P.16 (p. 66) – What is the technical basis for these ratios? Where do they come from? The incentive could be a 1:1 ratio if mitigation ratios are raised to account for the many sources of uncertainty and to raise them up to a level that is consistent with the published literature.

<u>Response 96.</u> The ratios were developed based on practical experience of application of the SEWIP approach to mitigation projects at lower (Port) and upper (City) Union Slough, and are intended to retain the desired incentive for tidal restoration in the

estuary. As noted above, these policies will result in a net loss of nontidal wetlands in the planning area.

5.7 (p. 72) – Both scenarios are based on the invalid assumption that non-tidal wetlands that will be lost through development will be replaced with tidal wetlands. This is not a fair assumption because no policy in this document requires that this will occur. In many cases it would be easier and cheaper for the developer to restore non-tidal wetlands. For example, the owner of Biringer Farms could mitigate for development that effects non-tidal wetlands at another location in the estuary simply by turning off the pump-station that keeps the property drained artificially. This would satisfy the policy as written and would be much cheaper than breaching a dike and constructing a new cross-dike to protect I-5. Not only would this not create salmon habitat, but it would eliminate an opportunity to restore tidal function. In fact, a smart developer could even mitigate in phases on the same site. First he could turn off the pump to mitigate for one development. At a later date he could breach a dike at the same site as mitigation for another development.

<u>Response 97.</u> *The scenarios presented in the document are just that – scenarios based on stated assumptions. While the example given is an interesting one, it seems unlikely to occur at that site, which is not in the UGA. See also Responses 36, 53, and 64.*

It is also important to note that even if the scenario happens, it results in a net loss of hundreds of wetland acres because the mitigation ratio is less then 1:1.

<u>Response 98.</u> *It is unclear how this would happen. Note that development impacts to nontidal wetlands must be mitigated at a minimum acre-for-acre basis (more, if nontidal wetlands are used for mitigation). Filling 20 acres of nontidal wetlands in a diked area would require creation of a minimum of 20 acres of tidal wetlands or a minimum of 25 acres of created nontidal wetland (on or off site). It is only when wetlands inside dikes are impacted by mitigation (not development itself) that less than a 1:1 ratio is called for in Policy P.16.*

One thing I do not like is the approach of tabulating many restoration/mitigation potentials/scenarios (Tables 5.2, 5.3, 6.4, 6.4, 6.5) based on an untested model and debits and credits within a spreadsheet that seek to highlight a futuristic endpoint (habitat restoration), which by itself justifies the means of getting there (use of an untested model, acceptance of enormous uncertainty, application of mitigation ratios inconsistent with peer reviewed literature, skeletal consideration of mitigation/restoration design, implementation, monitoring, and adaptive management, and little treatment of Washington state and federal regulatory compliance-new shoreline management rules, clean water act, endangered species act.). These many tables overly simplify the mitigation/restoration process, are scenarios, which cannot possibly be adhered to, and will only act to confuse any external reviewer of this document. Simply put they seem to attempt justifying the means to an endpoint that no jurisdiction or party to this plan can adequately predict or control.

Response 99. Noted. The City Planning Staff respectfully disagrees that the scenarios are misleading and unrealistic.

Chapter 6

6.2 (p. 78) – The second restoration goal discards legitimate restoration opportunities within the UGA.

Response 100. The City Planning Staff respectfully disagrees. This objective is focused on areas outside the UGA and does not address areas within the UGA, which are covered in goal 1; not addressing is different from discarding. Other, more generic goals (3 through 8) apply also to areas inside the UGA. A new goal has been added to specifically cover areas within the UGA.

6.2 (p. 79) – The fourth restoration goal should be broadened to include all riparian areas not just intact ones.

Response 101. That was not the intent. Goal is reworded to remove ambiguity.

6.2 (p. 79) – The eighth restoration goal is far too low, and it will not get us to recovery. The estuary will still be a bottleneck to chinook production.

Response 102. Noted. This is identified as an intermediate-term goal – not the end of restoration in the planning area.

6.4 (p. 80) – Subsidence of areas behind dikes is a serious issue that needs to be addressed.

Response 103. Noted: Please see Responses 13 and 31, above.

6.4 (p. 81) – Since the scoring for water quality and wildlife in the original SEWIP (SEWIP 1997) does not look at the estuary from a holistic perspective and was never revisited by the SSOTAC, it should not be used.

Response 104. Noted.

6.4 (p. 83) – The restoration scenario is based on assumptions that blur the distinction between restoration and mitigation and which are not supported by the compensation policies in the document.

Response 105. *Noted: Please see Responses 35 and 64, above.*

Sincerely,

ANDREW HAAS
Senior Habitat Specialist
Snohomish County Public Works,
Surface Water Management Division

Additional reference (not cited in SEWIP Salmon Overlay):

Cunningham, M., and J. Polayes-Wien. 1995. Mid-Spencer Island: A prototype for breached-dike wetland restoration in the fluvial brackish portion of the Snohomish Estuary. University of Washington, Certificate Program in Wetland Science and Management, Seattle.

Letter from
The Tulalip Tribes

December 29, 2000

Paul A. Roberts, Director
Planning and Community Development Department
2930 Wetmore, Suite 8A
Everett, WA 98201

Subject: **SEWIP Salmon Overlay Report, Review Draft 12/20/2000**

Dear Mr. Roberts:

The Tulalip Tribes have completed their review of the referenced report and suggest the draft be revised to address the comments and concerns expressed in this letter. The Tulalip Tribes are a sovereign entity, recognized as such by the Unites States. They are the present-day tribal entity, which is a political successor in interest to certain tribes, which were parties to the Treaty of Point Elliott, and as such have treaty rights to resources found within the Snohomish River and Port Gardner. This area provides critical habitat for species of anadromous salmon and shellfish that are harvested by the Tulalip Tribes. The City of Everett must consider the implications SEWIP has to the Endangered Species Act, the Clean Water Act, the Coastal Zone Management Act and Tribal Treaty Rights, and whether it is satisfying the requirements of each.

The Tulalip Tribes commend Everett on their effort to strengthen the salmon component of SEWIP. The final product will enhance the management of resources in the Snohomish Estuary. However, the Tulalip Tribes believe the report and salmon component of SEWIP can be improved substantially by addressing the comments and concerns that are to follow.

Section 2.7.3 and Section 6.2 establishes a restoration goal of a net 20% increase in habitat area and function in 15 years. The Tulalip Tribes depend upon salmon resources for their economic, subsistence, and spiritual well being. From the Tribes perspective establishing a goal of 20% is inadequate. A 20% increase in habitat area and function will not translate into a 20% increase in chinook production. When only 30% of the estuary is currently accessible to salmon increasing that by 20% results in a 6% gain in area and function estuary wide. It is my professional opinion, that in order to see a positive response in chinook production, accessibility needs to be increased to approximately 80 to 100% of what is currently available (i.e., short-term goal, next 20 years). The long-term goal (i.e., 50 years) for the estuary should be to ensure 80% of the estuary will be accessible to salmon.

<u>Response 1.</u> The City Planning Staff agrees that there is no known relationship between an increase in estuarine habitat area and function, and increases in salmon production. The City Planning Staff notes that the 70+ percent reduction in wetland area that has occurred in the estuary was largely completed by 1940 and that the decline in chinook runs was not evident until several decades later. The multiple causes of those declines defy simple assignment of cause and effect. The City Planning Staff agrees with the need for restoration of estuarine area and function for salmonids, and has suggested the 20 percent increase in 15 years as a realistic and achievable intermediate-term goal, not as the end point of restoration in the estuary. The City Planning Staff agrees that a larger increase would increase the chance that estuarine habitat does not limit salmon recovery, and would like to work with The Tribes and other agencies to find funding to support a greater rate of restoration.

The City Planning Staff notes that the maximum restoration scenario for restoration of selected sites outside the UGA (with the full development scenario and no mitigation within the UGA) shown in Table 6.4 would net approximately a 47 percent increase over the existing habitat area and a 70 percent increase in habitat function and would require a substantial outlay of funding. This same scenario would result in a 58 percent increase over existing acreage and a 118 percent increase in habitat function if the area and functions in AU 4.05, the delta west of Jetty Island, is excluded from the calculation, as suggested by The Tribes below.

Section 4.3, the entire SEWIP planning area encompasses 20,262 acres of which 42.4% comprise currently accessible salmonid habitat. However, 4,338 of those acres are found in EMU 4, which has not seen the historical modifications other portions of the estuary have witnessed. Excluding EMU4, 27% of the SEWIP planning area is currently accessible to salmonids. This percentage is more in line with what has been reported earlier.

<u>Response 2.</u> As The Tribes point out, a very large percentage of the existing habitat lies in EMU 4, specifically in AU 4.05. As shown on Table 6.5, if that single AU is considered a constant (little changed from its condition in 1850) that is removed from the equation, then the 20 percent overall increase in salmonid habitat function that is the suggested intermediate goal provides in a 38 percent increase in present habitat function (and a 25 percent increase in present habitat area) over the remainder of the planning area. We believe this is a more accurate representation of the level of increase that would result.

Page 39, section 4.5, from my review of the draft Shoreline Management Program (SMP), many uses (agriculture, residential uses, transportation, utilities) are conditionally permitted within the Urban Conservancy designation. In addition, the SMP does not mention as a condition, that habitat area and functions for salmonids cannot be diminished.

Response 3. *The SMP version adopted by the Planning Commission split the Urban Conservancy designation into two environment designations: Urban Conservancy and Urban Conservancy – Recreation. The Use Table was revised so that agricultural and residential uses are no longer permitted in the Urban Conservancy environment. The City Planning Staff agrees that the SMP does not specifically state that habitat area and functions for salmonids cannot be diminished. However, the SMP adopts by reference EMC 19.37 Environmentally Sensitive Areas and Planning Director Interpretation No. 2-2000. These require any project proposed within 200 ft of Port Gardner Bay or the Snohomish River to prepare a biological assessment to assess potential impacts and mitigation to chinook salmon and bull trout, and chinook salmon and bull trout habitat. If any potential unmitigated impacts would occur, preparation of a habitat management plan is required. Any impacts identified in the habitat management plan must be mitigated. Alternatively, the City Planning Staff could accept the results of a Section 7 consultation with the Corps of Engineers. The SMP will be revised to make these requirements more clear, and to adopt the SEWIP Salmon Overlay as best available science in identifying impacts to salmonid habitat and in mitigating those impacts to ensure a net gain in habitat function results from development allowed under the SMP. A copy of the revised SMP will be provided to The Tribes under separate cover.*

EMC 19.37 includes mitigation ratios for impacts to wetlands. The compensation ratio for Category 1 (all estuarine) wetlands is 6:1. The ratio may be decreased where the mitigation plan demonstrates that no net loss of wetland functional values will result from the decreased ratio. In no case shall the replacement acreage be less than 1:1. EMC 19.37 does not include mitigation ratios for impacts to the Snohomish River. Rather, it allows alteration to provide access to deep water in urban shoreline environments when the alteration does not act to degrade the functions of the stream, or the degradation can be fully mitigated (EMC 19.37.150B.1.). The SEWIP models and policies will be used as best available science to ensure that functional values are being adequately replaced in the estuary.

Page 43 and 44, section 4.6, from my review of the draft Shoreline Management Program (SMP) buffer enhancements are only required along non-water related redevelopment's, they are not required for water dependent or water related uses in any designation other than Urban Conservancy.

<u>Response 4.</u> *The SMP version adopted by the Planning Commission includes a new condition (#11 on page 3-44) which states, "As existing shoreline properties are redeveloped, impervious surfaces not needed for current or planned uses shall be removed and shoreline buffers shall be enhanced and/or restored to the buffer width required by EMC 19.37, except as necessary to accommodate access to the water necessary for the operation of water-dependent and water-related uses and/or public access. The Planning Director/Hearing Examiner shall have the authority to require redesign of the site and structures to minimize impacts to existing aquatic and buffer vegetation and to provide for buffer enhancement."*

Page 56 and 57, section 5.5, policy P.3, the minimum compensation requirements stated in SEWIP are inadequate. The Tulalip Tribes can not agree to a 1:1 minimum compensation ratio. The minimum compensation ratio must be at least 1.5:1 of restored littoral habitat for lost littoral habitat. The minimum IVA-acres compensation ratio must be at least 2:1.

<u>Response 5.</u> *Noted.*

Page 59, Section 5.5, Policy P.5, impacts to AUs in EMU 5 and 6 should be compensated in EMU 2,3,5, and 6. Furthermore, the compensation sites should be located along the main channel, if and whenever possible.

<u>Response 6.</u> *Noted. The City Planning Staff sees no reason to not allow mitigation to occur in EMU 4 if a good project is available. A recommendation that the compensation sites should be located along the main channel, if and whenever possible, has been added to text.*

Page 60, the first equation should have a 1.5 multiplier inserted in the equation.

<u>Response 7.</u> *The City Planning Staff believes that the stated mitigation ratios and policies are sufficient to ensure that a net gain in salmon habitat area and quality would result from any development within the UGA. The failure of the SSOTAC to reach consensus regarding minimum mitigation ratios has been noted in the revised text (Section 5.5).*

Page 60, Policy P. 7, the second equation should have a 2.0 multiplier instead of the 1.3.

<u>Response 8.</u> *The City Planning Staff believes that the stated mitigation ratios and policies are sufficient to ensure that a net gain in salmon habitat area and quality would result from any development within the UGA. The failure of the SSOTAC to reach*

consensus regarding minimum mitigation ratios has been noted in the revised text (Section 5.5).

Page 63, Policy P.16, the highest rated quartile should be 1.0, the third quartile should be 0.8. The rest should remain the same.

Response 9. *The City Planning Staff respectfully disagrees. Accepting the ratios suggested by The Tribes would greatly reduce the probability that certain promising areas for restoration could be restored as a mitigation project (e.g., north portion of South Spencer; northwest corner of South Ebey).*

Page 61, P.7, what is the reason for the language "cognizant regulatory agency", this language is ill advised. Does this mean regulatory agencies (even though they have regulatory authority) that are not aware of SEWIP or SSOTAC are not allowed to see the data the project owner has developed?

Response 10. *No. "Cognizant" was meant in the sense of having the right and authority to review and decide regarding permits for the actions. Text has been revised to clarify.*

Page 66, section 5.6.2, the monitoring reports should be submitted to the Tulalip Tribes irregardless of whether the Tribes are a member of SSOTAC.

Response 11. *Text revised.*

Page 67, section 5.6.3, who will be the responsible agency for coordinating the SSOTAC, managing the SEWIP information base, and evaluating and adjusting the model as new information is collected.

Response 12. *This is an excellent question and was intentionally left indefinite. However, the City of Everett has incorporated SEWIP into revisions to its SMP. By that action, the City has become the first jurisdiction to adopt SEWIP and is prepared to work with other jurisdictions, including The Tribes, to develop and implement meaningful restoration strategies for the estuary.*

Page 68 through 71, Section 5.7, the scenarios written into the report are a good examples of "fuzzy science." There is a difference between 226 acres of littoral habitat and the suggested restored tidal wetland habitat. I would suggest AUs along the main channel be prioritized.

<u>Response 13.</u> The City Planning Staff respectfully disagrees and submits that the model is sufficiently representative of littoral habitat quality to ensure that there would be a conservative replacement of like functions under the scenarios presented and under other probable scenarios that could be postulated. AUs along the main channel are prioritized for compensatory mitigation in Policy P.5 and for restoration in Chapter 6 and in Appendix D.

Page 75, Section 6.2, goal number 4 states "…provide for large wood and (I would replace smaller pieces with organic matter) and associated smaller pieces to enter the channel through natural process."

<u>Response 14.</u> Text has been modified as suggested.

In summary, the Tulalip Tribes believe the restoration goals stated in this report are to low. Much higher restoration goals are needed to see a response in salmonid production. The Tulalip Tribes greatest concern continues to be the compensation requirements in SEWIP and the fate of SEWIP and the salmon overlay as it moves on to the policy level. The Tribes also recommend restoration efforts prioritize areas along the main channel of the river. The stated compensation levels from the Tribes perspective are to low and should be raised to the levels suggested in this letter, at a minimum. It is unlikely the federal services will approve of the plan with the proposed mitigation ratios. The Tulalip Tribes continue to be concerned with how the salmon overlay and SEWIP will be modified (e.g., compensation levels relaxed) when it moves to the policy level. The Tulalip Tribes will not support SEWIP if modifications are made that reduce mitigation levels further.

<u>Response 15.</u> Noted. The Tribes' participation has been most helpful and appreciated.

Sincerely,
The Tulalip Tribes

Kurt Nelson
Fish and Water Resources Scientist

cc: Erik Stockdale, Department of Ecology
Andy Haas, Snohomish County Surface Water Management
Mike Chamblin, WDFW

Dan Mathias, City of Everett
Jon Houghton, Pentec