Snohomish Estuary Wetlands Study

SNOHOMISH RIVER
WASHINGTON TER.
1884 - 1885

VOLUME II
BASE INFORMATION & EVALUATION

MAY 1979

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A109466	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Snohomish Estuary Wetlands Study: Vol. II , Base Information and Evaluation		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Andrew L. Driscoll		8. CONTRACT OR GRANT NUMBER(s) DACW67-77-C-0103
9. PERFORMING ORGANIZATION NAME AND ADDRESS Shapiro & Associates, Inc. Smith Tower Seattle, Washington 98101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineers, Seattle District P.O. Box C-3755/4735 East Marginal Way South Seattle, WA 98124		12. REPORT DATE August 1978
		13. NUMBER OF PAGES 450
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Vol I - Summary
Vol II - Base Information and Evaluation
Vol III - Classification and Mapping
Vol IV - Delineation of Wetland Boundaries

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Snohomish River
Wetlands
Land Use
Estuaries
Washington (State)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This document represents the synthesis and integration of base information on the physical and biological and public and land use characteristics of the Snohomish estuary study area. It contains an identification of study area lands and wetlands, a description and evaluation of all wetlands and associated aquatic resources in the study area, and identification and description of areas to be considered Areas of Importance and Areas of Environmental Concern based on their physical, biological, and public and

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

land use characteristics. It also contains a description of activities and their impacts on wetlands/aquatic resources and a discussion of land use trends and development pressure in the estuary. It is designed to provide a method and the necessary base information for evaluation of the specific and cumulative effects of typical development activities on lands and wetlands of the study area. In so doing, it establishes an objective basis for the evaluation of permit applications in the Snohomish estuary study area.

VOLUME II

SNOHOMISH ESTUARY WETLANDS STUDY

Base Information and Evaluation

Prepared for

U.S. Army Corps of Engineers
in accordance with
Contract No. DACW67-77-C-0103

by

Shapiro & Associates, Inc./Andrew L. Driscoll, Consultant

August 1978

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF PLATES

LIST OF FIGURES

LIST OF TABLES

Table (Continued) — Page

EXECUTIVE SUMMARY

1. The Snohomish Estuary Wetlands Study (SEWS) has been conducted by the U.S. Army Corps of Engineers, Seattle District, under the authority of Section 404 of the Federal Water Pollution Control Act Amendments of 1972 as amended and Corps regulations 33 CFR 320-329. Section I of this report describes the basic authorities under which the study has been conducted and discusses the importance of Wetlands as expressed in national policies. The study has four volumes, as follows:

- Volume I, Summary
- Volume II, Base Information and Evaluation
- Volume III, Classification and Mapping
- Volume IV, Delineation of Wetland Boundaries in the Snohomish Estuary

The study provides a basis for the environmental evaluation of public interest factors and a factual body of physical, biological, public policy, and land use information for the Snohomish estuary study area, to be used in the environmental evaluation and review of Corps Section 10 and Section 404 permit applications. Wetlands and areas of particular importance or concern in the study area are identified and described. A method for the assessment of the specific and cumulative impacts of proposed permit activities is presented.

2. The study area (Section III) includes the entire 100-year floodplain of the Snohomish River north of its confluence with Ebey Slough, Everett Harbor, the north shore of Possession Sound including Tulalip Bay and adjacent upland boundaries. Emphasis is on the floodplain and areas under Corps jurisdiction; the upland areas are included because activities there may influence wetlands and floodplain areas. The permit review process as carried out by the Seattle District is described in Section IV.

3. The major findings of the study are summarized in Section V. The first major finding is an identification and classification of all wetlands in the study area (from Volume III) and a detailed description of the characteristics, distribution, history, and significant relationships and functions of each wetland type. The importance of all wetlands and the requirement to preserve and protect them as affirmed by Corps regulations 33 CFR 320.4 is emphasized. The second major finding is a designation of certain areas within the study area as Areas of Importance or Areas of Environmental Concern. The designation reflects the extent to which particular areas are considered to be vital to the continued functioning of the estuarine ecosystem and vital to the public interest. The criteria used in identifying areas to be considered Areas of Importance or Areas of Environmental Concern are directly derived form the stated poli-

cies of the Corps of Engineers (33 CFR 320.4) and of other federal, state, regional, and local agencies. Wetlands in Areas of Importance should be considered Wetlands of Importance as per Corps regulations 33 CFR 320.4(b)(2) and 33 CFR 320.4(b)(4). Areas of Importance and Areas of Environmental Concern are shown in Plate 2.

4. Section V also contains a general description of the environmental impacts of typical permitted activities in the Snohomish estuary study area. A method for the assessment of specific and cumulative impacts of permitted activities in the study area is outlined; it is designed to be used primarily by Seattle District personnel in reviewing permit applications. Section V also contains a description of the factors influencing the location of development in the study area and defines general areas in which pressure to develop is low, medium, or high.

5. Sections VI and VII of this report contain detailed information on the physical and biological characteristics of the estuary (Section VI) and public policy and land use trends in the study area (Section VII). Supporting information for the description of wetlands and designation of Areas of Importance/Areas of Environmental Concern may be found in Sections VI and VII.

6. In sum, the study underlines the importance of wetlands and provides a detailed identification and evaluation of all wetlands in the study area. The study recognizes that in consideration and evaluation of wetlands, the adjacent habitat types must also be considered, for such areas may have characteristics essential to the continued physical and biological function of the wetlands. Therefore, Areas of Importance and Areas of Environmental Concern should be considered as habitat units, of which wetlands are an integral part. Permit applications in such areas, particularly in Areas of Importance, will be subject to intensive evaluation of all factors relevant to the proposal, as most activities in these areas may seriously alter or destroy wetlands that are natural resources of critical importance to the people of the nation.

7. There are significant gaps in physical and biological information in the Snohomish estuary study area. Most notable is the lack of information on primary productivity, estuarine hydraulics, and wildlife habitat. A quantitative knowledge of the primary productivity of wetland plant species and habitat types is necessary to understand the biological contribution of an area to the estuarine ecosystem. An adequate description of the hydraulics of the estuary would allow both an analysis of the aquatic interaction between various habitat types and a determination of possible water quality problems. A complete understanding of habitat utilization by wildlife is an important aspect of the function of a habitat. This study was conducted using available information on these and all other subjects. Additional data will provide important refinements to the evaluations conducted in this study.

USERS' GUIDE TO THE SNOHOMISH ESTUARY WETLANDS STUDY (SEWS)

1. The Snohomish Estuary Wetlands Study provides base information and methodology to be used in evaluating permit applications and the environmental effects of proposed activities.

2. The study is organized to be useful to Seattle District Corps personnel in reviewing permit applications; however, permit applicants and other agency personnel may also find the information and methods helpful. The permit process described in Section IV shows how a permit application is reviewed by Seattle District and identifies the major criteria used in the review. Section V.C contains a method for the assessment of the specific and cumulative impacts of proposed activities. This method will be most useful to Seattle District personnel, but may also be used by the applicant.

3. Should the applicant desire only more generalized information, the following guide to the document may be used:

A. Define the proposed activity and its location:

Activity_____ Location_____

B. Go to Section V, FINDINGS IN THE SNOHOMISH ESTUARY.

C. Review the information on impacts of various activities contained in Section V.C.

D. Determine from Plate 2, Section V.B, if the proposed site is in an Area of Importance or Area of Environmental Concern.

E. If so, review the detailed description of the Area of Importance or Area of Environmental Concern (Section V.B).

F. From the large-scale maps on file at the Seattle District office, determine whether the proposed site is in a Wetland Type (Section V.A). If so, review the detailed description of the Wetland Type.

G. If the proposed site is in an Area of Importance, Area of Environmental Concern, or Wetland Type, consult a Seattle District representative for assistance and information.

4. Every permit application submitted to the Seattle District will be subject to review under Corps regulations. If a proposed activity is located in an Area of Importance, Area of Environmental Concern, or Wetland Type, this does not mean that the permit application will automatically be denied.

Section I

INTRODUCTION

Section I

INTRODUCTION

1. The introduction describes the legal and regulatory authority under which the Seattle District, Corps of Engineers has conducted the Snohomish Estuary Wetlands Study and presents national policy affirming the importance of wetlands.

STUDY AUTHORITY

2. The Seattle District, U.S. Army Corps of Engineers, is engaged in the regulation of activities in or upon the navigable waters (or navigable waters of the United States) and adjacent wetlands of the Snohomish River and Everett Harbor under provisions of Section 10 of the River and Harbor Act of 3 March 1899 (30 Stat. 1151; 33 U.S.C. 403), Section 404 of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500, FWPCA) as amended by the Clean Water Act of 1977, and other authorities as shown in Appendix B. Persons proposing to work in these navigable waters and wetlands are required to obtain permits from the Seattle District, Corps of Engineers, prior to initiating any contemplated activity including, but not limited to, dredging, filling, moorage, and other works affecting their navigational, fish and wildlife, water quality, economics, aesthetic, recreational, and other societal and ecological values. Section 10 permits cover the construction of any structure in or over any navigable water of the United States, the excavation from or depositing of material in such waters, or the accomplishment of any other work affecting the course, location, condition, or capacity of such waters. Section 404 permits are specifically for the discharge of dredged or fill material into the waters of the United States at specified disposal sites. The results of the Snohomish Estuary Wetland Study will be used in review of both Section 10 and Section 404 permit applications.

3. Under the authority of Section 404, FWPCA, as amended, and Corps regulations 33 CFR 320-329 (Appendix D), the District Engineer, Seattle District, Corps of Engineers, has conducted this study of wetlands and associated aquatic resources of the Snohomish estuary that serve important purposes relating to fish and wildlife, recreation, water quality, and other elements of the general public interest. The study has identified and evaluated wetlands, defined by Corps regulations (33 CFR 323.2(c)) as follows:

> "The term 'wetlands' means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for

life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

Vegetated intertidal areas are included under this definition. The study has also identified and evaluated aquatic resources related to wetlands, including mudflats and other estuarine shallows. Executive Order 11990 (see below) lends strong support to the need to include aquatic resources related to wetlands in the scope of this study.

4. Under Corps regulations a general policy for evaluation of permit applications indicates that "no permit will be granted unless its issuance is found to be in the public interest" (33 CFR 320.4(a)). Factors of the public interest include the conservation and preservation of wetlands, fish and wildlife resources, water quality, and historic, scenic, and recreational values (33 CFR 320.4(b)-(e)). Further, under Corps regulations 33 CFR 320.4(b)(4), no permit will be granted for work in wetlands identified as important under 33 CFR 320.4(b)(2) unless the benefits of the proposed work outweigh the damage to the wetlands resource and the proposed alteration is necessary to realize those benefits. Under 33 CFR 320.4, the interrelated nature of wetlands and the cumulative effects of numerous piecemeal alterations of wetlands that may result in a major impairment of the wetlands resource must be evaluated. The Snohomish Estuary Wetlands review has considered such effects. The Corps criteria for identification of wetlands important to the public interest (33 CFR 320.4 (b)) are central to the identification and evaluation of wetlands made in this study (Section V.B).

IMPORTANCE OF WETLANDS

5. The Chief of Engineers' Policy on Wetlands emphasizes the importance of wetlands as a public resource. The policy is contained in its entirety in Appendix A; parts of it are reprinted here.

Chief of Engineers' Policy on Wetlands:

a. Wetlands are vital areas that constitute a productive and valuable public resource, the unnecessary alteration or destruction of which should be discouraged as contrary to the public interest.

b. Wetlands considered to perform functions important to the public interest include:

1) Wetlands which serve important natural biological functions, including food chain production, general habitat, and nesting, spawning, rearing and resting sites for aquatic or land species;

2) Wetlands set aside for study of the aquatic environment or as sanctuaries or refuges;

3) Wetlands the destruction or alteration of which would affect detrimentally natural drainage characteristics, sedimentation patterns, salinity distribution, flushing characteristics, current patterns, or other environmental characteristics;

4) Wetlands which are significant in shielding other areas from wave action, erosion, or storm damage. Such wetlands are often associated with barrier beaches, islands, reefs and bars;

5) Wetlands which serve as valuable storage areas for storm and flood waters;

6) Wetlands which are prime natural recharge areas. Prime recharge areas are locations where surface and groundwater are directly interconnected; and

7) Wetlands which through natural water filtration processes serve to purify water.

.....

d. No construction activity will be performed in wetlands identified as important by subparagraph b, above, unless the District Engineer concludes that the benefits of the proposed alteration outweigh the damage to the wetlands resource and the proposed alteration is necessary to realize those benefits. In evaluating whether a particular alteration is necessary, the District Engineer shall consider whether the proposed activity is primarily dependent on being located in, or in close proximity to, the aquatic environment and whether feasible alternative sites are available. The District Engineer must demonstrate the need to locate the proposed activity in the wetland and must evaluate the availability of feasible alternative sites.

.....

The Chief of Engineers policy is virtually the same as found in Corps regulations 33 CFR 320.4. It is this regulation under which all permit applications for work in wetlands are reviewed. The emphasis on wetlands as vital areas constituting a valuable public resource indicates the importance given in Corps regulations to all wetlands.

6. Executive Order (EO) 11990, issued by President Jimmy Carter on 24 May 1977, reiterates the need to preserve and protect wetlands

as a national policy. The President's statement accompanying EO 11990 emphasizes wetlands as vital natural resources of critical importance to the people of the country. EO 11990 orders federal agencies to minimize the destruction of wetlands and to preserve and enhance the values of wetlands in management of federal lands, construction, and programs. EO 11990 does not apply to the issuance of Corps permits for activities on non-federal property. In EO 11990, wetlands are defined as follows:

> "The term 'wetlands' means those areas that are inundated by surface or ground water with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mudflats, and natural ponds."

This definition is broader than the definition used by the Corps of Engineers in administering their permit program under Section 404, FWPCA (33 CFR 323.2(c)); for example, unvegetated mudflats are here defined as wetlands. EO 11990 and the President's statement are in Appendix A.

7. Executive Order 11988, also issued 24 May 1977, is an order to federal agencies to preserve the natural and beneficial values of floodplains in management of federal lands, construction, and programs. The President's statement accompanying EO 11988 emphasizes the special values of the floodplains adjoining the nation's waters and calls for active floodplain management. EO 11988 and the President's statement are in Appendix A. Corps regulations 33 CFR 239 for implementation of EO 11988 are in Appendix D.

8. In sum, the importance of wetlands as a vital resource is expressed in the policy of the Chief of Engineers, reiterated in the regulations of the Corps of Engineers, and emphasized in Executive Orders as national policy.

Section II

Scope of Study

Section II

SCOPE OF STUDY

1. Section II describes the purpose and objectives of the Snohomish Estuary Wetlands Study. The section also presents the study approach and methodology and discusses the assumptions made.

STUDY PURPOSE AND OBJECTIVES

2. The purpose of the Snohomish Estuary Wetlands Study is to provide an objective basis for the evaluation of permit requests for development activities in wetlands and associated aquatic resources of the Everett, Washington, area. The principal users of the study will be Corps personnel involved in review of permit applications, planning of water resource projects, and environmental assessment. Results may also be used by permit applicants as well as concerned federal, state, and local agencies in evaluating the impacts of particular activities on wetlands and associated resources. The Snohomish estuary was chosen for the wetland study for primarily three reasons. First, the area has a history of significant permit activity and a probable future of continued permit demand. Second, it is a major port area where the Corps of Engineers is involved in the planning of proposed projects and the operation of existing projects, as well as in regulatory activities. Third, the Snohomish estuary contains diverse wetlands and habitats.

3. The Snohomish Estuary Wetlands Study has three components: (a) Classification and Mapping; (B) Delineation of Corps Jurisdictional Boundaries; and (C) Base Information and Evaluation. To provide an understanding of the scope of the study, all three (I) components are briefly described below. This document (Volume II) represents Component C, Volume III is Component A, and Volume IV is Component B.

4. Component A. Classification and Mapping. The objective of Component A was to classify and map wetlands in the study area from a biological perspective. This component has been completed and has resulted in a classification of study area lands, wetlands, and aquatic areas into seven different habitat types (e.g. urban, aquatic lands) at four levels of detail. These habitat types have been mapped at the most detailed level. The classification and mapping results are discussed and used in Section VI.B, Biological Profile, of this document.

5. Component B. Delineation of Corps Jurisdictional Boundaries. The objective of this component was to delineate the boundaries of the Corps of Engineers 404 permit jurisdiction in wetlands of the study area as interpreted from Corps of Engineers permit regulations (33 CFR 320-329). Completion of this component has

resulted in a set of maps showing the recommended line of Corps jurisdiction throughout the estuary. This component is discussed in Section III, Study Area, of this document.

6. Component C. Base Information and Evaluation. Component C has three principal objectives:

1) To synthesize and integrate background information pertinent to development of wetland evaluation guidelines and to preparation of a programmatic environmental impact statement (EIS) for the study area.

2) To evaluate the relative biological importance of various wetland types in the study area and to assess the impacts of typical development activities in the study area on these wetlands.

3) To identify land use trends in the study area and relate this information to the potential cumulative impacts of permit activities on wetlands and other aquatic areas.

This document represents the synthesis and integration of base information on the physical and biological and public and land use characteristics of the Snohomish estuary study area. It contains an identification of study area lands and wetlands, a description and evaluation of all wetlands and associated aquatic resources in the study area, and identification and description of areas to be considered Areas of Importance and Areas of Environmental Concern based on their physical, biological, and public and land use characteristics. It also contains a description of activities and their impacts on wetlands/aquatic resources (Section V.C) and a discussion of land use trends and development pressure (Section V.D) in the estuary. It is designed to provide a method (Section V.C) and the necessary base information for evaluation of the specific and cumulative effects of typical development activities on lands and wetlands of the study area. In so doing, it establishes an objective basis for the evaluation of permit applications in the Snohomish estuary study area.

STUDY APPROACH AND ASSUMPTIONS

7. To accomplish the purpose and objectives of the Snohomish Estuary Wetlands Study, the following approach was used:

1) An interdisciplinary team made up of representatives of many disciplines, including geology, botany, aquatic biology, terrestrial biology, ornithology, water quality analysis, plant ecology, hydrology, fisheries research, land use planning, and policy analysis was established. The team,

together with supporting staff in environmental analysis and graphic design, laid out the technical design for the study and conducted the necessary research, synthesis, and evaluation.

2) The boundaries of the study area were defined (Section III). The primary study area covers the navigable waters and wetlands under the regulatory jurisdiction of the Corps of Engineers (Section III) from the confluence of the Snohomish River and Ebey Slough downstream to the mouth of the estuary and to the north entrance of Tulalip Bay on the north and the south end of Port Gardner on the south the study concentrated on lands, wetlands, and waters within this area. However, information on physical, biological. and public and land use characteristics is also shown for areas outside the primary study area when such information is important and necessary to an understanding of ecological and environmental relationships within the primary study area.

3) A detailed work plan showing the tasks necessary to accomplish the study purpose and objectives was developed. Figure I-1 shows the tasks and approximate schedules for the study. For each task, the objective, process, and expected product were described in detail as part of the work plan. A draft Table of Contents for this document describing each section and what it would contain was also developed as part of the work plan.

4) The physical and biological (Section VI) and public and land use (Section VII) profiles of the Snohomish estuary study area were based on study and synthesis of existing literature and data available through federal, state, and local agencies, colleges and universities, local citizens, and research papers. Each profile presents a picture of the Snohomish estuary, designed to provide an understanding of the interactions, relationships, and existing conditions in the study area. The profiles in preliminary draft were provided to federal, state, and local agencies for informal review so that any gaps or inaccuracies in the base information could be corrected in the early stages of the study. The profiles were then revised in response to this informal review.

5) Based on profile findings, study area lands and wetlands were evaluated and recommendations for areas to be designated Areas of Importance or Areas of Environmental Concern were formulated. This was done as follows: the principal members of the study team individually delineated areas to be considered Areas of Importance or Areas of Environmental Concern based on criteria derived from the profiles and re-

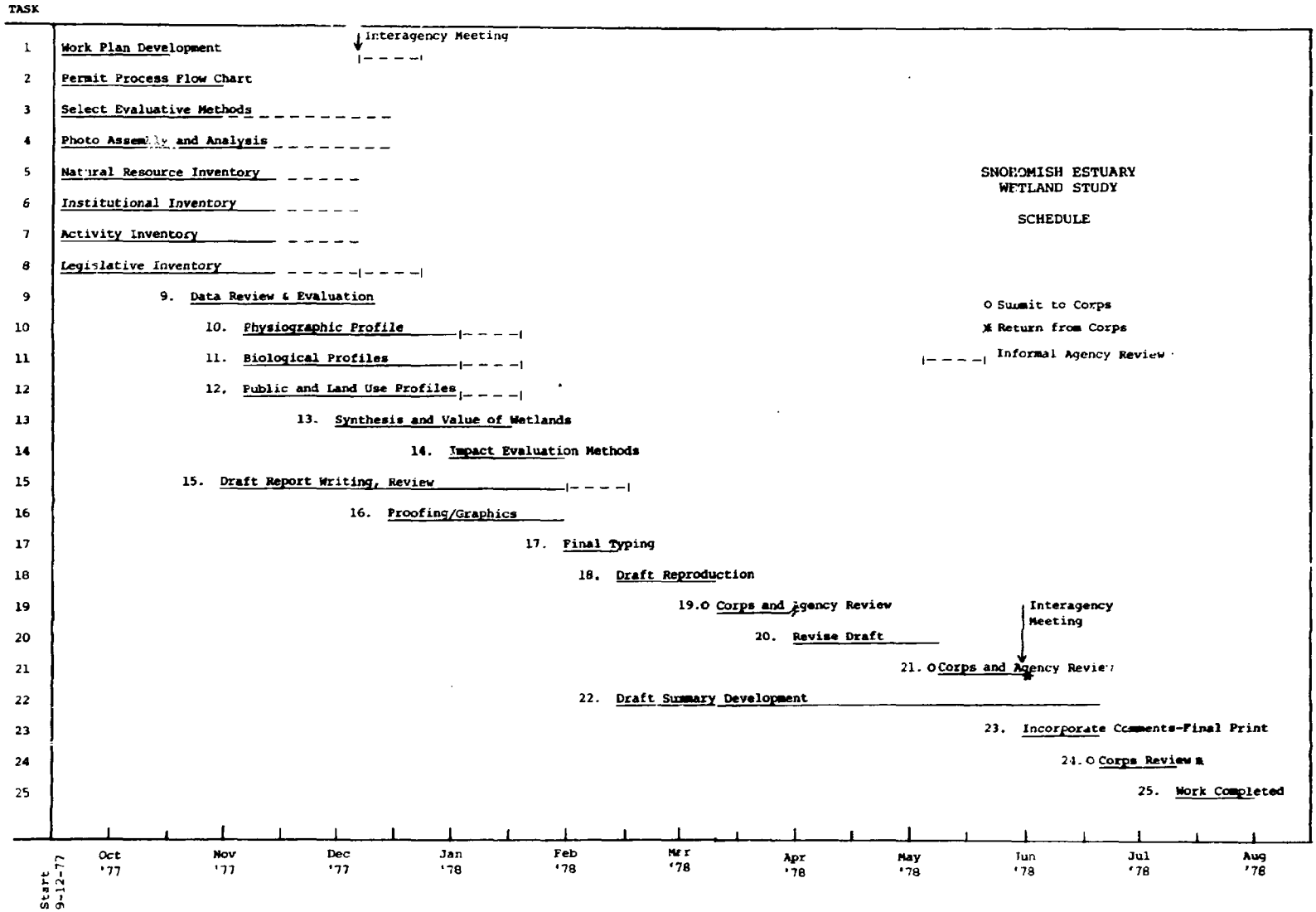


Figure II-I STUDY SCHEDULE

lated to each member's specific discipline. Each team member listed the specific criteria used in the judgment for each area. The team members then met and compared their delineated areas to determine the extent of agreement. Any delineated area for which every team member had supporting criteria was designated an Area of Importance (Section V.B). Areas which fulfilled all natural functional (physical and biological) criteria were also designated Areas of Importance. Areas which only fulfilled some of the criteria were designated Areas of Environmental Concern (Section V.B). The criteria used in the selection process are summarized as Criteria for Natural Functional Importance (physical and biological) and Ancillary Criteria (public and land use) in Section V.B. The Criteria for Natural Functional Importance are a direct reflection of Corps policy as identified in 33 CFR 320.4.

6) Following a review of several environmental impact assessment methodologies, a framework developed by the U.S. Army Engineer Institute for Water Resources was selected for use in the Snohomish study. It is described in the report titled Wetland Values: Interim Assessment and Evaluation Methodology, (Review Draft) July 1977. This framework was modified and is described as a methodology in Section V.C. Team members also reviewed extensively information on the observed environmental effects of Corps activities on lands and wetlands. This information is synthesized and presented in Section V.C.

7) Land use trends in the study area were determined using aerial photo interpretation and planimetry to quantitatively assess land use changes over time (Sections V.D, VII, and VIII.E). These land use trends and the history of permit applications in the Snohomish estuary were used to assess development pressure in the study area (Section V.D).

8. The following assumptions were made at the outset of the study:

1) That sufficient physical and biological data existed or could be extrapolated to provide a meaningful natural profile description of the Snohomish estuary. With the exception of some water temperature and salinity measurements (completed under Component B), ground-truth checks of aerial photo interpretations and visual/aesthetic characterization, no field studies were undertaken.

2) That stated policies of federal, state, regional, and local agencies are expressions of the public interest at the national, state, and local level, and further, that any areas called out in agency policy as areas to be preserved from development are areas in which public interest is high.

3) That certain terms must be carefully defined for purposes of the study and used consistently through the report. These terms are listed and defined following:

a) Wetland: There are many definitions of "wetland"; five are listed here and others may be found in Appendix A.

> "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas." (Corps regulations 33 CFR 323.2(c))

> "...those areas that are inundated or saturated by surface or groundwater at magnitude, frequency, and duration sufficient to select a plant community that tolerates such permanent inundation, periodic inundation or prolonged near surface soil saturation during the growing season. Certain unvegetated areas are also considered wetlands...These include such living assemblages as coral reefs, oyster bars, and clam flats; areas essential to and functionally related to wetlands including fluctuation zones and some transition zones where the inclusion of such an edge is essential to maintaining the functional integrity of the wetland; shallows, and flats, generally near wetlands, that are valuable, defineable and where the food chain for the animal community is in part dependent on detrital export from the nearby wetlands. (Macomber, 1978)

> "Lowlands covered with shallow and sometimes temporary or intermittant waters...referred to as marshes, swamps, bogs, wet meadows, potholes, sloughs and river overflow lands." (Shaw and Fredine, 1956 (Circular 39))

"...land where the water table is at, near or above the land surface long enough to promote the formation of hydric soils or to support the growth of hydrophytes. In certain types of wetlands, vegetation is lacking and soils are poorly developed or absent as a result of frequent and drastic fluctuations of surface-water levels, wave action, water flow, turbidity or high concentrations of salts or other substances in the water or substrate. Such wetlands can be recognized by the presence of surface water or saturated substrate at some time during each year and their location within, or adjacent to, vegetated wetlands or deep water habitats." (Cowardin, et. al., 1977)

"Naturally vegetated areas located between mean high water and the yearly normal maximum floodwater level." (Clark, 1974)

For purposes of this study, the Corps 404 definition (33 CFR 323.2(c)) is used. It is important to note that this definition is based on vegetation, so that unvegetated mudflats are not wetlands by this definition.

b) Tidal Datum Planes: "A plane of reference for elevations, determined from the rise and fall of the tides" (Marmer, 1951). Examples include mean high water, mean low water and mean tide level.

c) Tidelands: "All lands over which the tide ebbs and flows from the line of ordinary high tide to the line of mean low tide, except in front of cities where harbor lines have been established, where tidelands are the area between the line of ordinary high tide and the inner harbor line, excepting oyster lands" (Wa DNR Marine Land Management Division Manual 5109 01.03).

d) Habitat: "Place where a plant or animal normally lives, often characterized by a dominant plant form or physical characteristic" (Ricklefs, 1973).

e) Habitat Type: As used by Burrell (1978), a vegetative community, or, in the case of unvegetated aquatic lands, a substrate type, or, in the case of urban lands, a use or activity.

f) Aquatic Lands: "Lands which are either covered by water or strongly influenced by adjacent waters" (Burrell, 1978).

g) Intertidal: "Bounded by the high and low water extremes of the tide" (Sverdrup, et. al., 1970). The region between extreme lowest water (-4.5 feet MLLW) and extreme highest water (14.5 feet MLLW) in the study area.

h) Estuary: "That part of the lower river course that is affected by the mixing of salt water and fresh" (Fairbridge, 1968). In this study estuary includes the river and adjacent sloughs downstream from the confluence of the Snohomish River and Ebey Slough (see Hydraulics, Section VI).

i) Mudflats: Broad mud and/or sand deposits at intertidal elevations. Often located at a river mouth, non-vegetated mudflats are not wetlands according to the definition contained in Corps permit regulation 33 CFR 323.2.

j) Navigable Waters: "Those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce" (33 CFR 329.4).

k) Waters of the United States: "The territorial seas; coastal and inland waters, lakes, rivers and streams that are navigable waters of the United States, including adjacent wetlands; tributaries to navigable waters of the United States, including adjacent wetlands; interstate waters and their tributaries, including adjacent wetlands; and all other waters of the United States. (33 CFR 323.2)

Other terms which are defined in 33 CFR 323.2 (Appendix D) include:

- Adjacent (33 CFR 323.2(d))
- Ordinary High Water (33 CFR 323.2(g))
- High Tide Line (33 CFR 323.2(h))
- Dredged Material (33 CFR 323.2(k))
- Fill Material (33 CFR 323.2(m))

Section III

THE STUDY AREA

Section III

THE STUDY AREA

OVERVIEW

1. The Snohomish estuary is located adjacent to the city of Everett, approximately 30 miles north of Seattle. in Snohomish County, Washington (Figure III-1). The estuary system includes the main channel of the Snohomish River and Ebey, Steamboat and Union Sloughs. The estuary is about 9 miles long and 2.5 to 4 miles wide; it encompasses about 20 square miles in six major islands. In the Puget Sound region it is second only to the Skagit River in size and average annual discharge. A more detailed description of the physical characteristics of the study area may be found in the Topography and Geography section (Section VI, Volume II).

2. Adjacent to the estuary are three population centers: Everett, Marysville, and the Tulalip Indian Reservation. Everett has a population of about 54,000 persons (1970 Census); Marysville 4,000, and the Tulalip Reservation about 3,500 (Drost, 1977).

DESCRIPTION OF THE STUDY AREA

3. The study area includes the entire 100 year floodplain of the Snohomish River north of its confluence with Ebey Slough, Everett Harbor, the north shore of Possession Sound including Tulalip Bay, and adjacent upland areas (Plate 1). The approximate 100 year floodplain is the area which would be inundated by a flood of a magnitude expected to be equaled or exceeded only once every 100 years on the average. In the Snohomish Basin the 100-year floodplain was mapped by the Corps in 1967; it is approximately 8.5 feet above sea level at the mouth of the river and 18 feet above sea level at the confluence of Ebey Slough.

4. The study area is made up of uplands, aquatic areas, and intertidal lands. Uplands includes all land not inundated by the tide. Included within this definition are the diked islands of the floodplain (which would be inundated if there were no dikes). Intertidal lands are those areas with an elevation between extreme low water (approximately -4.5 feet MLLW) and extreme high water (approximately 14.5 feet MLLW at Everett). The aquatic area encompasses all the waters of the area. This includes the marine waters west of the river mouth (Priest Point to Preston Point) and the estuarine waters, from the river mouth to the confluence of Ebey Slough.

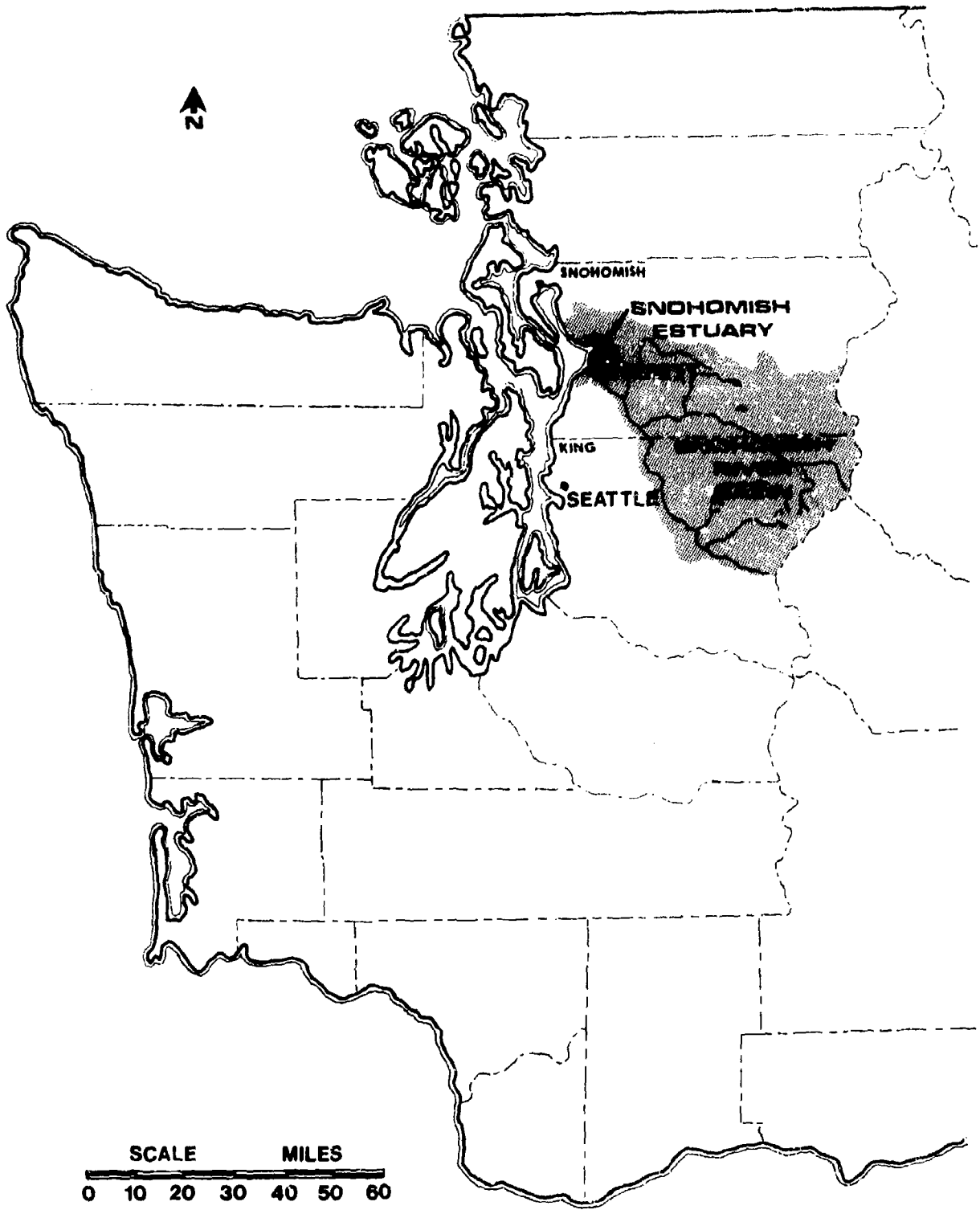
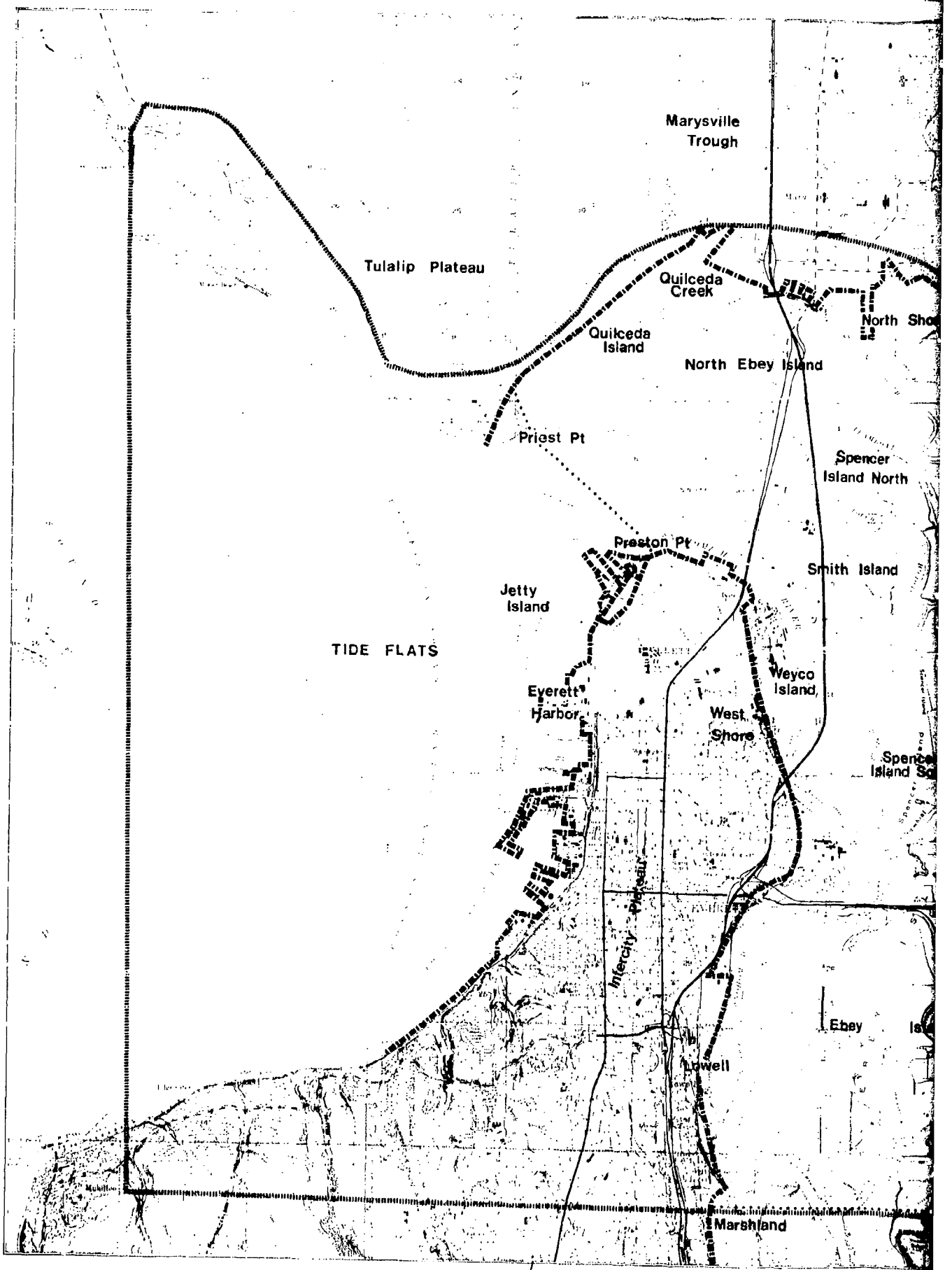
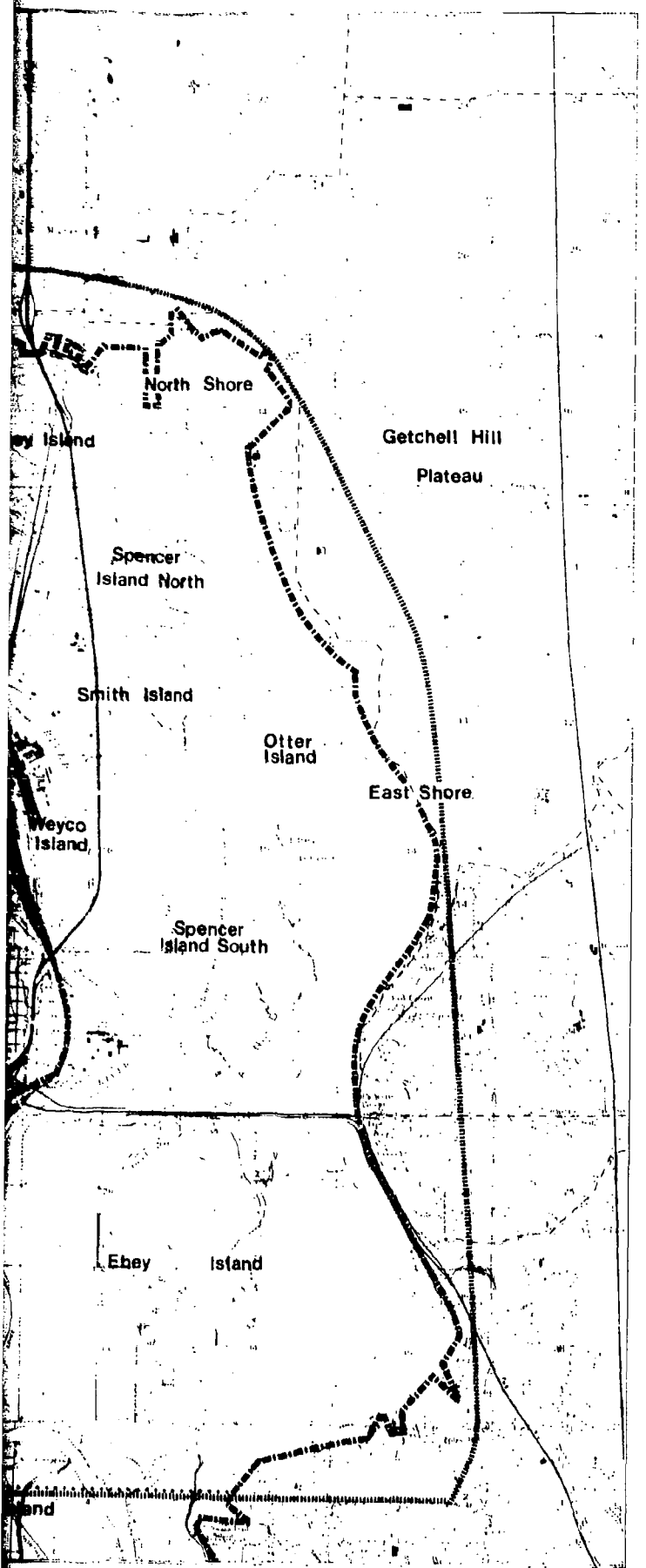


Figure III-1 LOCATION OF THE SNOHOMISH ESTUARY, WASHINGTON


Marysville
Trough
Tulalip Plateau
Quilceda
Creek
North Sho
Quilceda
Island
North Ebey Island
Priest Pt
Spencer
Island North
Preston Pt
Smith Island
Jetty
Island
TIDE FLATS
Weyco
Island
Everett
Harbor
West
Shore
Spence
Island So
Intercity Highway
Ebey
Is
Lowell
Marshland



GEOGRAPHY

PLATE NO 1

LEGEND

SEWS Study Area

Approx Limits of 100 Year Floodplain

Land Use Study Area

N

SNOHOMISH ESTUARY WETLANDS STUDY

Source: Newcomb 1952
Corps 1973

PLATE NO 1

HISTORY

5. The history of settlement in the Snohomish estuary began on 4 June 1792 when Captain George Vancouver landed on the beach at Port Gardner and ceremoniously claimed all the Puget Sound region for England. Since that time, the estuary and surrounding area have undergone extensive changes.

6. The Tulalip Reservation was created in 1855 by the Mukilteo Treaty. It has been suggested that the early development in the Snohomish estuary was inhibited by the proximity of the Reservation (Whitfield, 1926). For whatever reason, early settlement was centered around Snohomish City, located where the military road crossed the Snohomish River, rather than the river mouth.

7. Snohomish County was established in 1861 and the county seat located in Snohomish (City), where it remained until 1897. By that time the tremendous growth of Everett made it the choice for the county seat. The growth of Everett is reflected not only in its population figures, but also in the rate of industrial and agricultural development. Effects of this development boom at the turn of the century can be seen in the estuary today.

8. Construction of the Great Northern Railroad along Port Gardner and across the river mouth in 1891 was the first of many activities which would affect both Everett and the estuary. Besides connecting sparsely populated Everett to both Seattle and Marysville, the railroad tracks had several other impacts. A small pocket beach was isolated from Port Gardner, but remained tidally connected. This area later became known as Maulsby Swamp. Construction of railroad beds across Smith and North Ebey Islands also provided some initial fill to which an entire system of dikes was later attached.

9. The Everett and Monte Cristo Railroad was completed to Lowell in 1892 and shortly thereafter joined the Great Northern tracks near Preston Point. As with the Great Northern, these tracks had an impact on the estuary as well as on the city. The tracks ran near the southern end of Ebey Island; they were soon incorporated into a diking system which surrounded the entire island.

10. Construction of dikes in the estuary began as early as 1867 on the west end of Smith Island, though these early structures were unsuccessful. The map of 1884 shows approximately 100 acres of diked land in the estuary, most of it in a large parcel near the center of Spencer Island. In 1892 the county commissioners contracted for a dike around Ebey Island, thus forming Diking District No. 1. By 1895 diking was being carried out in the Marshland area. The 1895 and 1911 topographic maps of the study area show Smith, Spencer, Otter and North Ebey Islands, and most of the East Shore areas to be diked and drained. (Possible errors in these maps are

discussed in Methodology for Land Use Interpretation, Technical Appendix E.)

11. The final major development in the estuary was construction of a deepwater port and formation of the Port of Everett. The Port began as a riverside dock near the confluence of Steamboat Slough, where boats from both Seattle and Snohomish could land. With construction of the "Jetty" in about 1899, a protected harbor was created along the west side of Everett. It was not until a maintenance dredging program was established, however, that this entire port facility could be used. Prior to the dredging operation, the deepwater port was limited to several docks at the south end of Port Gardner. Fill placed for these docks was the first in a long series of such activities intended to create a major port and industrial location adjacent to the city of Everett.

12. Everett has always been primarily a timber-oriented city. This is apparent, not only from the numerous mills, but also from the vast expanses of log rafting facilities. Log rafts on mudflats in the port area, adjacent to the jetty and along the sloughs, date back to the early 1900's.

13. Thus, many of the patterns of development, and much of the development itself, were established in Everett's first 20 years. By 1910 all the railroads were built, most of the islands were diked, and the port was busy shipping timber to buyers throughout the world. From 1910 to 1940 the port expanded and new log rafting areas were located west of Smith and North Ebey Islands. In addition, the railroads filled more wetlands at Lowell and behind the Weyerhauser Mill to create switching yards.

14. After World War II the port and logging industries continued to expand, however, agriculture in the estuary began suffering setbacks. Dikes on North Ebey and Spencer Islands were breached and not repaired. Instead, some areas were "let go" to revert to wetlands. This happened to almost 500 acres in the estuary between 1947 and 1965. These reverted wetlands represent some of the most productive and valuable areas to the aquatic ecosystem in the Snohomish estuary today. Since 1965 there has again been a progressive loss of wetland habitat in the estuary. This new loss is the result of filling, primarily for industrial purposes. This is an irreversible process, which, unlike diking, prevents any recovery of the wetland area in the future.

CORPS JURISDICTION IN THE STUDY AREA

15. As described in Section 404 of the Federal Water Pollution Control Act Amendments of 1972, the Corps has regulatory authority

over the disposal of fill material in navigable waters and adjacent wetlands. "Wetlands" includes those areas that are "inundated or saturated by surface or groundwater at sufficient frequency and duration to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 CFR 323.2(c)). Adjacent wetlands have been defined to mean not only contiguous areas, but also those areas in a reasonable proximity but physically "separated by....man-made dikes or barriers, natural river berms, beach dunes and the like ..." (33 CFR 323.2(d)).

16. Section 67 of the Clean Water Act of 1977 (91 Stat. 1600; 33 U.S.C. 1344) is an amendment to Section 404 of the FWPCA: it affirms the authority of the Secretary of the Army, acting through the Chief of Engineers, to issue permits for the discharge of dredged or fill material into navigable waters. Section 67 specifies conditions for the issuance of general permits by the Secretary of the Army and establishes exemptions from the permit requirements. Section 67 also authorizes the development and administration of permit programs by the states to cover the discharge of dredged or fill material into the navigable waters (other than those waters which are presently used, or are susceptible to use in their natural condition or by reasonable improvement as a means to transport interstate or foreign commerce shoreward to their ordinary high water mark, including all waters which are subject to the ebb and flow of the tide shoreward to their mean higher high water mark on the west coast, including wetlands adjacent thereto). This section limits Corps 404 authority for permit issuance to Category 1 waters (33 CFR 323,329; FR 42, 138, 19 July 1977) in states with approved individual and general permit programs. Section 67 potentially removes tributaries and lakes greater than five acres in surface area, plus their adjacent wetlands, and all other waters of the United States from the Corps 404 permit program.

17. Delineation of the wetlands boundary as defined by Corps regulations (33 CFR 323.2(c)) was carried out as Component B of the Snohomish Estuary Wetlands Study. In this part of the study, aerial photographs and field verification were used to identify and map the extent of adjacent wetlands as defined by Corps regulations. The areas identified as adjacent wetlands have been the principal concern of this study. In evaluation of the biological importance of these areas, it is necessary to consider not only their physical and biological importance, but also the significance of activities surrounding them. Thus, the Snohomish Estuary Wetland Study has considered navigable waters and their adjacent wetlands as defined by 33 CFR 323.2(c)) and those surrounding areas which might have a significant impact on navigable waters and their adjacent wetlands. The specific wetlands boundary line in the Snohomish estuary study area is shown on maps at a scale of 1:6000, available for review in the Seattle District offices. For further information see Boulé and Shea, 1978 (Volume IV).

Section IV

THE PERMIT PROCESS

Section IV

THE PERMIT PROCESS

1. Section IV briefly describes the recent history of Corps permits and permit applications in the Snohomish estuary study area. The number and type of activities for which permits have been requested and the type of applicant is analyzed. The results are helpful in understanding the pressure for development which may be brought to bear on the estuary area. This section also discusses the usual process used by the Seattle District Corps of Engineers for review of permit applications.

HISTORY OF CORPS PERMIT APPLICATIONS IN THE STUDY AREA

2. Summary information on permit applications filed with the Seattle District from 1971 to mid-September 1977 was obtained from the files maintained by the Corps. The information included the following:

- Reference number
- Name of applicant
- Proposed location (waterway) of activity
- Date application received and date of public notice
- Whether permit issued or denied, or application cancelled with dates
- Type of activities involved in the proposal

3. Thirty typical activities requiring Corps permits are coded from applications; these are as follows:

Aquaculture facilities	Log dumps
Bulkheads	Marinas
Boat lift, grid	Mooring barges
Bank protection	Miscellaneous
Building	Marine ways
Breakwater, groins, jetties, dikes	Outfall structures
Covered moorage	Overhead wires
Disposal	Pier-commercial (wharves)
Dredging	Pier-non-commercial (private docks)
Discharges	Piling, dolphins
Exploratory drilling	Ramps
Fish haven	Sheer booms
Fills	Submerged cables (power)
Floats, buoys, booms	Submerged lines (sewer, oil)
Intake structures	Viaducts

4. Note that many of these activities are elements leading to other activities such as industrial development or shipping facili-

ties. Any one permit application may include several of the activities listed above. Permits under Section 404, FWPCA, are for discharge of dredged or fill material only.

5. Between 1971 and mid-September 1977 there was a total of 147 permit applications received by the Corps for areas in Snohomish County as a whole. Table IV-1 shows a breakdown of permit applications by year.

Table IV-1

Corps Permit Applications by Year in Snohomish County

Year*	Received	Permits Issued	Cancelled	Action Not Completed**
1971	14	11	3	-
1972	30	25	5	-
1973	34	21	7	6
1974	11	8	2	1
1975	22	13	8	1
1976	21	13	2	6
1977	15	4	-	11
TOTAL	147	95	27	25

* 1971 incomplete, 1977 data through 21 September 1977
** Status as of 21 September 1977

6. Of the 147 Snohomish County permit applications, 26 were determined to be clearly outside the Snohomish estuary study area; for example, in Port Susan or Skagit Bay. Of the remaining 121 permit applications in the study area, 100 are either listed as issued or have not yet had final action taken on them. These 100 applications were analyzed in detail to determine the type and location of the various activities and the type of applicant.

7. A total of 249 activities are proposed in the 100 applications. The most frequently proposed activities (as a percent of total activities) are dredging (22%), fills (18%), piling/dolphins (14%), and bulkheads (9%). The remainder of the activities are widely scattered among various categories such as non-commercial piers (5%), floats and booms (5%), marinas, commercial piers, bank

protection, and breakwaters (each less than 5%). Of the 100 applications, 56 involve dredging and 45 involve fills.

8. Fifty-six (56%) of the 100 applications are for locations in the Snohomish River, including Ebey, Steamboat, and Union Sloughs. These 56 applications represent 56% of the total number of proposed activities. Of the total number of proposed dredging, piling and dolphin, and fill activities, 60% of the dredging, 66% of the piling/dolphins, and 50% of the fills are for the Snohomish River and sloughs. Twenty-three percent (23%) of the dredging and 20% of the fills are for the Everett/Port Gardner area. Overall, 17% of the 100 applications are for Everett/Port Gardner, and 23% are listed as Puget Sound or Possession Sound. Only 1% are in Tulalip Bay.

9. The applicants for the 100 permits have been primarily private commercial interests (58%), including the lumber industry and boat and construction companies. Public entities such as the Port of Everett, Snohomish County, state agencies and local governments make up 29% of the applicants. Individuals (11%) and public groups such as the Tulalip Tribe (2%) account for the remainder.

10. The results of this analysis imply that dredging, filling, pilings/dolphins, and bulkheads will be predominant activities appearing in Corps permit applications in the study area. It should be noted that pilings are often part of log storage areas, and applications for pilings may reflect additional pressure for log storage. Section V of this document contains additional discussion of these and other activities and their impacts on wetlands and habitats of the study area.

11. The above analysis treats only activities requiring Corps permits. Corps activities such as maintenance dredging or civil works projects (dams, levy construction) do not require Section 10 or Section 404 permits. The Corps performs maintenance dredging in the Port of Everett and the Snohomish River. Such dredging is done every year, but at any given site only about every third year. For example, the settling basin in the Snohomish River south of the I-5 bridge is dredged every three or four years. Maintenance dredging requirements in terms of annual quantities are about 220,000 cubic yards (U.S. Army Corps of Engineers, 1975b). No civil works projects have been performed in the Snohomish estuary study area in the last three years.

SEATTLE DISTRICT PERMIT PROCESS

12. The flow chart in Figure IV-1 indicates the review process through which a permit application must go before a decision to issue or deny the permit is made by the District Engineer for the Seattle District. This process is taken from Corps regulations, 33 CFR 320-329 as implemented in the Seattle District.

13. Every permit application requires an environmental assessment and a finding of facts as part of the review process. If an enviromental impact statement (EIS) is prepared, the draft EIS may serve as the environmental assessment.

14. A public notice is issued for every permit application. As shown in Figure IV-1, this public notice contains a description of the proposed work, a preliminary environmental assessment, and a statement of criteria for the decision to issue or deny the permit. The criterion for the evaluation of a permit application is whether the proposed activity is in the public interest, as shown by the following quote from Corps Public Notices issued in 1978:

> The decision whether to issue a permit will be based on an evaluation of the probable impact of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefit which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered; among these are conservation, economics, aesthetics, general environmental concerns, historic values, fish and wildlife values, flood damage prevention, land use, navigation, recreation, water supply, water quality, energy needs, safety, food production, and, in general, the needs and welfare of the people. No permit will be granted unless its issuance is found to be in the public interest.

For permit applications under Section 404, the public notice also indicates how a request for a public hearing on the proposed activity may be made.

15. The public notice is routinely sent to over 150 federal, state, and local agencies, elected representatives, public and private interest groups, news media, and interested businesses and individuals. Owners of property adjacent to the proposed work are also notified. Any one may submit comments on the proposed work to

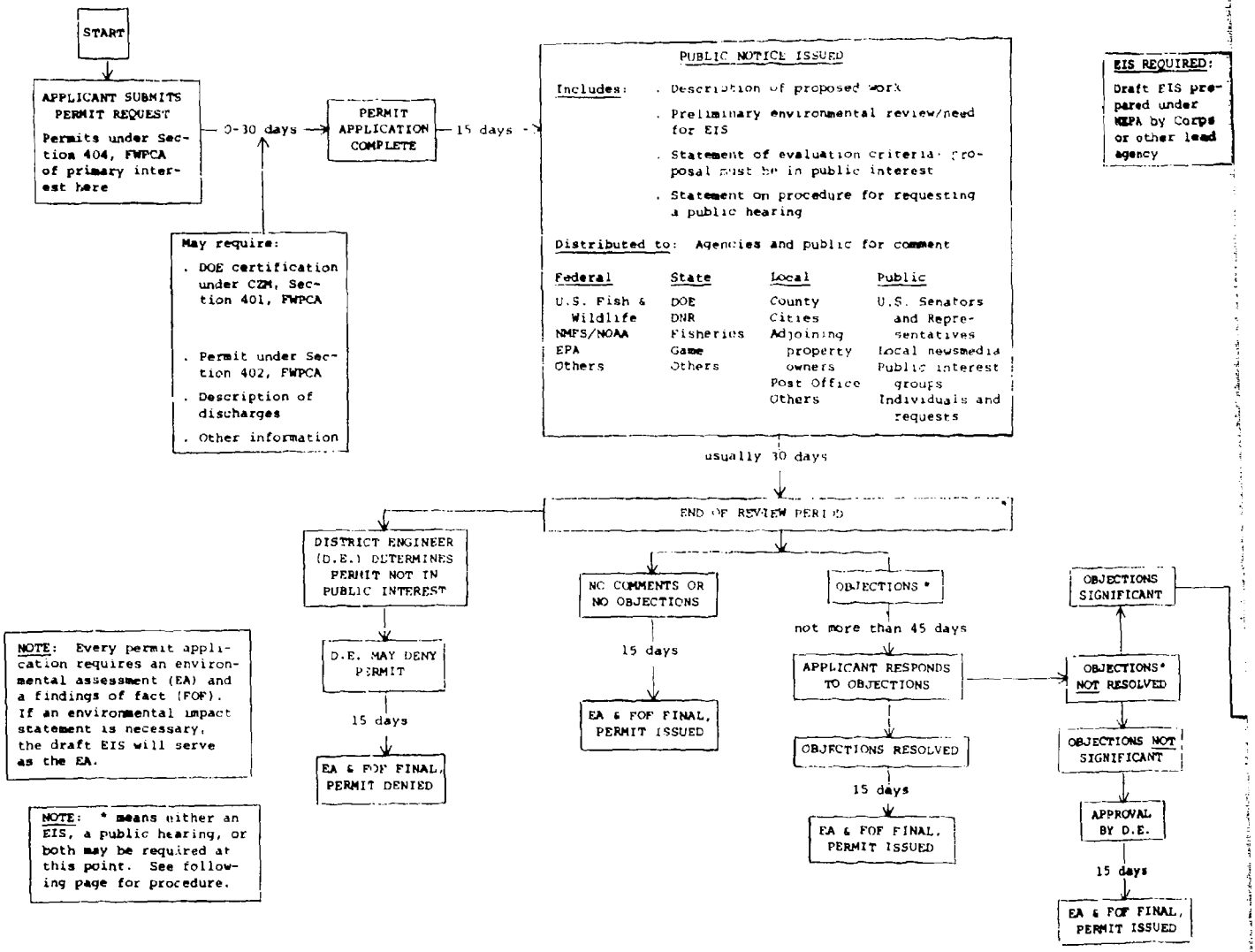
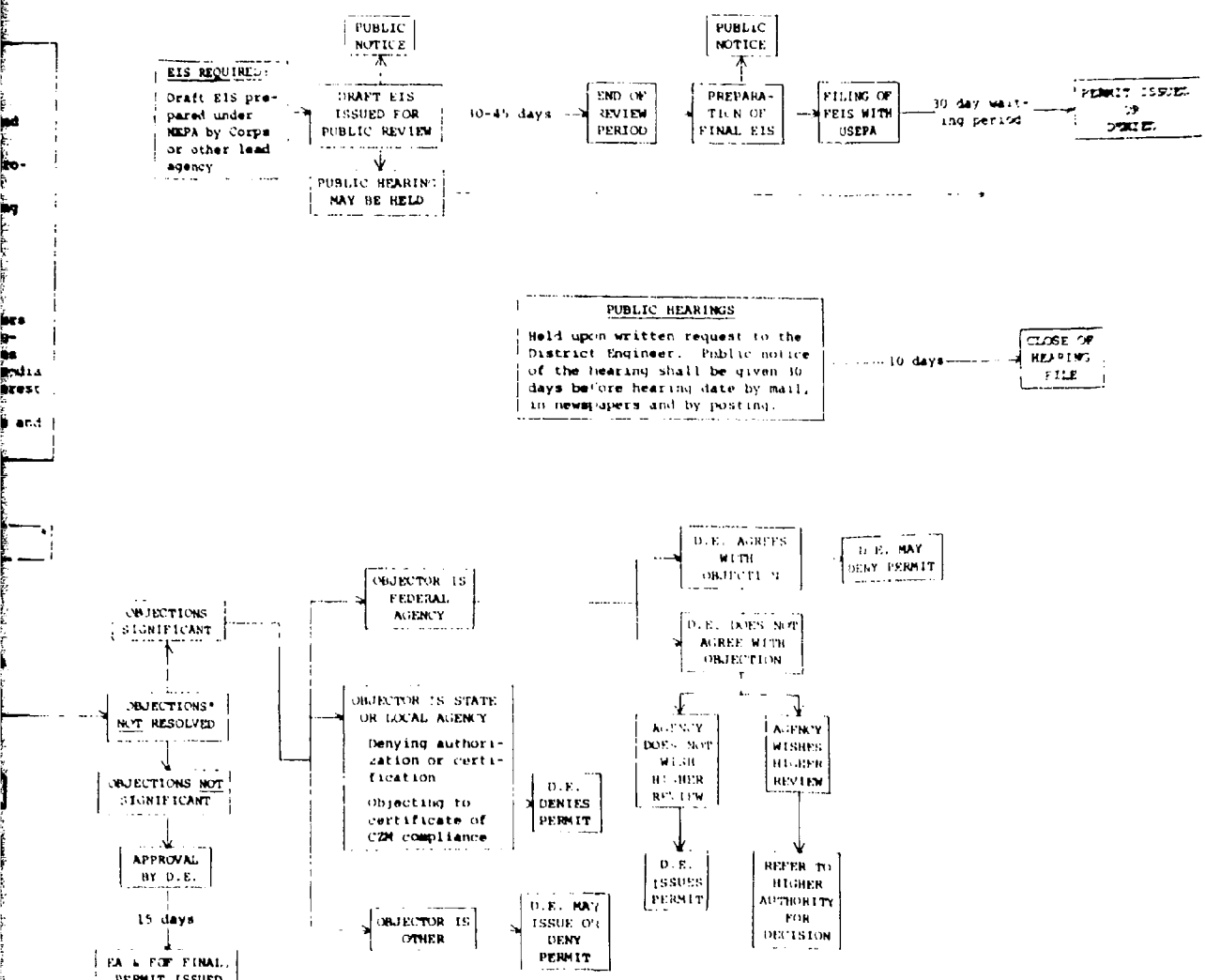

START
APPLICANT SUBMITS PERMIT REQUEST
Permits under Section 404, FWPCA of primary interest here
0-30 days
PERMIT APPLICATION COMPLETE
15 days
May require:
. DOE certification under CZM, Section 401, FWPCA
. Permit under Section 402, FWPCA
. Description of discharges
. Other information
PUBLIC NOTICE ISSUED
Includes:
. Description of proposed work
. Preliminary environmental review/need for EIS
. Statement of evaluation criteria: proposal must be in public interest
. Statement on procedure for requesting a public hearing
Distributed to: Agencies and public for comment
Federal
U.S. Fish & Wildlife
NMFS/NOAA
EPA
Others
State
DOE
DNR
Fisheries
Game
Others
Local
County
Cities
Adjoining property owners
Post Office
Others
Public
U.S. Senators and Representatives
Local newsmedia
Public interest groups
Individuals and requests
usually 30 days
END OF REVIEW PERIOD
EIS REQUIRED:
Draft EIS prepared under NEPA by Corps or other lead agency
DISTRICT ENGINEER (D.E.) DETERMINES PERMIT NOT IN PUBLIC INTEREST
D.E. MAY DENY PERMIT
15 days
EA & FOF FINAL, PERMIT DENIED
NO COMMENTS OR NO OBJECTIONS
15 days
EA & FOF FINAL, PERMIT ISSUED
OBJECTIONS *
not more than 45 days
APPLICANT RESPONDS TO OBJECTIONS
OBJECTIONS RESOLVED
15 days
EA & FOF FINAL, PERMIT ISSUED
OBJECTIONS SIGNIFICANT
OBJECTIONS* NOT RESOLVED
OBJECTIONS NOT SIGNIFICANT
APPROVAL BY D.E.
15 days
EA & FOF FINAL, PERMIT ISSUED
NOTE: Every permit application requires an environmental assessment (EA) and a findings of fact (FOF). If an environmental impact statement is necessary, the draft EIS will serve as the EA.
NOTE: * means either an EIS, a public hearing, or both may be required at this point. See following page for procedure.

Figure IV-1

PERMIT PROCESSING PROCEDURE
Corps of Engineers, Seattle District
33 CFR 320-329



the Corps or may request a public hearing.

16. As shown in Figure IV-1, there are several decision points for issuance or denial of a requested permit. If objections to the proposed work are raised during the public and agency review, the applicant is given opportunity to resolve these objections. If significant objections remain unresolved, then the District Engineer may issue or deny the permit or may refer it to a higher authority, depending on the nature of the objections.

17. The procedure depicted in Figure IV-1 insures that federal, state, and local agencies, and the public, have every opportunity for input to the Corps decision-making process. The solicitation of public and agency input is a means of identifying the public interest in the area and the probable impacts of the proposed work on that public interest. Section VII of this document contains a detailed discussion of the various agencies with authority in the study area and their stated policies for Corps permit applications review. Thus, Section VII is a specific discussion of highlights of the expressed public interest in the Snohomish estuary study area.

Section V

FINDINGS IN THE SNOHOMISH ESTUARY

Section V

FINDINGS IN THE SNOHOMISH ESTUARY

1. Section V presents the findings of the study in the Snohomish estuary study area. Section V.A. reiterates the importance of wetlands per Corps policy and EO 11990 and identifies and describes all wetlands by type in the study area. Section V.B discusses criteria for designation of Areas of Importance and Areas of Environmental Concern and the significance of such designation. The designated Areas are described in detail. Section V.C discusses the environmental impacts of various activities in the study area and presents a method for impact assessment (specific and cumulative) of proposed permit activities. Section V.D describes the factors influencing the location of development and evaluates development pressure on the various areas of the estuary.

2. Supporting data for the findings in Section V may be found in the Physical and Biological, and Public and Land Use Profiles, Sections VI and VII of Volume II, Snohomish Estuary Wetland Study. This section is cross-referenced to Sections VI and VII wherever possible. Sections VI and VII of Volume II are summarized in Section VI of the Summary Report (Volume I).

A. THE IMPORTANCE AND IDENTIFICATION OF WETLANDS

IMPORTANCE OF WETLANDS

1. As discussed in Section I (Introduction), the policy of the Chief of Engineers has expressed the view of wetlands as vital natural resources of importance to the people of this country. The regulations of the Corps of Engineers reiterate the importance of wetlands as follows:

> Wetlands are vital areas that constitute a productive and valuable public resource, the unnecessary alteration or destruction of which should be discouraged as contrary to the public interest. 33 CFR 320.4(b)(1)

Executive Order (EO) 11990 emphasizes the importance of wetlands as critically important resources and directs federal agencies to preserve and enhance the natural and beneficial values of wetlands in management of federal lands, construction, and activities.

2. Under EO 11990 wetlands are broadly defined as areas which do (or would under normal conditions) support a prevalence of vegetative or aquatic life requiring saturated or seasonally saturated soil conditions (Section I). Areas specifically mentioned as wetlands in EO 11990 are swamps, marshes, bogs, sloughs, potholes, wet meadows, river overflows, mudflats, and natural ponds. The Corps definition of wetlands under Section 404, FWPCA, is more limited than the EO 11990 definition in that it is strictly based on vegetation. As a result, mudflats are not "wetlands" by Corps definition unless vegetated. Executive Order 11990 requires the protection of wetlands by federal agencies engaged in carrying out their responsibilities for federal lands, federal construction, and federal activities and programs. It is clear from these statements of national policy that all wetlands are to be considered important, and should be portected and preserved wherever possible.

IDENTIFICATION OF WETLANDS

3. The first major aspect of the Snohomish Estuary Wetlands Study is the identification, description, and evaluation of all wetlands in the study area. All wetlands in the study area are classified and mapped as part of Volume III of the Snohomish Estuary Wetlands Study (Burrell, 1978). As described in the Biological Profile (Section VI), Volume III classifies study area lands, wetlands, and aquatic lands into seven different general habitat types: 1-Urban, 2-Agriculture, 3-Non-forested Vegetated Uplands, 4-Forested Uplands, 5-Water, 6-Aquatic Lands, and 7-Other Lands (vegetated spit).

Each class is subdivided to reflect more refined differences in habitat type; some classes are subdivided to a fourth level of refinement (for example 1-Urban, 15-Harbor/Port, 153-Log Storage, 1531-Log Yard and 1532-Log Raft).

4. Wetlands and associated aquatic resources fall under the water (5000 series) and aquatic lands (6000 series) habitat types. Water habitat types are rivers/streams, lakes/ponds, reservoirs, bays/estuaries, impoundments, lagoons, sloughs, canals/channels, and open water. Aquatic lands are those habitat types which are either intermittently covered by water or strongly influenced by adjacent waters. Aquatic lands are divided into the following categories:

6 Aquatic Lands
- 61 Forested
  - 611 Intertidal Freshwater/Brackish Swamp
    - 6111 with *Picea*
    - 6112 without *Picea*
  - 612 Freshwater Swamp
    - 6121 with *Picea*
    - 6122 without *Picea*
- 62 Vegetated-Non-Forested
  - 621 Kelp Community
    - 6211 Sparse *Nereocystis*
    - 6212 Dense *Nereocystis*
  - 622 Other Algal Associations
    - 6221 Ulvoids
    - 6222 Laminarian
    - 6223 Fucoid
  - 623 Eelgrass (*Zostera sp.*)
  - 624 Salt Marsh
    - 6241-6247 Various vegetative associations including *Carex*, *Triglochin*, *Potentilla*, *Agrostis*, *Deschampsia*, *Scirpus*, *Salicornia*.
  - 625 Brackish/Freshwater Intertidal Marsh
    - 6251 *Scirpus*
    - 6252 *Scirpus*-*Typha*
    - 6253 *Typha*
    - 6254 *Carex*
  - 626 Freshwater Marsh
    - 6261 *Scirpus*
    - 6262 *Typha*
    - 6263 *Scirpus*-*Typha*
    - 6264 *Juncus* depression/pasture
- 63 Non-vegetated
  - 631 Rock
  - 632 Cobble
  - 633 Mixed Coarse
  - 634 Mixed Medium

635 Mixed Fine
636 Sand
637 Sand-Silt
638 Mud

5. In the Snohomish estuary study area, all wetlands as defined by Corps regulation 33 CFR 323.2(c) are contained in the aquatic land (6000) habitat type. Aquatic lands-nonvegetated (63 class) are not wetlands by Corps definition. However, as emphasized in the broader definition of wetlands in EO 11990, nonvegetated aquatic lands are vital natural resources that should be preserved and protected.

6. Volume IV of the Snohomish Estuary Wetlands Study (see Section III) delineates the boundary of tidal wetlands in the Snohomish estuary study area. Certain of the wetland types classified in the aquatic lands (6000) series may not lie under Corps jurisdiction as defined in 33 CFR 323. Aquatic lands (wetlands) type 612 freshwater sqamp (with or without Picea) and type 626 freshwater marsh are not tidal wetlands and Corps jurisdiction may not include all such wetlands.

7. Because of the importance of all wetlands, a detailed description of wetlands by type is included in this section. Each wetland type is described in the format shown in Template 1 (attached). The template title is either Wetland Type (for the aquatic lands 6000 series) or Water (for the water 5000 series). The wetlands (aquatic lands) series is discussed at the third (600) level of detail, except where differences at the fourth level were judged to be biologically significant. The water series is presented as a single discussion. As shown in Template 1, a general description of wetland types and the distribution of that type in the study area is given. Detailed maps of the estuary study area at a scale of 1:6000 are on file at the Corps of Engineers Seattle District office; these maps show the distribution of all wetlands and water (and other habitat classes) in the study area. (These maps were not reproduced in this document because significant information would be obscured in the reduction.) The history of alterations of each type is briefly discussed. The templates also describe the significant relationships and functional importance of each wetland type; these descriptions represent a summary and synthesis of material presented in the Physical and Biological Profiles.

8. Two important historical aspects of the habitat types are referred to in the template discussions, but are not explained in detail therein. These are succession, and the effects of dikes and breached dikes. A short discussion of these aspects follows.

Succession

9. Succession is the process of plant community evolution. A bare substrate is colonized by pioneer plants tolerant to the sunlight, nutrients, periodic inundation, soil saturation, soil salinity and other conditions present. Pioneer plants alter these conditions through deposition of organic material, entrapment of sediment, formation of shade, and other changes. This alteration is usually in the direction of a less stressful condition, thereby creating an environment conducive to more and different species. Each step in the process of environmental change occurs for years and sometimes centuries. The question of the existence of a final stage, or climax, has been debated for many years and is not yet resolved.

10. In wetland habitats, the primary condition which changes through successional stage appears to be elevation, and the consequent frequency and duration of inundation. If this is the case, then the salt marsh pioneers in the Snohomish estuary are pickleweed and sedge. These are both relatively low elevation species. As the substrate elevation rises, arrowgrass, bent grass, and silverweed become established and the sedge is lost. At the upper elevation of the salt marsh all of these species are crowded out by a very dense, monotypic bulrush community.

11. The successional relationships of the intertidal brackish/freshwater marshes suggest the mixed cattail/bulrush community is the pioneer community. Invasion by spiraea, rose and other shrubs, eventually converts the area to a shrub swamp. Finally, with continued deposition of material, alder and spruce may become established, resulting in a forested swamp. This description of succession in the Snohomish estuary is based strictly on observation; research is needed to verify and refine the understanding of the process.

Diked and Breached Dikes

12. In diked areas several different situations have occurred. In areas where dikes have been maintained but the land not cleared, freshwater swamps (612 type) are often present. If the dikes have been maintained, and the land cleared, the land is presently agriculture or perhaps non-forested vegetated upland. In some areas dikes were built, the land cleared and then the dikes breached, allowing the site to revert to wetlands. These areas are presently vegetated with brackish intertidal marsh (625 type) and some appear to be undergoing succession to shrub swamp (6112 type). Finally, Sunnyside Swamp (see Section V.B) is an example of an area where dikes were constructed, but the land was not cleared. When the dikes were breached, the area reverted to its original intertidal state with no apparent significant change in habitat.

Template 1 (Sample format)

WETLAND TYPE

TYPE: Number and Name

DESCRIPTION: General description; that is, flora, substrate, inundation characteristics, etc. Indication of any subcategories under the third level, any significant differences between subcategories and whether the subcategories should be discussed separately.

DISTRIBUTION: Total acreage of this type in the estuary by subcategory and by overall category (level 3). Distribution of type by island. Distribution by parcel size; general numbers of parcels large and small.

HISTORY IN ESTUARY: Evidence of logging, dike/fill, dike breaching.

SIGNIFICANT RELATIONSHIPS AND FUNCTIONAL IMPORTANCE:

A. Plant diversity, and successional stages.

B. Fauna; feeding, nesting, resting. Mammals, birds and waterfowl, fish, shellfish and other invertebrates.

C. Productivity, nutrient cycles, food web.

WETLAND TYPE

WETLAND: 611 Intertidal Freshwater/Brackish Swamp

Description

This is a shrubby or forested area in which the tidal fluctuation results in inundation and/or water table fluctuation. Although the frequency and duration of tidal inundation are not known, the boggy soil and fluctuating water level in shallow depressions are strong evidence of tidal influence. The vegetation in these areas is of three major types: Coniferous trees, broadleaf deciduous trees, and shrubs. The coniferous trees are predominantly Sitka Spruce (Picea sitchensis), although red cedar (Thuja plicata) may also be found. Broadleaf deciduous trees found in the swamp include alder (Alnus rubra) and several species of willow (Salix spp.). Wild rose (Rosa pisocarpa), Noctka rose (R. nutkana), honeysuckle (Lonicera involucrata), Ninebark (Physocalpus capitatus) and Spiraea (Spiraea douglasii) are the most common shrubs found in the swamp habitat. Cattail (Typha sp.) and Goldenrod (Solidago sp.) may also be associated with swamp habitats. The habitat type has been subdivided according to the presence (6111) or absence (6112) of Sitka Spruce.

Distribution

There are about 300 acres of intertidal spruce swamp (6111) within the estuary study area. The largest parcel is 82 acres on Otter Island. Parcels at Quilceda Creek, the south end of North Ebey Island, Sunnyside Swamp and Cavalero Corner vary from 17 to 47 acres. These five locations represent more than 70% of this habitat type in the estuary. The remainder is scattered throughout the estuary, either as a narrow band between dike and slough, or in small parcels usually less then five acres in size.

The intertidal swamp without spruce (7112) encompasses 226 acres in the estuary. Almost one-half of this acreage is located on Ebey Island, including 42 acres at the Highway 2 location. The remaining acreage of this type in the estuary is divided into numerous parcels varying from one (1) to ten (10) acres. Many of these are narrow slough-side habitats located between the slough and the dike.

History

An old topographic map of the estuary (USGS,1884) suggests the entire floodplain was originally wetland, with a high density of trees in areas such as Otter Island, the east shore of Ebey Slough, the west

shore of the main channel and most of Ebey Island. This represents approximately 4,000 acres of swamp. Since 1884 almost all of Ebey Island and the east shore of Ebey Slough have been diked and much of the land cleared for agricultural uses. (The Sunnyside Swamp and approximately 500 acres owned by the Washington Department of Game were diked, but apparently never cleared). Much of the west shore of the river has been filled for industrial activity. Thus, of the approximately 4,000 acres of intertidal swamp in the estuary, only about 525 acres remain. In addition, there are approximately 640 acres of freshwater swamp which have been diked, and therefore removed from hydraulic interaction with the estuarine ecosystem.

Significant Relationships

The swamp habitat type is a diverse plant community with a wide variety of shrubs and trees. The shrub swamp (6112) appears to be the successional stage which follows the cattail marsh (6253) and precedes the spruce swamp (6111).

The swamp habitat type supports a wide variety of fauna. Insects are abundant in the boggy, densely vegetated community. These insects are an important food source to small songbirds such as wrens and chicadees. Insects are also an important food source to woodpeckers, which depend on snags for feeding grounds. A wide variety of small rodents, such as mice and moles, are common on the ground and in the low branches of swamps. These small mammals and birds are preyed on by larger mammals such as muskrat, mink and raccoon. These larger mammals often nest in dens or hollow logs within the swamp. Deer may also browse in swamps, especially forested swamps with a somewhat less dense understory. Raptors often nest in coniferous trees and also rest there when not hunting.

The swamp habitat type is highly productive, generating abundant detritus. However, since the swamp has a relatively high tidal elevation, much of this detritus is deposited as forest litter, rather than being exported into the aquatic ecosystem. As a habitat for a wide variety of birds and mammals the swamp is an important part of the food web which constitutes the estuarine ecosystem.

WETLAND TYPE

WETLAND: 612 Freshwater Swamp

Description

These shrubby or forested areas are characterized by saturated soils and some open water (at least seasonally). They are low areas, but are not inundated by tidal water; in most cases they are protected by dikes. The vegetation in these areas is of three major types: Coniferous trees, broadleaf deciduous trees, and shrubs. The coniferous trees are Sitka Spruce (Picea sitchensis), western red cedar (Thuja plicata) and lodgepole pine (Pinus contorta). The deciduous trees are willow (Salix spp.) and alder (Alnus rubra). Common shrub species include: ninebark (Physocarpus capitatus), swamp dogwood (Cornus stolonifera) and honeysuckle (Lonicera involucrata). The habitat type has been divided according to the presence (6121 habitat type) or absence (6122 habitat type) of spruce.

Distribution

There are approximately 640 acres of freshwater swamp in the estuary, of which 580 is spruce swamp (6121 habitat type). The largest single parcel is the 430 acres in the Washington Department of Game land on Ebey Island. There is another 150 acres in three moderate and several small parcels on Ebey Island.

Only 50 acres of freshwater shrub swamp (6122 habitat type) have been identified in the estuary. This is distributed as several small parcels on Ebey Island and the east shore of Ebey Slough.

History

The freshwater swamp probably represents a wetland which has been diked, but never cleared. The area was sufficiently low that it did not drain and as a result it maintains its wetland characteristics. Ebey Island was probably diked before 1900 and the east shore of Ebey Slough between 1911 and 1940; the dikes have been maintained ever since.

Significant Relationships

Freshwater swamps (612) have many species and functions in common with intertidal brackish/freshwater swamps (611). The only apparent differences between the two habitat types are the presence of lodgepole pine and absence of tidal connection in freshwater swamps.

Freshwater shrub swamps (6122) appear to represent a successional stage which follows freshwater cattail marsh (6262) and precedes freshwater spruce swamp (6121).

Freshwater swamps provide nesting, feeding and resting habitat for a great variety of wildlife. Woodpeckers, wood ducks and ruffed grouse will all feed and nest in wooded swamps. Insectivorous birds such as wrens and chickadees are usually common. Eagles, hawks and owls may all nest in the dense forest, feeding there or in nearby fields, streams or marshes. Deer, and small mammals such as mink, raccoons, squirrels and muskrat are commonly found in swamps.

As with intertidal swamps, freshwater swamps are highly productive; they generate extensive quantities of detritus from leaves and branches. Since there is no aquatic connection, however, even less of this detritus is exported to the estuary ecosystem than in the intertidal situation. The primary function of freshwater swamps within the estuary appears to be to provide a habitat for a wide variety of mammals and birds.

WETLAND TYPE

WETLAND: 623 Eelgrass

Description

Eelgrass is a rooted plant found in the lower intertidal and shallow subtidal zones of marine habitats. It often forms large dense beds on muddy sand flats. The abundant rhizomes and roots of eelgrass often form thick mats which resist erosion, thus stabilizing the substrate.

Distribution

Extensive eelgrass beds are found on the shallow mudflats at the mouth of the Snohomish River. These flats extend westward to Tulalip Bay and south to the south end of Jetty Island. More than 40% of the 3,000+ acres of flats in this area are vegetated with eelgrass. In addition, there are eelgrass beds in Tulalip Bay, although they are not extensive.

History

No historic data exists on the distribution of the flats or the associated eelgrass beds in the study area. An 1884 chart indicates that approximately 200 acres of flat was exposed at low water west of North Ebey Island. This chart does not display any other bathymetry data in the area. An engineer's report in 1892 indicates that tideflats extend 2.5 miles south from the mouth of the Snohomish along Port Gardner (Wellman, 1932). Creation of the jetty and disposal of dredged material seaward of the jetty has probably affected the size and distribution of the flats; a new route and deposition process has been created for the river-borne sediment. There is no data to indicate the extent of this alteration.

Significant Relationships

Eelgrass provides food, shelter, and substrate for a diverse population of organisms. Numerous species of algae, bacteria, and invertebrates reside on eelgrass blades. Many of these in turn are food for the fish and crabs which inhabit the beds. The dense vegetation and thick root mass provide shelter for fish, crabs and benthic organisms. All of these in turn are food for a diversity of larger fish, waterfowl and occasional raptors. Shellfish, including cockles and some clams, are found in eelgrass beds. Detrital material, the remains of dead plants such as eelgrass, are known to be food for a variety of filter feeding organisms, including many which are residents of unvegetated flats. Eelgrass beds are also important spawning and rearing grounds for herring.

WETLAND TYPE

WETLAND: 624 Salt Marsh

Description

These are communities of intertidal vascular plants which are capable of withstanding daily inundation with marine waters. The frequency and duration of inundation are a function of elevation and the various communities tend to segregate according to elevation. Thus, there is a plant community zonation within the marsh with respect to elevation. This phenomenon has been reported in the Snohomish estuary (Burrell, 1978) and elsewhere in the Northwest (Eilers, 1975; Disraeli, 1977).

Seven communities have been identified along an elevational gradient in the Snohomish estuary. The lowest is a Pickleweed community (Salicornia virginica). Above this are several sedge communities, each with a different composition of associated plant species. The uppermost salt marsh community is often a monotypic community of bulrush (Scirpus spp.) (Burrell, 1978).

Distribution

There are approximately 430 acres of salt marsh in the study area. About 170 acres is located on North Ebey Island, west and south of the landfill. There are 145 acres of salt marsh between Priest Point and I-5, with 90% in the Quilceda Creek area. Finally, there is about 80 acres of salt marsh along the west end of Smith Island. The remaining salt marsh areas are scattered small parcels on Spencer Island, Jetty Island and Tulalip Bay.

History

The distribution of salt marshes within the estuary prior to development is not known. Salinity data (see Hydrology) and the present extent of salt marsh habitat types suggests that salt marshes did not extend much farther upstream than the present location of the Great Northern Railroad. Assuming this to be the case, and assuming the entire floodplain was wetland (as indicated in the 1884 chart) then there were approximately 1,000 acres of salt marsh at the mouth of the Snohomish River in 1884. At present there are about 400 acres in the area, suggesting a reduction by about 60%.

Two activities are responsible for most of the elimination of salt marsh habitat types in the estuary. The first is the diking of Smith

Island before 1911. This removed approximately 300 acres of wetland from the system west of the railroad tracks. The second is the North Ebey Island landfill. This site has covered approximately 130 acres of tidal wetland between 1965 and 1978.

Significant Relationships

Salt marshes are composed of a variety of communities; some of these communities are monotypic, and some are extremely diverse. The successional sequence appears to begin with the low elevation, monotypic pickleweed and sedge communities. The moderate elevation communities are much more diverse. The uppermost community, however, appears to be a monotypic bulrush community. Further research is necessary to establish the exact elevational and successional relationships of these habitat types.

Salt marshes provide a feeding habitat for a variety of birds and mammals. Seeds of marsh plants (e.g. sedge) are a food source to waterfowl, especially dabbling ducks. Songbirds such as sparrows, and small mammals also feed on marsh plants when the tide is low. Insectivorous birds such as swallows, wrens and tits are often observed to feed on the numerous insects associated with marsh habitats. These small birds and mammals in turn provide prey for the raptors (especially hawks) and carnivorous mammals (mink, raccoon, muskrat) which often enter marsh areas.

In addition to feeding, numerous birds use the marsh for nesting and resting. Some waterfowl may nest in the salt marsh, and many take shelter there during moulting. Rails, bitterns and some wrens breed in the high marsh; they build their nests above the high water mark or hang them from the vegetation.

Salt marshes are highly productive habitat types which, due to frequent tidal inundation, export much of that productivity as detritus into the aquatic system. This detrital material in turn is a major food source for the abundant detritovores that occupy nearby mudflats.

WETLAND TYPE

WETLAND: 625 Brackish/Freshwater Intertidal Marsh

Description

These are vegetated intertidal areas which receive regular brackish or freshwater inundation. Almost 90% of this habitat type is represented by a mixed cattail/bulrush community (6252 habitat type). The remainder is either monotypic cattail (6253 type), monotypic sedge (6254 type) or an undefined mix (6250).

Distribution

Of approximately 720 acres of this habitat type in the estuary about 270 acres are located on North Ebey Island east of I-5. Another 120 acres are scattered as small parcels west of I-5 on Ebey Island. There are about 105 acres of this habitat type in the Quilceda Creek area, with about 95% east of the creek. There are 65 acres of mixed cattail/bulrush (6252) habitat type on Otter Island and 56 acres on mid-Spencer Island, 12 acres to the south and 44 acres to the north. The remainder of this habitat type is scattered throughout the estuary in numerous small parcels of one to 20 acres. Many of these are narrow bands of sedge marsh along the slough edge.

History

There is no information concerning distribution of this habitat type prior to development of the estuary. An 1884 map of the estuary does indicate, however, that almost all of the floodplain was wetland prior to its development. If this was an accurate analysis of the estuary, then wetlands have decreased from approximately 12,000 acres in 1884 to some 1,800 acres in 1977 (see Land Use Profile). This represents elimination of approximately 85% of the wetlands, primarily through diking.

Significant Relationships

This is a low diversity habitat type which is characterized by a dominance of only one or two species. The cattail marsh appears to be an early successional stage preceding the shrub swamp. There is no information to suggest the successional relationships of the sedge marsh or the mixed cattail/bulrush marsh.

The sedge marsh is an important feeding habitat for waterfowl; the seeds are eaten by numerous dabbling ducks. Its low elevation along

the slough makes it a popular feeding area which is easily reached from the water at most stages of the tide.

Cattails and bulrushes are an important feeding and breeding habitat for a wide variety of fauna in the estuary. Many small rodents nest on the floor of the marsh and feed on insects, seeds and vegetation. Small songbirds also feed on insects; their nests are often attached to a clump of reeds. Rails and bitterns are also common residents in this habitat type, although due to their shy manner they are rarely seen. Larger rodents, such as beaver and muskrat, also feed in these marshes (the only known beaver dam in the estuary is in a cattail marsh near Lowell). Evidence of deer has been seen near marsh-swamp borders, indicating use of the habitat as a resting area. With the abundance of small mammals and birds, numerous predators find the marsh an important feeding ground. Raptors, mink, and raccoons all enter the marsh to hunt.

The low diversity brackish marshes have an extremely high rate of productivity. In addition, the relatively low tidal elevation and consequently high aquatic interaction means a significant percentage of this material is exported as detritus, adding to the food base of an important aquatic food web. These marshes also aid in the regulation of nutrients and contaminants in the estuary through the deposition of suspended solids. Nutrients, such as phosphorous and nitrogen, and assorted contaminants which adhere onto these suspended solids before deposition, are absorbed by the vegetation, trapped in the sediment or slowly broken down by microbial action.

WETLAND TYPE

WETLAND: 626 Freshwater Marsh

Description

These are low, wet areas which do not receive any tidal inundation. They are characterized by cattails, bulrushes or rushes. Often rushes will dominate in a marsh which is being grazed. Subdivisions are defined according to dominant species, such as bulrushes (6261), cattails (6262), cattail/bulrush (6263), and rush (6264).

Distribution

Only 83 acres of freshwater marsh have been identified in the estuary. The largest single parcel is a 10-acre marsh located between the Weyerhauser Mill and the Great Northern Rail Yard in northeast Everett. Elsewhere, fresh marshes are common in sloughs which have been dammed or equipped with tide gates, preventing the influx of tidal water.

History

The marsh behind the Weyerhauser Mill was probably once a tidal marsh. Construction of the mill between 1911 and 1940 probably resulted in the isolation of that marsh from tidal influence. In other locations streams or small sloughs (such as the one bisecting Smith Island) were dammed. These low areas remain wet and support freshwater marshes.

Significant Relationships

Freshwater marshes are often low in diversity but high in productivity. They do not export much of this productivity, however, since they have little or no hydraulic connection with the estuary. The successional relationships appear to be the same as for intertidal freshwater/brackish marshes. That is freshwater marshes develop into freshwater shrub swamps, which in turn succeed to spruce swamps. As with other successional relationships in the Snohomish estuary, further research is needed to adequately describe the process.

Freshwater swamps provide resting and feeding habitat for waterfowl, especially where they are associated with open water. Shorebirds, such as rails and bitterns, and songbirds, such as red-wing blackbirds and wrens, use the freshwater marsh as both feeding and nesting habitat.

Where freshwater marshes are associated with riparian habitat, numerous upland birds and mammals will use the marsh. Rodents and small songbirds will feed in the fresh marsh. Carnivorous mammals such as minks and raccoons will prey on the smaller animals. Hawks and other raptors will feed on these small animals also.

As mentioned above, freshwater marshes are usually highly productive. However, as with other aquatic lands which are not strongly connected with the estuary, they export little to the aquatic ecosystem. The primary function of these wetlands appears to be as a habitat for a wide variety of organisms. Nonetheless, movement of those organisms into the estuary represents export of some productivity and a contribution to the food web.

WETLAND TYPE

WETLAND: 637 Muddy Sand Substrate
638 Mud Substrate

Description

These two unvegetated substrates are found throughout much of the flats which extend from the Snohomish River mouth to Tulalip Bay and the southern end of Jetty Island. The substrate is mud or a silt and sand mixture which contains an abundant biological community, including benthic diatoms.

Distribution

In addition to the flats extending into Port Gardner, mud and silty sand substrates are found along the east side of the Port of Everett and through much of Tulalip Bay. Small parcels of this habitat type have been identified along Quilceda Creek and in the area between the landfill and the railroad tracks on North Ebey Island.

History

Although the distribution of these flats has not been recorded historically, they have probably been accreting westward for centuries. River-borne sediments and materials eroded from both the Everett and Mission Beach Bluffs have been deposited in this area, slowly extending the flats outward from the estuary. With construction of the jetty and settling basin the deposition of river-borne sediments has been diverted somewhat but not halted.

The major impacts on these unvegetated flats have been filling and log rafting. Filling raises the substrate surface out of the marine environment, thus eliminating it from direct interaction and making it available for development. This has occurred in several locations within the Port of Everett. Log storage restricts access by waterfowl which would use the shallow flats for feeding. It also results in the deposition of large quantities of bark and wood chips. This material generates a significant biochemical oxygen demand and eliminates much of the potential habitat value for benthic organisms. Additionally, log rafting shades the substrate, thus potentially impacting benthic diatoms. The shallow flats west of Smith Island and North Ebey Island along the east portion of the Port of Everett and in much of Tulalip Bay have traditionally been used for log storage activities.

Significant Relationships

Mud and sand flats in the Snohomish River mouth have been shown to be

highly productive habitats for benthic invertebrates and plankton (Smith, 1977). These bottom dwelling organisms feed on detritus washed out of marshes and eelgrass beds, and on each other. They in turn provide food for waterfowl and a variety of fish, such as salmon and flatfish. Shallow sand and mud flats have been noted as having some of the highest fish densities of all nearshore fish habitats (Miller, et al, 1976). In part this high density results from use of the areas by schooling juvenile salmon, herring and smelt. This activity makes these shallows extremely important to the later commercial and sport harvest of these species.

In addition to fish, invertebrates and waterfowl, mud and sand flats are important habitats for shellfish. Bent-nosed clams, soft-shell clams, horse mussel, cockles and littleneck clams are all commonly associated with these habitats.

WATER

TYPE: 5 Water

Description

This habitat type includes a wide variety of water bodies within the study area. The estuarine river channels and small streams, inland ponds and lakes, and the open waters of Possession Sound are part of this habitat type. Salinity varies from the marine waters of Possession Sound to freshwater lakes and streams. Water is the medium which transports detritus from wetland and upland habitat types to intertidal and subtidal areas. Phytoplankton are the primary producers of the water habitat, and the basis of a grazing food web which includes zooplankton, crabs, salmon, and other aquatic fauna.

Distribution

There are about 2,000 acres of water within the land use study area of which 1,530 acres represent the main channel and adjacent sloughs, and 370 acres represent open water at the river mouth. In addition, there are 80 acres of old sloughs which have been cut off as a result of diking activities. The remaining acreage represents several small inland ponds.

History

Prior to the diking and channelization activities all of the sloughs were tidally influenced and numerous small creeks emptied directly into the estuary. During the late 1800's Steamboat Slough was the main channel of the estuary system, as evidenced by use of the channel for steamboat navigation upriver and reports that the bottom of the old channel (now main channel) was often exposed at low tide. After completion of the Jetty in 1895, the main channel was dredged for navigation purposes. Since then the main channel has been maintained for navigation. The channels have also been used for log rafting for many years. Since completion of the diking, many of the creeks empty into the estuary through tide gates.

Significant Relationships

Water is not only the habitat for fish, shellfish, and plankton, it also provides resting and feeding habitat for waterfowl, wading birds and a few upland mammals such as beaver, muskrat and otter. Water is the transport medium of detritus, carrying it from the wetland habitat types to the intertidal flats and beyond.

Water is also used to dilute and dissipate municipal and industrial wastes. Materials which are discharged into the estuary are meant to be transported out of the river and into Possession Sound.

B. AREAS OF IMPORTANCE AND AREAS OF ENVIRONMENTAL CONCERN

1. The second major finding of the Snohomish Estuary Wetlands Study is a designation of certain areas in the study area as Areas of Importance or Areas of Environmental Concern. The following discussion presents the significance of the designation, the criteria by which designations were made, and a detailed description of each designated area. Plate 2 shows these areas. A matrix (Figure V-1, shows which criteria are met by each area in a summary form.

SIGNIFICANCE OF THE DESIGNATION

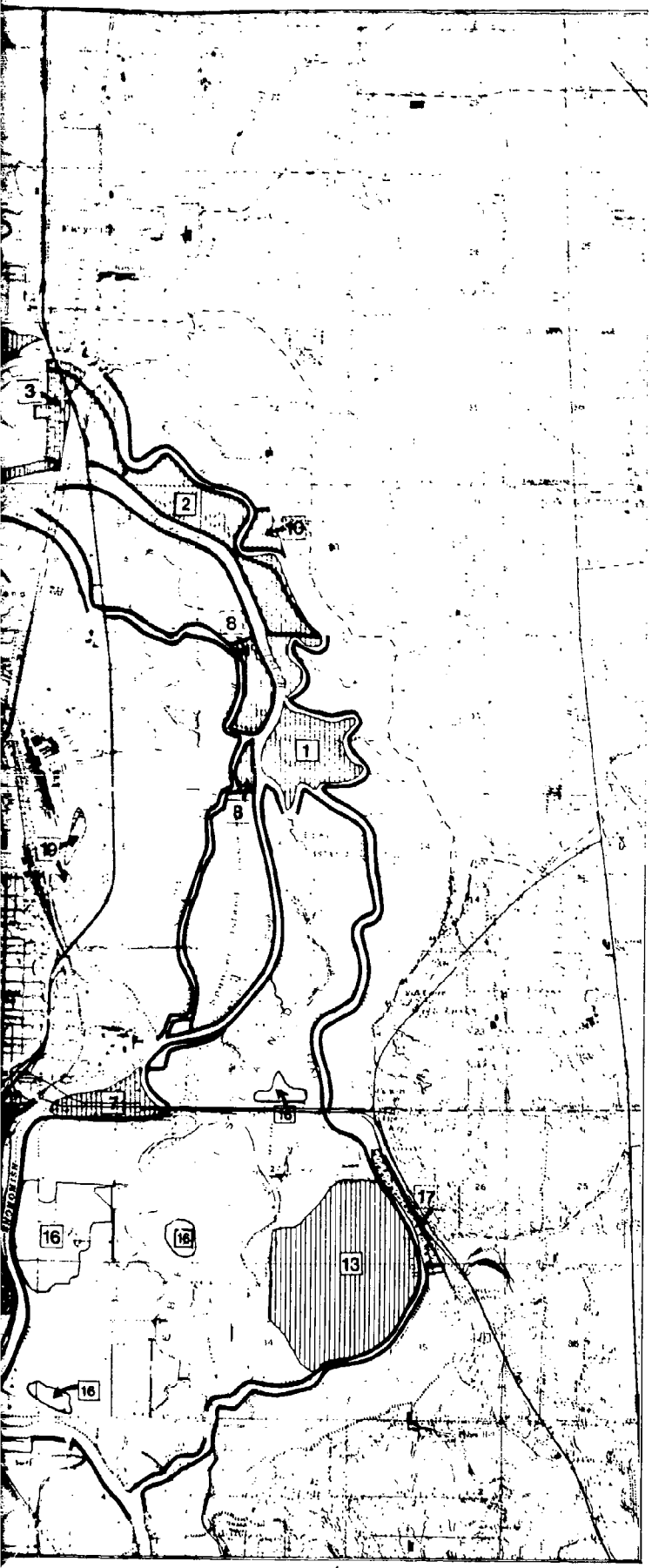
2. Areas of Importance are those areas of such importance and/or uniqueness to the functioning of the Snohomish estuary ecosystem and its aquatic resources that potential destruction or alteration would be discouraged unless it was found to be in the best public interest. Therefore, permit applications in Areas of Importance will require intensive review to determine (1) whether the public interest requires the issuance of the requested permit; (2) whether the benefits of the proposed alteration outweigh the damage to the estuarine resource; and (3) the proposed work is necessary to realize these benefits. According to Corps regulations, 33 CFR 320.4(a)(1):

> "The decision whether to issue a permit will be based on an evaluation of the probable impact of the proposed activity and its intended use on the public interest....That decision [whether to authorize a proposal and any necessary conditions] should reflect the national concern for both protection and utilization of important resources.... No permit will be granted unless its issuance is found to be in the public interest."

Thus, the public interest is clearly established as a major criterion for the permit issuance decision. The Chief of Engineers' Policy on Wetlands and Corps regulations 33 CFR 320.4(b)(2) identify characteristics which make wetlands important to the public interest. Areas of Importance include wetlands and adjacent habitats which as a unit perform functions important to the public interest. Wetlands in Areas of Importance should be viewed as Wetlands of Importance per Corps regulations 33 CFR 320.4(b)(2) and 320.4(b)(4).

3. Areas of Environmental Concern are areas which are environmentally sensitive, in which any use or activity should be carefully controlled. The location of any permit activity in such areas must be carefully examined to make certain that the siting has considered the existing fragile resource. Any use or development in Areas of Environmental Concern must be subject to the following general guidelines recognized as key to the estuarine ecosystem:


14
4
5
3
5
15
2
15
6
8
12
11
9
20
19
8
16
16
18
16



FINDINGS

PLATE NO 2

LEGEND

Areas of Importance

Areas of Environmental Concern

Dikes of Concern (19)

N

SCALE 1:24000

SNOHOMISH ESTUARY WETLANDS STUDY

2

PLATE NO 2

. There must be no unnecessary alteration of drainage which would

a. destroy vital areas;
b. impede the natural rate or pattern of water flows within the estuarine system;
c. reduce the natural supply of nutrients from freshwater inflows;
d. increase the discharge of nitrogenous compounds into confined waters;
e. increase natural turbidity and temperature;
f. significantly change natural salinity and oxygen;
g. increase suspended solids or toxic materials;
h. alter or destroy shallows in inundated areas serving essential or desirable ecological functions.

Note: It is important to restate here that any permit application for any location in the study area must and will be subject to review of the extent to which such permit is in the public interest and meets all Corps criteria, including environmental criteria, for permit issuance. It should also be noted that all wetlands, whether they be in Areas of Importance or Areas of Environmental Concern or not, must and should be viewed as important. Any permit application potentially affecting any wetland in the estuary must be subjected to intensive review.

CRITERIA FOR DESIGNATION

4. Criteria for designation of Areas of Importance and Areas of Environmental Concern were developed as follows. In Corps regulations, the public interest is clearly established as a major criterion for the permit issuance decision.

5. Corps regulation 33 CFR 320-329 list factors which must be considered in defining the public interest (see also Section IV). These factors include potential impacts on important wetlands. From 33 CFR 320.4(b)(2), "Wetlands considered to perform functions important to the public interest include:

. wetlands which serve important natural biological functions, including food chain production, general habitat, and nesting, spawning, rearing, and resting sites for aquatic or land species;

. wetlands set aside for study of the aquatic environment or as sanctuaries or refuges;

. wetlands contiguous to the above, the destruction or alteration of which would affect detrimentally the natural drainage characteristics, sedimentation patterns, salinity distribution, flushing characteristics, current patterns, or other environmental characteristics of the above areas;

. wetlands which are significant in shielding other areas from wave action, erosion, or storm damage;

. wetlands which serve as valuable storage areas for storm and flood waters;

. wetlands which are prime natural recharge areas; and

. wetlands which through natural water filtration processes serve to purify water."

Of the seven functions identified above, six are natural biological and/or physical functions. The seventh (study of the aquatic environment, santuaries, refuges) is a cultural determination, requiring the setting aside of wetlands for these purposes. In identifying wetlands which perform the biological and physical functions listed above, it is essential to consider adjacent habitats, for those habitats may have characteristics vital to the continued functioning of the wetlands. Consequently, the study team has identified areas which contain wetlands and adjacent habitats that as a unit perform functions important to the public interest.

6. In addition to the above, there are other factors which express or contribute to the public interest. In evaluating permit applications the Corps considers all applicable official state, regional, or local land use plans and/or policies as reflecting local factors of the public interest (33 CFR 320.4(j)(2)). The Corps also coordinates and consults with certain federal and state agencies (33 CFR 320.4) so that permit decisions will reflect factors of the national and statewide public interest. Federal, state, and local plans and policies thus provide additional criteria for the selection of areas important to the public interest. Such areas may be identified from specific local policies recommending particular locations to be preserved from development and from general agency policies recommending types of areas to be preserved from development. In the first case, particular areas are often defined very specifically and delineated on maps; in the second case, a general type of area such as a valuable wildlife habitat, a recreational area, or a highly biologically productive area is called out for preservation. Specific areas are then identified by first determining which areas fit the primary criterion of productivity, wildlife habitat, and so on.

7. Other expressions of the public interest may be found in cultural resources (such as archeologic or historic sites or areas used for public recreation). Areas providing economic benefits, such as harvestable resources, or aesthetically pleasing areas may also be identified as holding public interest value.

8. The criteria used in the selection of Areas of Importance/ Areas of Environmental Concern are thus based on considerations of natural biologic and physical functions, agency plans and policies, and cultural resources. These criteria are summarized below under two headings:

1) Outline of Criteria for Natural Functional Importance

a. Natural biological functions, including productivity, vegetation density, plant and animal diversity, and threatened or endangered animal species habitats.

b. Ecosystem support functions, including hydrologic periodicity, location or elevation, areal extent, and ecological importance.

c. Physical protection.

d. Storm and floodwater storage.

e. Natural groundwater recharge.

f. Water filtration and purification.

2) Outline of Ancillary Criteria

a. Specific local preservation policies.

b. General agency preservation policies.

c. Archeologic/Historic significance.

d. Educational, scientific, and/or recreational value.

e. Harvestable resource value.

f. Visual/aesthetic value.

Definitions

In applying Criteria for Natural Functional Importance, it is necessary to understand certain ecological terms and concepts. These are:

. Ecosystem: A community of organisms, both plant and animal, and its physical environment.

. Food web (food chain): This concept is used to describe the pathway of energy through the ecosystem, from primary producers (plants) to primary consumers (herbivores) to secondary consumers (carnivores), and ultimately to decomposers (detritivores).

. Riparian: Adjacent to a stream or river, used to describe a habitat type.

. Trophic: Relating to nutrition or energy conversion within an ecosystem. In a food web primary producers represent the first trophic level, primary consumers the second trophic level, and so on.

. Detritus: Loose material which results from decomposition. In ecological systems this refers to plant and animal fragments which result from the death and decomposition of once living organisms.

. Aquatic Interaction: The periodic or permanent movement of water through an area. Water transports detritus to aquatic lands where it can be used by detritus feeders.

. Nutrient: Any substance which is necessary for the growth, maintenance and reproduction of an organism.

. Productivity: The rate at which energy is stored in an organism (usually measured as the rate at which carbon is assimilated in $g/m^2/yr$). Net primary productivity is the rate at which energy is stored in plants minus that utilized for respiration. Secondary production is the energy stored by consumer organisms.

1. Criteria for Natural Functional Importance

a. Natural Biological Functions

1a) Primary Productivity. Wetlands which have high natural rates of net primary productivity are considered highly valuable. This net primary productivity is the basic energy source for the entire food web in the estuary. Areas with high rates of productivity can support large and diverse populations of organisms. Highly productive areas include algal beds, salt marshes, brackish/freshwater marshes and swamps. This criterion should not be used alone,

however. It is still a qualitative measure in the Snohomish estuary since no productivity measurements are available for the study area. The estimated level of aquatic interaction (see below) should be considered along with estimated net productivity. The combination of the two better describes the potential for a given area to be a source of energy for the major food webs in the estuary.

1b) Secondary Productivity. Aquatic lands with dense populations of benthic organisms have high secondary productivity. Benthic fauna store energy extracted from detritus, thus reintroducing it to the food chain.

2) Vegetation Density. Dense vegetation provides protective cover for a wide variety of animals. This is particularly important to small mammals, molting waterfowl, or other relatively defenseless animals. Dense vegetation also functions to slow water flow through the area, thus enhancing sedimentation of suspended solids and their associated nutrients and pollutants. Cattail, bulrush and mixed cattail/bulrush marshes are prime examples of dense vegetation.

3) Plant and Animal Diversity. The more diverse plant communities tend to support more diverse animal communities. More diverse animal communities in turn exploit the available energy resources more efficiently. Thus, in areas with more diverse animal populations, less of the energy stored as plant material is lost. In addition, diverse populations are considered to be more resistant to changes in environmental conditions. Elimination of a single species does not result in the collapse of the community. Finally, the presence of diverse populations within a single trophic level results in interspecific competition and co-evolution, thus strengthening the genetic character of the species involved (Ricklefs, 1973).

4) Threatened or Endangered Animal Species Habitats. Wetlands where there have been observations of a threatened or endangered or otherwise rare or unique animal species are considered important. Habitats containing locally vanishing or restricted species are also included here.

b. Ecosystem Support

This criterion refers to those areas the destruction or alteration of which would detrimentally affect natural drainage characteristics, sedimentation patterns, salinity distribution, flushing characteristics, current patterns or other environmental characteristics. For example, filling the mudflats in front of Maulsby Swamp might severely impact the flushing and hydraulic characteristics of that area.

1) Hydrologic Periodicity The frequency and duration of inundation due to tides, river flow or runoff is a measure of the interaction between habitat types within an ecosystem. Subtidal algal and eelgrass habitat types exhibit continuous inundation, and therefore very high interaction with adjacent aquatic areas. Salt marshes and intertidal brackish/freshwater marshes and swamps are usually inundated twice daily providing high aquatic interaction. Non-tidal marshes and swamps such as those behind dikes are inundated only by flooding and therefore have lower aquatic interaction with the estuarine ecosystem.

2) Location or Elevation. The location of a habitat is an important part of its contribution to the ecosystem. Proximity to the open water system is important when evaluating aquatic interaction. In addition, a wetland which is adjacent to other wetland areas contributes to a larger and more diverse wetland habitat. Isolated habitats, surrounded by urban or agricultural areas, may not contribute as much to the total estuarine ecosystem, although they may be productive units in themselves. Elevation of a wetland is important in evaluating the extent of the aquatic interaction between the wetland and the open water ecosystem. Hydrologic linkages deteriorate as the depth of flooding decreases.

3) Areal Extent. The size value of an area can be very important either by itself or in combination with contiguous related areas. A large unit provides cover and protection for wildlife. It may also provide a functionally intact system, relatively free from outside disturbances. A large unit made up of a variety of habitat types provides a diverse habitat. The shape of a habitat can also be very important in increasing the wildlife value of an area. For example, swamps and riparian habitats possess high wildlife values in different configurations. A swamp

serves identical productivity functions whether it be compact or linear. However, wildlife values to swamp species are greatly enhanced by a compact shape. The protection and security provided by the interior of a swamp are necessary for the survival of many animals which are very wary of, or cannot tolerate, human activity. In contrast, a riparian woodland has more value in a linear shape. The vegetation functions to support wildlife, provide shade for the stream or slough (maintenance of cool water temperature is important to fish habitat), provide a source of primary production to stream detritus feeders (through vegetation falling into the stream followed by decomposition), and provide habitat for insects, many of which become food for fish, or small birds. Also, dense stream or dike bank vegetation provides erosion protection.

4) Ecological Importance. This criterion refers to the characteristics of an area that make it valuable for resting, breeding or feeding. The characteristics required for each species are different, and include specialized nesting or spawning sites, security from predators, availability of nest sites and materials, and food sources. As knowledge of individual species requirements is refined, this criterion will become more valuable. For example, the use of the wetlands by browsing and foraging herbivores is well known. Also, the spawning and nesting of some species are known to occur in the estuary, and identification and protection of these specific habitats is important to maintain the populations.

c. Physical Protection

Wetlands included here are those that are significant in shielding other areas from wave action, erosion, or storm damage. Good examples are Jetty Island and the Tulalip spit.

d. Storm and Floodwater Storage

Wetlands are valuable if they are able to store storm or floodwaters and thereby protect upland areas from erosion and safe private property from destruction. This function is particularly critical for major floods such as occur in the Snohomish Basin every few years.

e. Natural Groundwater Recharge

Wetlands which serve as prime groundwater recharge areas are important. These areas help maintain the general groundwater table. There are no major groundwater recharge areas in the Snohomish estuary.

f. Water Filtration and Purification

Wetlands included here are those that serve to purify water through natural filtration processes. Suspended solids and associated contaminants are trapped in wetland sediments and may be released slowly through incorporation by wetland organisms. Recent studies have indicated that particular plant species and communities have the ability to concentrate or decompose contaminants, such as excess nitrogen and phosphorus compounds, heavy metals, and various hydrocarbons. For example, the cattail (Typha latifolia) has been shown to concentrate nitrogen, phosphorus and manganese by removing them from the sediment (Lee, et al, 1976). The wetland plant community thus incorporates free nutrients and releases them slowly as detritus.

2. Ancillary Criteria

a. Specific Local Preservation Policies

This criterion identifies any specific local policy statements or recommendations for preservation of the area under consideration. In the Snohomish estuary study area, particular areas recommended for preservation are identified in several documents. The Snohomish River Basin Mediated Agreement identifies preservation areas (Plate 17, Volume II). The Port of Everett's Consensus Guidelines identify areas in which the Port will not seek dredge material disposal sites (Plate 17). Three local governments have comprehensive plans, zoning, and/or shoreline master programs (SMP) which contain site-specific statements; these governments are Snohomish County, the City of Everett, and the City of Marysville. Under the SMP's for these three governments, shorelines environment designations of Conservancy, Natural, and Rural were viewed to be expressions of local desire to preserve various shorelines from urban development (Plate 16, Volume II). The Snohomish County Comprehensive Plan for the Marysville Planning Area and the Everett Community Plan each have areas specifically recommended for preservation as green belt or open space.

b. General Agency Preservation Policies

This criterion identifies any general agency preservation policies under which the area falls. For example, the U.S. Fish and Wildlife Service (FWS) discourages encroachment into biologically productive wetlands. It should be noted that FWS has a broader definition of wetlands than that stated in 33 CFR 323.4 (see Section II). Similarly, the State Comprehensive Outdoor Recreation and Open Space Plan (SCORP) recommends for preservation in the natural state those swamp, marsh, or bog sites with natural qualities and unique value for wildlife conservation, scientific, educational, or recreational purposes. Agencies with such general preservation policies include federal (FWS, NMFS, EPA), state (DOE, Game, Fisheries, SCORP, DNR), regional (PSCOG) and various local governments and agencies. These agencies and their policies are discussed in detail in Section VII, Volume II.

c. Archeologic/Historic Significance

The criterion identifies whether the area under consideration has archeologic or historic significance. Known archeologic areas and historic sites in the Snohomish estuary study area are shown in Plate 19 (Volume II). The existence of an archeologic or historic site in a given area adds to the area's public interest value. The State Office of Archeology and Historic Preservation is responsible for the promotion and enhancement of preservation efforts and public interest in such sites.

d. Educational, Scientific, and/or Recreational Value

The criterion identifies whether an area is known to be used for recreation or for educational or scientific study. In the Snohomish estuary certain groups were identified as users of particular wetland areas for educational or research purposes. These groups include local school districts and interest groups such as the Audubon Society. These are discussed in Section VII. No formal sanctuaries or refuges exist in the Snohomish estuary study area, although the large parcel of land on Ebey Island owned by the State Department of Game is managed as a refuge. Areas used for recreation are shown on Plate 19 and discussed in Section VII, Volume II; they include parks, marinas, and public access boat launch and fishing areas.

e. Harvestable Resource Value

The criterion identifies whether an area is used for commercial or sport hunting or fishing or whether it is essential as habitat for species of commercial or recreational importance. Such harvestable resources generate direct economic benefits and preservation of areas important for maintenance of these resources is in the public interest.

f. Visual/Aesthetic Value

This criterion identifies whether an area is considered to provide a visually or aesthetically pleasant experience to most observers. In the Snohomish estuary views from roads and buildings were subjectively rated as good, average, or poor. Areas considered to provide a good view are held to be areas of public interest.

9. The above criteria are not all equal in importance. Those criteria derived from the factors listed in 33 CFR 320.4(b)(2) were considered more important than the others and were given greater weight in the process of areas designation. All criteria under Natural Functional Importance and the Ancillary Criterion of Educational or Scientific Value are considered very significant, and areas which meet many or all of these criteria were generally designated Areas of Importance. Areas which meet fewer of these criteria were designated Areas of Environmental Concern. All criteria involving local, state or federal policy, other than 33 CFR 320.4(b)(2) were given lesser weight than the physical and biological criteria. The process of criteria weighting and application was performed subjectively by the study team.

DESIGNATED AREAS

10. In the Snohomish estuary study area, 14 areas are identified as Areas of Importance (Plate 2). These are as follows:

1. Otter Island
2. North Ebey Island, east of I-5
3. North Ebey Island, west of I-5, east of Tulalip Reservation
4. Quilceda Creek
5. North Ebey Island, on Tulalip Reservation, including Quilceda Island
6. Smith Island
7. Highway 2
8. Mid-Spencer Island

9. Maulsby Swamp
10. Sunnyside Swamp
11. Jetty Island
12. Jetty Island Mudflats
13. Ebey Island Washington Department of Game Land
14. Tulalip Bay

Another seven areas are identified as Areas of Environmental Concern; these are:

15. Entrance Mudflats
16. Ebey Island, A, B, C
17. Cavalero Corner
18. Lowell
19. Weyco Islands
20. Maulsby Mudflats
21. Dikes of Concern

The areas are not listed here in order of importance. Both the Areas of Importance and the Areas of Environmental Concern are shown on Plate 2; the number of each area is lsited on the Plate for easy identification. The boundaries of each area are defined by physical and biological criteria; each area represents wetlands and adjacent habitat identified as a functioning unit.

11. Matrix V-1 shows which criteria are met by each Area of Importance (AOI) and Area of Environmental Concern (AEC). The matrix does not indicate the relative importance of the criteria but merely shows whether they are met or not. It can be seen from the matrix that some of the AOI do not meet many of the criteria. However, the significance lies in which criteria are met. As stated above, the AOI generally meet most of the criteria for Natural Functional Importance and Ancillary Criterion for Educational or Scientific Value. In the case of an area such as (3) North Ebey Island, west of I-5, which meets only a few of the criteria, the Remarks column of the matrix indicates additional factors which contributed to the designation of the area as an AOI.

12. Each Area of Improtance or Area of Environmental Concern is described in detail in the format shown on Template 2 (page). The title of Template 2 is either Area of Importance or Area of Environmental Concern, depending on area presented. Shown in Template 2, the location and total acreage of the area is shown, the habitat types (Burrell, 1978; see description in Section V.A) that constitute each area are given with their acreage in the area, and percentage acreage in the estuary. The history of each area, in terms of diking, logging, and other activities is presented. The natural functional importance of the area is discussed; the questions on Template 2 reflect the criteria for judging natural functional im-

portance; that is, the physical and biological importance of the area. The ancillary importance of the area, that is its importance in terms of public policy and cultural resources, is also described. Last, as shown on Template 2, the pressure for development of the area is described. The purpose of a format such as Template 2 is to provide for the reader a complete description of the important characteristics of each area in a brief and easily readable manner. Such a format also allows a ready comparison between areas.

Matrix V-1

CRITERIA FOR ESTABLISHMENT OF AREAS OF IMPORTANCE
AND AREAS OF ENVIRONMENTAL CONCERN

	AREAS	FUNCTIONAL CHARACTERISTICS CRITERIA												ANCILLARY CRITERIA						REMARKS
		Biologic Functions				Ecosystem Support														
		Productivity	Vegetation Density	Plant and Animal Diversity	Threatened/ Endangered Habitats	Hydrologic Periodicity	Location or Elevation	Areal Extent	Ecological Importance	Physical Protection	Storm and Floodwater Storage	Groundwater Recharge	Water Purification	Specific Local Policy	General Preservation Policy	Archeologic and Historic	Education, Scientific, Recreation	Harvestable Resource	Visual Aesthetic	
Areas of Importance	1. Otter Island	X	X	X				X	X		X		X	6,8,9	A	X			X	Nearly pristine area
	2. N. Ebey Island east of I-5	X	X			X	X	X	X		X		X	6,8,9	A	X			X	Largest single wetland area in estuary
	3. N. Ebey Island west of I-5	X		X		X			X					6	A		X			Unique for fresh marsh and mudflat proximity
	4. Quilceda Creek	X	X	X				X	X				X	4,5, 8,9	A	X	X			Unique for transition zone (salt to fresh upland)
	5. N. Ebey Island Reservation	X	X	X		X	X	X	X	X				6	A					
	6. Smith Island	X	X	X	X	X	X	X	X	X				6,9	A		X			Unique for gradual transition without clear zonation
	7. Highway 2	X	X	X				X	X		X		X	2,6, 8,9	A		X		X	
	8. Mid-Spencer Island	X	X	X		X	X	X	X		X		X	6,8	A					
	9. Maulsby Swamp	X	X						X				X	3	A		X			Strong local policy. Unique location and accessibility
	10. Sunnyside Swamp		X	X			X		X		X			7,8	A		X		X	Minimally disturbed area in estuary
	11. Jetty Island			X					X	X				1,3,6	A	X	X			Very strong local policy
	12. Jetty Mudflats	X		X		X		X	X					1,3,6	B,F, G,P		X	X		
	13. Ebey Island		X	X			X	X	X		X			6,8	A		X			Refuge
	14 Tulalip Bay	X		X		X		X	X	X				8,10	B,C, F,G	X	X	X	X	Unique sheltered bay. Important fish hatchery.
Areas of Environmental Concern	15. Entrance Mudflats	X		X		X		X	X					6,8,9	B,C,F G,P			X		Portion in log raft presently low productivity
	16. Ebey Island, A,B,C,D		X	X					X		X			6,8	A					
	17. Cavalero Corner		X	X			X		X		X			8	A				X	
	18. Lowell	X	X						X		X		X		A					Planned for industry. Only known beaver habitat
	19. Weyco Island			X					X					2	A					Partly not in Corps jurisdiction. Very small.
	20. Maulsby Mudflats									X				1	B, C, F, G, P					Presently low productivity due to log rafting
	21. Lagoon		X	X					X					1,9	B, C, F, G, P					Need to maintain important riparian habitat

Matrix V-1 (Continued)

KEY

1 Everett Comprehensive Plan

2 Everett Park Plan

3 Everett Shoreline Master Program

4 Marysville Comprehensive Plan

5 Marysville Shoreline Master Program

6 Port of Everett Consensus Guidelines

7 Snohomish County Comprehensive Plan

8 Snohomish County Shoreline Master Program

9 Snohomish River Basin Mediated Plan

10 Tulalip Comprehensive Plan

A Environmental Protection Agency (EPA)
National Marine Fisheries Service (NMFS)
Puget Sound Council of Governments (PSCOG)
Snohomish Conservation District (SCD)
State Comprehensive Outdoor Recreation and Open Space Plan (SCORP)
Washington State Department of Ecology (DOE)
Washington State Department of Game (DOG)
Washington State Department of Natural Resources (DNR)
U.S. Fish and Wildlife Service (FWS)
and local agencies

B Environmental Protection Agency (EPA)
Washington State Department of Ecology (DOE)
Washington State Department of Natural Resources (DNR)

C National Marine Fisheries Service (NMFS)
U.S. Fish and Wildlife Service (FWS)

D Snohomish Conservation District (SCD)

F Washington State Department of Fisheries (DOF)

G Washington State Department of Game (DOG)

P Puget Sound Council of Governments (PSCOG)

Template 2 (Sample format)

AREA OF IMPORTANCE/AREA OF ENVIRONMENTAL CONCERN

LOCATION: Name and identification number as indicated on Plate 2

Total Acreage: As calculated by Burrell, 1978

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. Classification name and number of each habitat within area as defined by Burrell, 1978	Acreage of each habitat type at location	% of total area of each type within the estuary	Points of interest concerning each habitat type. For example, largest single parcel within estuary; brackish swamp behind saline marsh; exhibiting successional change to swamp.
2.			
3.			
4.			

History of Area:

Has the area been diked? When? Were the dikes breached? When? Has the area been logged? When? Have adjacent activities affected the area? How? When?

Natural Functional Importance:

What important natural biological functions does this area perform? Is it highly productive, providing an important input to the food web of the estuary? Is it an important nesting, resting, breeding or feeding site for wildlife in the estuary? Does this area provide important ecosystem support for another important wetland area? (This support might include aids to drainage, control of sedimentation patterns, salinity, flushing characteristics or current patterns). Does this area serve to protect other areas from storm or wave induced erosion? Does the area provide storage for floodwater? Does the area function to recharge local groundwater? Does the area act as a water filtration site, aiding in water quality maintenance?

Ancillary Importance:

Are there specific local policies for preservation of this area? Have local jurisdictions identified this area for particular purposes, and if so, what? How does the area relate to general federal, state, regional, or local preservation policies? Is there an archeologic or historic site in the area? Is the area used for edu-

cational, scientic, or recreational purposes? Does it have a high aesthetic value? Is it valuable for commercial or sports fishing or hunting?

Development Pressure:

What is the present land use and recent permit history in the area? What is the use of surrounding lands and water? What is the Accessibility and availability of urban services? What are the specific local policies permitting development? Ownership of the area and adjacent lands and tidelands? What is the current zoning? Summary statement of development pressure.

Note: A star (*) under Habitat Type means this type of habitat is generally under Corps jurisdiction.

The symbol (W) means the habitat type is a Wetland under Corps definition 33 CFR 323.2(c).

AREA OF IMPORTANCE

LOCATION: (1) Otter Island — Total Acreage: 147

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. *6111 Spruce Swamp(W)	82	28	Largest parcel of habitat within estuary
2. *6252 Cattail/Bulrush Marsh (W)	65	10	Numerous shrubs within habitat indicate successional transformation toward swamp

History of Area

Approximately 4 acres along west shore was diked around 1900, probably for agricultural use. The dike was breached by 1947. There is no other evidence of disturbance in the area.

Natural Functional Importance

This marsh is a highly productive plant community. The marsh also provides feeding and nesting habitat for red-wing blackbirds, bitterns, rails and other marsh birds. The cattails and bulrushes are food sources for muskrats. The spruce swamp provides browse forage for deer, muskrat and other herbivores. The numerous associated rodents provide food for carnivores, especially hawks, owls, and minks. The spruce swamp provides nesting/breeding habitat for raptors, wood duck, muskrat, and mink. The large compact, isolated unit provides security for wildlife. The island provides some floodwater storage area. Since regrowth is slow, the mature spruce swamp is sensitive to any activity which would kill the trees.

Ancillary Importance

The entire island has been designated for preservation under the Snohomish River Basin Mediated Plan. It is designated Conservancy in the Snohomish County Shoreline Master Program. It is within the non disposal area under the Port of Everett's Consensus Guidelines. As a highly productive swamp/marsh wildlife habitat, it is under general preservation policies of FWS, NMFS, EPA, Game, DOE, DNR, SCORP, PSCOG, and SCD. There is an archeologic site on the island. The island is in the viewshed of residences to the east.

(Continued)

LOCATION: (1) Otter Island

Development Pressure

Otter Island has never been used extensively and is presently in open space. It has not been the location of any permit requests in recent years. The lands around it are either in agriculture or open space, except for the Lake Stevens sewage treatment plant which is just upstream. The island is only accessible by boat and has no urban services available. Otter Island is almost entirely under one owner, who also owns large and more accessible portions of Smith Island and Spencer Island. The state owns a tiny parcel of the east side of the island and also owns the surrounding tidelands and bedlands. The island is zoned Rural Use (RU), as is most of the area around it. Because of its past history, its inaccessibility, and the many policy indicators for preservation, development pressure is viewed to be negligible.

AREA OF IMPORTANCE

LOCATION: (2) North Ebey Island East of I-5

Total Acreage: 322

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. *6111 Spruce Swamp(W)	35	12	
2. *6112 Shrub Swamp(W)	6	3	
3. *6252 Cattail/Bulrush Marsh(W)	267	42	Largest single parcel in estuary
4. *6254 Sedge Marsh(W)	9	35	Largest single parcel in estuary
5. 155 Dike	5	4	Dike; mixed blackberry and riparian

History of Area

The westernmost portion of the area was diked prior to 1911, the remainder sometime later, probably for agricultural use. The dikes of the southern section were breached between 1941 and 1947, and those of the western and central sections between 1950 and 1963. Because the dikes were not repaired, all areas have reverted to wetland habitats. About 9 acres next to I-5 in the northwest portion have been filled; the area shown as Wetland Area of Importance does not include this fill.

Natural Functional Importance

Cattail and bulrush are both highly productive species. They also provide shelter and nesting for a variety of birds and small mammals. Cattail, bulrush and sedge are all valuable food for numerous waterfowl and small mammals. The spruce swamp offers nesting and feeding habitat for wood duck, raptors, songbirds, and furbearers. The swamp may also provide shelter and forage for deer, muskrat and other herbivores. The elongate shape, high shoreline-to-area ratio and numerous tidal creeks create significant aquatic interaction resulting in both detritus export and nutrient regulation through sedimentation of suspended solids. Thus the area is important in maintenance of natural water quality of the estuary.

Ancillary Importance

The Snohomish River Basin Mediated Plan recommends preservation of

LOCATION: (2) North Ebey Island
East of I-5

this entire parcel except for the existing fill. That portion located within Snohomish County (the middle and southeast portions) is designated Conservancy under the Shoreline Master Program. It is within the non-disposal area under the Port of Everett's Consensus Guidelines. As a highly productive, diverse, wetland wildlife habitat, this area is under general preservation policies of FWS, NMFS, EPA, DOE, Game, DNR, SCORP, PSCOG, and SCD. The area has several identified archeologic sites. It is in the viewshed of residences and roads to the east.

Development Pressure

The area is best discussed as separate parcels. The northwest parcel, from the existing fill to the narrow neck of land opposite the Marysville sewer lagoon, is under much more immediate development pressure than the middle and southeastern parcel. There is a permit application for dredging, filling, and construction on 45 acres of this parcel. The northwest parcel is easily accessible by road. It is in the city of Marysville and is mostly Urban under Marysville's SMP. The State DOE shows it as mostly Conservancy. The northwest parcel is under one owner, who also owns the southeastern part. The middle portion is under another single ownership. The middle and southeastern parts are not easily accessible. Tidelands along the middle and southeastern portions are state-owned but leased out. The Snohomish County rural (RU) zone covers all of the middle and southeast portions. Because of its proximity to the existing fill, its accessibility, and the pressure from Marysville to dedicate it to urban uses, the northwest parcel is under immediate pressure to develop. Because of the various preservation policies on the middle and southeastern parcels, development pressure on this area is less.

AREA OF IMPORTANCE

LOCATION: (3) North Ebey Island, west of I-5, east of Tulalip Reservation

Total Acreage: 53

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. *571 Slough	8	17	
2. *624 Salt Marsh(W)	1	8	
3. *6252 Cattail/Bulrush Marsh(W)	42	7	
4. *6262 Cattail Marsh(W)	2	8	

History of Area

This area was diked before 1911 and by 1963 the dikes had been breached, allowing the area to revert to wetland. Construction of the railroad (1895) and Highway 99 (1926) sectioned the area. Construction of I-5 (1968) provided the eastern boundary to the unit.

Natural Functional Importance

The cattail and bulrush marshes in this area are highly productive and probably export considerable detritus to nearby mudlfat and slough habitats for consumption by benthic invertebrates. The abundant populations of benthic invertebrates are a food source for numerous shorebirds such as sanderlings, dunlins and sandpipers, and waterfowl such as mallards, shovelers and pintails. The juxtaposition of marsh and mudflat provides important interaction; waterfowl nest in the marsh, feed in the mudflats and slough, on benthic organisms which feed on marsh detritus. This is the only example of fresh marsh and mudflats in close proximity in the entire study area.

Ancillary Importance

Because of the unique nature of this area in the estuary and its value as waterfowl habitat, it falls under preservation policies of FWS, NMFS, EPA, DOE, Game, DNR, SCORP, PSCOG, and SCD. It is readily accessible for educational and scientific study. The area is within the non-disposal area under the Port of Everett's Consensus Guidelines.

(Continued)

LOCATION: (3) North Ebey Island, west of I-5, east of Tulalip Reservation

Development Pressure

This area is under very heavy development pressure. For example, a permit application for dredge, fill, and other activities is presently undergoing Corps and agency review; it is highly controversial. An extensive fill is located just west of the area and another fill is located directly east. The area is sectioned by several transportation corridors. The area is in the city of Marysville, and Marysville's Shoreline Master Program shows it as Urban. DOE shows it as Conservancy. Most of this area is under the same ownership as the land east of I-5. The Snohomish River Basin Mediated Agreement recommends an economic development plan for "the area west of I-5", and there appears to be a general feeling that industrial development will occur mostly west of I-5. Such feelings may contribute to continued pressure to develop this area, as may the proximity of this area to existing fills.

AREA OF IMPORTANCE

LOCATION: (4) Quilceda Creek Total Acreage: 302

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. *572 Marine Slough	3	21	
2. *6111 Spruce Swamp(W)	47	16	
3. *6241 Sedge Marsh(W)	33	29	
4. *6242 Mixed Marsh(W)	25	40	
5. *6243 Mixed Marsh(W)	3	27	33% of salt marsh in estuary
6. *6244 Mixed Marsh(W)	44	33	
7. *6245 Sedge Marsh(W)	6	23	
8. *6246 Bulrush Marsh(W)	19	31	
9. *6250 Brackish Marsh(W)	22	84	
10. *6252 Bulrush/Cattail Marsh(W)	83	13	
11. *638 Mud Flat	17	47	

History of Area

There has been very little activity in this area. A railroad spur once extended along the south shore. A portion of the south shore was bulkheaded and filled for log storage (tidal connection for remaining marsh was maintained). The area is within the Tulalip Reservation boundaries.

Natural Functional Importance

The marsh communities are all highly productive. These diverse communities provide food, shelter and nesting area for a variety of wildlife. The proximity to a large wooded area provides feeding area for upland species. The dense vegetation provides security and protection for various wildlife. Juvenile salmon migrating down the creek begin schooling in the vicinity of Ebey Slough; these salmon feed on the benthic invertebrates found on the mudflats and along slough bottoms. The numerous drainage channels provide important aquatic interaction for trapping suspended solids and exporting detritus, thus aiding water quality and estuarine productivity. This is the only example of salt marsh-brackish swamp-fresh marsh-upland zonation in the study area.

Ancillary Importance

The Snohomish River Basin Mediated Agreement shows this area for

LOCATION: (4) Quilceda Creek

preservation. The Snohomish County Marysville Area Comprehensive Plan shows this area as greenbelt. The Snohomish County SMP designates it as Conservancy, and this has generally been accepted by the Tulalip Tribes. The City of Marysville SMP shows Conservancy on Quilceda Creek upstream of this area. Because of the unique nature of this area in the estuary and its value as wildlife and fish habitat, it falls under preservation policies of FWS, NMFS, EPA, DOE, Game, DNR, SCORP, PSCOG, and SCD. There are archeologic sites in this area. It is used by several school districts for field trips as a biological study area. Access and unique zonation make this an excellent research and education site.

Development Pressure

The area is wetland/open space. No permit applications have been filed in the area except along the south shore. The surrounding area is wetland/open space. The area is easily accessible. There are no policies encouraging development here. The land is on the Tulalip Reservation. Development pressure on this area is negligible.

AREA OF IMPORTANCE

LOCATION: (5) North Ebey Island, on Tulalip Reservation, including Quilceda Island

Total Acreage: 207

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. *572 Marine Slough	11	79	
2. *6111 Spruce Swamp(W)	11	4	
3. *6241 Sedge Marsh(W)	21	18	
4. *6242 Mixes Salt Marsh(W)	21	42	
5. *6243 Mixed Salt Marsh(W)	8	73	50% of salt marsh in the estuary.
6. *6244 Mixed Salt Marsh(W)	81	60	
7. *6245 Sedge Marsh(W)	13	50	
8. *6246 Bulrush Marsh(W)	21	34	
9. *6252 Cattail/Bulrush Marsh(W)	19	3	
10. *6253 Cattail Marsh(W)	1	3	

History of Area

Western portion of North Ebey Island was included as part of Tulalip Reservation in Treaty of 1855. No diking or logging has occurred on the island. The 160 acre sanitary landfill on the island was begun in approximately 1966. The landfill site is filled almost to capacity at present.

Natural Functional Importance

Most salt marsh species are highly productive. The marshes and swamps provide nesting and breeding for a variety of waterfowl and other birds. Cattail and bulrush provide food for both waterfowl and small mammals. Spruce provides nesting for raptors and songbirds. The inaccessibility of the area provides security for wildlife. Diverse habitats provide a variety of plant species for food and shelter. Aquatic interaction aids detritus export and suspended sediment trapping. The area acts as a buffer, slowing discharge of landfill leachates into the aquatic system. The area has good examples of habitat zonation and successional sequence in marine and brackish wetlands. It protects the landfill from erosive wave action.

Ancillary Importance

The area is within the non-disposal area under the Port of Everett's

(Continued)

LOCATION: (5) North Ebey Island, on Tulalip Reservation, including Quilceda Island

Consensus Guidelines. Because of its productivity and value as wildlife habitat, it falls under preservation policies of FWS, NMFS, EPA, DOE, Game, DNR, SCORP, PSCOG, and SCD.

Development Pressure

The area is wetland open space with no permit history. The mudflats to the west are used for log storage; the landfill to the east has not yet been developed. The area is not readily accessible by road. No shoreline designations are shown for this area because of disagreement between the Tulalip Tribes and Snohomish County. The area is on the Tulalip Reservation. Its location west of I-5 and its proximity to existing fill may contribute to pressure to develop this area (see also Area 3, North Ebey Island).

AREA OF IMPORTANCE

LOCATION: (6) Smith Island — Total Acreage: 93

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. 4221 Immature Broad-leaf	12	6	
2. *522 Inland Pond	1	6	
3. *6112 Swamp(W)	3	1	
4. *6242 Sedge Marsh(W)	45	39	
5. *6242 Mixed Salt Marsh(W)	5	10	
6. *6246 Bulrush Marsh(W)	21	34	
7. *6252 Cattail/Bulrush Marsh(W)	6	1	

History of Area

Construction of wood product waste treatment ponds between 1947 and 1955 increased sediment deposition on the eastern edge of this area. Some deposition may have resulted from construction of the dike around the ponds, the remainder from hydraulic changes in the vicinity.

Natural Functional Importance

The diverse marsh species, especially sedge, cattail and bulrush are highly productive. Bulrush and cattail provide feeding and nesting area for songbirds, shorebirds and small mammals. The swamp and broadleaf forest provide feeding and nesting area for numerous songbirds and mammals. Deer rest in the upper edges of the marsh and graze along the edge of the nearby woodland. There are unpublished reports of bald eagles resting in the spruce. The small pond is a feeding and resting area for waterfowl, which will also feed and nest in adjacent marsh areas. The isolation of this area offers security for the wildlife which use it. The marsh and swamp habitats provide some protection to the treatment ponds from wave attack. The gradual transition from marsh to upland without clear zonation is the only example in the estuary.

Ancillary Importance

The Snohomish River Basin Mediated Agreement recommends this area for preservation. It is within the non-disposal area under the Port of Everett's Consensus Guidelines. Because of the unique nature of this area in the estuary, its productivity, and its value as wildlife habi-

LOCATION: (6) Smith Island

tat, it falls under general preservation policies of FWS, NMFS, EPA, DOE, Game, DNR, SCORP, PSCOG, and SCD. It is used by the Everett School District as a wetland study area. Because it is a gradual transition zone, it is valuable for research.

Development Pressure

The area is partly wetland and partly in industrial (forest products) use. Surrounding areas are used for log storage, wood waste treatment ponds; there is some remaining open space just east of the area. The area is accessible by road. It is in Snohomish County and is shown as Urban in Snohomish County's Shoreline Master Program. It is under several small ownerships. The surrounding tidelands are all under private ownership. Zoning in the area is a mixture of rural (RU) and light industry (LI). Because of its proximity to and accessibility from existing industrial uses and its location west of I-5, there will be pressure to develop this area.

AREA OF IMPORTANCE

LOCATION: (7) Highway 2 Total Acreage: 68

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. *6112 Shrub Swamp(W)	42	19	Largest single parcel in estuary
2. *6252 Bulrush/Cattail marsh(W)	11	2	
3. *6253 Cattail Marsh(W)	15	42	Largest single parcel in estuary

History of Area

There is no indication of either diking or logging in this area. Highway 2 was originally constructed before 1895. The bridge was located about 0.5 miles downstream of its present location, with the Ebey Island approach bisecting the area. The bridge was moved to its present location before 1910. The 1884 map identifies this location as wetland, the 1895 does not. The 1942 USGS quadrangle identifies the area as wetland. The Everett water pipelines were installed before 1947.

Natural Functional Importance

The bulrushes and cattails are both highly productive species. The numerous channels provide aquatic interaction to export this productivity. The diverse vegetation of the marsh and swamp provide feeding, nesting and breeding habitat for numerous songbirds and small mammals. This area exhibits a prime example of the cattail marsh to shrub swamp transition zone. The area also provides floodwater storage.

Ancillary Importance

The Snohomish River Basin Mediated Agreement recommends this area for preservation. It is within the non-disposal area for the Port of Everett's Consensus Guidelines. It is designated Conservancy in Snohomish County's SMP. As a highly productive natural area and a valuable wildlife habitat, it falls under preservation policies of FWS, NMFS, EPA, DOE, Game, DNR, SCORP, PSCOG, and SCD. It is easily accessible for educational or research field trips (although it has not been mentioned by any group as presently in this type of use).

AREA OF IMPORTANCE

LOCATION: (8) Mid-Spencer Island Total Acreage: 88

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. *571 Freshwater Channel	13	27	
2. *6111 Spruce Swamp(W)	2	<1	
3. *6112 Shrub Swamp(W)	17	8	
4. *6252 Bulrush/Cattail Marsh(W)	56	9	

History of Area

Approximately 70 acres in the northern portion of this site were diked prior to 1884, probably for agriculture. By 1969 the dikes had been breached and the area was reverting to wetland. Between 1955 and 1963 a channel was dredged from Steamboat Slough to Union Slough through the narrowest portion of this site. A wood waste fill has been extended along the southwestern portion of this location since 1974.

Natural Functional Importance

The cattail/bulrush marsh is highly productive. There are numerous channels connecting the area to both Union and Steamboat Sloughs, thus providing extensive aquatic interaction for export of detritus. The proximity to large open water bodies makes the area an important feeding, resting, and nesting habitat for waterfowl. Herons and other shorebirds feed along much of the breached dike shoreline of this area. The swamp is available nesting and feeding habitat for songbirds and mammals. Raptors use the spruce for nesting and resting. The proximity of the area to Otter Island and the south end of North Ebey Island creates an important system of interacting water and aquatic lands habitat types. The extensive network of tidal channels allows the area to filter large amounts of estuarine water, removing suspended solids.

Ancillary Importance

This area is within the non-disposal area for Port of Everett's Consensus Guidelines. It is designated Rural in Snohomish County's SMP. As a highly productive area and a valuable wildlife habitat,

LOCATION: (8) Mid-Spencer Island

it falls under preservation policies of FWS, NMFS, EPA, DOE, Game, DNR, SCORP, PSCOG, and SCD.

Development Pressure

The area is presently wetland open space, but has been diked in the past. The surrounding land is in agricultural use or is wetland/open space. The area is quite inaccessible, with no public roads. The area is under one owner, who owns about 1,000 acres in the estuary. It is zoned rural (RU) by Snohomish County. The surrounding tidelands are state-owned. Because of its inaccessibility, development pressure is generally low, although there may be some pressure to extend the woodwaste fill areas to the southwest.

AREA OF IMPORTANCE

LOCATION: (9) Maulsby Swamp Total Acreage: 16

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. *6251 Bulrush Marsh(W)	16		

History of Area

The swamp was originally a small pocket beach located in the indentation in the bluff. Construction of the railroad in about 1890 isolated the area and provided a culvert for drainage. The protection and ponding created by the railroad allowed the area to transform into the marsh that is present today.

Natural Functional Importance

This brackish marsh is highly productive and probably exports much of this productivity to detritovores of the adjacent mudflats. Redwing blackbirds nest in the area. Herons, mallards, sandpipers, swallows and sparrows have all been observed feeding in the area. A variety of birds, especially insectivorous songbirds, probably nest in the shrub swamp and uplands adjacent to the area. The area probably acts as a filter for runoff coming down the bluffs, removing some suspended solids prior to its discharge across the mudflats.

Ancillary Importance

This area is in the city of Everett and has been given a special environmental designation under Everett's SMP. It is designated Conservancy-Resource Protection because of its biological and ecological qualities; activities allowed there include educational and scientific investigation and public enjoyment of a natural area. Because of its unique nature in the estuary and its productivity, it falls under general preservation policies of FWS, NMFS, EPA, DOE, Game, DNR, SCORP, PSCOG, Everett, and SCD. Although not mentioned as in educational use at present, it is easily accessible for research field trips.

Development Pressure

Maulsby Swamp is isolated from residential development to the east, north, and south by topography (it is at the foot of a high bluff)

LOCATION: (9) Maulsby Swamp

and from industrial development to the west by a highway. It has only one point of interaction with tidal waters; this is a culvert under the road at the south end of the swamp. Maintenance of water flow through this culvert is essential to the biologic functioning of Mauslby Swamp. The swamp is accessible on foot from the road. Development pressure on this area is viewed to be negligible because of the preservation policies of Everett. However, the swamp could be hurt by development around it. Uncontrolled urban runoff from increased residential development on the bluff could degrade water quality in the swamp; however, the bluff appears to be already in stable development. More importantly, uncontrolled or improper development or filling of the mudflats around the culvert could change the hydrology of the area and the nature of tidal interaction with the swamp. There is presently some pressure to develop the mudflats west of the swamp.

AREA OF IMPORTANCE

LOCATION: (10) Sunnyside Swamp Total Acreage: 31

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. *6111 Spruce Swamp(W)	30	10	
2. *6254 Sedge Marsh(W)	1	4	

History of Area

This area appears to have been diked, however, the date of diking has not been determined. The land was not cleared and the dikes were breached prior to 1947. Since then it has remained altered.

Natural Functional Importance

The sedge marsh is highly productive. Sedge is an important food source for waterfowl. The narrow slough-side marsh readily exports its primary productivity to the aquatic ecosystem. The adjacent swamp provides nesting and feeding habitat for songbirds and small mammals. The swamp, located next to an upland woods and shrub thicket offers a diversity of habitat to deer, mink, and other mammals which use both habitat types. The spruce offer valuable nesting and resting habitat to raptors. This is a minimally disturbed natural area within the estuary.

Ancillary Importance

This area is designated Rural in Snohomish County's SMP. The Snohomish County Marysville Area Comprehensive Plan shows it as greenbelt. Because of its value as wildlife habitat, this area falls under preservation policies of FWS, NMFS, EPA, DOE, Game, DNR, SCORP, PSCOG, Marysville, and SCD. It is readily accessible to Sunnyside School, making it potentially useful for educational field trips. It contributes to a good view from roads and residences to the east.

Development Pressure

The area is presently wetland open space, with surrounding lands to the west, north, and south in wetland or agriculture and residential development and a school to the east. It is not accessible by road, but is easily reached on foot from the school. The area is in vari-

LOCATION: (10) Sunnyside Swamp

ous small ownerships. It is zoned for rural residential uses (low to medium density). Although development pressure on this area is negligible at present, its relative accessibility and its zoning increase pressure to develop in the future.

AREA OF IMPORTANCE

LOCATION: (11) Jetty Island — Total Acreage: 159

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. 182 Dredge Fill	34	--	
2. 312 Beach Grassland	49	--	
3. 321 Successional Shrub	18	--	
4. *622 Algal Assoc.(W)	11	--	
5. *6241 Sedge Marsh(W)	0.5	--	
6. *6247 Salicornia Marsh(W)	3	--	40% of Salicornia in estuary
7. *636 Sand Flat	11	--	
8. *638 Mud Flat	32	--	

History of Area

Jetty Island is formed from natural deposition and dredge material disposal around the jetty, built in 1895.

Natural Functional Importance

The mud and sand flats support large populations of sediment dwellers. These in turn are a food source for shorebirds, some waterfowl and numerous small fish including juvenile salmon, trout and flat fish. These fish are a major food source for the great blue herons which feed here extensively. Some small mammals occupy the island, providing food for raptors. The island provides a security buffer from industrial area for waterfowl. Island and associated flats protect Port of Everett from storm induced waves and erosion.

Ancillary Importance

Jerry Island is in the city of Everett and the Port of Everett. The City of Everett's Community Plan specifically recommends preservation of either the entire island or all but the southernmost portion of the island for open space, educational use, and public recreation. The plan further declares that no industrial use should be developed on the island unless there is demonstrable need and all other alternatives have been exhaused. Everett's SMP shows a special environment designation for Jetty Island; it is a Diverse Resource Management Area, and specific management policies, including the development of a comprehensive plan for the island, must be implemented before any devel-

LOCATION: (11) Jetty Island

opment is allowed there. All these policies point toward preservation of Jetty Island. The Port of Everett's Consensus Guidelines contain seven policies specifically relating to Jetty Island (in these Guidelines, Jetty Island includes upland, wetland, and tideflats); several of these refer to the Jetty Island comprehensive plan to be developed. Three of these policies make specific reference to preservation and non-development of Jetty Island. Because of the uniqueness of the Jetty and its value as waterfowl habitat, it falls under general preservation policies of FWS, NMFS, EPA, DOE, Game, DNR, SCORP, PSCOG, Everett, and SCD. Jetty Island has been recommended as an historic site, but formal applications have not been made. There is a recreational boat landing on the island (leased by State Parks from the Port). The Everett School District uses Jetty Island for study of aquatic biology.

Development Pressure

Jetty Island is not presently used by industry; however, the waters and lands to its east are used for log rafting and intensive Port activities. The island is used for recreation and education. It is only accessible by boat. About 25 acres at the southernmost end are proposed for dredge material disposal by the Port; however, the Port's Consensus Guidelines contain a policy to mitigate the impacts of filling tidelands by designating on Jetty Island at the time of each filling an equal area of wetlands, tidelands, and/or uplands for marine, park use. The Port of Everett claims ownership of Jetty Island, but this is disputed by DNR. The comprehensive plan for the island will have to be developed by local agencies and the public, according to Port Guidelines. Everett's SMP designates disposal on Jetty Island as a conditional use, to be allowed only if all other sites in the disposal plan are not available. Development pressure on the island is low, since local agency policies generally tend to emphasize preservation.

AREA OF IMPORTANCE

LOCATION: (12) Jetty Island Mudflats Total Acreage: 3,632

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. *54 Bays	607	--	
2. *622 Algal Assoc.(W)	183	--	
3. *623 Eelgrass(W)	1,332	--	
4. *637 Sand/Silt Flats	1,510	--	

History of Area

The extent of the mudflats prior to construction of Jetty Island and the dikes is not known. The flats have probably been extending westward throughout recent geologic time. Timber harvest and dike construction have probably increased the amount of sediment brought to the river mouth. Diversion of the main channel probably increased deposition south of Jetty Island. Subsequent dredge material disposal west of the jetty has added to the area of the flats. Neither the present rate, nor the change in rate of the growth of the flats due to all the activities is known.

Natural Functional Importance

Eelgrass and algae are both highly productive species which contribute extensive detritus to the aquatic ecosystem. This detritus is the primary food source for the dense populations of detritovores inhabiting mud and sand flats. These detritovores in turn are the primary food source for herring, smelt, juvenile salmon and other small fish, and also a wide variety of shorebirds and waterfowl. Eelgrass is a major spawning substrate for herring. Eelgrass also acts as a nursery habitat for salmon, smelt, herring, shad, sole and flounder. Crabs commonly feed in the eelgrass beds. The shallow flats are a critical schooling area for salmon and searun trout. The nearshore area from Priest Point to Tulalip Bay is an important shellfish area with populations of clams and cockles. The abundant and diverse populations of fish make the area important for both sport and commercial harvest.

Ancillary Importance

Everett's Community Plan specifically states that industrial develop-

LOCATION: (12) Jetty Island Mudflats

ment on or by extension of Jetty Island to the west by filling in Port Gardner Bay is unacceptable. This plan also has a specific policy prohibiting filling of tidal flats. About 1,650 acres of the Jetty Island Mudflats area is included as part of Jetty Island in the Port's Consensus Guidelines. Important Port policies relating to preservation of the mudlfats in particular are those on the acre-for-acre designation of areas for preservation at the time tideland fills are made (see Area 11, Jetty Island) and on the development of a comprehensive plan. As a highly productive fish habitat and migration route, this area falls under preservation policies of EPA, DOE, DNR, Fisheries, and Game. PSCOG has a specific policy that publicly owned tidelands should remain in public use. About 200 acres of Jetty Island, including tideflats, are leased to DNR as a marine park. The Jetty Island Mudflats are used as an aquatic biology study area by the Everett School District. These mudflats provide a schooling area for anadromous fish (salmon), a commercial resource.

Development Pressure

The Jetty Island Mudflats are presently open area, not used for commercial fishing because of shallow water. Sport boating takes place in the area. They are only accessible by boat or on foot from Jetty Island. The Port of Everett claims ownership of part of the mudflats but this is disputed by DNR. There is a specific Port policy on the placement of dredge materials on these mudflats at the southern end of Jetty Island. Except for this area, development pressure is low, since local agency policies tend to emphasize preservation and non-development.

AREA OF IMPORTANCE

LOCATION: (13) Ebey Island, Washington State Department of Game — Total Acreage: 518

Habitat Types			Acreage at Location	% of Total type in Estuary	Remarks
1.	155	Dike	4	3	
2.	321	Shrub	6	--	
3.	42	Broadleaf Forest	89	12	
4.	43	Mixed Forest	1	1	
5.	*611	Intertidal Swamp (W)	27	5	
6.	*612	Fresh Swamp (W)	388	65	60% of fresh swamp in the estuary
7.	*626	Fresh Marsh (W)	3	3	

History of Area

Ebey Island was diked early in this century, but this parcel has never been logged or used for other purposes.

Natural Functional Importance

This area provides habitat for large populations of wildlife. The diverse wooded area provides feeding, breeding and resting habitat for raptors, songbirds, deer, mink, raccoon and numerous mammals. Many species may use both the swamp and the adjacent estuarine areas. Others may rest and breed here and feed on rodents in neighboring agricultural areas.

Ancillary Importance

The shoreline of this area is designated Rural under Snohomish County's SMP. The area is within the non-disposal area under the Port of Everett's Consensus Guidelines. As valuable wildlife habitat, this parcel falls under general preservation policies of FWS, NMFS, EPA, DOE, Game, DNR, SCORP, PSCOG, and SCD. The parcel is managed by the Department of Game as a refuge, providing protection for all species using the area.

Development Pressure

The area is presently wetland open space. The surrounding land is used for agriculture. The area is not accessible by road. The entire par-

LOCATION: (13) Ebey Island, Washington
State Department of Game

cel is owned by the Department of Game. Tidelands in the area are state-owned. The entire area is zoned Agriculture 10 Acre (A-10), in which allowed uses are agriculture and residential units at one unit/10 acres. Development pressure on this parcel is negligible.

AREA OF IMPORTANCE

LOCATION: (14) Tulalip Bay — Total Acreage: 364

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. *54 Bay	143		
2. *622 Algal (W)	55		
3. *623 Eelgrass (W)	19		
4. *624 Salt Marsh (W)	4		
5. *637 Sand-Silt Flats	40		
6. *638 Mudflats	100		
7. 711 Vegetated Spit	3		

History of Area

The lumber mill at Tulalip was the first major commercial activity in this area of the Snohomish River. It was purchased by the government in 1855, to become part of the Tulalip Reservation, and there has since been no lumber mill in the bay. Until recently, broad expanses of the mudflats were for log storage. At the north end of the bay is a hatchery which produces a sizable return each year.

Natural Functional Importance

This is the only protected saline bay within the study area. The Tulalip Hatchery is an important producer of steelhead which are harvested as both a sport and commercial fishery. The mudflats inside Tulalip Bay are probably inhabited by abundant populations of sediment dwelling detritovores. These organisms are an important food source to both juvenile salmon and other fish, and also shorebirds such as dunlins and sandpipers. In addition, some dabbling ducks such as mallards and shovelers also feed on the detritovores. The small fish that feed here are an important food item to herons, grebes, mergansers, and other fish-eating birds. The spit at the mouth of the bay is an important resting area for shorebirds and waterfowl, offering considerable security. The spit also acts as a wave break, protecting the bay shoreline from wave attack.

Ancillary Importance

The Tulalip Reservation Comprehensive Plan recommends the protection and conservation of the natural assets of the reservation, including fish and wildlife and recreational opportunities; this area is a habitat for various species and is a recreational location. The

(Continued)

LOCATION: (14) Tulalip Bay

Tulalip Tribes have accepted the Snohomish County SMP for this area, which designates the tidelands Conservancy and the shoreland Suburban. There are archeological sites and the tribal potlatch grounds along the Tulalip Bay shore. The Marysville School District uses the Tulalip Bay area for educational field trips to study intertidal flora and fauna. Because of its value as wildlife habitat, the area is under preservation policies of FWS, NMFS, EPA, DOE, DNR, Game, and Fisheries.

Development Pressure

The area is an open space sand spit, with associated tidelands. The land around the bay is used for residential development, and there are undoubtedly recreational opportunities for residents near this area. The area is quite accessible on foot from the nearby roads. The reservation land use plan shows residential development along the shores of Tulalip Bay. A large marina complex (500 moorages) is planned in the southeast portion of the bay. The area is either owned by the Tulalip Tribes or by private owners of the surrounding residences. Development pressure on this area is considered low except for the area of the planned marina complex.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (15) Entrance Mudflats Total Acreage: 470

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. *1532 Log Rafts	254	--	
2. *511 Estuarine River	8	--	
3. *62 Aquatic Land	3	--	
4. *622 Algae(W)	2	--	
5. *6241 Sedge Marsh(W)	2	--	
6. *638 Mudflat	201	--	

History of Area

There has been no diking of these exposed flats. Continuous use for log rafting has severely decreased the predominantly secondary productivity. Construction of training dikes, jetty and breakwater may have altered sediment deposition patterns.

Natural Functional Importance

Intertidal flats such as these are highly productive as an important habitat for invertebrate benthos. Benthic organisms are an important food source for salmon, shad, shorebirds and some waterfowl. These areas are used by juvenile salmon for feeding and schooling. Shad also use the flats for a feeding and nursery area. Water flows across these flats to enter the sloughs, thus currents, salinity, and flushing are controlled in part by the configuration of these flats. Although the flats are heavily impacted by lografting, research indicates a quick recovery after removal of the logs.

Ancillary Importance

The southern portion, west of Smith Island, is in Snohomish County and is designated Conservancy in the SMP. It is recommended for preservation by the Snohomish River Basin Mediated Agreement. The northern portion, between North Ebey Island and Priest Point, is within the Tulalip Reservation boundaries; its shoreline designation is undetermined. The entire area is in the non-disposal area in the Port of Everett's Consensus Guidelines. As a highly productive habitat and fish migration route, this area falls under preservation policies of FWS, NMFS, EPA, DOE, DNR, Fisheries, and Game. PSCOG has a policy that publicly owned tidelands should be retained in public

LOCATION: (15) Entrance Mudflats

use. This area is critical habitat and migration route for commercial species.

Development Pressure

The southern area is extensively used for log rafting and has pilings throughout. Nearby land areas have forest products industry and/or have been filled. The area is accessible by boat. The southern portion is privately owned; the northern portion is on the Tulalip Reservation. Development pressure for activities other than continued piling/log rafting is considered low.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (16) Ebey Island, A, B, C, D Total Acreage: 273

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. 42 Broadleaf Forest	22	3	
2. 43 Mixed Forest	3	4	
3. 612 Fresh Swamp(W)	248	33	

History of Area

This area is made up of three parcels on Ebey Island. The island was diked after 1895 but before 1941. Most of these areas have not ever been logged.

Natural Functional Importance

The swamps are highly productive habitat types. This diverse wooded area provides breeding, feeding and resting habitat for many varieties of wildlife, including raptors, songbirds, birds, deer, mink, raccoon and numerous small to medium size mammals. Many species may use this habitat for one aspect of life and the intertidal estuarine habitat for other aspects. Raptors and other carnivores may nest here and feed on rodents in neighboring agricultural areas.

Ancillary Importance

Shorelines of these areas are designated Rural under Snohomish County's SMP. All these areas are within the non-disposal area under the Port of Everett's Consensus Guidelines. As valuable wildlife habitat, they fall under general preservation policies of FWS, NMFS, EPA, DOE, Game, DNR, SCORP, PSCOG, and SCD.

Development Pressure

All these areas are presently wetland open space. The surrounding land is used for agriculture. The smaller areas are accessible by road. Ownership varies from area to area; some are under one ownership. Tidelands in the area are state-owned. The entire area is zoned Agriculture 10 Acre (A-10), in which allowed uses are agriculture and residential units at one unit/10 acres. Development pressure is slight on the smaller inland parcels, but somewhat higher on the parcel on the west bank of the Snohomish River (there is a possibility that some of this area may be filled).

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (17) Cavalero Corner — Total Acreage: 42

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. *6111 Spruce Swamp(W)	17	6	
2. *6112 Shrub Swamp(W)	17	8	
3. *6260 Freshwater Marsh(W)	8	27	

History of Area

Most of the area shows no evidence of disturbance except construction of a highway along the upland boundary. The southern 8 acres was originally part of the agricultural area to the south. The dike between the southern portion and the agricultural area was constructed between 1969 and 1974.

Natural Functional Importance

Both marsh and swamp habitats are highly productive. Marsh provides nesting and feeding habitat for songbirds, small mammals and some shorebirds such as bitterns. The diverse swamp communities provide feeding and nesting habitats for a wide variety of mammals and songbirds. Waterfowl feed and nest along the breached dikes bordering the area. Raptors nest and rest in spruces. In conjunction with the Washington Department of Game property immediately across the slough, creates a major ecosystem. The area provides some floodwater storage.

Ancillary Importance

This area is designated Conservancy in Snohomish County's SMP. As a valuable waterfowl habitat, it falls under general preservation policies of FWS, NMFS, EPA, DOE, DNR, Game, SCORP, PSCOG, and SCD. The area provides a pleasing view from the road and buildings to the east.

Development Pressure

The area is wetland open space with agriculture to the north and south, development to the east, and the Game Department's large parcel to the west. It is readily accessible on foot from the road. The area is in small ownerships and is zoned Agriculture 10 acres (A-10) which per-

(Continued)

LOCATION: (17) Cavalero Corner

mits agriculture and residential development at one unit/10 acres. Tidelands in the area are state-owned. Development pressure is slight because of the floodplain location and the shape of the area (it is long and very narrow).

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (18) Lowell — Total Acreage: 28

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. *6112 Shrub Swamp(W)	14	6	
2. *6253 Cattail Marsh(W)	14	39	

History of Area

The first lumber mill in Everett was located immediately south of this area. This area was also the initial Pacific Coast terminus of the Great Northern Railroad. The Everett Pulp and Paper Mill was located along the southwestern edge of this area until about 1970. This area was diked, but the dikes are now breached. Dates of construction and breaching are not known. The adjacent area between railroad tracks was filled by 1974. This area is substantially impacted by runoff from developed and urbanized areas upstream.

Natural Functional Importance

Cattails are highly productive. They provide feeding and nesting habitat for a variety of songbirds and small mammals. The marsh is the only site in the estuary known to be inhabitated by beaver. The swamp is a diverse community which provides nesting and feeding habitat for a variety of furbearers, small mammals and songbirds. Raptors nest and rest in trees along the old dike. The area provides some floodwater storage. Urban runoff through this marsh is slowed down significantly, allowing sedimentation of suspended solids before the runoff enters the river.

Ancillary Importance

As a highly productive habitat and the only known beaver habitat in the estuary, this area falls under general preservation policies of FWS, NMFS, EPA, DOE, DNR, Game, SCORP, PSCOG, and SCD.

Development Pressure

The area is wetland open space, with the surrounding land in industrial (forest products) use and a railroad. The Snohomish River at this point is used for log storage. The area is accessible from the

LOCATION: (18) Lowell

railroad line and from the industrial area to the south. The area is in the city of Everett and is designated Urban in Everett's SMP. This area is part of Everett's industrial Area III; the City's stated policy is that the preferred location for future water related new industry should be in Area III along the west bank of the Snohomish River from Pacific Avenue south to Lowell. There is a proposed dredge disposal site at the southern end of this area. In the Port of Everett's Consensus Guidelines, the Port acknowledges the need to encourage private development of and/or seek public acquisition of the Lowell Industrial Site (at the south end of this area) for development and deposition of maintenance dredge materials. The tidelands along this area are mostly state-owned. The area is clearly planned for industrial development by the City of Everett. Development pressure is high here.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (19) Weyco Islands Total Acreage: 20

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. 311 Meadow	.4	100	
2. 321 Successional Shrub	1.6	<1	
3. 42 Broadleaf Forest	7.7	1	
4. *6112 Shrub Swamp(W)	1.4	<1	
5. *6250 Brackish Marsh(W)	2.0	10	
6. *6252 Cattail/Bulrush Marsh(W)	5.7	<1	
7. *6254 Sedge Marsh(W)	.4	1	

History of Area

About 8 acres of the northern island has been used for dredge material disposal since 1969. Other than this there has been no known development activity on the islands.

Natural Functional Importance

The cattail/bulrush marsh is highly productive. This marsh provides feeding and nesting habitat for songbirds and small mammals. The sedge marsh is also highly productive. The sedge is an important food source for some waterfowl. The close proximity of marsh, swamp and forest allows all three habitat types to be used by small mammals. Hawks have been identified as nesting in the forest habitat. The isolation of the islands creates a sanctuary for birds which use them.

Ancillary Importance

The islands are in the city of Everett and are shown as a future park in Everett's park plan. Everett already has Wiggums Hollow park just to the southeast. As a productive wildlife habitat, the area is under preservation policies of FWS, NMFS, EPA, DOE, DNR, Game, SCORP, PSCOG and SCD

Development Pressure

The area is meadow open space with a small amount of wetland. The

(Continued)

LOCATION: (19) Weyco Islands

river around the islands is used for log rafting. To the west of the river the land is in industrial (forest products) use. The Everett sewage lagoons are to the east. The area is only accessible by boat. The islands are designated Urban in Everett's SMP. The tidelands around the islands are privately owned. There may be pressure to develop this area, as part has already been filled and it is near existing industrial uses. However, its relative inaccessibility may restrict the type of development which would occur.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (20) Maulsby Mudflats — Total Acreage: 165

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. *638 Mudflat	57		
2. *1532 Log Rafts	108		

History of Area

These mudflats are a portion of what was a continuous shoreline of mudflats from Preston Point to the south end of the Port of Everett. Since 1900 most of these flats have been used for log storage. Several portions of these flats have been filled for use as wharfs or industrial sites.

Natural Functional Importance

This area has the potential for abundant detritovore production (log storage activities tend to inhibit that production at present). Detritovores are a major food source for juvenile salmon and flatfish, herring and other small fish. They are also the prime food for sandpipers, dunlins and other shorebirds. Herons, grebes and other fish eating birds often feed over these mudflats when the tide is right. These open flats allow adequate flushing of Maulsby Swamp and probably use much of the detritus exported from that area.

Ancillary Importance

The area is in the city of Everett and the Port of Everett. Everett's Community Plan has policies to prohibit filling of tidal flats, encourage log storage on land sites, and locate new water-related industry in the Lowell area. These mudflats are of expressed concern to USFWS, NMFS, and EPA; these agencies view the area as a productive mud salt marsh which should be preserved. As a potential fish and wildlife habitat, the area will be of concern to DOE, DNR, Fisheries and Game.

Development Pressure

The area is presently used for log storage. It is located in the main port waterfront area and the surrounding land and water uses are all industrial and port-related. Fills have already occurred to the north and south of this area. The mudflats are easily accessible

LOCATION: (20) Maulsby Mudflats

from the port areas and from the road. Urban services could readily be extended from existing developed areas. Everett's SMP shows the whole port waterfront as Urban. A dredge material disposal site is proposed on these mudflats by the Port. The Port's Consensus Guidelines support the placing of dredge materials on areas identified for development in the central waterfront. Although the area is in the Port central waterfront, it is privately owned. The Port has indicated possible future acquisition and expansion in this area. Development pressure on this area is high; there is an existing permit application to fill about 11 acres at the north end of the mudflats adjacent to the existing fill. No action has yet been taken on this application. Development pressure on the area will continue to be high, because of its location and the policies directing development toward the central waterfront.

AREA OF ENVIRONMENTAL CONCERN

LOCATION: (21) Dikes of Concern Total: 42 miles

Habitat Types	Acreage at Location	% of Total type in Estuary	Remarks
1. *6254 Sedge Marsh(W)			
2. *6253 Cattail Marsh(W)			
3. *6112 Shrub Swamp(W)			
4. *6111 Forested Swamp(W)			

History of Area

The construction of most of the dikes in the study area occurred between 1884 and 1910. Since their initial construction many of these have been breached during storms and floods. Occasionally, such as on North Ebey Island, the breaches were not repaired. In other cases a new dike was constructed inside the older one. On top of some dikes a roadway is maintained, on others the vegetation is completely overgrown. In recent years, maintenance and repair have used riprap construction.

Natural Functional Importance

The vegetated dikes provide a unique and valuable habitat for wildlife. This is particularly true where one or more old dikes are located on the slough side. The habitat along the dikes is a series of narrow zones of brackish marsh, brackish swamp, water and riparian shrub habitat types. This dense and diverse vegetation provides feeding areas for waterfowl, songbirds, and shorebirds. Small mammals and muskrats nest on the dike banks as do some waterfowl. Songbirds are common nesters in the shrubs and trees. Carnivores and raptors may find suitable nesting sites and abundant food in these narrow vegetated zones. In addition, insectivorous birds and carnivores can easily enter adjacent agricultural areas to prey on insect and rodent pests. The dikes often create a buffer between the fauna-dominated slough and human-dominated upland areas, thus providing secure environment for nesting and feeding. The dense vegetation also helps protect the dike from erosion.

Ancillary Importance

The dikes on North Ebey Island east of I-5 fall in the preservation areas recommended in the Snohomish River Basin Mediated Agreement. Much of these dikes are in the non-disposal area under the Port of

LOCATION: (21) Dikes of Concern

Everett's Consensus Guidelines. Because of their value as wildlife habitat, the dikes fall under the general preservation policies of FWS, NMFS, EPA, DOE, DNR, Game and SCD. Most of the dikes are located along shorelines designated Rural, Conservancy, or Natural.

Development Pressure

The dikes are themselves a form of development, in that they are artificially created to allow a change in the area they protect. In most of the floodplain, the dikes protect agricultural and rural uses. Where the dikes have breached, as on North Ebey Island, the area within has reverted to wetlands. The dikes provide accessibility to some areas, in that vehicles can often drive along the top of the dikes. Where the dikes are along shorelines designated Urban, the dikes may be changed themselves or they may protect urban development. Diking districts, of which there are 5 in the estuary floodplain (Plate 19), are responsible for construction and maintenance of the dikes. These districts are formed of estuary land-owners and whether the dikes are maintained depends on the desires of these owners. The diking districts have eminent domain rights. The dikes have the same zoning as the land they protect. Development pressure on dikes of concern is low, except for pressure to maintain the dikes and possibly to repair breached dikes.

C. THE IMPACTS OF PERMITTED ACTIVITIES IN THE SNOHOMISH ESTUARY STUDY AREA

1. This section discusses the major types of activities requiring Corps permits in the Snohomish estuary study area and the impacts of these activities on the physical and biological estuarine systems. The purpose of this section is three-fold:

- To provide general information on the types of impacts associated with particular activities and a summary matrix showing the types of impacts which can result from the various activities.
- To provide an annotated bibliography of references which contain detailed information on the impacts of various uses and activities.
- To describe an approach for the assessment of the environmental effects of a proposed permit activity in a given location in the study area.

2. There are 30 activities which are listed on Corps permits in the study area. Of these 30, four account for over 60% of the total non-cancelled permit activities since 1972. These four are dredging, fills, piling and dolphins, and bulkheads. Other activities less frequently listed but still significant in number include piers (commercial and non-commercial), floats, buoys, booms, and dredge material disposal.

3. Some of these activities are closely related to common uses of the area. For example, the placement of pilings and dolphins in the study area is related to log storage in open water or intertidal areas. Log storage is a very common water use in the Snohomish estuary and Port Gardner, as shown in Table VII-7, Public and Land Profile, Section VII, Volume II. Non-commercial piers are related to recreational boating, as are marinas.

4. Environmental impacts may be related to construction and/or operation of the use or activity. The impacts may be short-term or long-term. There may be secondary activities, such as increased commercial growth induced by new industrial development on a filled area or increased boating activity associated with the placement of mooring buoys. Secondary activities will have environmental impacts which must be considered at least qualitatively in the evaluation of the primary activity.

5. An issue of great importance in evaluation of permit applications is that of cumulative impacts of permit activities on the study area. Cumulative impacts can be defined as those impacts resulting from the implementation of pending or future permit appli-

cations in the study area. More specifically, the term "cumulative impact" may have either or both of the following meanings:

- The continued loss of or encroachment on wetlands in the study area and the consequent loss of a valuable resource.

- The environmental degradation of the study area resulting from the additive effects of activities of the same type or of activities with the same types of impacts.

6. The first meaning may be amplified as follows: If there are five pending permit applications which contain requests to fill wetland areas in the estuary, what will be the total loss of wetlands in the estuary and what will be the loss in wetland acreage by type if these permits are granted? What is the value of these wetlands in terms of natural functional characteristics and ancillary issues of the public interest? How much of the wetlands resource will remain?

7. The second meaning may be amplified as follows: How much activity (for example, boat slips) can the area support without significant degradation of water quality, air quality, the ambient noise environment, and so on? If there are five pending permit applications for marinas, what will this mean in terms of additive water pollutant loading, for example?

8. The following discussion describes each use or activity and the physical, chemical, and biological impacts it may have on the environment of the study area. A judgment of general impact potential is made. Secondary activities which might occur as a result of each use or activity are listed. References, such as Section VII, refer to sections of Volume II.

1. Uses, Activities, and Impacts

The uses and activities described here include: dredging; dredged material disposal, fill, and dikes; piers and docks, pilings, and dolphins; bulkheads; floats, buoys, booms; log storage; marinas; outfall structures; breakwaters, and in-water construction of large marine facilities. Section 10 permits are required for any of the above activities in navigable waters. Section 404 permits are specifically for the discharge of dredged or fill material into waters and adjacent wetlands of the United States. Any activity which involves such discharge, for example the construction of a fixed breakwater on fill, will thus require

a Section 404 permit as well as a Section 10 permit. In addition to the above activities, secondary activities and impacts, and cumulative (additive) impacts are discussed.

Dredging

Description: Dredging is the removal from a water body of either original or recently deposited bottom material. From Corps regulations (33 CFR 323.2) dredged material is defined as material that is excavated or dredged from waters of the United States. New dredging is usually associated with construction of moorages, marinas, and piers. Maintenance dredging is done to keep navigation channels and mooring areas open for navigation; in the study area maintenance dredging is done in the settling basins in the waterfront area of Port Gardner and in the Snohomish River north of Highway 2. Once an area has been dredged, it usually must be periodically dredged to maintain it.

Dredging in the study area is most frequently done by clamshell (hopper, bucket) dredge or by hydraulic pipeline dredge; however, Hoffman (1978) describes seven less well-known methods which may be useful in circumstances requiring particular environmental controls or dredging techniques.

Physical Effects: The primary (but not necessarily the most important) physical effects of dredging are the creation of deep holes or channels which change the hydraulics in the vicinity, and the temporary suspension of clouds of sediments, causing turbidity in the water body. The finer the sediment, the higher the resulting turbidity. In the study area finer grained sediments (silts and muds) are found in Ebey Slough north of Otter Island, in Union Slough, and in the Port Gardner area. Dredging in these areas would create more turbidity than in the areas of the estuary with sandy or gravelly bottoms (Plate 8). Different methods of dredging result in more or less turbidity; a hydraulic pipeline dredge stirs sediment at one location (the cutterhead) during dredging, while the hopper dredge stirs sediment at three locations (the prop wash, the suction heads, and the hopper overflow ports). The sediments suspended in the water column may settle out downstream, creating a new sediment layer on the bottom.

Chemical Effects: Dredging breaks through the thin oxidized layer of the submerged soil and exposes the unoxidized layer. The sediments placed in suspension are also chemically reduced. The exposure of these reduced sediments creates a high chemical and biological oxygen demand. In the Snohomish estuary dissolved

oxygen levels vary seasonally and through tidal cycles. The estuary substrate has high organic content and a shallow reducing layer.

If the dredging is done in an area where dissolved oxygen concentration is low and flushing is poor, or where there is a very high concentration of oxidizable substance in the exposed materials, dissolved oxygen concentrations may be significantly reduced. In the Snohomish estuary study area, however, dissolved oxygen levels have been found to be generally within standards even in poorly flushed areas such as Ebey Slough (except in Everett Harbor, where dissolved oxygen is often below standards).

Dredging may expose toxic materials such as hydrogen sulfide, organic compounds, and heavy metals which have been discharged as industrial wastes and absorbed and buried in the sediments. Such discharges have occurred in Port Gardner (sulfite discharges from the pulp mills) and historically in the Lowell area; however, pulp mills in Port Gardner have significantly reduced the sulfite discharges in recent years (Water Quality, Section VI).

Biological Effects: Dredging may destroy or adversely affect flora and fauna in the water and aquatic lands habitats of the study area. The water and aquatic lands habitats contain a variety of flora, including phytoplankton, algae, eelgrass, and marsh plants (Flora, Section VI). The rivers and sloughs are spawning and juvenile nursery areas for salmon, shad, and other fish (Fish, Section VI). Clams, crabs, cockles, and sediment dwellers (worms and crustaceans) are all found in the mudflats at the mouth of the river, inside the Port of Everett, west of Jetty Island and along the slough sides and bottoms. Insect larvae are found in all marsh and swamp habitats (Shellfish and Other Invertebrates, Section VI). Dredging destroys the benthic habitat and with it the associated eelgrass, algae, and the benthic organisms such as clams, worms, and crustaceans. Recovery time may be fairly short (two to three months) as has been observed for recovery from the effects of log rafting (see below); however, this will be dependent on season, sediment composition, and rate of deposition and numerous other factors.

An excellent general discussion of the biological effects of suspended sediments, increased turbidity, sedimentation, changes in oxygen concentrations, and toxic materials is contained in Darnell (1976, pp. 234-270). More detailed information on the effects of maintenance dredging (and disposal) on aquatic vegetation, fish, avian and mammalian fauna, ecological relationships, juvenile salmonids, and crabs may be obtained from the

Corps of Engineers study in Grays Harbor, Washington, published in 1976-77. In general, turbidity and suspended sediments interfere with primary productivity (photosynthesis), respiration, feeding and nutrition, and migration and spawning. Sedimentation may smother eggs, larvae and adult forms of benthic fauna and fish. Changes in dissolved oxygen may suffocate aquatic plants and animals, and toxic materials may kill or be absorbed by flora and fauna.

Impact Potential: Medium

Secondary Activities: Dredged material disposal and fill, navigation and placement of navigational aids, marina construction and operation, port development and expansion.

Disposal of Dredged or Placement of Fill Material, Dikes

Description: From Corps regulations (33 CFR 323.2), dredged material disposal, or the discharge of dredged material, means any addition of dredged material into the waters of the United States. The term includes, without limitation, the addition of dredged material to a specified disposal site located in waters of the United States and the runoff or overflow from a contained land or water disposal area. In the Snohomish estuary study area, very little disposal of dredged material is done in the open water; there is only one deep water disposal site which is located near the southwestern corner of the study area (Plate 17). Thus, most dredged material disposal in the study area is on uplands. Fill material is material used for the primary purpose of replacing an aquatic area with dry land or of changing the bottom elevation of a waterbody. Discharge (placement) of fill material is the addition of fill material to waters of the United States, including adjacent wetlands (33 CFR 323.2). Sometimes an area may be filled primarily to dispose of the material (for example, the Tulalip fill). For purposes of discussing environmental impacts, dikes may be considered a form of fill in that they are placed on and around wetlands to prevent continued water intrusion. The protected area (and the dike) are then useful for other purposes. In the study area, locations of known fill are shown on
Sites of dredged material disposal (past, present, and propsoed future) are shown on Plate 17. Fill materials used in the study area include sand and gravel dredged from the river and harbor, wood wastes, including chips, sawdust, bark, and "hog fuel" (wood and trash). The Tulalip fill is the only municipal waste fill in the estuary. Typical wood waste fills are the dikes on Spencer Island South. Riprap is sometimes used to protect dike

banks. Discharge of dredged or fill material requires a Section 404 permit.

Physical Effects: Fills and dikes interfere with the surface flow through the wetland by blocking it off (or covering it) from water interaction. This may change flow characteristics of the estuary; for example, the diking of large portions of the study area resulted in the faster movement of a unit of water through the estuary, since it was forced into unimpeded channels and removed from wetland interaction. A result of this is reduced areas for floodwater storage and perhaps higher flood heights downstream. Fill banks may tend to erode and in some cases need to be protected. The area filled is raised above its former elevation, and this will induce biological changes. Storm runoff may be different (faster) and may result in short-term salinity fluctuations in the area around the fill.

Chemical Effects: Fill materials may produce water quality problems if leachate from the fill enters the river and sloughs of the estuary. Wood waste fills and fills composed of municipal wastes (sanitary landfills) produce leachate containing substances which may be toxic to aquatic organisms. Depending on the composition of dredged materials, their disposal may result in leachate problems if they are used for fill. Sand, gravel, and clean earth do not produce toxic leachate. Dissolved oxygen levels may be lowered at the site where discharge of dredged or fill material occurs.

Biological Effects: The immediate biological effect is the loss of the existing habitat at the fill site. If it is a marsh or swamp habitat, filling it will mean the loss of a highly productive area. All vegetation and soil or sediment dwellers in the filled area will be lost. Vegetation may ultimately regrow in the filled area, but it will be different from the original vegetation because of the difference in elevation and drainage characteristics. There is considerable interest in the use of dredged material to create new marsh habitats by placing it as fill on intertidal areas (Beeman and Benkendorf, 1978; Reimold, 1978; Eckert, 1978; Smith, 1978). Marysville has a specific policy calling for dikes to be located landward of swamps, marshes, and other wetlands associated with the river.

Any habitat will usually be at its carrying capacity for the species using it. If a significant amount of the habitat is lost by filling, there may be a resulting loss in the numbers of fauna in the estuary, unless they can use the newly created habitat as well. If the habitat is specialized, particular species may be eliminated. For example, filling of the Lowell

marsh area would eliminate the only known beaver habitat in the study area. There do appear to be other areas suitable for beaver habitat, but the animals may find migration too difficult.

Some filled areas, for example, dikes in the estuary, provide a valuable habitat. When riprap is placed on the dike face, it eliminates this habitat. Diking an area converts that area from wetland to upland, thus causing a loss of wetland-type habitat. There is some trade-off value in the creation of the dike habitat. Unlike filled areas, diked areas may revert to the original wetland habitat if the dikes are allowed to degenerate through lack of maintenance.

If the filled area produces toxic leachates, flora and fauna may be killed. Changes in salinity from increased runoff may affect flora and fauna around the fill.

Impact Potential: High

Secondary Activities: In filled areas, secondary activities may include industrial, commercial, residential, or any other form of intensive development. In diked areas, land uses such as agriculture are often in the protected area behind the dikes. In general, filling and diking serve to create land which may be used for development of various types.

Piers and Docks, Pilings, and Dolphins

Description: A pier or dock is a structure, usually of open construction, extending from the shore out into the water, designed to serve as a mooring place for boats. Pilings are long, heavy timbers driven into the bottom and protruding above the water surface. A dolphin is a cluster of piles bound together. In the study area, the most common use of pilings and dolphins is in log rafting areas, for controlling the rafts.

Piers and docks in the study area are located generally in the Port Gardner waterfront area, in Tulalip Bay, along the Snohomish River, and along the sloughs near I-5. Where there is residential development (Plate 12) there may be small single-family docks. Pilings are located in Port Gardner, in Tulalip Bay, and in the entrance mudflats where extensive log rafting is done. Pilings are also located along the Snohomish River and parts of Ebey, Steamboat, and Union Sloughs. This discussion does not cover log rafting effects; they are described further on.

Physical Effects: The placing of pier supports or pilings may cause some turbidity if the bottom sediments are fine-grained, as is the case in Ebey Slough north of Otter Island and in the Port Gardner area. The effect is small and temporary. A very small area of bottom for each piling or support would be affected.

Chemical Effects: None of these structures has any significant effect on water quality; however, activities such as log rafting or boating which use the structures may adversely affect water quality (secondary impact).

Biologic Effects: Pilings have minimal effects in and of themselves on the biological environment. Both pilings and pier supports can provide a suitable substrate for algae, attachment sites for invertebrates (barnacles, mussels, etc.), cover and feeding sites for fish, and sites for perching birds.

Piers can have more major effects on biological systems, primarily because of shading effects. Growth of wetland or tideland vegetation (algae, eelgrass, marsh vegetation) may be impeded or eliminated because of decreased light. Local turbidity and sedimentation may be increased because of changes in local currents, affecting fish and benthic fauna.

Impact Potential: Low

Secondary Activities: Vessel moorage, log rafting, various types of development (industrial, commercial, residential) depending upon the size and ownership of the pier or dock.

Bulkheads

Description: A bulkhead is a structure or partition designed to prevent erosion of the land behind it and/or to protect the upland from wave damage. They may be constructed of timber, steel, or concrete, and may be associated with all types of development. In the study area bulkheads are principally found in Port Gardner and along the Snohomish River west bank near the Weyerhauser Mill. Bulkheads require a Section 404 permit.

Physical Effects: Turbidity in the water column will be temporarily increased during construction, particularly in fine-grained areas (see Dredging for effects of increased turbidity). The structure is an abrupt vertical wall which may extend into relatively deep water to allow boat mooring. The vertical face of the structure creates reflection waves in shallow water which

may further disturb sediments and/or erode the foreshore. This would be a minor problem in sheltered areas with low wave action (such as inside the estuary). Effects of activities associated with bulkheads (such as boat moorage) are secondary effects not described here.

Chemical Effects: Bulkheads have little chemical effect on water quality. If the bulkhead eliminates marsh area, then any water purification characteristic of the marsh will be eliminated.

Biological Effects: The construction of the bulkhead permanently buries established terrestrial and intertidal vegetation. If the bulkhead is constructed in a wetland, it will eliminate the natural habitat there; if it is constructed landward of the wetland growth, the fringe marsh area will be preserved but may be impacted by increased freshwater runoff or erosion. Bulkhead construction in wetland areas may affect all fauna using the wetland, including birds and mammals. For mammals, the bulkhead may eliminate access from the aquatic area to the upland, thus limiting use of the seaward habitat.

The newly created deep water zone in front of a bulkhead may have a lower concentration of detritus, lower phytoplankton production, and fewer benthic organisms than unbulkheaded areas. Turbulence from reflected wave action may prohibit vegetation growth. Bulkheads cause an abrupt habitat change, eliminating shallow water areas. Salmon fry may go into deeper water when confronted with a bulkhead or congregate near the bulkhead, not going around it. Both circumstances make the fry vulnerable to predation.

Impact Potential: High

Secondary Activities: Industrial, commercial, and residential development, or any type of on-shore development needing protection. Bulkheads may be built to allow boat moorage.

Floats, Buoys, Booms

Description: A buoy is an anchored or moored floating object intended as a navigational aid, for vessel moorage, or to mark an underwater object. A floating platform is held in place by anchors or other moorage and may be used by boaters or swimmers. A boom is basically a floating log, moored at each end, the purpose of which is to enclose an area of water.

In the study area, booms are moored between pilings whenever they are being used for log rafting and storage. Floating breakwaters are designed to smooth wave action in the area behind the breakwater; they are similar to floating platforms.

Physical Effects: Physical effects of buoys are minimal. Floating platforms, booms, and breakwaters may create smooth water and so protect and shelter areas behind them.

Chemical Effects: These structures have negligible chemical effects on water quality.

Biological Effects: There may be shading effects of floating structures; these are usually small. Floating structures may provide habitat for sessile organisms and cover for fish.

Impact Potential: Low

Secondary Activities: Boating and navigation, recreational water use, log storage and log rafting.

Log Storage or Log Rafting

Description: Log storage or rafting is the storage of logs in the water or intertidal mudflats and marsh in the study area. The logs are often stored for long periods of time. The amount of storage area covered by logs at any one time varies greatly depending on the intensity of logging activities and pulping operations. In the study area, log storage occurs on the Maulsby mudflats in the Port waterfront area, on the entrance mudflats west of Smith, Spencer, and North Ebey Islands, in the Snohomish River as far south as Lowell, and in the northern part of Union, Steamboat, and Ebey Sloughs. As shown in Table VII-7 (Section VII), there were about 720 acres of water or intertidal area devoted to log storage in 1977. Log rafts stored in intertidal areas are usually above water and lying on the substrate once a day. Smith (1977) conducted an extensive study of the effects of log rafting in the Snohomish estuary; the following discussion is taken from his work.

Physical Effects: Log rafts make large areas of the water surface unavailable for any other use. The storage areas do not generally accumulate much bark on the bottom, unlike log dumps or handling sites (where the logs are bundled and lowered into the water). However, the sediments do have a somewhat higher organic content than in non-rafting areas. When log rafts ground on the substrate, they squeeze and compress

the substrate, creating a series of troughs and ridges. The log rafts knead the substrate into different ridges each time they settle.

Chemical Effects: Water quality around the study area log rafts is generally good, with turbidity low and dissolved oxygen relatively high. However, log rafts may leach lignins and tannins, and release floatables such as bark or wood debris.

Biological Effects: Log rafts which settle on the substrate at low tides greatly reduce the number of species of the benthos, and the species abundances. In some cases, a particular taxon of benthic invertebrates was completely eliminated; these included the crustaceans, Corophium salmonis and spinicorne, among others (Smith, 1977). In 10 out of 11 cases, the benthic fauna tested were significantly reduced. The time interval required to seriously damage the benthos is probably only a few days. Interestingly, this is a relatively short-term effect; if log rafting is stopped, the recolonization period for the return of the complete range of benthic invertebrates is about two months (observed in the study area, Smith, 1977). Recovery time may depend on season.

Log rafts, stored in water areas where they do not ground, shade these areas and thus reduce aquatic vegetation.

Impact Potential: High, except that the recovery time for recolonization of the area by benthic invertebrates is short once the rafts are removed.

Secondary Activities: Forest products industry (pulp mills, sawmills, lumber yards, and so on), supporting commercial development, navigation.

Marinas

Description: Marinas are areas providing docking space, water access, and harbor area for small boats. In the study area, marinas are located in the waterfront area of Port Gardner, on Spencer Island, and on the north shore of Ebey Slough near Marysville. A marina on Smith Island is under construction, and there are plans for a 500-boat marina complex in Tulalip Bay. A marina may be a somewhat open dock in a generally sheltered area such as Port Gardner, or it may be in a small protected harbor (sometimes artificial) as on west Spencer Island and in Marysville. Marinas may require a Section 404 permit if discharge of fill mateiral is involved in the construction.

Physical Effects: If an artificial harbor is created, maintenance dredging must often be done (see Dredging above). The construction of breakwaters, groins, and jetties for marina protection may change hydraulic characteristics of the area.

Chemical Effects: The buildup of fouling communities (growth of mussels, amphipods, barnacles, etc. on floats and pilings) exerts a significant oxygen demand on marina areas. If circulation and flushing are poor, the low dissolved oxygen levels may result in problems for aquatic fauna and buildup of any water pollutants may occur. Harbor water tends to be warmer, and observations in Washington State indicate that pink and chum salmon fry tend to congregate inside marinas.

Without proper control over waste discharge, marinas may produce sewage type wastes, oil and grease, and litter. Shellfish beds located near marinas are considered potentially unfit for certification by the State Department of Social and Health Services. Fish may also be affected by water quality degradation.

Biologic Effects: Nixon et al, (1973) compared a marina area and a salt marsh cove to evaluate marsh grass productivity, suspended particulates, phytoplankton, nutrients, bacteria, dissolved organics, copper levels, fish, and sediments. No major differences were found except for higher copper levels in the marina cove and greater abundance of fish in the marsh cove. However, another study showed a drop in benthic population in the area one year after construction of a marina.

Impact Potential: Medium to High

Secondary Activities: Recreation and boating, commercial development, on-shore traffic and parking.

Outfall Structures

Description: An outfall is a pipe extending into a body of water to discharge wastes such as storm water runoff, treated sewage effluent, or industrial wastes. In the study area, all three types of wastes are discharged. Storm water runoff discharges are located in all parts of the study area. There are three sewer lagoons discharging to study area waters; the discharges are in Ebey Slough south of Otter Island (Lake Stevens lagoon), in Ebey Slough near Marysville (Marysville lagoon), and in the Snohomish River near Weyco Islands (Everett lagoons). There are many industrial discharges in the study area including lumber mills, food processing plants, and pulp

mills; among the most notable are the discharges of the Everett pulp mills. The Scott Mill discharges most of its sulfite waste liquors through a deep water diffuser 700-800 meters offshore and 100-120 meters deep in Port Gardner. Another mill pumps effluent to settling ponds on Smith Island where it undergoes secondary treatment. The treated effluent is discharged to Steamboat Slough on ebb tides. If the construction of the outfall structure requires discharge of fill material, a Section 404 permit will be required.

Physical Effects: The physical act of discharge may cause local turbidity and changes in substrate. The outfall construction would cause temporary effects.

Chemical Effects: The major effect of an outfall is the impact of the discharge on water quality. Urban storm water runoff contains oil and grease, coliforms, heavy metals, suspended solids and other pollutants. Sewer lagoon effluent also contains coliforms. In the estuary, agricultural sources of runoff add pollutants such as coliform, fertilizers, and pesticides to receiving waters. The industrial waste discharges may contain sulfites, organics, calcium, and other organic and inorganic substances. The level of impact depends on the type of discharge and the quality of receiving waters.

Water quality in the study area has improved greatly in the past few years (Water Quality, Section VI). At present dissolved oxygen, temperature, and pH are within standards in the estuary. In the Snohomish River total coliforms are in excess of standards, but fecal coliforms are low. In Ebey Slough, water quality is generally good, with somewhat high total coliforms. The Port Gardner area had low dissolved oxygen in the past and generally low water quality because of the sulfite waste liquor discharges but it has now improved. Lowland agriculture does tend to adversely affect water quality, with water in ditches and floodways showing low dissolved oxygen, high phosphorus and high coliform levels.

Discharges of any pollutant in an area where that pollutant is already present in high levels may cause water quality standards to be violated. For example, new discharges of wastes high in coliform added to the Snohomish River south of the Everett sewer lagoons might mean more violations of standards downstream.

Biological Effects: The effects of the discharge depend upon the type of material discharged. Studies of benthic populations around the Seattle West Point Treatment Plant (a primary

treatment facility) showed no substantial differences before and after the outfall was operational. Most aquatic organisms will find industrial waste discharges such as sulfite liquors toxic (although gulls and waterfowl have been observed in the treatment ponds). If the discharge is located in a well-flushed area as is the West Point outfall, then effects on benthic populations would be small. Discharges into a low-flushing area such as Ebey or Union Slough may cause problems for aquatic flora and fauna.

Storm water outfalls on tidal flats and in wetland areas would affect flora and fauna. The discharges would have different temperature and dissolved gas content, and different salinity depending on location in the estuary. Organisms may suffer from the discharge load of urban type pollutants.

An outfall structure placed in a wetland will destroy the vegetation on which it is placed. The act of discharge may affect vegetation in the flow path. This is a minor impact. If the pipe blocks water interaction throughout the wetland, this would be a major impact.

Impact Potential: High

Secondary Activities: Industrial, commercial, or residential development.

Breakwaters

Description: A breakwater is a structure offering wave protection to a shore area, harbor, or basin. Breakwaters may be fixed or floating, shore connected or detached. The most notable example of a breakwater in the study area is the Jetty, a long breakwater protecting the Port of Everett waterfront. There are other breakwaters in the study area, notably in the entrance mudflats west of Smith and North Ebey Islands. All of these breakwaters are large and have been built for a long time. They are all fixed construction and detached from the shore. A fixed breakwater requiring fill needs a Section 404 permit; a floating breakwater would only require a Section 10 permit.

Physical Effects: Construction of a fixed breakwater is much like filling in its effects. Turbidity, destruction of habitat, flora, and fauna, and sedimentation are all effects of breakwater construction.

Breakwaters reduce wave energy in the area behind them. Solid breakwaters can decrease or change circulation, interfere with

tides and currents, and obstruct littoral drift. Toe scour can cause local turbidity and damage to the structure. Sediment compositions in the area inside the breakwater may change.

Chemical Effects: If circulation and flushing are impaired by the breakwater, adverse impacts on water quality may result.

Biological Effects: If sediment composition changes behind the breakwater, the benthic population may change in species distribution, diversity, and numbers. Breakwaters may affect fish migration routes; this has been documented in the Columbia River and coastal bays by the Washington State Department of Fisheries. If migration routes change, fish may be subject to increased predation.

Floating breakwaters generally have less severe environmental effects than fixed ones, and the Washington State Department of Fisheries generally recommends their use to protect fish resources (Washington State Department of Fisheries, 1971).

Impact Potential: High

Secondary Activities: Port and harbor activities, navigation and boating, marina development, other types of development.

In-Water Construction of Large Marine Facilities

Description: Large marine facilities are structures used for energy development (oil rigs and platforms), raw material processing, and marine terminals. Such facilities are constructed either in deep water or in graving docks (a construction pit below MLLW in which large structures are built; the pit is then flooded to float the structures. Examples of proposed activities of this type include:

- A marine assembly facility in the existing industrial area of Port Gardner Bay (Kaiser Steel Company proposal in the Port of Everett). The proposal involves hydraulic dredging of about 3 million cubic yards from the existing channel and marina and filling about 80 acres of tidelands. The facility would be used to fabricate steel towers and appurtenances for transport and use as offshore oil well drilling platforms. The placement of fill material would require a 404 permit.

- A proposed temporary construction site offshore in Commencement Bay, to be used to construct a semisubmersible

floating concrete platform supporting a working deck. The platform would be used for deep-ocean oil field operations. The proposed construction facilities include work barges, floating cranes, a floating concrete batch plant, and attendant equipment.

The difference between the two proposals is that the Port Gardner facility is shore-connected and involves dredging and filling, while the Commencement Bay construction site would be located in deep water (in the navigation channel). The impacts of each proposal are discussed separately below.

Physical Effects:

Port Gardner: The physical effects of the dredging and filling required would include temporary suspension of sediments and turbidity in the water column. Hydraulics in the immediate vicinity will be changed. Tidelands would be converted to upland area; for this particular proposal less than 1% of the tidelands in the Snohomish River estuary would be converted.

Commencement Bay: Temporary turbidity in the water column would result from any spillage of batch plant wash water or concrete materials. The location may cause navigation problems in the area.

Chemical Effects:

Port Gardner: Reduction in dissolved oxygen levels may occur at both the dredging and disposal sites. Dissolved oxygen levels are already low and of concern in the Everett harbor.

Commencement Bay: Spillage of fuel oils or possible leaching from the concrete might affect water quality locally.

Biological Effects:

Port Gardner: Impacts on benthic organisms will occur at the dredging and disposal sites as described above. Population levels would be reduced. Intertidal wetlands would be destroyed, so nursery or feeding areas for fish and shellfish would be lost. Turbidity and dissolved oxygen reduction may cause migrating fish to become disoriented and stressed.

Commencement Bay: Because of the deep water location of the construction, no benthic organisms would be affected

(except if there were spillage of concrete). An interesting problem peculiar to this proposal is that it is located in a major gill net fishing area of the Puyallup Indians. The location is directly in the gill net drift path.

Impact Potential:

Port Gardner: Medium to High
Commencement Bay: Medium to High

Secondary Activities:

Port Gardner: On-shore development of additional support facilities, induced commercial development, on-shore traffic.

Commencement Bay: Navigation.

Secondary Activities and Impacts

Secondary activities are any activities associated with or induced by the primary proposed activity. Many Corps permit activities have increased boating and navigation as a secondary activity. Disposal of dredged material is a secondary activity to dredging. Log storage is a secondary activity in the sense that if pilings or booms are placed, then log storage can occur. The widest range of possible secondary activities results from fill as a primary activity, because the purpose of fill is to create new land. The new land can be used for any form of development allowed under area zoning, comprehensive planning, and shoreline policy. It is essential in assessing the environmental effects of a proposed permit activity to list the most likely secondary activities which may occur and to evaluate their impacts, at least qualitatively.

Some of the secondary activites noted above have already been discussed (e.g., log storage or disposal of dredged or fill material). Types of impacts of the others mentioned are listed below.

Secondary Activity	Impacts		
	Physical/Chemical	Other	Biological
Navigation and Boating	Water quality degradation, discharge of gas, oil, phenols, sanitary wastes, heavy metals	Noise, navigational difficulty.	Effects of boat wastes on aquatic flora and fauna.
Industrial, Commercial, Residential development	Water quality degradation from outfalls (storm water or industrial wastes).	Traffic, noise, air quality degradation.	Effects of outfalls on aquatic flora and fauna. Loss of habitat, changes in type and number of aquatic organisms.
Port expansion and development	Water quality degradation from oil and grease, floatables, particulates.	Traffic, noise, air quality degradation.	Loss of habitat, changes in type and number of aquatic organisms. Water quality effects on aquatic organisms.

Cumulative Impacts

As defined above, cumulative impacts means loss of or encroachment on wetlands and/or degradation of the environment from the additive effects of similar activities or activities with similar impacts. Loss of or encroachment on wetlands can be calculated from the known acreages of wetlands by type in the study area (Section V.A and B and Component A of the overall Study (Section I, Introduction)). Such a calculation is demonstrated in the method for the assessment of environmental impacts below.

Assessment of additive effects requires (a) the determination of the baseline conditions (e.g., number of boats presently using area) and pending or future proposals (e.g., how many boat moorages are proposed), (b) the baseline environmental conditions (e.g., existing water quality), and (c) the cumulative impacts of all proposed similar activities (e.g., amount of pollutants added to water body and consequent degradation of water quality). Much of the detailed information necessary to make a quantitative

assessment of cumulative impacts of this type is not available. However, a qualitative assessment should be made, to express the types and comparative magnitudes of impacts which may occur.

Summary Matrix

Matrix V-2 summarizes the types of environmental impacts or effects which can result from the various activities described above. The purpose of this matrix is to allow a rapid qualitative assessment of a proposed activity and to alert the reviewer to the types of impacts which may occur. More detailed information and annotated references for each activity may be found in Section V.C, Volume II.

The matrix indicates physical, chemical and biological effects of the various activities. Physical/chemical effects include:

- Hydraulic changes - decrease or change water circulation, interfere with tides and currents, change or obstruct littoral drift, create protected smooth water areas, create reflection waves, change aquatic interaction.

- Erosion/sedimentation/substrate - cause or prevent erosion of shorelines, stirring and suspension of sediments, change substrate composition, physically change substrate.

- Water quality - increase turbidity, change salinity, reduce dissolved oxygen, add toxic chemicals, coliform or other organisms, or other pollutants which degrade water quality.

Biological effects include:

- Benthic flora and fauna - destruction of benthic organisms, changes in species and/or abundance of populations, destruction of vegetation.

- Water column flora and fauna - changes in phytoplankton and/or zooplankton production, obstruction or change of fish habitat and migration routes.

- Wetland flora and fauna - destruction of marsh or intertidal populations, changes in species or abundance, impacts or marshes of freshwater runoff or erosion, abrupt habitat change from upland to water.

Matrix V-2

ACTIVITIES AND THEIR EFFECTS

ACTIVITIES \ EFFECTS	PHYSICAL AND CHEMICAL EFFECTS			BIOLOGICAL EFFECTS				IMPACT POTENTIAL	REMARKS
	Hydraulic Changes	Erosion/Sedimentation/ Substrate	Water Quality *	Flora and Fauna: Benthic	Flora and Fauna: Water Column	Flora and Fauna: Wetland	Habitat Loss		
1. Dredging	X	X	X	X	X	X	X	Medium	Effects depend on method of dredging, substrate composition, and erosion
2. Disposal of Dredged or Placement of Fill Material, Dikes	X	X	X	X	X	X	X	High	Significance of impacts depends in part on composition and quantity of fill or dredged material
3. Piers & Docks, Pilings, and Dolphins	← Slight and localized effects →			Slight		X		Low	Shading effects of piers and docks. Some habitat provided for invertebrates
4. Bulkheads	X	X	X	X	X	X	X	High	Abrupt habitat change and elimination of shallows and wetlands
5. Floats, Buoys, Booms	X			← Slight shading effects →				Low	Provides some habitat for sessile organisms and cover for fish
6. Log Storage or Rafting	X	X	X	X	X	X	X	High	Recovery time for affected benthic areas once rafts are removed is about 2 months
7. Marinas	X		X	X	X	X	X	Medium to High	If dredging or filling necessary, then dredging or filling impacts would occur
8. Outfall Structures		X	X	← Effects dependent on type of discharge →				High	Industrial discharges may be toxic to flora and fauna
9. Breakwaters	X	X		X	X	X	X	High	Floating breakwaters have less severe effects than fixed ones
10. In-water Construction of Large Marine Facilities	X	X	X	X	X	X	X	High	Effects depend on whether construction site is located wholly in deep water or partly on shore

* This includes turbidity, biochemical oxygen demand, dissolved oxygen, and chemical effects.

. Habitat loss - reduction of amount of available wetland, intertidal, or water habitat, affecting all fauna including mammals and birds.

The matrix also indicates qualitatively the potential for adverse impacts of each activity on lands, wetlands, and waters of the study area. Particular facts about each activity are noted under Remarks.

2. Annotated Bibliography

The purpose of this bibliography is to list references which contain detailed information on the incidence, magnitude, and duration of impacts resulting from the activities discussed above. The list is annotated to indicate the type and level of information and the types of activities considered in each reference. The references are listed in the following order: National Studies; West Coast Studies; Washington State Studies.

National Studies

a. Dredged Material Research Program; Corps of Engineers, Environmental Effects Laboratory, U.S. Army Engineers Waterways Experiment Station, 1973-1978. The Dredged Material Research Program (DMRP) of the Corps of Engineers was authorized under the River and Harbor Act of 1970 (PL 91-611, Sect. 123(i)) and research was commenced in 1973 under the direction of the Waterways Experiment Station (WES). The program is projected to be completed in 1978. The objective of the program is to provide definitive information on the environmental impacts of dredging and dredged material disposal operations and to develop dredging and disposal alternatives, including consideration of dredged material as a manageable resource. The DMRP is divided into four major research projects, which are subdivided into 20 task's representing discrete objectives, as shown below. Upon completion, the DMRP results will include the following: 57+ Information Exchange Bulletins, 40 Technical Reports, 94 Contract Reports, 13 Field Site Reports, 24 Synthesis Reports, and 11 Miscellaneous Papers. In addition, there will be a single document summary of the entire DMRP and a comprehensive index and retrieval system.

DMRP Technical Structure:

RESEARCH PROJECTS	RESEARCH TASKS
ENVIRONMENTAL IMPACTS AND CRITERIA DEVELOPMENT	1A Aquatic Disposal Field Investigations 1B Movements of Dredged Material 1C Effects of Dredging and Disposal on Water Quality 1D Effects of Dredging and Disposal on Aquatic Organisms 1E Pollution Status of Dredged Material 2D Confined Disposal Area Effluent and Leachate Control
HABITAT DEVELOPMENT	2A Effects of Marsh and Terrestrial Disposal 4A Marsh Development 4B Terrestrial Habitat Development 4E Aquatic Habitat Development 4F Island Habitat Development
DISPOSAL OPERATIONS	2C Containment Area Operations 5A Dredged Material Densification 5C Disposal Area Reuse 6B Treatment of Contaminated Dredged Material 6C Turbidity Prediction and Control
PRODUCTIVE USES	3B Upland Disposal Concepts Development 4C Land Improvement Concepts 4D Products Research 5D Disposal Area Land Use Concepts
	9A Research Results Applications

Source: DMRP, Fourth Annual Report, 1977

A complete list of all DMRP reports is available by request to the DMRP, WES. The annual reports on the DMRP provide a description of work accomplished and work to be completed. The annual report references the published technical reports, so that detailed papers on any of the 20 tasks can readily be found. The DMRP deals principally with dredging and dredged material disposal (or fill). The information available from this program is highly detailed and technical in nature.

b. Guidelines for the Environmental Impact Assessment of Small Structures and Related Activities in Coastal Bodies of Water; D. Carstea, A. Binder, R. Strieter, L. Boberschmidt, L. Thomas, [illegible] Golden; the Mitre Corporation, MTR-6916, August 1975, for the U.S. Army Corps of Engineers, New York District. Provides quantitative methods for estimating the environmental impacts of various activities requiring Corps Section 10 and Section 404 permits. The activities considered are riprap; bulkheads; groins; piers, mooring piles, dolphins, ramps; dredging (new and maintenance); outfalls; submerged lines and pipes; and aerial crossings. Environmental factors considered include water quality (turbidity, storm runoff, boat emissions); erosion, sedimentation and deposition; flood heights and drift; ecology (impacts on biota, impacts on vital areas); air quality; noise; safety/

navigation; recreation; aesthetics; and socioeconomics. Case study examples of impact analysis for the various activities are shown. The study is useful at both the general and specific level.

c. Guidelines for the Analysis of Cumulative Environmental Effects of Small Projects in Navigable Waters; D. Carstea, J. Golden, L. Thomas; the Mitre Corporation, MTR-6939, Revision 1, December 1975, for the U.S. Army Corps of Engineers, Baltimore District. Treats cumulative impact as the additive impacts of various activities resulting in boating, traffic, construction, and economic changes in a project area. Provides a method and background data for the quantitative estimate of the additive impacts of various activities on navigation, noise, air quality, water quality, and socioeconomics. Derived from a detailed environmental assessment by the Baltimore District, Corps of Engineers, titled "Environmental Assessment, Proposed Projects on Spa and Bach Creeks. Annapolis, Maryland," May 1975.

d. Reference Manual, Environmental Assessment of Small Structures and Related Activities in Coastal Bodies of Water; D. Carstea, J. Golden, R. Holberger; the Mitre Corporation, MTR-7062, October 1975, for the U.S. Army Corps of Engineers, New York District. Develops an environmental matrix for use in assessing the specific and cumulative impacts of various activities; the matrix and background information on activities and impacts are derived from reports (b) and (c) above. Allows assessment of quantified efforts of construction and boating and provides a framework for assessment of non-quantified factors (for example, ecology).

[Note: The use of references b, c, and d requires either very specific knowledge about the nature and extent of the proposed activity or detailed assumptions. Detailed knowledge of the existing physical, biological, economic, and social conditions is also necessary. These references may be most useful at the level of the environmental impact statement rather than in preliminary environmental assessment.]

e. Impacts of Construction Activities in Wetlands of the United States; R.M. Darnell, et. al.; April 1976, U.S. Environmental Protection Agency, Report No. EPA-600/3-76-045. A study of the physical, chemical and biological effects of construction activities on wetlands. Construction activities include: floodplain surfacing and drainage; mining; fills and dredged material disposal; canalization; impoundments (dams); dredging and channelization; and bank and

shoreline construction. This is an excellent general reference with some quantitative data cited from specific case studies. The description of general biologic effects is particularly good as an introduction to the subject.

f. Small Coastal Structures - A Review; L.R. Shanks; Coastal Zone '78, Vol. II, p. 1386. A literature search and review of small coastal structures and their effects on physical, chemical, and biological factors. The study is part of the Coastal Ecosystems Project of the Office of Biological Services of the U.S. Fish and Wildlife Service. Structures examined include: breakwaters; jetties; groins; bulkheads; revetments; ramps; piers, pilings, and other support structures; buoys and floating platforms; small craft harbors (marinas); bridges and causeways. The article presents qualitative findings on the environmental effects of the structures and contains a list of detailed references.

g. Wetland Values - Interim Assessment and Evaluation Methodology; L. Messman, R. Reppert, and E. Stakhiv; U.S. Army Engineer Institute for Water Resources, July 1977. Presents methodology for impact evaluation in terms of natural functional characteristics and ancillary characteristics (aesthetics, commercial fishery, etc.). The report also describes a procedure for designers in planning or evaluating wetland construction activities. General design guidelines to mitigate the adverse environmental effects of activities in wetlands are discussed. Activities examined include: piles and pile-supported structures; aerial crossings; shoreline stabilization structures; water management structures (levees, canals, ditches, culverts, outfall structures); dredging and filling activities; submerged pipes; and roads.

West Coast Studies

h. Dredge Disposal Study, San Francisco Bay and Estuary, Main Report and Appendices A-M; U.S. Army Corps of Engineers, San Francisco District, August 1977. Authorized in 1972, the study has as its purpose the elucidation of the interrelationships of the various physical, chemical, and biological parameters with dredging and dredged material disposal activities. The study is similar in scope to the DMRP, except that it is problem-specific and site-specific to San Francisco Bay.

The following is an index of appendices in the Dredge Disposal Study:

APPENDIX	REPORT	DATE PUBLISHED
-	MAIN REPORT	February 1977
A	Main Ship Channel (San Francisco Bar)	June 1974
B	Pollutant Distribution	
C	Water Column (Water Column-Oxygen Sag)	April 1976
D	Biological Community	August 1975
E	Material Release	August 1977
F	Crystalline Matrix	July 1975
G	Physical Impact	July 1975
H	Pollutant Uptake	September 1975
I	Pollutant Availability	October 1975
J	Land Disposal	October 1974
K	Marsh Development	April 1976
L	Ocean Disposal	September 1975
M	Dredging Technology	September 1975

The study contains a great deal of data which can be useful in predicting environmental effects of dredging and dredged material disposal in other areas. The appendices are highly detailed and very technical.

i. Dredging in Estuaries, Schools of Engineering and Oceanography, Oregon State University, 1977. Three Volumes: Guides Manual, Technical Manual, and Environmental Impacts of Dredging in Estuaries.

The first two volumes, Guides Manual and Technical Manual, are manuals to be used by reviewers of environmental impact statements (EIS) on estuary dredging. They provide a detailed standard with technical backup information for what should be measured and considered in evaluating the environ-

mental impacts of dredging. These two volumes are excellent references for the lay reviewer to assess either the possible effects of dredging or to determine if a dredging EIS is adequate. Elements considered include hydrodynamics and circulation, water quality, sediment quality, geology, biology (habitats, diversity measures, food webs, productivity, recreational and endangered species, re-establishment of communities after dredging and dredge disposal, toxicity, and effects of suspended solids and reduced oxygen on biota), economics, and sociology. The third volume, Environmental Impacts of Dredging in Estuaries, is the result of four years of work in measurement of dredging impacts. The methodology uses a plane plotted as the relationship between rate-of-sediment-turnover (RST) and organic content-of-the-sediment (OCS). Various physical and biological properties of an estuary (e.g., sediment particle size, oxygen content of sediment, distribution of animal populations) can be plotted on the RST-OCS plane. Impacts are then predicted on the basis of known alterations in the RST and OCS. The bulk of the volume is the relation of various parameters to the RST-OCS plane. A detailed sampling study of 10 stations in Coos Bay, Oregon, is included.

Washington State Studies

j. Maintenance Dredging and the Environment of Grays Harbor, Washington, Summary Report and Appendices A-N; U.S. Army Corps of Engineers, Seattle District, January 1976. A research study undertaken to determine the environmental impacts of maintenance dredging operations and alternative dredging procedures. The research evaluated the effects of pipeline dredging, hopper dredging, pipeline disposal in upland diked areas and in unconfined tidal areas, and hopper disposal in and adjacent to the mouth of Grays Harbor. Baseline information on the physical and biologic setting was collected, and dredging impacts were evaluated in terms of direct mortality, habitat loss and conversion, and water quality. The reports completed as part of this study include:

Appendix A	Hydrodynamics
Appendix B	Heavy Minerals
Appendix C	Grain Size
Appendix D	Underwater Investigations
Appendix E	Invertebrates
Appendix F	Vegetation
Appendix G	Fish

Appendix H	Avian Fauna
Appendix I	Mammals
Appendix J	Ecological Relationships
Appendix K	Water Quality
Appendix L	Oyster Bioassays
Appendix M	Salmon Bioassays
Appendix N	Dungeness Crabs

The appendices contain detailed technical information, some of which can be extended to other areas.

k. A Marine Ecological Study at Ferndale, Washington; prepared for Mobil Oil Corporation by B.C. Research, May 1974. A study of marine ecology in relation to the refinery effluent discharge at Ferndale, Washington. The objectives were to provide baseline information on the distribution and abundance of benthic sediment organisms in relation to the discharge and to monitor these organisms. The report contains photographs and documentation of the interrelationships between organisms and a description of populations at various distances from the outfall. There is also some discussion of the effects of sediment on the various organisms.

l. Evaluation of Effects of Channel Maintenance, Dredging, and Disposal on the Marine Environment in Southern Puget Sound, Washington; Washington Department of Fisheries, June 1975. A study of the effects of harbor and channel dredging in Olympia Harbor, Budd Inlet, and Dana Passage. Salmon bioassays, bivalve embryo bioassays, water quality testing, phytoplankton studies, and diver observation of bottom substrates and associated macroscopic benthic organisms were carried out before and during dredging and disposal. Effects of both pipeline and clamshell dredges were examined. The study provides a complete baseline description of the areas evaluated.

m. Case Studies of Effects of Dredging and Dredged Material Disposal. Six studies of the effects of dredging and dredged material disposal on water quality, sediment transport, substrate composition and bottom conditions, and the floral and faunal benthic communities in various areas of Washington State. The studies contain detailed information on baseline conditions and changes in observed parameters for the specific areas. References are as follows:

(1) Contaminants from Dredge Spoils off Fourmile Rock; College of Fisheries and Department of Oceanography, University of Washington, December 1976, for the Municipality of Metropolitan Seattle.

(2) Effect of Dredging on Water Quality and Sediment Transport in the Duwamish Estuary; Stevens, Thompson, and Runyan, Inc., November 1972, for the Seattle District Corps of Engineers.

(3) Effects on the Biota of Fidalgo Bay, Washington, due to Construction of Anacortes Navigation Channel; Huxley College of Environmental Studies, July 1977, for the Seattle District Corps of Engineers.

(4) Observations on the Effects of Dredging to Subtidal Communities at Keystone Harbor, Whidbey Island, Washington; Huxley College of Environmental Studies, June 1976, for the Seattle District Corps of Engineers.

(5) Padilla Bay Dredge Spoil Disposal Project, Final Report; State of Washington Department of Fisheries, July 1974, for the Seattle District Corps of Engineers.

(6) Swinomish Dredge Spoil Disposal Project, Interim Report; State of Washington Department of Fisheries, November 1973, for the Seattle District Corps of Engineers.

n. Pacific Oyster Embryo Bioassays of Bottom Sediments from Washington Waters; State of Washington Department of Fisheries, May 1974, for the Seattle District Corps of Engineers and the U.S. Environmental Protection Agency. An evaluation of bottom sediments from nine areas using a Pacific oyster embryo bioassay. Areas evaluated were Grays Harbor, Duwamish River, Bellingham Bay, Henderson Inlet, Eld Inlet, Liberty Bay, Point Whitney Lagoon, Budd Inlet, and Oro Bay. Contains detailed data on sediment composition and percent of abnormal embryo response to different sediment concentrations.

o. Baseline Study of Sediment Provinces and Biotopes of Elliott Bay and Vicinity, Washington; R.A. Harman, J.C. Serwold, et. al., Shoreline Community College, 1974, for the Seattle District Corps of Engineers. This study analyzed sediment characteristics, microbiogenic sediment components (diatoms, foraminifers, wood fragments, and ostracods), and microfauna in Elliott Bay and from areas adjacent to former dredged material disposal sites. Contains detailed data on 97 samples and maps of the distribution of each parameter measured throughout Elliott Bay.

p. A Baseline Study of Invertebrates and of the Environmental Impact of Intertidal Log Rafting on the Snohomish River Delta; J.E. Smith, College of Fisheries, University of Wash-

ington, March 1977. A detailed study of substrate composition, water quality, and benthic organisms in the Snohomish River delta. The impacts of intertidal log rafts on the number and abundance of species of the benthos are discussed. Useful for baseline information on the Snohomish River delta and on log rafting.

One case study of a marina facility in Rhode Island is included here because it is a comparison of a yacht marina cove and a salt marsh cove to evaluate biological populations and magnitudes of production and respiration. The study is:

q. Ecology of Small Boat Marinas; S.W. Nixon, C.A. Oviatt, S.L. Northby; University of Rhode Island, 1973.

Interestingly, little difference between the marsh cove and the marina cove was found for the following parameters: marsh grass production, concentrations of suspended particulate matter, nutrients, bacteria, dissolved organics, infauna, or sediment metabolism. Fish species reached the same levels of diversity in the two coves. Dissolved oxygen levels were lower in the marina cove, and bioassays showed some toxicity due to outboard motor exhaust water.

3. Assessment of Environmental Impacts

The method chosen for the assessment of environmental impacts of proposed Corps permit activities in a given location is a modification of that described by Messman, Reppert, and Stakhiv in Wetland Values: Interim Assessment and Evaluation Methodology, Institute for Water Resources, July 1977. The method allows the evaluator to predict the specific and cumulative impacts of a proposed activity in a particular wetland given the dimensions of the activity and the characteristics of the wetland. It is designed to function as a desk-top analysis to allow the evaluator to assess the relative value of a wetland and the potential encroachment of the activity on the wetland's value and functional characteristics.

This approach to impacts assessments is a "red flag" mechanism to separate proposed permit activities with minimal impact from those which cause more significant adverse impacts. The method should provide key input for the decision on whether to require an EIS on the proposed activity. It should provide the evaluator with a means of assessing the public interest.

The method sets up a framework for the assessment of wetland

or habitat values using the criteria for natural functional importance and the ancillary criteria as discussed in Section V.C above. The propsoed activity is then evaluated in terms of its effect on the natural functional characteristics and the ancillary characteristics. The severity and significance of the effects of the activity are considered by describing the INCIDENCE, MAGNITUDE, and DURATION/TIME. DURATION/TIME assesses when and for how long an effect is expected to persist. INCIDENCE relates to a determination of what significant effect is occurring and where. MAGNITUDE addresses the question of how much of an effect, measured in absolute units (acres, cfs) or as a relative proportion (percent increase or decrease).

An activity or use shows a series of effects which can be divided into four categories of causative elements:

- Construction activities
- Physical presence of a structure
- Operation activities
- Cumulative effects and secondary effects

Cumulative effects are defined as both the loss of wetlands and habitat acreage in comparison to the remaining amount acreage of wetlands habitats of various types in the estuary and as the additive effects of activities of the same type or with similar impacts. Secondary activities, which indirectly result from the implementation of the proposed activity, should be identified for each proposed activity and their impacts listed.

In general, construction activities and associated effects have been viewed as short-term, while the physical presence of structures, operation, and cumulative effects are considered long-term. The mode of operation, however, may be seasonal, with short-term effects while the operation is on-going but with no significant long-term consequences.

As part of the permit application evaluation, in addition to impact assessment, Corps reviewers must also consider the need for the proposed activity, whether the activity is dependent on being near or in the aquatic environment, and whether feasible alternative sites are available. (These factors are not addressed here.)

The framework proposed by Messman, et. al., attempted to quantify wetland values and activity effects by applying a numerical value system to each value criterion or effect. The numerical value system is an expression of qualitative judgement, but it is one which can lead to an over-reliance on the number generated and an overlooking of qualitative judgment used in assigning the number. The Messman, et. al. format has been modified in

or habitat values using the criteria for natural functional importance and the ancillary criteria as discussed in Section V.C above. The proposed activity is then evaluated in terms of its effect on the natural functional characteristics and the ancillary characteristics. The severity and significance of the effects of the activity are considered by describing the INCIDENCE, MAGNITUDE, and DURATION. DURATION/TIME assesses when and for how long an effect is expected to persist. INCIDENCE relates to a determination of what significant effect is occurring and where. MAGNITUDE addresses the question of how much of an effect, measured in absolute units (acres, cfs) or as a relative proportion (percent increase or decrease).

An activity or use shows a series of effects which can be divided into four categories of causative elements:

- Construction activities
- Physical presence of a structure
- Operation activities
- Cumulative effects and secondary effects

Cumulative effects are defined as both the loss of wetlands and habitat acreage in comparison to the remaining amount acreage of wetlands habitats of various types in the estuary and as the additive effects of activities of the same type or with similar impacts. Secondary activities, which indirectly result from the implementation of the proposed activity, should be identified for each proposed activity and their impacts listed.

In general, construction activities and associated effects have been viewed as short-term, while the physical presence of structures, operation, and cumulative effects are considered long-term. The mode of operation, however, may be seasonal, with short-term effects while the operation is on-going but with no significant long-term consequences.

As part of the permit application evaluation, in addition to impact assessment, Corps reviewers must also consider the need for the proposed activity, whether the activity is dependent on being near or in the aquatic environment, and whether feasible alternative sites are available. (These factors are not addressed here.)

The framework proposed by Messman, et. al., attempted to quantify wetland values and activity effects by applying a numerical value system to each value criterion or effect. The numerical value system was in fact an expression of qualitative judgment, but one which can lead to an over-reliance on the number generated and an overlooking of the qualitative judgment used in as-

signing the number. The Messman, et. al., format has been modified in this study to leave the judgments of effects and values expressed in qualitative terms only. This does not mean that quantitative data, if available, cannot be used in the expression of value or effect. On the contrary, quantitative measures (specific wetland acreage, percent of habitat in estuary, specific fauna associated with area, specific pollutants generated) are to be used wherever possible. However, for purposes of this study it was determined that the numerical value rating system was not a meaningful part of the method and only tended to obscure the fact that value judgments must and will be made by the permit application reviewer.

The approach to impact assessment of a proposed activity in a given location is shown in the following example. Notes in brackets are procedures to be followed during the assessment.

EXAMPLE

a. Proposed Activity: A sanitary landfill on the northwest portion of Otter Island. Fill materials will be household wastes compacted into high-density bales barged to the site. Fifty (50) acres is to be filled. [Note: A landfill similar to this but located on Ebey Island just south of Otter Island was proposed in 1975.]

b. Exact Location: The 50 acres is in the northwest corner of Otter Island, north of a small tidal channel, running northwest from the center of the island. [Using the detailed habitat maps (from Component A) locate the proposed activity boundaries as exactly as possible.]

c. Habitat Types: [Identify from the habit type maps the habitat types affected by the proposal.]

   1. 6111 Spruce Swamp
   2. 6252 Cattail/Bulrush Marsh

d. General Value of Area: It is in an Area of Importance. [Check the Findings (Plate 2) to see if the proposed activity is located in an Area of Importance (AOI) or Area of Environmental Concern (AEC), Section V.B.]

e. General Value of Habitats: Both 6111 and 6252 are identified as Wetland Types. [Check Section V.A to see if the habitat types identified in (c) above are Wetland Types (WT).]

f. Characteristics of Area and Habitats: [If the proposed activity is in an AOI, AEC, or WT, review the characteristics of the area discussed in the area-specific description (Sections V.A and V.B).]

g. Acreage Affected by Proposed Activity:

Area:	Total acreage	147
	Amount proposed for activity	50
	Amount remaining	97

Total Acreage of Wetlands in Estuary (1977) = 1,862. Area represents about 8% of total estuary wetlands.

Wetland Types:		Acres	
1. 6111	Total in area	82	
	Amount proposed for activity	30	(37% of area total)
	Amount remaining	52	
	Total in Estuary	300	
	Amount proposed for activity	30	(10% of total)
2. 6252 (625)	Total in area	65	
	Amount proposed for activity	20	(30% of area total)
	Amount remaining	45	
	Total in Estuary	720	
	Amount proposed for activity	20	(3% of total)

[Obtain these numbers as follows: Total acreage and wetland acreage in area from AOI description. Total acreage of wetland types in estuary from WI descriptions. For some wetland types, it is best to work at a less detailed level than level 4 in the classification scheme. In this example, for instance, the fourth level of detail in 625 habitat is not an important distinction.]

h. Characteristics of Activity: [Describe the general characteristics of the proposed activity, using the material given in the application and supplemented by the applicant, if necessary.]

Characteristic of Activity:

1) Construction of fill; operation of a sanitary landfill is a construction process.

2) Duration: 5 years to complete the fill.

3) Incidence: Clearing spruce swamp, covering marsh and swamp, and filling to a final elevation of 18 feet above mean sea level (after settling).

4) Magnitude: 30 acres of spruce swamp and 20 acres of cattail/bulrush marsh will be destroyed, at the average rate of 10 acres total per year.

5) Long-term/Short-term: Placing of fill is irreversible. It constitutes a long-term destruction of the marsh habitat.

i. Specific Impacts of the Proposed Activity: [Assess the effects of the proposed activity on the natural functional characteristics and ancillary characteristics of the area and habitat types in terms of incidence, magnitude, and duration. Use the general impact description in Section V.C, supplemented by specific data at level of analysis desired (where available). Specific data may be obtained from references listed for each activity. Use the specific area descriptions (Sections V.A and V.B) to determine the existing characteristics where possible. If area is one for which there is no specific description, then information on physical and biological characteristics of habitat types may be found in Section VI and data on ancillary characteristics is in Section VII. The analysis should proceed in the order laid out in Section V.A (Criteria). Examples of assessment are shown for the characteristics of natural biological functions and specific local policies (Section V.A).]

1) Example: Natural Biologic Functions

. The area: 50 acres valuable for feeding, nesting, and breeding of marsh birds, small mammals, and deer will be destroyed. The encroachment of 50 filled acres on this 147-acre isolated unit will

reduce the security for wildlife it now provides, both because one-third of the habitat will be destroyed and because the entire isolated island will be invaded. If the fill affects the small tidal channel, or changes the drainage characteristics in its vicinity, the aquatic interaction capacity of the undisturbed portion of the island may be adversely impacted; this may in turn affect detritus export, nutrient cycles, and fish nurseries and feeding. If leachate from the fill degrades water quality in the remaining marsh and swamp and in the slough waters around the island, it may adversely affect marsh and swamp inhabitants and might result in kills of juvenile fish in the tidal channels and sloughs.

- Wetland 6111, Spruce Swamp: 30 acres (37%) of the largest parcel of this habitat type in the estuary will be destroyed; this 30 acres represents 10% of this habitat in the entire estuary. Its destruction means the loss of a substantial percentage of a diverse plant community, supporting a wide variety of fauna including birds and large and small mammals. The swamp is highly productive and harbors organisms that represent important links in the food web.

- Wetland 6252, Cattail/Bulrush Marsh: 20 acres (30%) of this habitat type in this area will be destroyed; however, this is only 3% of the total amount of this habitat type in the estuary. The acreage on Otter Island is one of the larger and more isolated parcels in the estuary. The dense vegetation in this marsh provides protective cover for birds and animals; the protective value will be diminished because of the destruction of 30% of the marsh and the proximity of the fill (and possible future development). A highly productive area will be destroyed. A substantial percentage of a habitat type valuable to birds and small mammals for feeding and nesting and to deer for resting will be lost.

2) Example: Specific Local Policies

- The entire island has been recommended for preservation in the SRB Mediated Agreement; filling 50 acres would mean disregard of this policy. The filled area would make the remainder of the island less valuable and less attractive for preservation/

acquisition. Filling this area would be inconsistent with the intent of Snohomish County's Conservancy shoreline designation, which applies to the entire island.

j. Summary of Specific Impact Potential: [Summarize and judge level of specific impacts on natural functional characteristics and ancillary characteristics. Describe impact potential as low, medium, high, and list most important reasons.]

The impact potential of the proposed 50-acre fill on Otter Island is high, because of the following:

1) The complete destruction of 50 acres of highly productive marsh and swamp wildlife habitat, representing one-third of an AOI and 10% of the spruce swamp habitat in the estuary.

2) The loss of habitat with dense vegetation and diverse plant and animal populations.

3) The loss or reduction of aquatic interaction, changing nutrient cycles and detritus export in the estuary.

4) (other natural functional characteristics affected)

5) Inconsistency with expressed preservation policies of Snohomish County and the SRB Mediated Agreement.

6) (other ancillary characteristics affected)

k. Cumulative Impacts; Loss of Wetlands: [Compare the acreage proposed for the activity with the historic trend for the activity in the estuary over time, obtained from Tables VII-1 to VII-5 in Section VII. Review other active permit applications to determine acreage proposed for the same activity (or resulting in the same loss) and the areas and habitat types affected. Find the total amount of existing acreage of these habitats (Sections V and VI) and the acreage lost if all pending permits were issued. These figures should indicate the cumulative effects of the proposed activity and other activities resulting in loss of wetlands.]

1) Acreage proposed for this fill 50 acres

2) Historic trend in filling; acres converted to fill per year since 1970 (Note: the fill rate in the estuary is increasing exponentially) — 13.7 acres/yr; 68.5 acres/5 yrs

3) Other active permit applications which would result in loss of wetlands by fill

Name		
	Total wetland area	89 acres
	Habitat 6252	80 acres

4) Total loss of wetlands if all permits issued — 144 acres

5) Total wetlands in study area 1977 — 1,862 acres

6) Percent of total wetlands lost — 8%

7) Total loss of Habitat 6252 if all permits granted — 100 acres

8) Total Habitat 6252 in study area 1977 — 720 acres

9) Percent of total 6252 lost — 14%

l. Summary Statement of Loss of Wetlands: If all permits for which applications have been made are granted, 8% of study area wetlands will be lost. The proposed activity represents 30% of the 8%, or 2.4% of total wetlands lost. Fourteen percent (14%) of habitat type 6252, a highly productive cattail/bulrush marsh valuable as wildlife habitat, would be lost; the proposed activity represents 20% or 2.8% of total catail/bulrush marsh lost.

m. Cumulative Impacts; Additive Effects: [Determine baseline conditions of environmental factors likely to be affected by the proposed activity (Sections VI and VII). Review other activities and active permit applications to determine where other similar activities or activities with similar impacts are occurring. Qualitatively assess the likelihood of significant additive impacts. An example is shown for water quality impacts.]

Environmental Factor: Water quality
Baseline Condition: Generally within standards in this portion of the estuary

Active Permit Applications:

	Name	Location	Activity	Impacts
1)	--	South of Otter Island, on north tip of Ebey Island	Woodwaste, fill	Possible leachate toxic to aquatic organisms
2)	--	South of Otter Island on Ebey Slough	Expansion of Lake Stevens sewer lagoon	Increased discharge of lagoon effluent

n. Summary Statement of Additive Effects: Two permit applications for activities having possible adverse effects on water quality are pending; the locations are just upstream from the proposed sanitary landfill location. There is a potential for significant water quality degradation from the additive effects of these three proposals.

o. Secondary Activities and Impacts: [Determine allowed uses in the area from the description of development pressure in the area-specific descriptions (Section V.B), general development pressure (Section V.D) and agency plans and policies (Section VII). List possible or likely secondary activities and general impacts.]

Secondary Activities: Use of the fill for development.

Development Pressure: Negligible, due to specific area preservation policies, lack of access or public services.

Allowed Uses (under present zoning): Agriculture (unlikely on fill); Residential Development at one unit/10 acres.

Possible Other Uses: Park development.

Secondary Impacts: Residential Development. If there is pressure to rezone for higher density and to establish some road access, then likely impacts include increased storm water runoff and water quality degradation, construction impacts of

roads, traffic, noise, further wildlife habitat loss, and so on.

Park Development. If no road access is developed, then boating would increase. Further encroachment on and disturbance of wildlife habitat would occur.

p. Is an EIS on the Proposal indicated?

_____Yes _____No

The decision as to whether an EIS would be necessary on this proposed activity is not made here. It is a question of judgment, which would be made by Seattle District in considering not only the information and guidance contained in this study, but also the significance of the impacts in relation to project benefits, degree of water-dependency and alternative sites, and the public interest. This study outlines the framework and basic information that provides key input with which to make that judgment. Supplemental information may be developed in much more detail from references on activity characteristics. (For example, one could compute increased runoff volumes due to the fill and examine drainage characteristics in more detail.)

[Note: In the final document, a matrix may be used as a summary sheet on which to make the evaluation.]

D. DEVELOPMENT PRESSURE IN THE SNOHOMISH ESTUARY STUDY AREA

1. Of the many factors influencing land development, the following are discussed here:

- Existing and historic land use
- Accessibility and availability and urban-level services
- Plans and policies
- Ownership patterns and zoning.

Each of the above factors is discussed for the estuary study area as a whole. The history of permit applications and the historical changes in land use over time are described and used to project a general level of activity for the future. A summary describes general areas in which pressure for development is expected to be high, medium, or low. Reference is made to specific plates and sections of Volume II where detailed information can be found. Finally, wetland enhancement is discussed with reference to specific sites in the estuary.

Existing and Historic Land Use (Land and Water Use, Section VII)

2. In the 100 years since development began in the Snohomish estuary, many changes have occurred. The floodplain of the Snohomish River and its sloughs has mostly been diked and converted to agricultural use. The 10,950 acres of wetland which existed in the estuary in 1885 have been diminished by diking and filling to about 1,900 acres in 1977. Industrial and urban uses have taken over the Everett shoreline and the waterfront in the Port of Everett almost completely, leaving isolated areas of open space and mudflats. Land use in 1977 is shown in Plate 12 (Section VII, Land and Water Use).

3. Figure VII-1, derived from aerial photo interpretation and analysis of historical topographic maps (Land and Water Use, Section VII), shows the historic trends in land use in the study area in terms of wetlands, diked areas, agriculture, and industrial land use. As dikes were built, wetlands behind the dikes were drained and used for agriculture. In some diked areas large amounts of acreage remain in wetland, but they are non-tidal wetlands, isolated from tidal influence by the dikes. The lowest amount of wetlands acreage was in the 1940's; this remained about the same until some time after 1955, when dikes were breached on North Ebey Island, Spencer Island North, and the east and west shores of the estuary. When the dikes breached, the acreage within reverted to tidal wetlands.

4. Since the early years of development in the area, industrial or heavily urbanized uses have encroached on the river floodplain only to a limited extent. Old Highway 99 (SR 529) and the railroads cross the floodplain between Everett and Marysville; I-5 was built close to this existing floodplain transportation corridor at the

north end of the estuary. This transportation corridor is viewed as a possible line of demarcation for groups interested in both development and preservation of the estuary. East of this corridor there is very little urban-type development. There are a few scattered residences, but no areas of concentrated housing in the floodplain. Between the Snohomish River and Ebey Slough east of I-5 the largest amount of land given to urban development is that on which the Everett sewer lagoons are located. Virtually the entire remainder of the estuary floodplain east of I-5 is either in agriculture or open space/wetland (mostly agriculture). West of and immediately around the transportation corridor the land use situation in the floodplain is quite different. A substantial amount of this acreage has been filled (Plate 12). Former wetlands on Smith Island are now used for forest products industry, including large settling and treatment ponds for the wastes from the pulp mills. The transportation corridor serves as a symbolic dividing line in the estuary between industrial and rural land uses.

Accessibility and Availability of Urban Services (Institutional Profile and Land and Water Use, Section VII)

5. Much of the estuary floodplain is accessible only by boat or by private roads. There are very few public roads into the floodplain itself between the Snohomish River and Ebey Slough; these are on parts of South Ebey Island and in the Highway 2 area and in the areas of Smith, Spencer, and North Ebey Islands around the SR 529-I-5 corridor. There are no sewer districts with service in the floodplain (Plate 18, Section VII) and the only sewer lines are those to the sewer lagoons and the lagoon discharges. Residential development in the estuary floodplain east of I-5 between the Snohomish River and Ebey Slough is not sewered. Water service in the floodplain is from private wells serving one or several families (Institutional Profile, Section VII). Overall, although the estuary floodplain is adjacent to a major port and urban area, most of the area does not have urban-level services.

Plans and Policies (Institutional Profile, Section VII)

6. Many of the local (city and county) plans have policy statements referring to specific parts of the estuary study area in which development should be encouraged or which should be preserved free from development (Section VII, Institutional Profile, Local Government). Snohomish County's Comprehensive Plan and the specific area plans which are parts of the overall comprehensive plan emphasize the retention of agricultural land in agricultural use. These plans show areas of greenbelt, open space, and agriculture. Ever-

ett's Community Plan has specific policies for retention of agriculture, development of recreational areas and open space, and the location of new industrial growth along the west bank of the Snohomish River near Lowell. The shoreline designations of Snohomish County, Everett, and Marysville under their Shoreline Master Programs show almost the entire west bank of the Snohomish River, all of the Port Gardner area, all of Smith and Spencer Islands west of I-5, and North Ebey Island west and east of the highway corridor as an Urban environment, suitable for urban-type development (Plate 16, Section VII). The remainder of the estuary floodplain is designated Rural or Conservancy, except the large Game parcel on Ebey Island which is designated Natural. Jetty Island has a special shoreline designation requiring the development of a comprehensive plan for the island before any urbanization can be done. The shoreline from Priest Point to north of Tulalip Bay is almost all designated Suburban, while these tidelands are Conservancy.

7. The Port of Everett's Consensus Guidelines indicate the Port's intent to preserve the entire floodplain from mid-channel of the Snohomish River to mid-channel of Ebey Slough free from any further designation of dredge material disposal sites (Plate 17, Section VII). The Snohomish River Basin Mediated Agreement (Institutional Profile, Local Governments, Section VII) makes recommendation for preservation of the delta lobes and biologically functioning surge plains of the Snohomish River; the areas indicated are shown in Plate 17 (Section VII). Federal, state, and regional agencies with interest and/or jurisdiction in the floodplain have general policies calling for the preservation of biologically important, productive, valuable wetlands, agricultural and floodplain lands, archeologic and historic sites, and educational, scientific and recreational areas (Plate 20, Section VII).

Ownership and Zoning (Ownership and Institutional Profile, Section VII)

8. Land ownership patterns in the estuary floodplain are shown in Plate 13, Section VII. A substantial portion of the floodplain is in large ownerships (400 to 1,100 acres per owner). The area around the Everett and Marysville sewer lagoons is public-owned, as are the Department of Game lands. Several areas on South Ebey Island have been platted; these are in the vicinity of the main north-south road on this island. The remainder of the floodplain is in various small ownerships.

9. The Snohomish County Agriculture zone (A-10), allowing one house/10 acres, covers the floodplain south of Highway 2. The Rural zone (RU) covers Ebey Island, Spencer Island South, and Smith Island north of Highway 2 and east of I-5. Otter Island and North

Ebey Island are also RU. Spencer Island North is zoned for heavy industry (HI). West of I-5, Smith Island is a mixture of Rural and Light Industry (LI) zones (Institutional Profile, Local Government, Section VII).

10. About half of the Port Gardner area is owned by the Port of Everett or the state; the remainder is in private ownerships, usually businesses (Plate 13, Section VII). There is some controversy about the ownership of Jetty Island. The Port of Everett claims ownership of the Jetty, defined as about 230 acres of uplands and 1,650 acres of wetlands and tide flats in the Port's Consensus Guidelines (31 October 1977). However, the State Department of Natural Resources (DNR) also claims ownership of Jetty Island and its tidelands, in particular of the sand of which the island is made. As far as can be ascertained, Jetty Island and its tidal flats may be partly the result of deposition of dredge materials along the west side of the Jetty and partly the result of the diversion of flow from the main channel of the Snohomish to the south through Port Gardner. The resolution of the ownership question is unclear. Almost all of the tidelands east of I-5 are state-owned, although some are leased out. Areas of private tideland ownership east of I-5 are along the west banks of the Snohomish River and Steamboat Slough. West of I-5 all the tidelands/mudflats along and west of Smith Island are in private ownership (Plate 13, Section VII).

11. The shoreline and tidelands along the coast from Priest Point to north of Tulalip Bay are on the Tulalip Reservation. Their development is managed by the Tulalip Tribes. Much of this area is already in residential development and small private ownerships. The ownership of the tidelands between Quilceda Creek and Marysville was disputed between DNR and the Tulalip Tribes until 1976, when the conflict was decided in favor of the Tulalip Tribes. The DNR believes that the tidelands and bedlands west of North Ebey Island are also under Tulalip ownership.

History of Permit Applications and Industrial Land Use (Section IV and Land and Water Use, Section VII)

12. In the Snohomish estuary study area about 15 to 30 permit applications per year have been made since 1972 (Section IV). About 80% of the 1971 and 1972 applications were issued, while about 60% of the 1973-1975 applications were issued. Sixty percent (60%) of applications in 1976 have been issued, but about 30% have not yet had action taken. Numbers for 1977 are incomplete. The majority of the issued and no-action permit applications are located in the Snohomish River and its sloughs. Proposed activities have mostly been dredging, fill and dredge material disposal, pilings, bulkheads,

and piers (Section IV). These are activities supporting shipping and industry, log storage, marinas, and other types of land and water use in the estuary (Section IV). Using the historical data, one would expect between 15 and 30 permit applications per year, involving mainly dredging, fill, pilings, and bulkheads. Fifty to sixty percent of these would be located in the Snohomish River and sloughs.

13. As shown in Figure VII-1 and Table VII-8 (Land and Water Use, Section VII), the amount of land used for industry in the estuary study area (including the Port of Everett) has increased about 120 acres per decade since 1947. Projecting this rate of industrial land increase, there would be about 800 acres in industrial use by 1990 and about 920 acres by the year 2000.

Development Pressure in the Study Area

14. Portions of the study area in which development pressure is judged to be high include the following.

1. The Port Gardner waterfront and channel, from the water tank at the south end to Preston Point at the north. Pressure on parts of the Maulsby mudflats is heavy and immediate.

2. The west bank of the Snohomish River from Preston Point to the curve south of the Lowell area.

3. Smith Island west of SR 529 to the beginning of the entrance mudflats.

4. Spencer Island west of I-5.

5. North Ebey Island from the narrow neck opposite the Marysville sewer lagoon west to the westward boundary of the Tulalip fill.

15. Areas in which development pressure is judged to be medium to high include:

1. The south tip of Jetty Island, where a specific dredge material disposal site is proposed.

2. The Weyco Islands, which have been partly filled already. Their inaccessibility may tend to reduce this pressure.

16. Areas in which development pressure is judged to be medium include:

1. North Ebey Island from the west boundary of the Tulalip fill west to and including the north part of entrance mudflats and Quilceda Island.

2. The south part of the entrance mudflats from the west end of Smith Island west to the breakwater and the west end of Priest Point. All of this area is in private ownership.

3. On Smith Island, the area east of SR 520 and west of I-5, but including the proposed dredge material disposal site just east of I-5 near the Everett sewer lagoons.

4. Spencer Island North from the northern end of the mid-Spencer wetland north and west to the I-5 corridor. Althouth this area is east of I-5 and is actively used for agriculture, its present zoning is for heavy industry (HI).

5. The portion of Tulalip Bay in which the proposed marina complex is located; this is the southeastern part of the bay.

17. The remainder of the floodplain study area and the coast are judged to be under low to negligible development pressure. This area includes the following:

1. The coast from Priest Point north to and including Tulalip Spit and its associated mudflats (except the proposed marina site).

2. All of Jetty Island and the Jetty Island mudflats.

3. Maulsby Swamp.

4. The Quilceda Creek area.

5. The estuary floodplain including Smith Island to I-5 (except the sewer lagoon area), South and Mid-Spencer Islands, all of Ebey Island, Otter Island, North Ebey Island south and east of the narrow neck opposite the Marysville sewer lagoon, and the east shore from the confluence of the Snohomish River and Ebey Slough north to the Marysville sewer lagoon. It should be noted that a considerable portion of Ebey Island south of Highway 2 has been platted and is accessible by road, and thus it might feel more pressure to develop. However, its zoning (A-10) is quite restrictive.

18. In conclusion, it may be useful to relate the amount of land converting to industrial use each year to some of the areas under heavy development pressure. From the historical trend, about 120 acres of land every 10 years converts to industrial use. The Maulsby mudflats and the Tulalip fill are each larger than 120 acres. North Ebey Island from the narrow neck west to the east edge of the Tulalip fill has about 100 acres of wetland area at present.

Enhancement Possibilities

19. Wetland enhancement is the process of improving or creating wetland habitat types. Enhancement possibilities considered in the study include elimination of log rafts on tidal flats and creation of wetlands through dike removal.

20. Extensive mudflats at the west end of Smith and North Ebey Islands, and in the vicinity of Maulsby Swamp, have historically been used for log rafting. Smith (1977) assessed the biological importance of these areas, the environmental impacts of log rafting, and the return of the habitat to a natural state with the removal of the log rafts. The study showed that log rafting areas recover from the impacts very quickly, and may revert to natural productivity within a few months (depending on season). Approximately 350 acres of mudflats in the study area are routinely used for log storage. Permanent removal of log rafts from these flats would probably result in their reverting quickly to their natural productivity. This would improve the habitat value of these flats to both fish and waterfowl.

21. Removal or breaching of dikes protecting areas within the floodplain would result in reversion of these areas to wetlands. This occurred on North Ebey Island in the 1940's due to flood damage to dikes. The result was the conversion of approximately 300 acres of agricultural land to wetlands. This same process might be carried out on any of the other islands. However, unless the entire island were to be converted to wetlands, new dikes would have to be built around the area of interest in order to protect the remaining part of the island. Any floodplain areas which were returned to hydrologic connection with the estuary would probably revert quickly to wetlands.

Section VI

ENVIRONMENTAL PROFILES

PHYSICAL PROFILE

Introduction

1. The Physical Profile is a description of the various physical characteristics of the estuary and surrounding area. The profile includes discussion of the following topics:

- Topography and Geography
- Climatology
- Geology
- Mineral Resources
- Agricultural Soils and Erodability
- Geologic Hazards
- Sedimentation
- Hydraulics
- Tidal Characteristics
- Water Quality

2. Each topic is discussed using the best available data from the estuary. These data are sometimes sparse or of questionable accuracy. Nonetheless, it was possible to create a comprehensive picture of the physical aspects of the estuary. This physical environment is the context within which the biological resources and processes function.

Introduction

1. The Snohomish River basin drains approximately 1,780 square miles of the west slope of the Cascade Range and adjacent Puget Sound lowlands, and flows into the Possession Sound-Port Gardner complex, an arm of Puget Sound (Figure VI-1). The Snohomish River itself is 20.5 miles long and extends upstream from Possession Sound to the confluence of the Skykomish River (844 square mile basin) and the Snoqualmie River (693 square mile basin) approximately ten miles southeast of the upper limits of the study area.

2. The headwaters of the basin lie on the crest of the Cascade Range, some 60 miles to the southeast. The upriver half of the basin drains narrow mountain valleys containing swift flowing streams maintained by rainfall and snowmelt. At lower elevations the valleys of the Skykomish and Snoqualmie widen and the surrounding hills decrease in elevation above the stream bed. Below the confluence of these two rivers, the Snohomish Valley is one to three miles wide and the river thalweg* has an average slope of 1.2 feet per mile. The river is tidal to approximately river mile 16, roughly halfway between the town of Snohomish and the confluence of the Skykomish and Snoqualmie Rivers (Corps, 1967).

3. The Snohomish estuary, located between the cities of Everett and Marysville in Snohomish County, Washington, is some 30 miles north of Seattle. It extends from the mouths of the Snohomish, approximately eight river miles upstream to the divergency of Ebey Slough from the Snohomish River. The study area is centered on the Snohomish estuary and also includes portions of the adjacent geographic features: the Intercity Plateau, the Port Gardner-Everett Harbor area, Marshland, the Getchel Hill Plateau, Marysville Trough, and the Tulalip Plateau. These features are identified on Plate 1. The topography of the area is also shown on this plate.

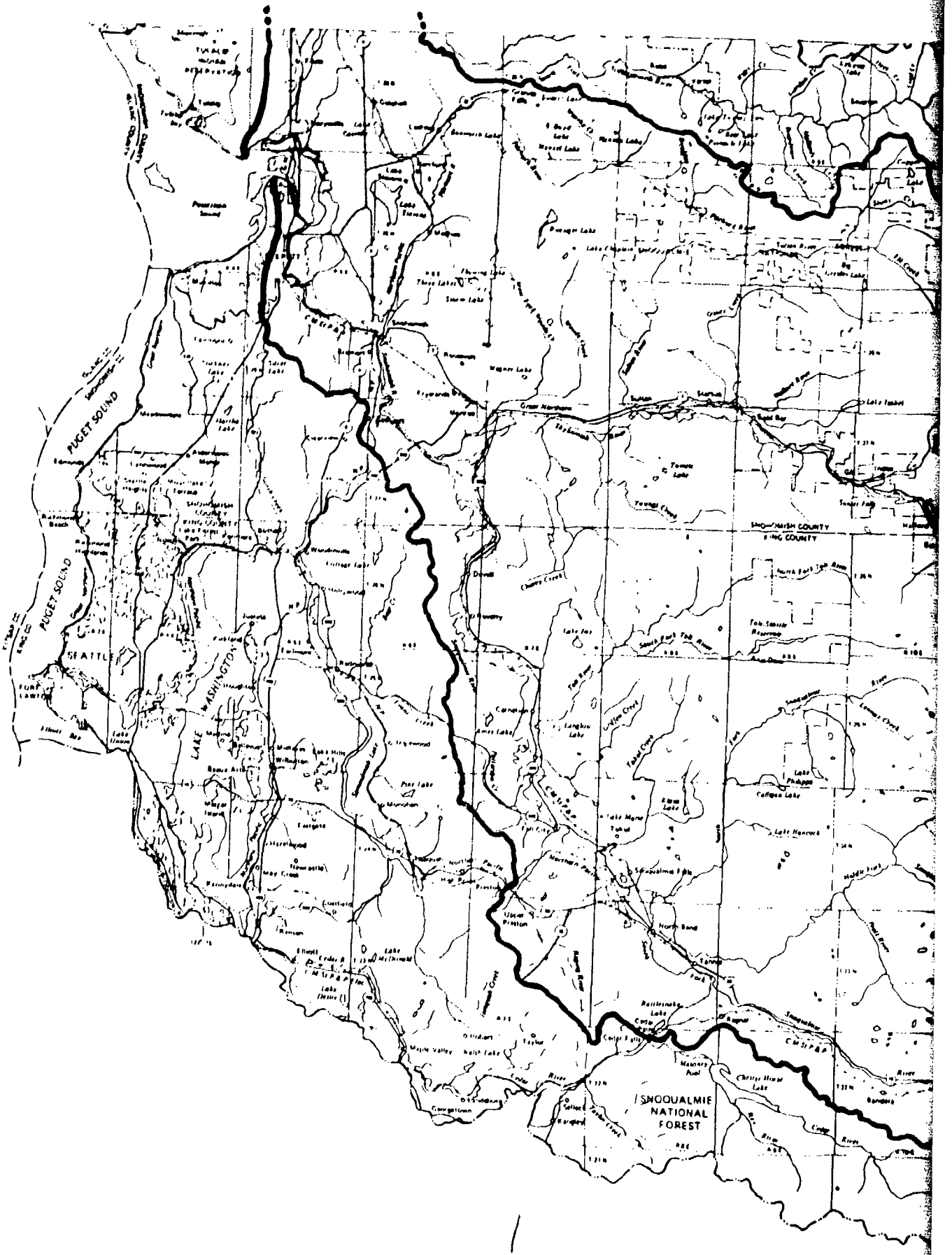
4. A generalized slope map, also based on the above topographic maps, has been prepared (Plate 3). Slope groupings were chosen to coincide, as much as possible, with U.S. Soil Conservation Service (SCS) soil descriptions. It must be emphasized that Plate 3 is a generalization and may not reveal local details of greater or lesser slopes.

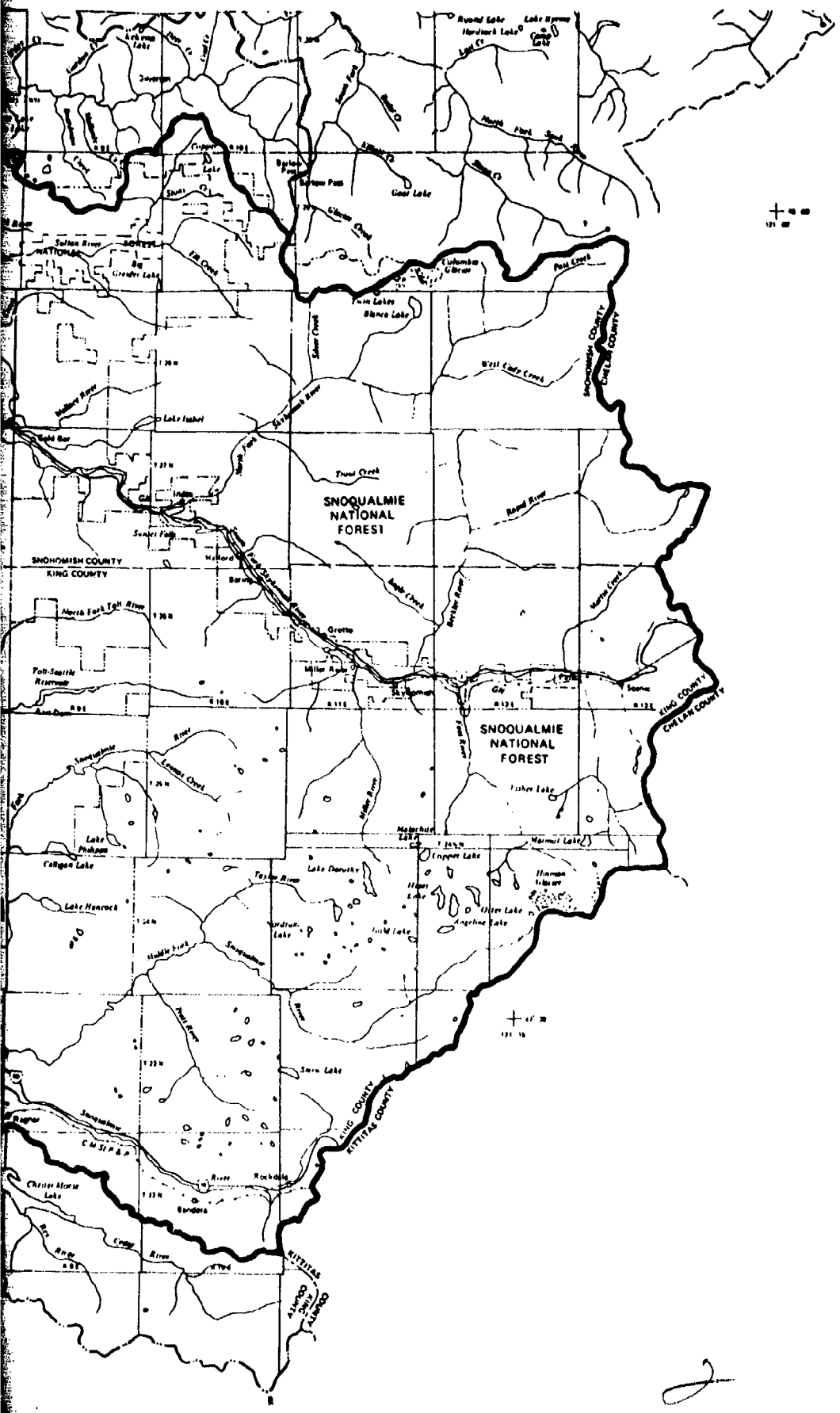
Snohomish Estuary

5. The Snohomish estuary is 1.9 to 2.8 miles wide (east to west) and approximately 7.5 miles long (north to south), covering some 20 square miles. It is essentially contained within the bounds of the Snohomish River on the west and Ebey Slough on the east.

---

*Thalweg - The axis of the channel bottom. A line joining the low points of the channel.


PUGET SOUND
PUGET SOUND
SEATTLE
LAKE WASHINGTON
SNOQUALMIE NATIONAL FOREST



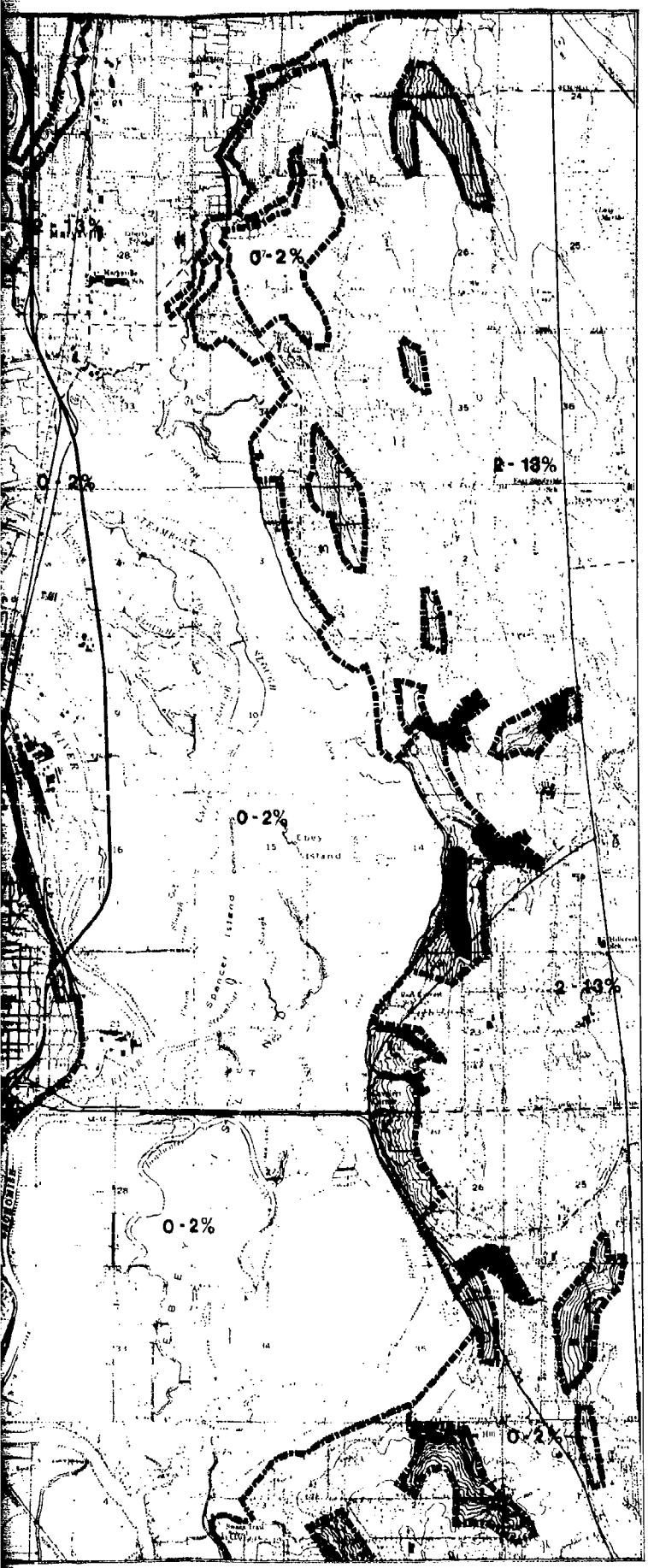
SNOHOMISH RIVER BASIN

— Boundary of Snohomish River Basin

Figure VI-1

Source: Snohomish River Basin Mediated Agreement, 1975


0 - 2%
2 - 13%
0 - 2%
2 - 13%
0 - 2%
2 - 13%
0 - 2%
>2 - 13%



SLOPE

PLATE NO 3

LEGEND

- 0-2% Slope
- 2-13% Slope Boundary
- 13-25% Slope
- > 25% Slope

N

SCALE 1:24000

SNOHOMISH ESTUARY WETLANDS STUDY

Source: Derived from U.S.G.S. 7 1/2 minute topographic maps.

PLATE NO 3

Ebey Slough diverges from the main channel at Snohomish River mile 8 and meanders 14 miles to Possession Sound. The estuary is cut by two major channels, Union and Steamboat Sloughs, which diverge from the Snohomish River at river mile 4 and converge at their common mouth into Possession Sound. Union and Steamboat Sloughs are connected opposite Otter Island, and Steamboat Slough has two connections with Ebey Slough north and south of Otter Island. Altogether, the free-flowing sloughs of the estuary constitute some 37 miles of channel.

6. Most of the slough banks have been diked, and the lands behind the dikes drained for agriculture. Some of the dikes, through lack of maintenance and/or flood damage, have been breached.

7. The four major channels cut the estuary into a number of islands: North Ebey Island, Otter Island, Ebey Island, Smith Island, and Spencer Island, now divided by the recently formed connection between Union and Steamboat Sloughs. Prior to diking, these islands were freely drained by a number of smaller sloughs, most of which are now blocked by dikes or tide gates.

8. Elevations in the estuary range from below sea level to seven feet, averaging between two and three feet. The tops of dikes along the sloughs are at an elevation of ten feet or greater. Slopes in the estuary are generally between 0-2%, except on dike slopes and stream banks.

Intercity Plateau

9. The estuary is bounded on the west by the Intercity Plateau, a peninsular ridge lying between Puget Sound, the Snohomish and Snoqualmie Rivers, and the Lake Union-Lake Washington-Sammamish River system. The top of the Plateau has elevations ranging between 100 and 300 feet; its sides slope directly to the shore of the Snohomish River on the east and north, and to Possession Sound and Port Gardner on the west. The plateau is occupied in part by the urban areas of Everett and Lowell.

10. The majority of the Intercity Plateau is rolling, urbanized slopes of 2 to 13%. Shoreline bluffs in the 13 to 25% range occur along the Port Gardner shoreline, and also in the vicinity of Lowell. The southwest portion of the study area is a rugged series of small creek canyons with slopes in excess of 25%.

Marshland

11. South of the Snohomish estuary is the Marshland district of the Snohomish valley. Marshland extends along the west shore of

the Snohomish River from Lowell to the town of Snohomish. The area has been diked and drained, and is intensively farmed. Most of the district is less then 10 feet above sea level with slopes of less than 2%. Although only a small portion of Marshland is located within the study area, most of the runoff from the area drains into the Snohomish just upriver of Lowell.

Getchel Hill Plateau

12. On the east, the Getchel Hill Plateau rises from a narrow plain (less than 0.1 miles to approximately 0.5 miles wide) along Ebey Slough, to elevations of 300 to 400 feet. The rolling hills of the plateau are relatively sparsely populated. The town of Snohomish lies at the south end of the plateau near the confluence of the Pilchuck River with the Snohomish River. Lake Stevens and the town of Lake Stevens are located at an elevation of 210 feet in the central part of this area.

13. As in the Intercity Plateau, most land of the Getchell Hill Plateau lies in the slope range 2 to 13%. Patchy inclusions of steep land, mostly in the 13 to 25% range occur along the base of the plateau where they rise from the Snohomish estuary. Slopes in excess of 25% are generally associated with small creek canyons.

Marysville Trough

14. The Marysville Trough lies north of the estuary and adjacent to the west slopes of the Getchel Hill Plateau. It extends north to the Stillaguamish River (approximately ten miles) and is three to five miles wide. The flat valley floor is drained by Quilceda Creek and Allen Creek into Ebey Slough. The city of Marysville and its suburbs are at the south end of the valley on the banks of Ebey Slough. Elevations range from 15' at Marysville to between 110' and 130' at the drainage divide between the Snohomish (Quilceda) and Stillaguamish basins.

15. Slopes are generally less than 2%. Steeper slopes in the 2 to 13% range occur as narrow troughs along portions of Quilceda Creek and Allen Creek.

Tulalip Plateau

16. Northwest of the mouth of the Snohomish estuary, the Tulalip Plateau rises abruptly from the Marysville Trough and the shores of Possession Sound. Most of this area lies within the Tulalip

Indian Reservation and is heavily forested. Land sales to non-Indians have resulted in intensive residential development at Priest Point and Tulalip Bay. The topography varies from steep cliffs along Possession Sound (greater than 25% slope), to rolling uplands cut by irregular gulches, generally in the 2 to 13% slope range, to the creek valleys that drain into Tulalip Bay. Flat (0-2% slope) marshy areas along Mission Creek and Tulalip Creek are common and occasionally extensive.

B. CLIMATOLOGY

1. The Snohomish River Basin has a moderate climate typified by mild, moist winters and cool, dry summers. This climate is controlled by the proximity of Puget Sound to the mouth of the river and by the mountain elevations at the headwaters.

2. As an example of the influence of the ocean on climate, compare the average daily temperature extremes for two locations within the river basin. Everett is located on Possession Sound at the mouth of the river, while Startup, located in the Skykomish River valley, is about 25 miles from Possession Sound. Both sites also have approximately the same elevation (Everett-100 ft.; Startup-170 ft.). It is apparent from Table VI-1 that the average daily temperature range at Everett is not as great as at Startup. Thus, the proximity of Puget Sound has a greater effect on the temperature regime at Everett than at Startup.

3. Similarly, the effect of mountains on the climate can be shown by comparing the average precipitation records for Everett, located in the Puget lowland and Grotto, located on the south fork of the Skykomish River, approximately 15 miles from the Cascade crest (Table VI-2). From this table, the influence of the Cascade Mountains on the precipitation regime is apparent. Moist air, moving east from the Pacific Ocean, is forced over the mountains, where the decreased pressure causes cooling and condensation. The resulting "orographic" precipitation causes Grotto to receive from two to three times the precipitation that falls at Everett.

4. The high precipitation on the Cascade slopes in the Snohomish Basin provides a significant flow into the estuary. This flow is an important part of the hydraulic regime of the estuary. In addition, this flow carries sediment and organic matter which is deposited in the estuary and mudflats. This suspended sediment is an important factor controlling the habitats found in the estuary.

5. Winds in the Everett area are summarized in the wind rose in Figure VI-2. The figure summarizes the frequency of occurrence of winds by direction and speed. The prevailing wind direction is southeasterly. There is, however, a significant component from the west.

6. Wind data is important not only from a meteorological point of view, but also in evaluating air quality conditions in an area. Table VI-3 lists the values of various air quality parameters determined in the Everett area in 1976. Also listed are ranges of data collected in Seattle during the same period. The Seattle data may represent from one to twelve sampling locations depending on the parameter. Finally, national and local air quality standards are included for comparison.

Table VI-1

AVERAGE DAILY TEMPERATURE EXTREMES, MONTHLY*
AT EVERETT AND STARTUP, WASHINGTON
(From PNRBC, 1969a)

	J	F	M	A	M	J	J	A	S	O	N	D	Avg
Everett													
Max.	44.6	48.0	52.6	58.8	64.1	68.1	72.4	71.6	67.4	59.8	51.2	47.0	58.8
Min.	32.6	34.1	36.6	40.4	45.2	49.7	52.3	52.1	48.5	43.8	37.6	35.5	42.4
Startup													
Max.	45.0	49.4	54.1	62.0	68.4	72.0	78.0	77.7	71.9	62.4	52.8	47.5	61.8
Min.	32.2	33.8	35.7	39.4	43.7	47.4	49.1	49.2	46.5	42.5	36.9	34.7	40.9

* For the period 1931-1960

Table VI-2

AVERAGE MONTHLY PRECIPITATION
AT EVERETT AND GROTTO, WASHINGTON **
(from PNRBC, 1969b)

	J	F	M	A	M	J	J	A	S	O	N	D	Avg
Everett (elev. 94 ft)	4.97	4.07	3.28	2.44	2.00	2.18	.73	1.67	1.59	3.33	4.73	4.56	35.55
Grotto (elev. 849 ft)	13.59	10.57	9.25	7.76	4.14	3.14	1.28	2.82	5.96	9.67	15.77	15.18	99.13

** For the period 1956-1965

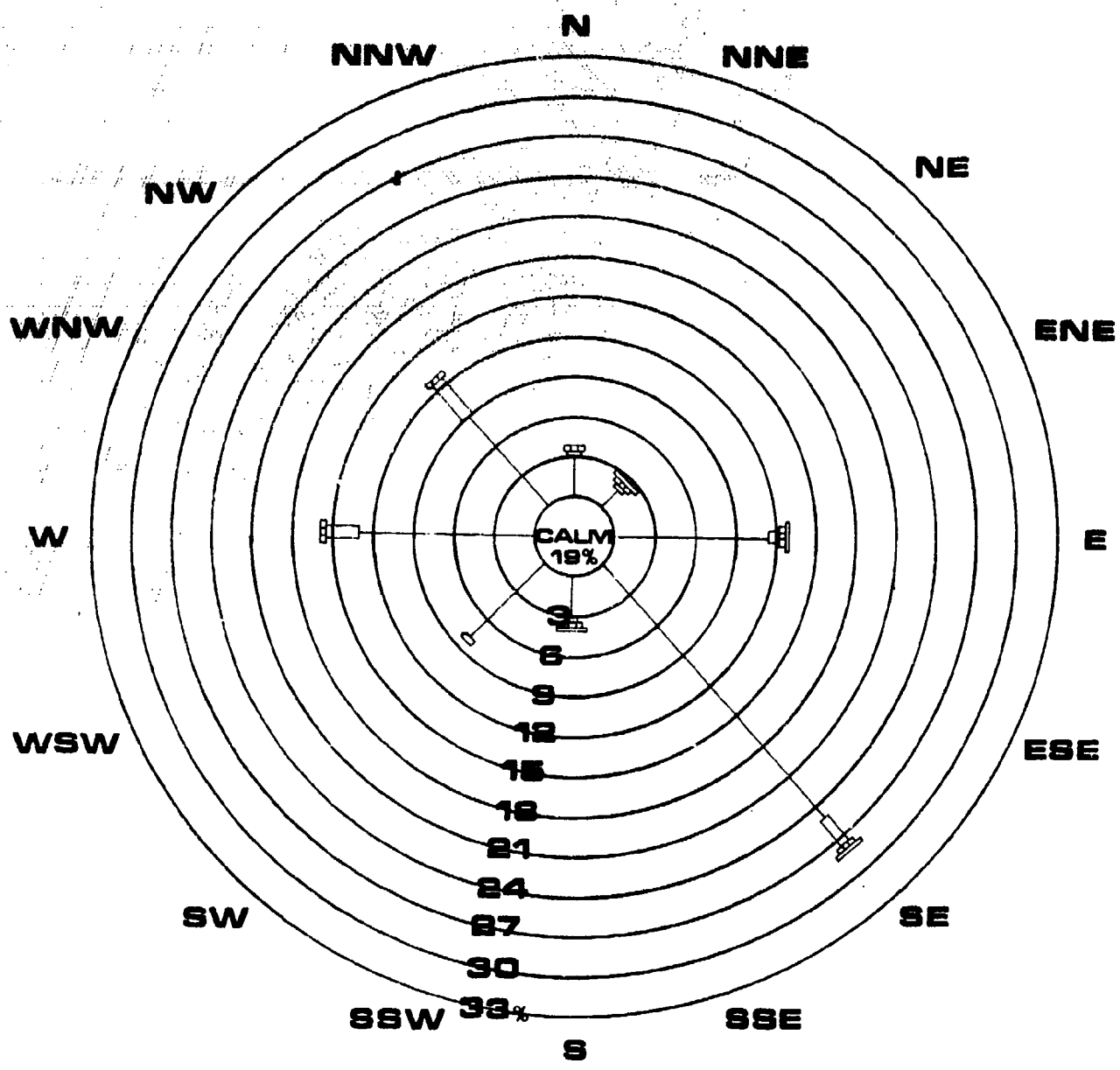


Figure VI-2 WIND ROSE FOR EVERETT

Table VI-3

AIR QUALITY STANDARDS AND DATA
FOR SEATTLE AND EVERETT, WASHINGTON, 1976
(from PSAPCA, 1977)

Air Quality Parameter	Air Quality Standards		Maximum Value	
	National	Puget Sound	Seattle	Everett
SO_2 (ppm)				
24 hr Average	.14[b]		.03-.08	.06
3 hr Average	.5[b]		.10-.28	.24
1 hr Average		.25[c]	.18-.46	.60
Suspended Particulates (ug/m^3)				
Annual Geom. Average	75	60[a]	46-83	45
24 hr Average	260	150[b]	134-314	112
CO (ppm)				
8 hr Average	9	9	8-24	1
1 hr Average	35	35	12-27	2
NO_2 (ppm)				
Annual Average	.05[a]	.05[a]	.027[d]	.009[d]
Hydrocarbons (Less Methane) (ppm)				
3 hr Average	.24[b]	.24[b]	1.61	0.43
Number of days exceeding standard			150	5

a) Never to be exceeded
b) Not to be exceeded more than once per year
c) Not to be exceeded more than twice in seven days
d) Annual arithmetic mean

7. The climatological characteristics of the Snohomish estuary determine in part which organisms can survive and best compete in the river basin habitats. Climate is also an important factor to man in identifying locations to live and work. It also affects the intensity and duration of air quality impacts in an area. Thus, climate has a significant influence on man and all other organisms which inhabit the area.

C. GEOLOGY

1. The surficial geology of the Snohomish estuary and adjacent lands is characterized by two aspects--the older, glacial parent material of the uplands, and the recent sediments (alluvium) of the Snohomish Trough. The Intercity Plateau to the west, Tulalip Plateau to the north and the Getchel Hill Plateau to the northeast are all made up of glacial material. The estuary itself consists of recent alluvial sediments, the result of the erosion of both glacial material and the older rock of the Cascades. Both the alluvial and glacial material overlie Tertiary bedrock which varies from 400 to 2,000 feet below the surface in this area.

2. The glacial material can be correlated with two time periods: the Vashon stage of the Fraser Glaciation; and the pre-Vashon period. Newcomb (1952) described the pre-Vashon material as a 2-3,000 foot (700-1,000m) sequence of compacted, horizontally stratified, blue and gray clays and silts with some thin sand and gravel beds. Only the upper 200 feet (70m) is ever exposed above sea level. He attributed this Admiralty Clay to local glaciers rather than the previously suggested extensive ice sheet. Smith (1976), on the other hand, has divided the pre-Vashon material into the lower Double Bluff Drift and the upper Whidbey Formation. The Double Bluff is described as a well compacted series of iron-oxide cemented gravel, pebbly silts, and massive silts interbedded with sand and gravel. A glacio-lacustrine origin has been suggested for the pebbly silts. The Whidbey Formation consists of well-sorted, medium beds of sand, silt and clay varying in color from light brown to gray to blue. Smith (1976) attributes a non-glacial, river floodplain origin to this 200 foot (65m) sequence.

3. Both Newcomb (1952) and Smith (1976) divided the Vashon Drift into the following units: Esperance Sand, advance outwash, till and recessional outwash. (Newcomb distinguished between Esperance Sand and advance outwash, but mapped them together.) This drift overlies the previously described material throughout the region. The Esperance Sand consists of thin bedded, light gray, medium to coarse sand with occasional pebbles. Advance outwash is compact, cross beds of sand and gravel. Most of the upland plateaus in the vicinity of the Snohomish estuary are overlain with a till up to 150 feet (45m) in thickness. The Vashon till is an extremely compact, unstratified mixture of clay, silt, sand, gravel, and boulders often referred to as "hardpan". Recessional outwash is usually loosely compacted, permeable sand and gravel.

4. Recent deposits within the study area include older landslides and alluvium, and younger alluvium. The older landslides occurred during or since the retreat of the Vashon ice sheet. Older alluvium, mostly sand and gravel with some clay and silt, is found as alluvial fans along steep valley sides. The younger alluvium

Figure VI-3

GEOLOGIC CROSS SECTION OF THE
SNOHOMISH ESTUARY

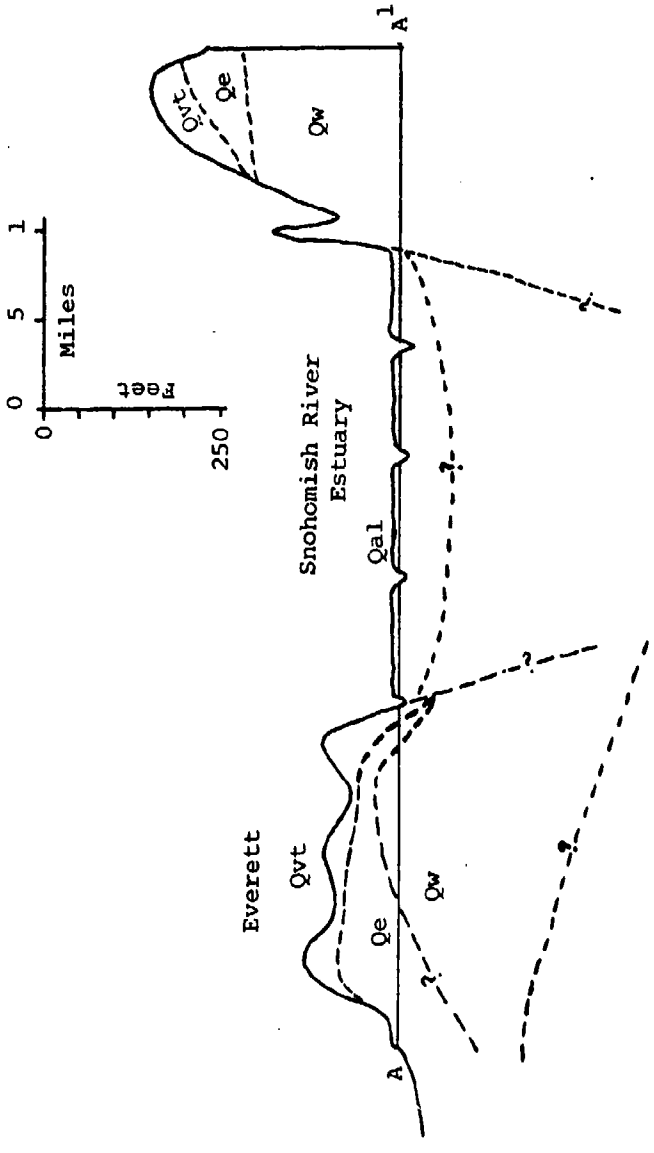


Table VI-4

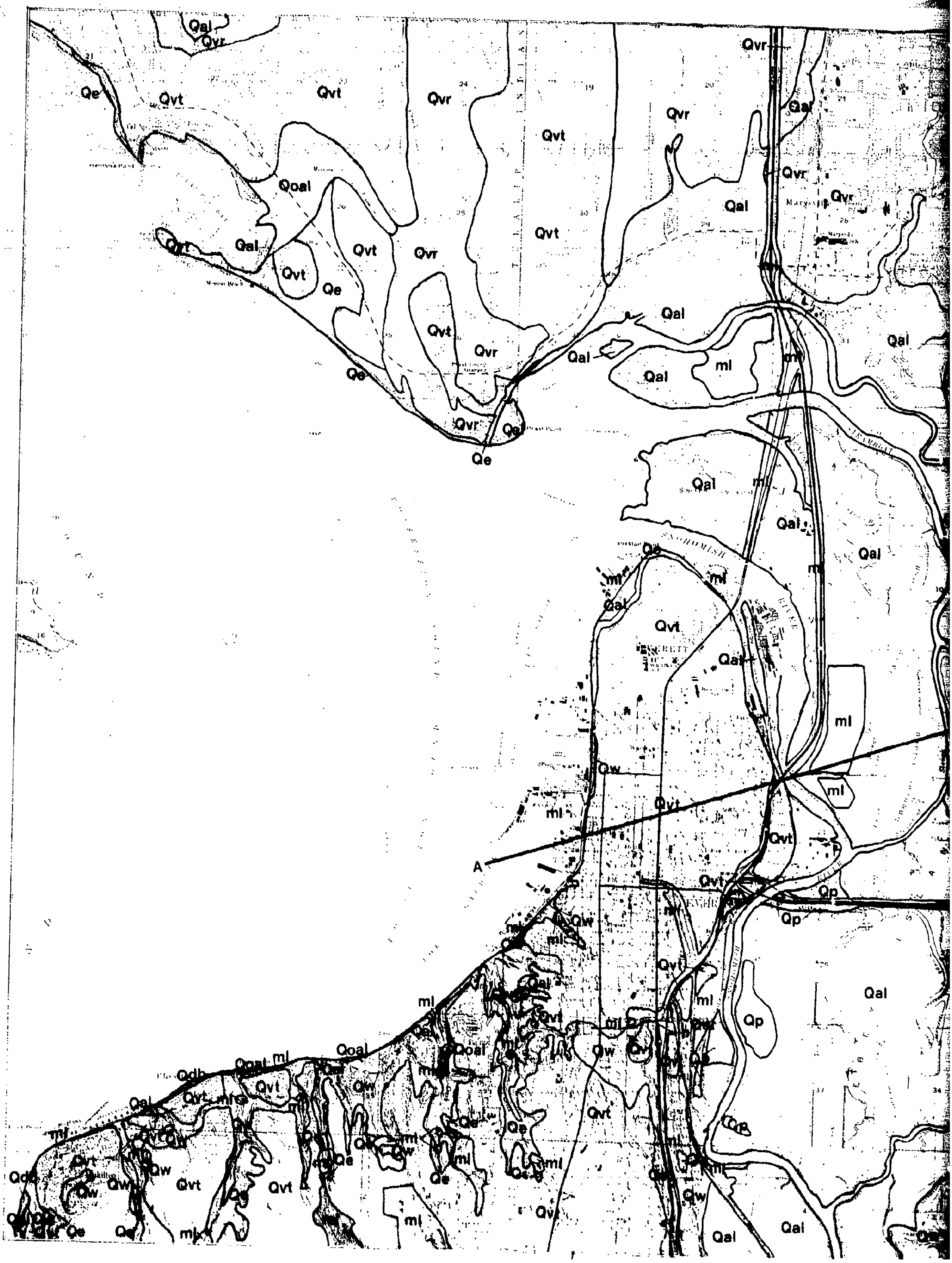
COMPARISON OF GEOLOGIC UNITS IN THE SNOHOMISH ESTUARY

Newcomb (1952)	Smith (1976)	Mapped Units (Plate 3)
Qyal - Young alluvium, clay, silt, peat, sand and gravel. Includes some artificial fill	Qal - Alluvial sand and gravel. May contain silt, clay and organics. Qls - Recent landslides ml - Modified land af - Artificial fill Qb - Beach deposits Qp - Peat	Qal - Recent alluvium including beach deposits. Sand and gravel, with some clay, silt and organics. ml - Modified land including artificial fill Qls - Recent landslides Qp - Peat
Qoal - Old alluvium, clay, silt, sand and gravel	Qoal - Old alluvium Qols - Old landslides (no evidence of recent activity)	Qoal - Old alluvium. Sand and gravel with some clay, silt and organics.
Qvr - Undifferentiated Vashon recessional outwash	Qvr - Vashon recessional outwash	Qvr - Recessional outwash. Permeable sand and gravel.
Qvt - Vashon till	Qvt - Vashon till	Qvt - Vashon till. Impermeable gravel, sand, silt, clay.
Qvap - Pilchuck Clay; Vashon advance outwash, mostly clay. Qvac - Esperance Sand; Vashon advance outwash, sand & gravel	Qva - Vashon advance outwash; sand and gravel Qe - Esperance Sand; sand with occassional gravel	Qe - Esperance Sand.[1] Permeable sand and gravel with some clay.
Qa, Qat - Admiralty Clay; silt and clay with occasional till	Qw - Whidbey Formation, non-glacial sand, silt and clay river floodplain deposits. Qdb - Double Bluff; glacio-lacustrine silts, sand and gravel	Qw - Whidbey Formation. Sand, silt and clay. Qdb - Double Bluff. Silt, sand and gravel.

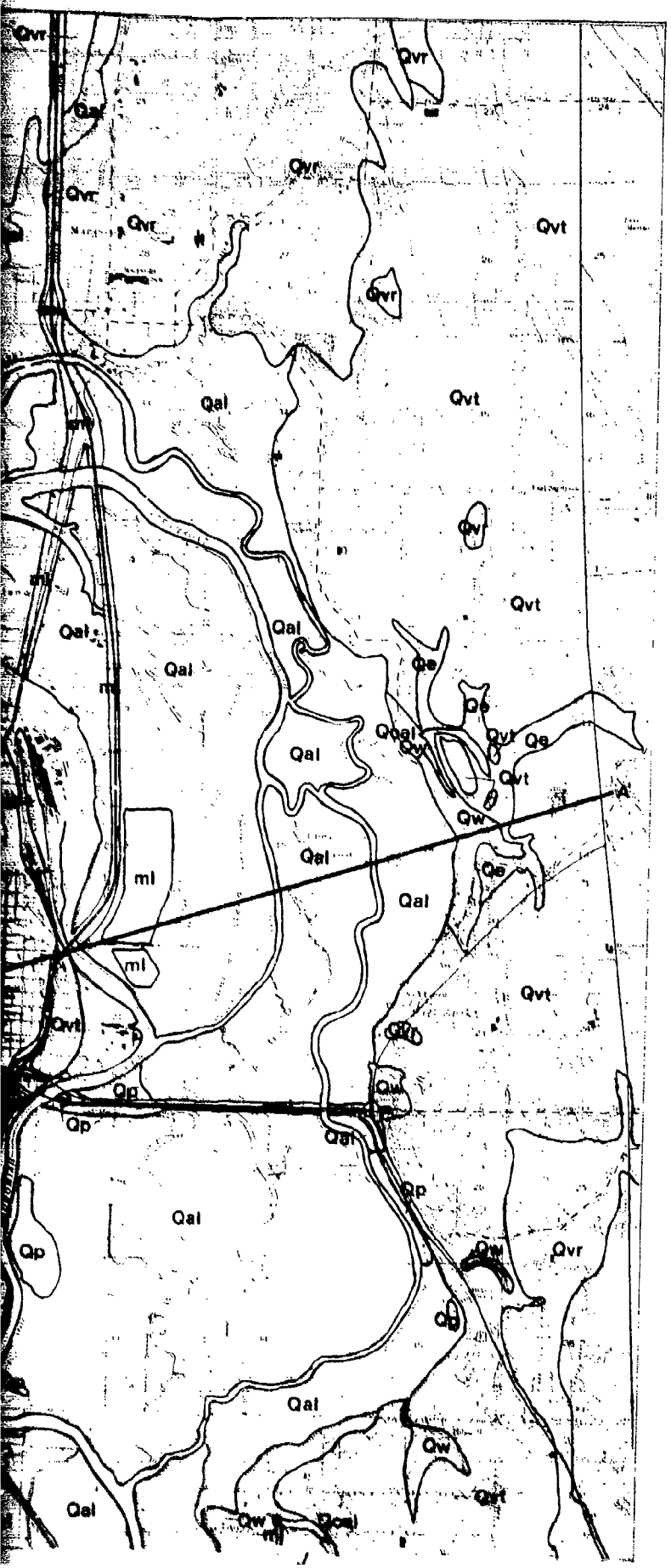
[1]Only two exposures of Qva are identified by Smith within the study area. Both are located on Intercity Plateau and designated Qe_1.

consists primarily of river and stream deposited sands and gravels in the Snohomish Valley; some silt, clay and peat may also be included. These recent alluvial sediments are predominantly material which has eroded from the Cascades in the Skykomish and Snoqualmie Valleys. In addition, recent deposits also consist of landslides, beach deposits, fill and peat.

5. Plate 4 is a composite of the geologic map of Newcomb (1946) and Smith (1976) in the Snohomish region. Discrepancies between the two works have been noted, and where possible resolved. Table VI-4 compares the units of the two authors and designates the units identified on Plate 4. Figure VI-3 is a diagramatic cross-section (A-A' on Plate 4) adapted from Newcomb (1952). Some interpretation has been added based on well logs and the work of Smith (1976) and Drost (1977).



Qal
Qvr
Qvt
Qe
Qoal
ml
Qw
Qp
Qdb
A



GEOLOGY

PLATE NO4

LEGEND

Qal	Recent Alluvium
ml	Modified Land
Qp	Peat
Qoal	Old Alluvium
Qvr	Recessional Outwash
Qvt	Vashon Till
Qe	Esperance Sand
Qw	Whidbey Formation
Qdb	Double Bluff

N

SNOHOMISH ESTUARY WETLANDS STUDY

Source: Smith 1976
Newcomb 1952

D. MINERAL RESOURCES

1. There is a broad spectrum of mineral resources within the Snohomish Basin. Most of these are located considerably east of the estuary and are therefore beyond the scope of this study (Huntting, M.J., 1956). The principal mineral resources in the study area are sand and gravel, clay, and peat (Valentine and Huntting, 1960). These resources are associated with both the Pleistocene glacial and interglacial deposits and the more recent alluvial deposits. Location of mineral resources is shown on Plate 5.

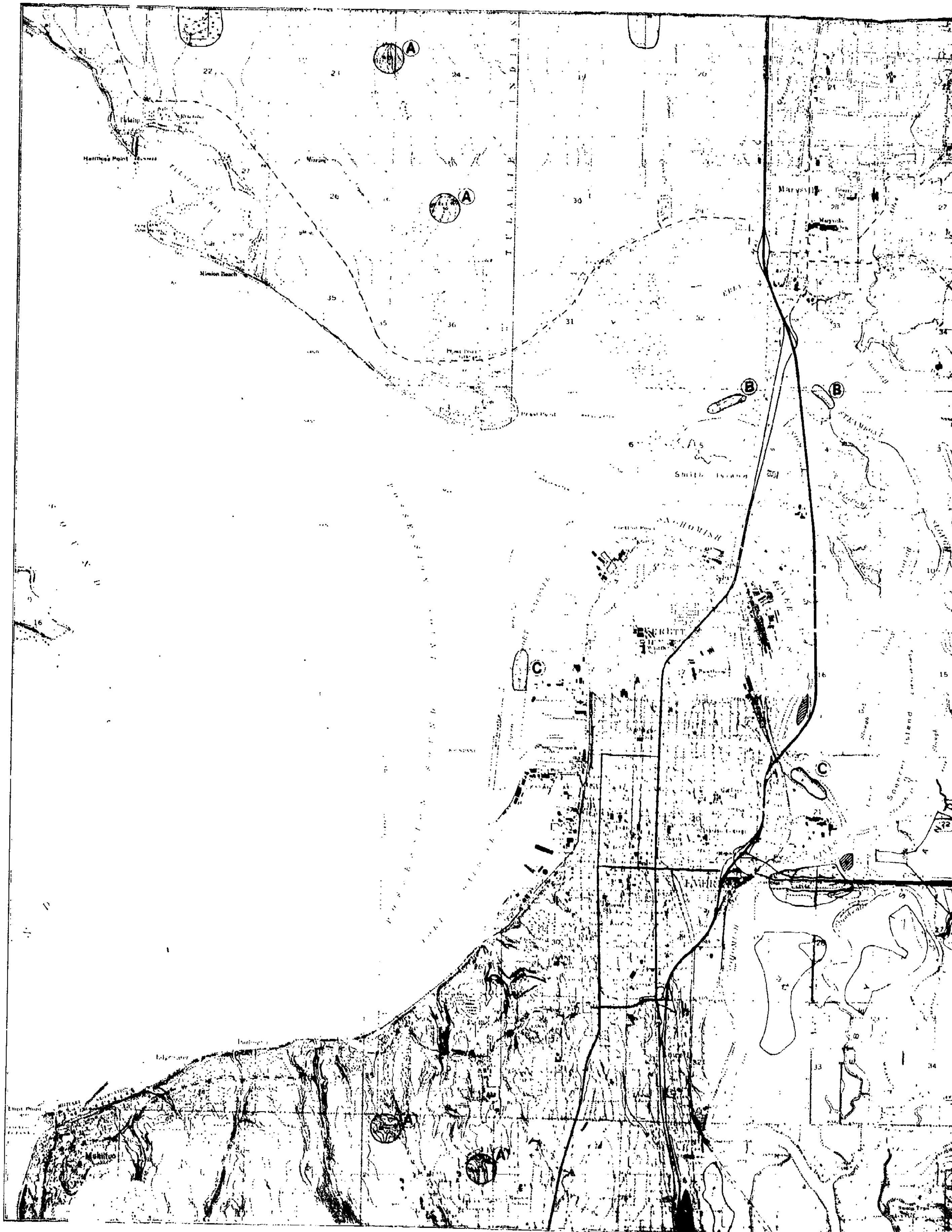
2. One of the principal sources of sand in the estuary is the channel bottoms. Material was dredged from two locations near the mouth of Steamboat Slough for construction of Highway I-5. In addition, sandy material is regularly dredged from the settling basin near the confluence of Steamboat Slough and the Snohomish River. This material is stored for rehandling on Smith Island, just east of the DNR boat launch area. Some has also been placed along the east shore of the Deadwater Slough.

3. Two private, active gravel pits are located adjacent to the estuary. One is located just above the floodplain, east of Otter Island. The other is located just south of the Everett city limits. Several other pits have been used in the area over the years. Most of these, however, have been emptied, abandoned, or reclaimed.

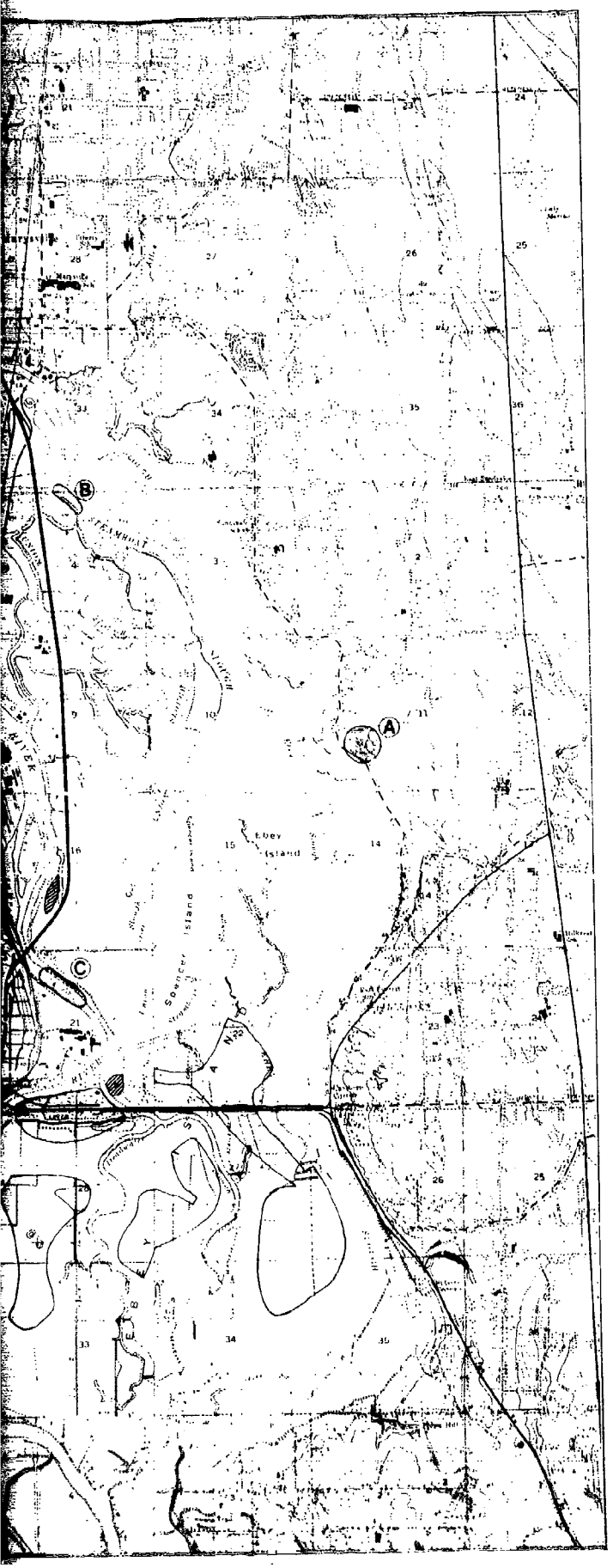
4. Most of the clay which has been mined in the area of the Snohomish estuary has been removed from a bed on the east side of the Everett (Intercity) Plateau. This clay has been mapped as Admiralty Clay by Newcomb (1952) and Whidbey Formation by Smith (1976). It is a blue clay used in the manufacture of brick and has been the basis of several brick yards in the history of Everett. At present, only the Lowell Brick Yard, in the southeast portion of the city, is actively mining the clay.

5. It is probable that peat deposits are associated with most wetlands (both past and present) in the estuary. Those areas which have been diked and cultivated may no longer have definable peat deposits. The only areas which have been identified as peat resources are on Ebey Island and in the Marshland area (Rigg, 1958). These areas cover more than 1,800 acres, varying from 5 to 25 feet in depth. According to Rigg most of this is a fibrous peat, the remains of sedges, rushes, and other herbaceous marsh plants. This type of peat is used primarily for soil improvement purposes in lawns and gardens.

6. Although commercial peat production is not a major activity in Washington, it did amount to about 15% of U.S. production



Mission Beach
Marysville
Smith Island
Mukilteo



MINERAL RESOURCES

PLATE NO 5

LEGEND

- Sand & Gravel:
  - A — Upland Pits
  - B — Channel Dredge Sites for I-5
  - C — Channel Settling Basin
- Peat
- Clay
- Dredge Material for Rehandling

N

SCALE 1:4000

SNOHOMISH ESTUARY WETLANDS STUDY

Source: Valentine 1960

2

PLATE NO 5

in 1955 (Rigg, 1958). There is no historical mention of production of peat from the study area, though considerable supplies do exist.

E. AGRICULTURAL SOILS AND ERODABILITY

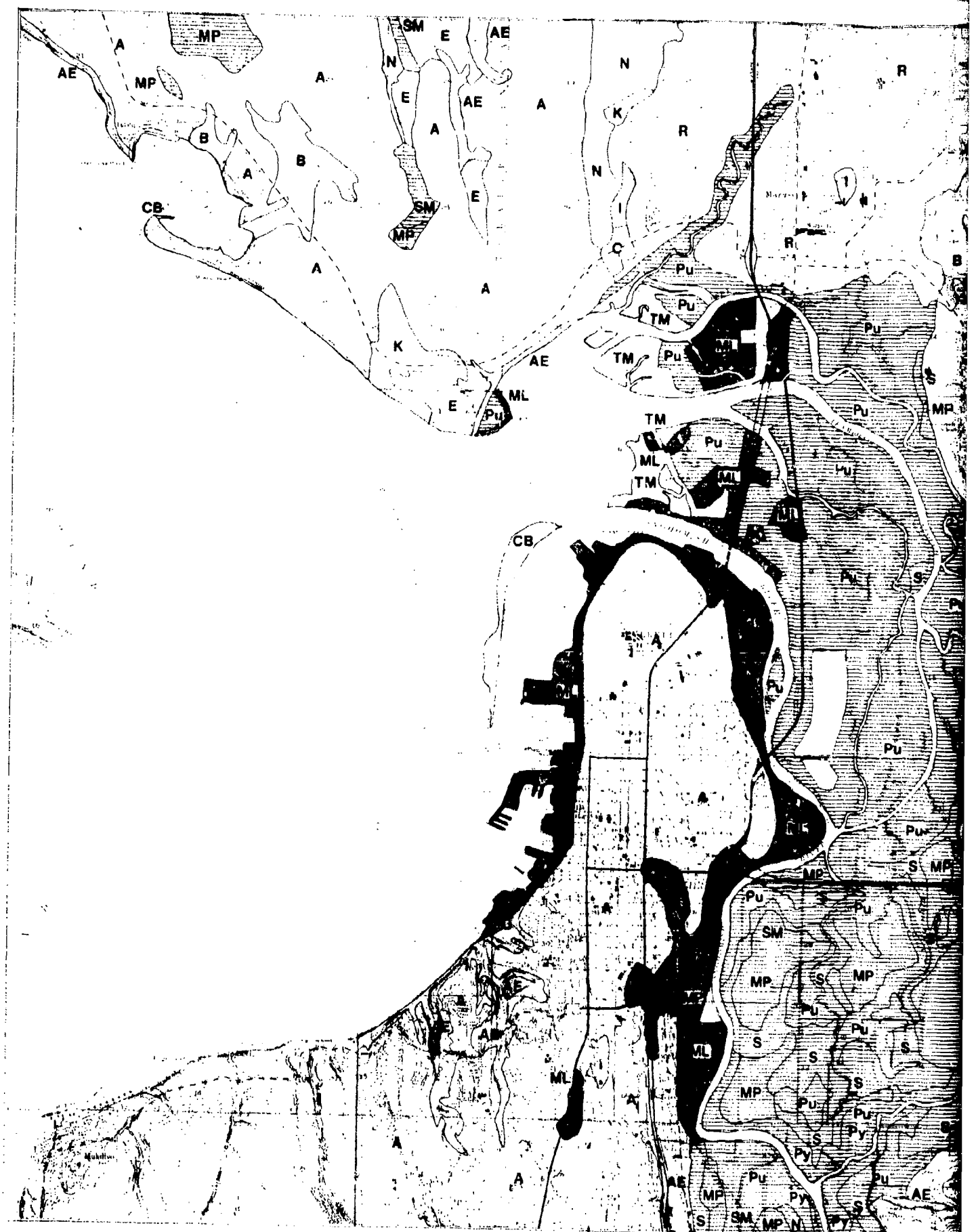
1. Soil is a mixture of organic matter and weathered rock or other source material. The characteristics of a soil are a product of climate, topography, parent material, associated vegetation, recent geologic events, and occasionally the activities of man. As a means of identifying different soil types and describing their characteristics the U.S. Soil Conservation Service (SCS) has developed a classification system based primarily on the parent material, texture, and slope of the soil. Although initially developed to assess the agricultural capability and erodability of the soil, the system has been expanded to describe other soil attributes, such as resource value, urban development limitations, and woodland suitability.

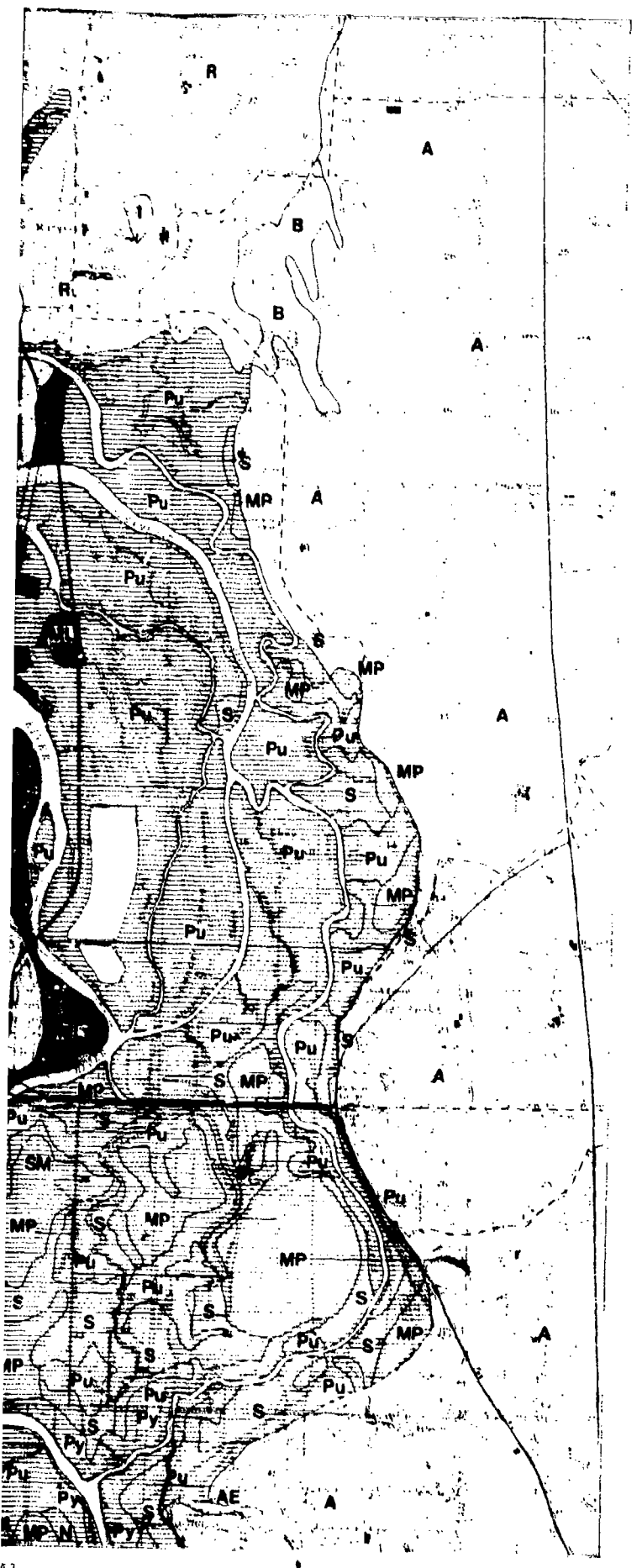
2. The term soil refers only to the top few feet of the ground surface. Since these top few feet are often removed from construction sites during site preparation, or are mixed with subsurface material during earthmoving operations, soil descriptions have minimal engineering value. Of greater value in an engineering sense would be data regarding the soil parent material. The description of each soil includes the identification of its parent material. Further information regarding the parent material will be found in Section VI.C., Geology.

3. The soils map (Plate 6) is developed from SCS soil maps. The data shown are derived from preliminary, prepublication soil maps being prepared by the Snohomish County Soil Conservation Service Unit (Lake Stevens, Washington) as part of an ongoing remapping of all the Snohomish County soils. It is possible that some revisions to the preliminary SCS maps will be made before their publication.

4. The soil groups, type names, and textural descriptions used here are consistant with SCS nomenclature to facilitate cross references with SCS reports, and also because no other textural descriptions are known to exist. SCS defines particle sizes as follows: clay (0.001 to 0.005 mm); silt (0.005 to 0.074 mm); sand (0.074 to 2.0 mm); fine gravel (2.0 to 9 mm); medium gravel (9 to 25 mm); coarse gravel (25 to 75 mm). Loam, as defined by SCS, is a distinct grain size mixture consisting of approximately 40% sand, 40% silt, and 20% clay. Detailed information regarding textural descriptions may be found in the SCS Soil Survey Manual (SCS, 1951) or Snyder (1971).

5. Many of the soils of the Snohomish estuary have been determined to be of significant importance to agriculture and are, among other criteria, indices in determining Prime Farmland. Prime Farmland is defined by the U.S. Department of Agriculture (USDA) as "land best suited for producing food, feed, forage, fiber, and oil-


A
MP
AE
B
CB
SM
E
N
K
R
I
C
Pu
TM
ML
S
Py



AGRICULTURAL SOILS

PLATE NO 6

LEGEND

	Prime Agricultural Soil
ML	Made Land (fill)
A	Alderwood
AE	Alderwood - Everett
B	Bellingham
C	Custer
CB	Coastal Beach
E	Everett
I	Indianola
K	Kitsap silt loam
MP	Mukilteo Peat
N	Norma fine sandy loam
Pu	Puget silty clay loam
Py	Puyallup
R	Ragnar
S	Snohomish silt loam
SM	Shalcar Muck
TM	Tidal Marsh

N

SNOHOMISH ESTUARY WETLANDS STUDY

Source: Soil Conservation Service (Unpubl.)

Table VI-5

SOIL DESCRIPTIONS SUMMARY

Soil Type	Depth (inches)	Soil Texture	Drainage Characteristics	Parent Material
Alderwood Group (A)	24-50	Mixed clay, silt, sand, gravel, loam	Moderately well drained	Glacial till
Everett Group (E)	14-60+	Gravelly sandy loam, gravelly loamy sand	Well drained	Recessional outwash, sand and gravel
Alderwood-Everett Complex (AE)	14-60+	Mixture of Alderwood and Everett groups	Moderate to well drained	Mixed parent material
Bellingham Soil (B)	48	Silty clay loam, clay	Poorly drained	Alluvial material
Kitsap Soil (K)	60+	Silty loam, clay	Moderately well drained	Silty glacial deposits
Puget Soil (Pu)	60+	Silty clay loam	Poorly drained	Alluvial material
Ragnar Soil (R)	60+	Fine sandy loam	Well drained	Glacial outwash
Snohomish Soil (S)	40-60+	Silt loam	Poorly drained	Alluvial material
Custer Soil (C)	12-30	Fine sandy loam	Poorly drained	Recessional outwash, sand
Indianola Soil (I)	34	Loamy sand	Well drained	Recessional outwash sand
Norma Soil (N)	12	Fine sandy loam	Well drained	Recessional outwash sand
Shalcar Muck (SM)	32	Muck, mucky peat	Poorly drained	Alluvial material
Mukilteo Peat (MP)	48	Mucky peat, sedge peat	Poorly drained	Alluvial material
Tidal Marsh (TM)	60	Silty clay loam	Poorly drained	Alluvial material
Made Land (ML)	varies	Mixed	Varied	--

seed crops." It must also be available for those uses; i.e. it must not yet be urbanized. It must have the "soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed, including water management, according to modern farming methods" (USDA Soil Conservation Service Land Use and Monitoring Memo, WA-1, June 1, 1976). The Council on Environmental Quality (CEQ) in concert with USDA has recognized the importance to the nation of our prime agricultural soils and has directed (August 30, 1976) that Federal agencies "carry out evaluations of the impact of major agency actions on Prime Agricultural Farmland in the course of preparing environmental impact statements." They further directed that "efforts should be made to assure that such farmlands are not irreversibly converted to other uses unless other national interests override the importance of preservation or otherwise outweigh the environmental benefits derived from their protection." The Economic Development Administration (U.S. Department of Commerce) also requires conformance with USDA and CEQ directives in the granting of funds. While not yet a widely accepted term, for convenience these soils will be referred to here as Prime Agricultural Soils. Prime Agricultural Soils are indicated on Plate 6.

6. Limited engineering data is available regarding the soils of the project area. Snyder (1971) provides crude grain size analysis data and classification codes for the major soil horizons. Grain size analysis data is in the form of percentage ranges of material (by weight) passing U.S. Standard Sieve Numbers 4, 10, 40, and 200. Classification codes include SCS texture descriptors, U.S. Department of Defense Unified Soil Classification System codes, and AASHO "A" series bearing strength codes.

Soil Descriptions

7. The following soil descriptions are based primarily on Snyder (1971, 1972), Snyder, et. al. (1973), and Anderson, et. al. (1974). Table VI- 5 summarizes the information presented here.

8. The Alderwood soils group consists of gravelly loams and gravelly sandy loams lying 24 to 50 inches deep over a glacial till parent material of mixed clay, silt, sand and gravel. They are moderately well drained soils, usually located on uplands where they formed under conifer forests. They are the most extensive single soils group in the study area, and in the past were used extensively for timber, pasture, berries, row crops, and urban development.

9. The Everett soils group consists of gravelly sandy loams and gravelly loamy sands which intergrade through very gravelly sands to a recessional outwash glacial sand and gravel parent material. The depth to parent material varies widely with topography

and ranges from less than two feet to greater than five feet. These are well drained soils, usually located on uplands where they formed under conifer forests on terraces and terrace fronts. Their past uses are similar to Alderwood soils.

10. Alderwood-Everett complex soils are a new, undescribed, SCS mapping unit which combines the features of the Alderwood and Everett soils in areas where parent material mixing is complex. They generally occur on steep canyon slopes and shoreline bluffs.

11. The Bellingham soil of the study area is a silty clay loam which formed under grasses and sedges from alluvial parent material. The silt and clay from which this soil developed is found in shallow, poorly drained depressions in glacial till.

12. The Kitsap soil of the study area is a silty loam lying up to two feet deep over clays. They are described as having formed under conifers and shrubs on silty glacial lake deposits. On steep slopes the soil has severe erosion and slippage potential. This soil is moderately well drained and is relatively uncommon in the study area.

13. The Puget soil is a silty clay loam which formed under grasses and sedges from recent river bottom alluvial material. This young, poorly developed soil makes up some of the most fertile land in the county. It has been designated a Prime Agricultural Soil.

14. The Ragnar soil is a fine sandy loam. It is a well drained soil that formed under conifers from a glacial outwash material. The unconsolidated sand from which this soil develops is subject to severe erosion on slopes greater than 15%. It, too, is a Prime Agricultural Soil. In the study area it is restricted to the Marysville Trough.

15. The Snohomish soil is a silt loam lying up to two feet thick over a stratified clay and peat deposit. The stratified parent material is stream or river valley alluvium, usually bank washover onto high intertidal peat. Small, complex inclusions of this poorly drained Prime Agricultural Soil are located throughout the upper estuary.

16. The Custer soil is a fine sandy loam that lies approximately one foot thick over a one to two foot thick weakly cemented sandy loam hardpan which grades into a moist sand, the parent material. The only Custer soil in the study area is located in the glacial outwash material of the Marysville Trough. It is a wet, poorly drained soil with the seasonal water table within two feet of the surface.

17. The Indianola soil of the Marysville Trough region of the study area is a loamy sand lying up to three feet thick over the sand parent material. It is derived from estuarine and beach deposits of old glacial streams and is extremely well drained.

18. The Norma soil of the Marysville Trough region of the study area is a fine sandy loam lying approximately one foot thick over an unconsolidated sand parent material of variable texture. It is a moderately well drained soil which is often damp due to its development in ponded areas.

19. Shalcar Muck is a very poorly drained organic soil that is stratified with mineral soils, and overlies alluvium. This soil is formed in deposits of sedge peat and alluvium in river valleys and on glaciated uplands. Small inclusions of Shalcar Muck are scattered throughout the upper estuary and at one location in the Tulalip Highlands. It is a Prime Agricultural Soil.

20. Mukilteo Peat is a fairly well disintegrated mucky peat lying less than two feet thick over a sedge peat which also contains considerable woody material. Parent material is not noted but is likely recent alluvium. After being drained and cultivated for a number of years, the soil becomes more compact and the surface may subside one to three feet. There are extensive tracts of Mukilteo Peat in the upper estuary; the soil is also found in the Tulalip Highlands. It is a Prime Agricultural Soil.

21. Tidal Marsh occurs in salt marshes at the mouths of creeks and sloughs in the study area. Its composition is variable as might be expected. The surface is occasionally a peaty material overlying deep silty clay loam soils derived from recent alluvium.

22. Made Land is a generalized classification for a wide variety of land forms created by man. It includes industrial waterfront fill which is generally composed of demolition debris, wood waste, dredged material, and other similar waste materials. Highway and railroad embankment fill is generally a mineral material such as soil parent material or dredged material. On North Ebey Island there are extensive tracts of urban waste (garbage) fill and wood waste fill. Water quality problems due to leaching are commonly attributed to these latter types of made land. When originally placed, these materials merely constitute a potential soil parent material which in time may form a soil layer on the surface as vegetation becomes well established.

Regional Descriptions

23. The Intercity Plateau is almost exclusively composed of soils of the Alderwood group. The steep canyons and Puget Sound shoreline bluffs in the southwest portion of the province have Alderwood-Everett complex soils. Most of the shoreline areas are "made land"--industrial fill, dredged material, drained marshland, or the like. Jetty Island is an indistinct combination of dredged material and accretionary sand.

24. The Tulalip Plateau is mostly composed of soil of the Alderwood group with numerous and various inclusions of other soil types. The steep shorelines northwest of Tulalip Bay and east of Priest Point are classified as Alderwood-Everett complex. Everett, Bellingham, and Kitsap soils are scattered throughout the rolling uplands. Some Shalcar Muck and Mukilteo Peat, Prime Agricultural Soils, are located along flat drainage courses in the uplands. The undeveloped flat land at Priest Point is Puget silty clay loam, also a Prime Agricultural Soil.

25. The Marysville Trough is mostly Ragnar fine sandy loam with Puget silty clay loam, both Prime Agricultural Soils, common along Quilceda Creek and the banks of Ebey Slough. Some Tidal Marsh is still present at the mouth of Quilceda Creek and the Banks of Ebey Slough.

26. The Getchel Hill Plateau is almost exclusively composed of Alderwood group soils.

27. The Snohomish estuary, with the exception of some areas near the mouths of the sloughs, is a complex association of a variety of Prime Agricultural Soils, primarily Puget silty clay loam, with lesser areas of Mukilteo peat, Shalcar Muck, and Snohomish silt loam. Made Land is common between Everett and Marysville where highway and railroad embankments, wood waste, and urban waste fill has been extensive. Some Tidal Marsh remains at the mouths of the sloughs. Considerable land is used for sulphite waste liquor and sanitary sewage treatment lagoons.

Erodability

28. Erosion, in a general sense, is an inevitable result of the urbanization-industrialization process, though there are commonly accepted mitigative measures available to retard and/or contain the effects. Any sloped soil will erode if its protective vegetation is removed. Subsequent to development some degree of erosion is likely to continue due to inadequate vegetative ground cover in conjunction with storm flows of greater intensity. Particularly severe erosion hazard potentials exist for Alderwood soils in excess of 13% slope, Everett soils in excess of 25% slope, and any soils in the Alderwood-Everett complex.

F. GEOLOGIC HAZARDS

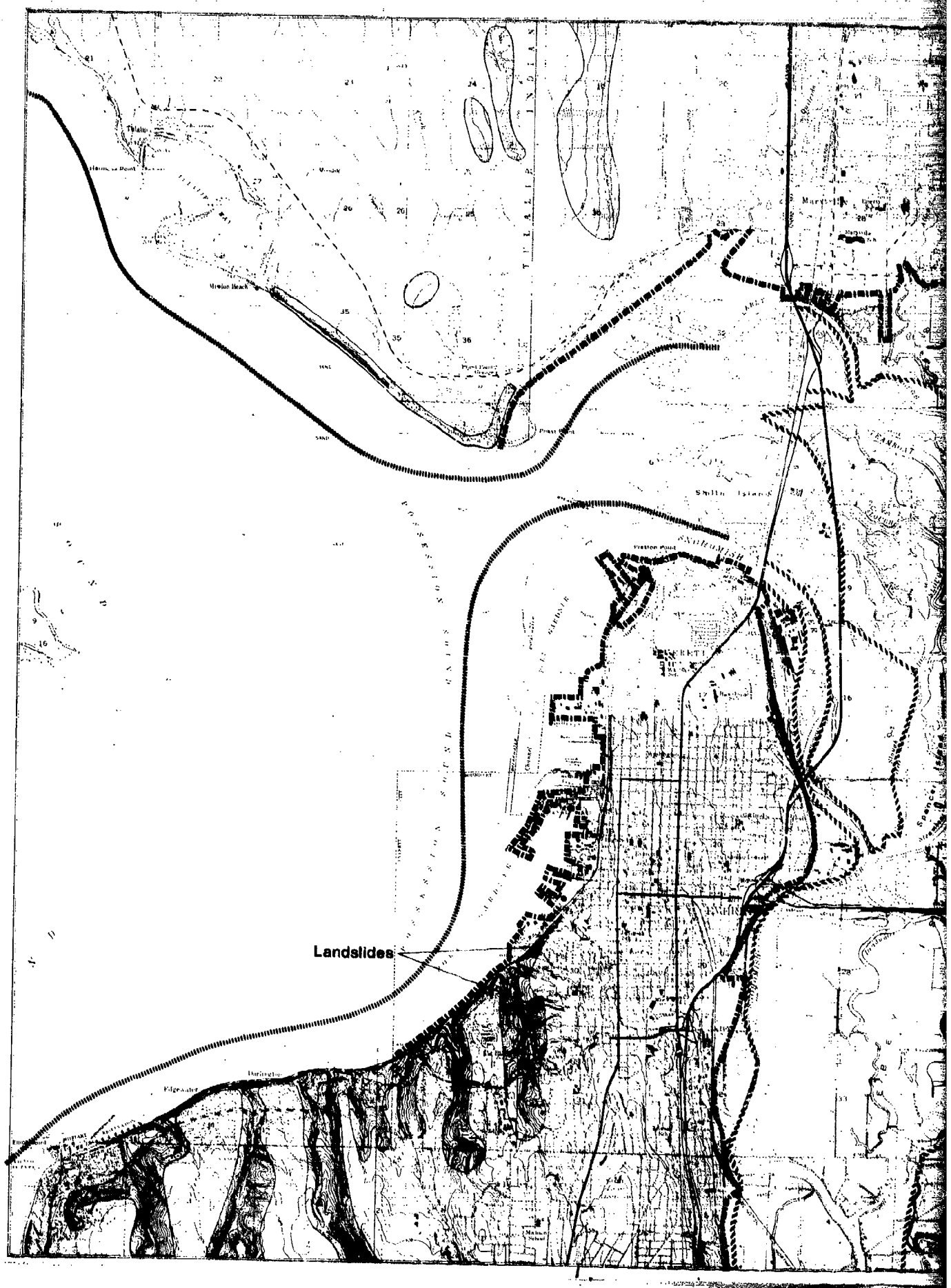
1. The primary geologic hazards which have been identified in the Snohomish estuary are: flooding, landslides, and earthquakes. The extent of identified flood and landslide hazards is shown in Plate 7. Plate 3 identifies the slopes within the study area. Finally, Figure VI-4 provides an indication of recent seismic activity in the surrounding area.

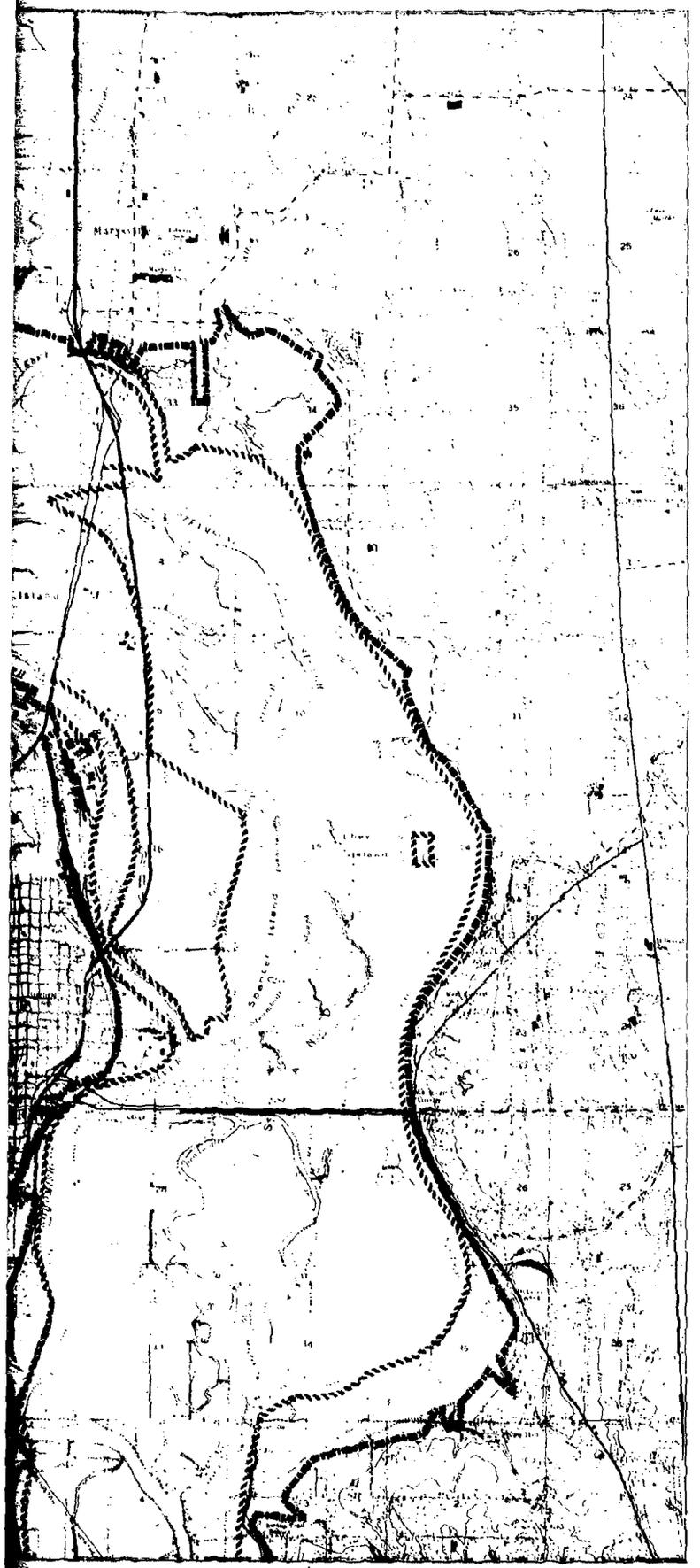
2. Flooding is the hazard most familiar to residents of the Snohomish Valley. The floodplain designated in Plate 7 was determined by the Corps as a part of the Flood Insurance Study done for HUD (U.S. Army Corps of Engineers, 1975c). The floodplain is the extent of flooding expected with a 100 year (144,000 cfs @ river mouth) flood. (Note: the floodplain designated west of I-5 and north of the estuary was not designated in the Corps study. In this area the 10 foot contour was identified as the floodplain boundary.)

3. The 100 year floodplain has been divided into the floodway and the floodway fringe. The floodway incorporates the river channel and any other adjacent portions of the floodplain necessary to carry the 100 year floodwaters without substantial changes in floodwater height (one foot maximum increase in water height according to the Federal Insurance Administration). In other words, if the entire floodway fringe were filled, the water level within the floodway during a 100 year flood would be not greater than one foot higher than if the floodway fringe were not encroached upon, and the entire floodplain were available to carry the floodwaters.

4. The significance of the flood hazard has been recognized by the various jurisdictions within the study area. The floodway boundary designated on Plate 7 is one of four alternatives presented in the Corps study. It is the configuration selected by Snohomish County, Everett and Marysville for planning considerations. According to Snohomish County Ordinance 18.68, permanent structures, landfills, and excavations are prohibited within the floodway. In addition, all permanent structures within the floodway fringe must be floodproofed and most landfills are prohibited.

5. Recent landslides have also been designated on Plate 7. This is probably not a complete identification, however, a comprehensive inventory of slides has not been undertaken. Slides are usually associated with steep slopes, such as those found along valley sides and sea cliffs in the study area. The correlation between landslides and steep slopes is readily apparent. Slopes within the study area are designated on Plate 3. Steep slopes along the west side of both the Intercity Plateau and the Getchel Hill Plateau can be noted.


Landslides



GEOLOGIC HAZARDS

PLATE NO 7

LEGEND

- Approx. Limits of 100 Year Floodplain
- Approx. Limits of Hydraulic Floodway
- Storm Impact Areas
- Unstable Soils
- Landslides

N

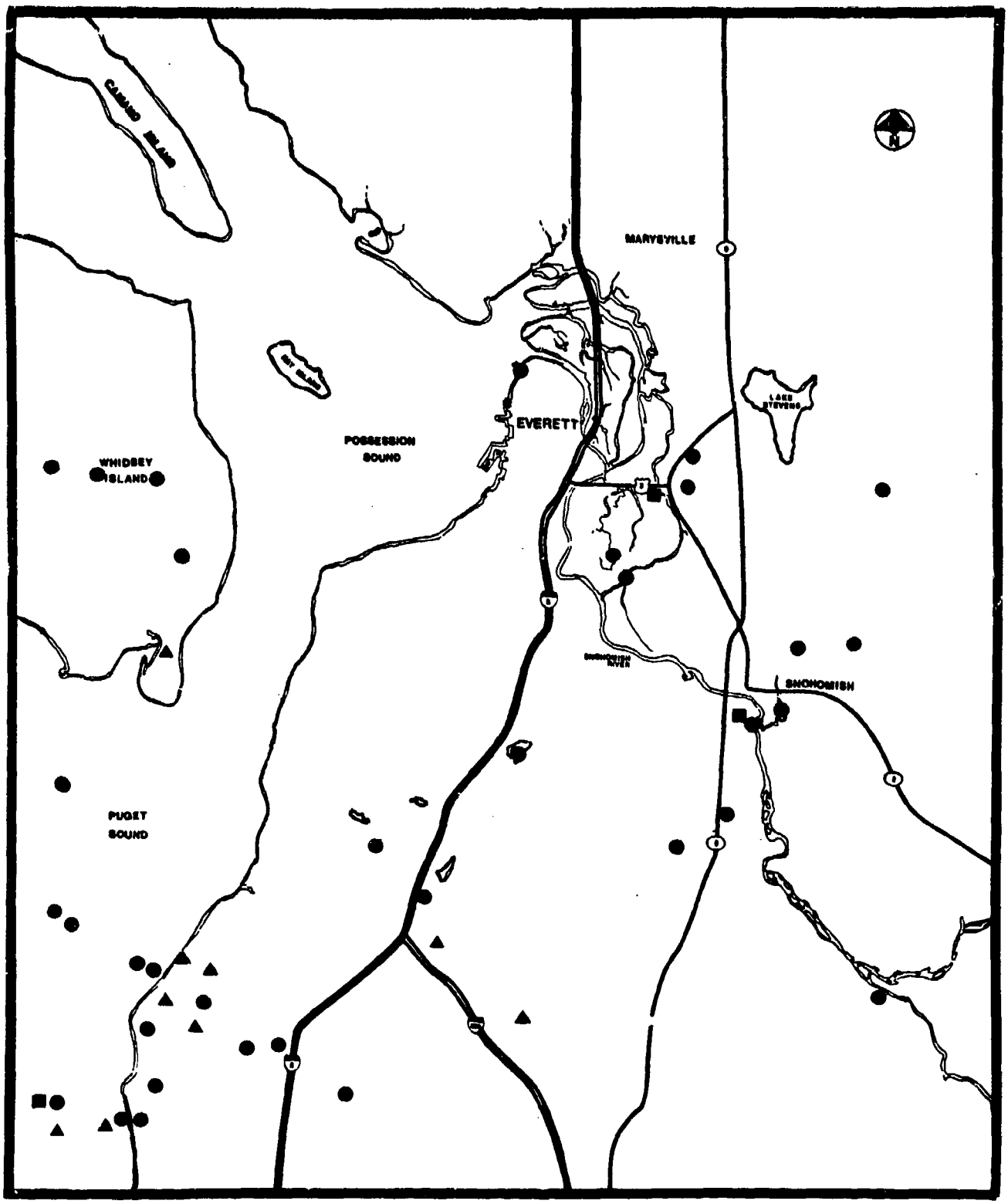
SNOHOMISH ESTUARY WETLANDS STUDY

Source: Smith 1977
Corps 1973
Corps 1978 (unpub)

2

PLATE NO 7

EARTHQUAKES IN THE VICINITY OF THE
SNOHOMISH ESTUARY 1970-1974



Richter Magnitude (M)

■ M > 3

▲ 1.5 ≤ M ≥ 3

● 1.5 < M

6. In addition, groundwater contributes to landslide hazard. Under some conditions, groundwater perched above impermeable substrata may act as a "lubricant", easing the movement of overlying materials. This situation is particularly common where the impermeable substrate is a thick layer of clay. Clay layers are known to occur in the Pilchuck Clay, identified on the east side of the Snohomish Valley (Newcomb, 1952), and the Whidbey Formation (Admiralty Clay of Newcomb, 1952).

7. This discussion is meant only to identify the study area as having some characteristics associated with landslides. No study of slide hazards has been made in the study area; landslide potential should be analyzed on a site-by-site basis.

8. The final hazard to be considered in the study area is earthquakes. Western Washington has long been known to be seismically active, and the Puget Sound region may be the most active portion of the state. Recently, a network of seismic stations has been established in Western Washington and the results have been summarized and published (Crosson, 1975 a,b.c). Figure VI-4 shows the distribution of earthquake hypocenters in the region over the last four years. While few tremors have been felt and no damage has been reported, it should be noted that one of the largest events recorded to date within 15 miles of Everett was located directly below Ebey Island, near the center of the Snohomish estuary.

9. The impact of seismic activity on an area is related to several parameters. These include earthquake magnitude, strength of surface material, and degree of development. It is generally felt that loose sand and gravel and soft clay, such as the alluvial sediments associated with river valleys, provide a poor foundation support for large or rigid wall structures under conditions of seismic loading (Donovan, 1974). In addition, saturated soils may be subject to a variety of effects resulting from seismic activity.

10. Landslides are commonly associated with earthquakes. In addition to the causes mentioned earlier, slope failure may also result from the partial liquifaction of saturated sand or silt during an earthquake. Under these conditions unconsolidated but stable materials might lose sheer strength and move downslope, even on shallow slopes.

11. Another result of the liquifaction of unconsolidated sediments is lateral motion of the material (NAS, 1971). This appears to be a type of downslope movement over very low angle slopes. The effect is often a narrowing of stream and river channels through downslope movement of bank materials. This type of materials movement in the heavily diked Snohomish estuary could have significant consequences.

12. The settling of unconsolidated and saturated sediments is also a well documented result of earthquakes. This may result both from ground vibrations or compression-tension factors (NAS, 1971). The settling may only take place under loaded conditions, such as beneath a building or heavy equipment, or it may result in large crater-like depressions. This settling may also be accompanied by the ejection of water, mud, or sand (waterspouts, sand spouts). Settling in low coastal areas always increases flooding dangers.

13. Thus, flooding is the most prevalent geologic hazard in the estuary. Landslides, however, do occur and locations susceptible to mass movement should be carefully considered in planning and development. Finally, although seismic activity is not frequent in the Puget Sound region, the possible impacts may not be ignored.

G. SEDIMENTATION

1. The deposition of sediment is common to all estuaries. Sedimentation may create a problem if the estuary is used as a commercial waterway, as is the Snohomish. Sediments may be deposited as mudflats, as natural levees, in channel bottoms, or on marsh surfaces. The amount of deposition and sediment type are dependent on the numerous parameters which control the hydraulics of the estuary.

Sediment Source

2. The origin and type of sediment may vary considerably, but four primary sources have been identified for most estuaries: upland water runoff (river discharge), shore erosion, the ocean, and biological activity. Unfortunately, there is little information to determine the relative contribution of these sources to the total sediment within the Snohomish estuary. Since only river-carried sediments have been studied in detail, the other sources can only be discussed in general terms.

3. Suspended sediment transport in the Snohomish Basin has been studied in detail by USGS (Nelson, 1971). This study showed that "sediment discharge is very sensitive to even minor increases in stream flow" (p. 1). As a result, most of the sediment transport occurs during periods of high stream flow, amounting to a few days a year. In addition, increased stream flow also leads to an increased percentage of sand in the suspended sediment. More importantly, however, this study estimated annual sediment discharge as a function of annual water discharge. Results of these estimates for several points in the Snohomish Basin are shown in Table VI-6. Assuming a sediment density of 100 lb/ft^3 (1.4 $tons/yd^3$), this amounts to 200,000-600,000 yd^3 of suspended sediment per year at Highway 99. Just how much of this is deposited in the estuary has not been determined, however, the Corps estimates approximately 250,000 yd^3/yr are trapped in the main channel (R. Regan, U.S. Army Corps of Engineers, personal communication). The Corps has also noted a variation in bottom elevation of up to 5 feet over a year, due to deposition and scour.

Table VI-6

Water and Sediment Discharge in the Snohomish River Basin

Station	Average Water Discharge (cfs)	Estimated Annual Discharge (Tons) 1967	1968
Skykomish River at Monroe	6142	131,000	443,000
Snoqualmie River at Carnation	3782	143,000	372,000
Snohomish River at Confluence of Snoqualmie and Skykomish Rivers	10102	--	--
Snohomish River at Highway 99	--	290,000	840,000

4. Due to the difficulties and expense in accurately analyzing bedload transport this was not undertaken in the USGS study. Rather, it was estimated that bedload discharge varied between 5 and 12% of annual suspended sediment discharge. Since bedload movement is often limited to high stream flow situations the percentage of bedload discharge would probably be greater during years of large peak flows. Thus, in 1968, bedload discharge at the mouth of the Snohomish River might have been as much as 100,000 tons (70,000 yds^3) in addition to the suspended sediment discharged (Nelson, 1971).

5. The presence of high bluffs along the shores of Possession Sound provides another possible source of sediments into the estuary. Erosion of these bluffs adds material to the littoral drift system which might then be transported into the estuary. It is very doubtful, however, that this process actually contributes much sediment to the estuary. South of the river mouth development of Everett Harbor and the railroad have effectively prevented any erosion of these bluffs, thus eliminating any source of sediment for the littoral drift system. To the north, however, the cliffs between Priest Point and Tulalip Bay are actively eroding. Based on topographic comparisons, it appears that the sediment along this north shore is moving northward toward Mission Beach, contributing to the spit at Tulalip Bay. Thus, shore erosion probably does not add much material to the estuarine system.

6. The ocean has been noted as a source of sediments in some estuaries (Fairbridge, 1968) but it is unknown if Possession Sound is an important source in the Snohomish estuary. The deep fiord-like waters of the sound, and low energy wave regime, may preclude any significant contributions of marine sediments to the estuary. In addition, the dynamics of the estuary suggest that any upriver bottom current might occur only occasionally, and then only a few miles upstream (see Hydraulics section); thus, any incoming marine (or littoral) sediments are restricted to the mouth of the river. Further research is needed to determine the characteristics of this situation.

7. Biological activity is also a probable source of sediment within an estuary. The material is represented by the waste products and remains of plants and animals living in the estuary. Much of this material is generated and deposited in marshes and swamps, from which some of it is slowly released through resuspension or grazing. That material which is not added to the estuarine system is often buried and compressed, forming peat deposits (see Mineral Resources). That organic material which is released from the wetlands is either consumed, transported to Possession Sound or deposited in the estuary. Smith (1977) analyzed sediments from several locations at the estuary mouth. His results show organic composition at 3.8 to 5.0% weight (at an elevation of +2.5 feet

MLLW), and 7.6 to 13.6% (elevation +8.5 feet MLLW). It is unknown whether these data are also representative of sediments farther up the estuary. Thus, although biologic activity does not account for a major amount of sediment in the estuary, it does contribute organic material, which in turn is utilized by numerous estuarine organisms.

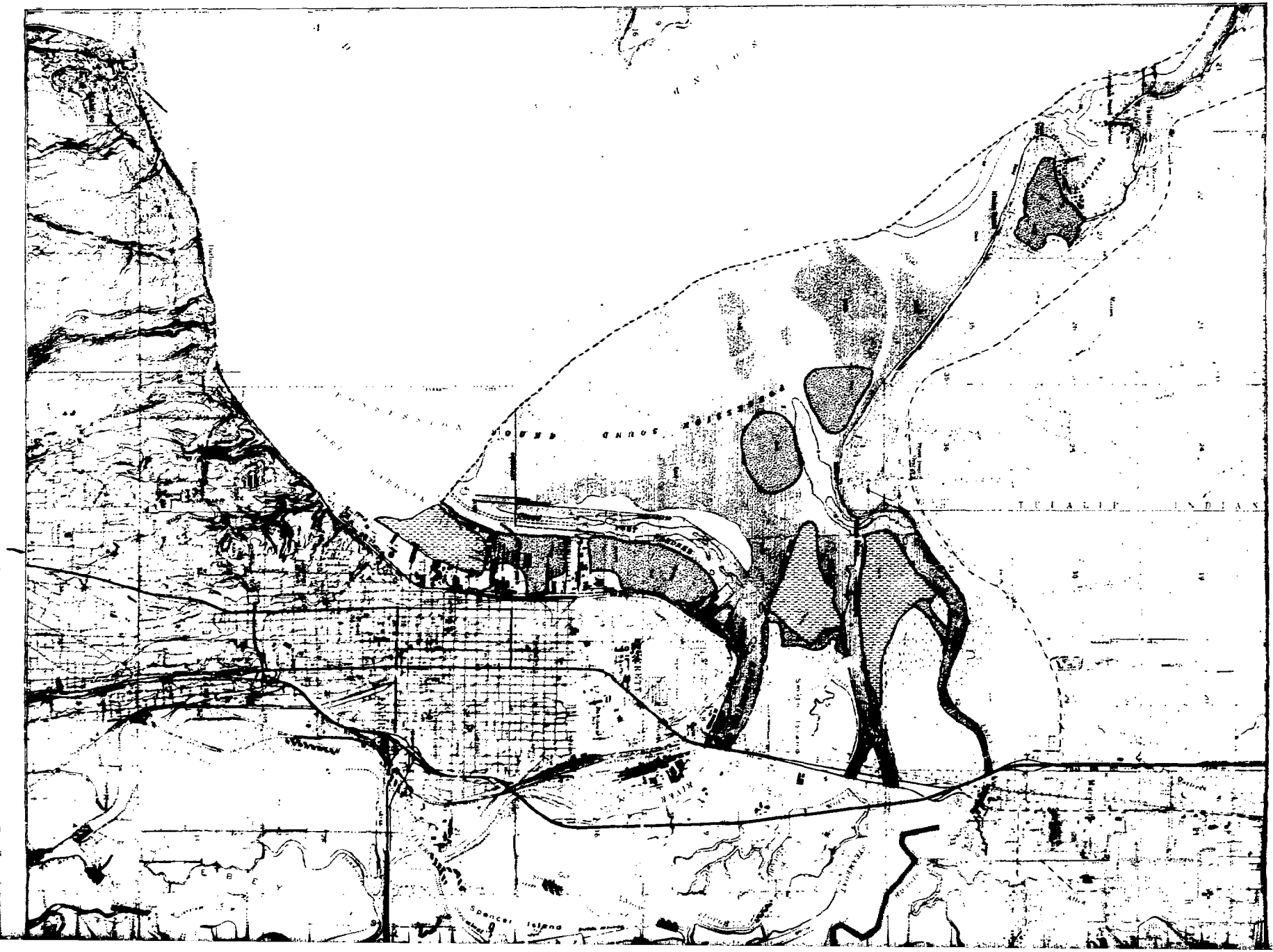
8. In addition to these sources, human activities also add sediments to the estuary. Wood fragments from logging operations are common in some sediments, especially near the mouth of the main channel. Riprap, sand, and other construction materials used in dikes, bulkheads, and other structures also may become estuary sediments.

Sediment Distribution

9. Plate 8 displays the distribution of sediment types as identified in: a study done by the Snohomish County Planning Department (J. Grinols, 1977, personal communication); the sediment analysis done by Smith (1977); an environmental appraisal of Tulalip Bay (Wilsey and Ham, 1977); and the USGS Topo. Although the sediment character for much of the estuary is unknown, the information presented does provide a general description of bottom types.

10. Of particular interest in Plate 8 is the wide distribution of sand in the estuary. Sand or sandy silt was found in all locations but the lower reaches of Ebey Slough. This sediment distribution suggests adequate bottom velocity to prevent deposition of fine materials in most of the estuary, and very low velocities, allowing deposition of clay and silt in the lower reaches of Ebey Slough. Considerable data will be needed to provide a comprehensive view of either the sedimentation or circulation characteristics of the estuary (see Hydraulics).

11. A final point to be noted is the sedimentation pattern at the mouth of the estuary. Considerable changes in this pattern have resulted from construction activities in the area. The jetty, breakwater, and training groins have caused a diversion of flow from the main channel to the south through Port Gardner. This has probably enhanced the growth of tide flats west of Smith and Jetty Islands. In addition, disposal of dredge materials from Port Gardner along the west side of the jetty has probably also contributed to the growth of tidal flats in that area. Due to a lack of accurate charts preceding many of these activities, it is difficult to ascertain the exact extent of sedimentation alteration resulting from construction.


TULALIP INDIAN
Spencer Island

BOTTOM SEDIMENTS

PLATE NO 8

LEGEND

Silt / Mud

Sand

Gravel

Sand / Silt

Unmarked areas - no data
Boundaries are approx.

N

SNOHOMISH ESTUARY WETLANDS STUDY

Source: SCPD (Unpub)
Smith 1977

H. HYDRAULICS

Discharge

1. The Snohomish River and its tributaries drain an area of approximately 1,780 square miles, with an average annual discharge of approximately 2.4 cubic miles per year (approximately 11,000 cubic feet per second). It is estimated that the Snohomish River accounts for at least 30% of the freshwater discharge into Whidbey Basin and 20% of the total freshwater discharge into Puget Sound (Table VI-7) (Lincoln, 1977).

2. The Snohomish River extends approximately 20 miles from its mouth at Preston Point to the confluence of the Skykomish and Snoqualmie Rivers. The river is comparatively flat, falling northward an average of 1.2 feet per mile (Corps, 1967). Comparison of river bottom elevation with tidal observations (Figure VI-5) suggests that mean higher high water intersects the river bottom about 18 miles (29 km) from the mouth of the main channel. It appears likely that river elevations are affected by tides along the majority of its length. USGS and the Corps indicate that tidal effects are noted at the Snohomish gauge (Mile 12), but not at the Monroe gauge located just south of the confluence (D. McLaughlin, Corps). It has also been indicated that tidal effects are not apparent at Snohomish when flows exceed 60,000 cfs.

3. The Snohomish River discharges into Possession Sound through three primary channels: the Main Channel, Ebey Slough, and Steamboat Slough. On the basis of cross sectional areas, one study divided the total discharge among these channels as follows: Steamboat Slough 61%; Main Channel 32%, and Ebey Slough 7% (Orlob, et. al., 1949). These figures do not include any discharge through Union Slough. In an unpublished study, flow at the confluence of Ebey Slough and the Main Channel was distributed as follows: Ebey Slough 32%, and Main Channel 68% (Douglas Houck, DOE, personal communication, 30 November 1977). It appears that the distribution of discharge may be constantly changing due to siltation in the sloughs or realignment of the sand bar located at the confluence of Ebey Slough and the Main Channel; there has been no research to verify this, however.

4. Due to tidal influence in the estuary, stream flow for the entire river can only be estimated. This estimation involves combining the streamflow data from several gauging stations to determine the streamflow for the entire river basin. Where a portion of the basin is not gauged, streamflow can be approximated by identifying a gauged stream within the area with a representative specific water yield (in cfs/square mile) and applying that value to the entire ungauged area. The estimation of river streamflow also requires that all data be of the same time period or correlated to the same time period. Using these techniques, the Hydraulics and Hydrology Branch, U.S. Army Corps of Engineers, estimates an average discharge

ESTIMATED AVERAGE ANNUAL DISCHARGE, PUGET SOUND
(after Lincoln, 1977)

	Approximate Discharge* cfs	Approximate Percentage of Puget Sound Total
Whidbey Basin		
Skagit	16,200	32
Stillaguamish	4,400	9
Snohomish	11,000	21
Other**	800	1
Subtotal	32,400	63
Main Basin		
Lake Washington Ship Canal	1,700	3
Green (Duwamish)	1,800	4
Puyallup	3,800	7
Other	400	1
Subtotal	7,700	15
Southern Basin		
Nisqually	2,800	6
Deschutes	800	1
Other	1,800	4
Subtotal	5,400	11
Hood Canal		
Quilcene	600	1
Dosewallips	800	2
Duckabush	500	1
Hamma Hamma	600	1
Skokomish	1,200	2
Other	1,800	4
Subtotal	5,500	11
Admiralty Inlet		
Ungauged runoff	300	<1
TOTAL PUGET SOUND	51,300	100

* Discharge values corrected for ungauged areas tributary to named rivers and streams.

** Other = Miscellaneous ungauged small streams not tributary to named river drainage basins.

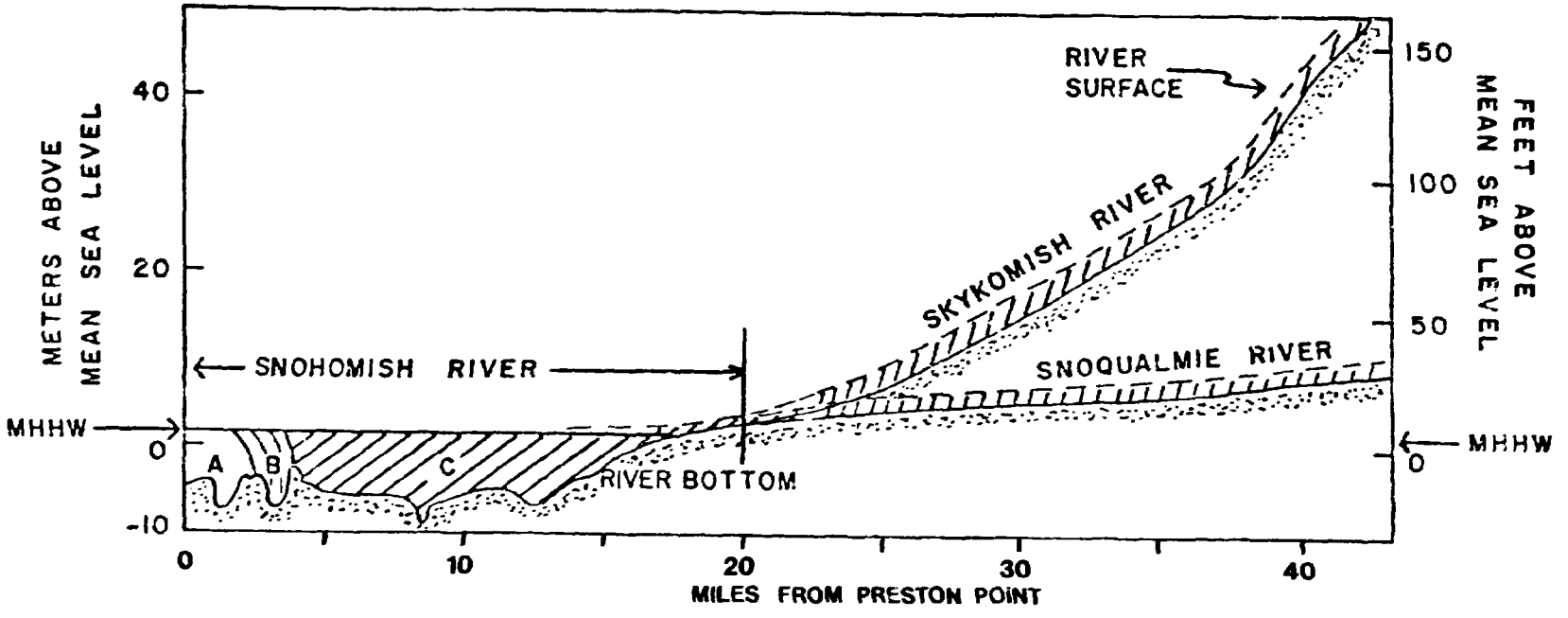


Figure VI-5 River bottom (solid) and surface (dashed) elevation versus distance inland. Notation: A, Puget Sound water intruding upstream; B, salinity gradient separating Puget Sound and river waters; C, Snohomish River water; and MHHW, mean higher high water.

of 13,500 cfs from the Snohomish River in 1976 (D. McLaughlin, Corps, Seattle District, personal communication).

5. The seasonal cycle of monthly average discharge of the Snohomish River may be approximated from records using the Monroe gauge (Figure VI-6). There is considerable drainage area at high elevation. Consequently the normal high-flow period associated with winter rains is followed by a second high-flow period in spring associated with snowmelt. Typically, minimum monthly flows are recorded during August. Greatest variability in monthly flows occurs in December, and the least variation occurs in August.

Groundwater Recharge

6. The principal aquifer in the study area is the Esperance sand (Newcomb, 1952), a highly permeable sand and gravel unit which overlies the Admiralty Clay (Double Bluff formation of Smith, 1976). This aquifer is recharged through percolation of rainfall on the Tulalip, Getchel Hill, and Intercity Plateaus. In most locations the aquifer is located well above sea level, thus precluding any direct connection with the Snohomish estuary.

7. The alluvial deposits of the river valley may also serve as an aquifer within the river basin. These deposits are usually connected directly to the river. Large wells at Monroe tap this source for city water. In the region of the estuary, however, water from these deposits is often saline, indicating contamination from intruding sea water. In addition, water bearing strata in these deposits are often lenses of permeable sand and gravel within finer grained impermeable layers. Thus, water may be trapped or stagnant and recharge slow.

Estuary Type

8. According to Pritchard's (1955) definition, the estuarine portion of a river extends upstream only as far as the saline intrusion. The type and position of saline intrusion in the different sloughs varies with tide, discharge, and channel configuration. In addition, discharge within each slough will vary seasonally and with distribution at the confluences.

9. The few available observations of saline intrusion in the Snohomish estuary were all taken in the Main Channel. These data suggest a high tide saline intrusion of approximately 7 miles (12 km) upriver from Preston Point during low discharge and about 3 miles (5 km) at times of average discharge (Figure VI-7). From the figure it is apparent that the Main Channel varies from being

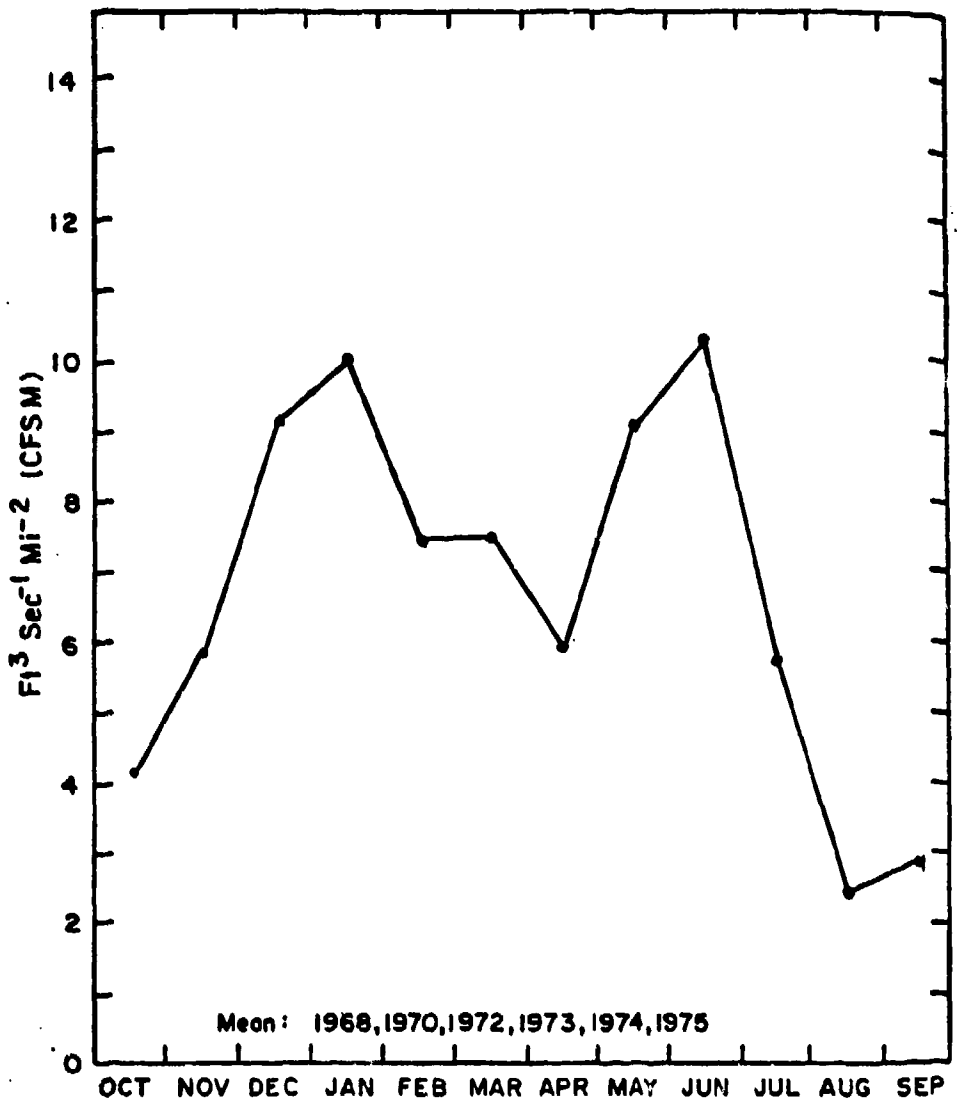


Figure VI-6 Seasonal cycle of monthly average discharge (from Lincoln, 1977). Ordinate reads 'cubic feet per second per square mile of drainage area', abbreviated CFSM.

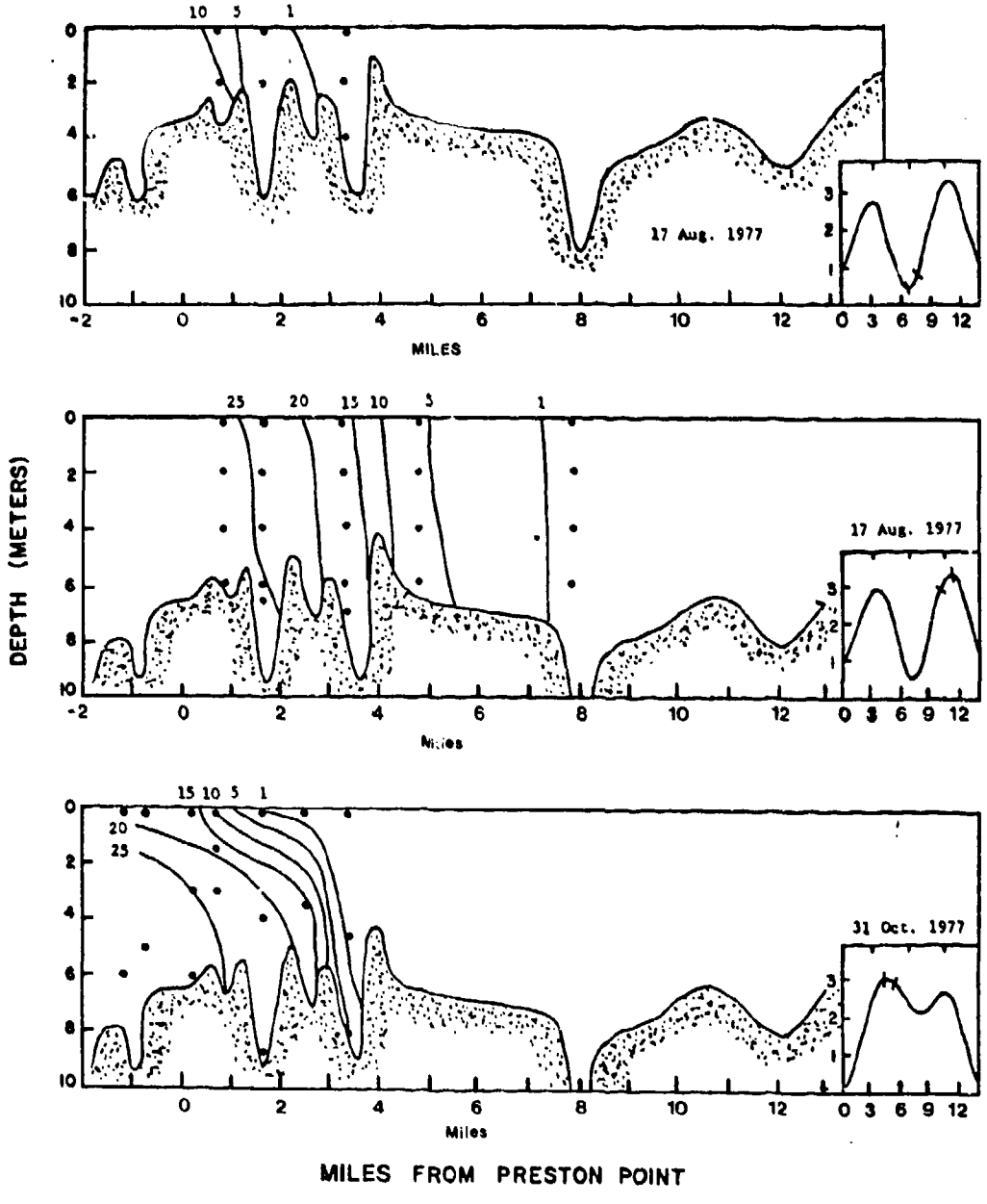


Figure VI-7 Salinity contours (°/oo) lower Snohomish River, Main Channel. Top--low discharge (43m^3/sec) and low tide (inset); Middle--low discharge (43m^3/sec) and high tide; Bottom--average discharge (317m^3/sec) and high tide. Data sources: top and middle from Yearsley, 1972; bottom from Boulé and Shea, 1978.

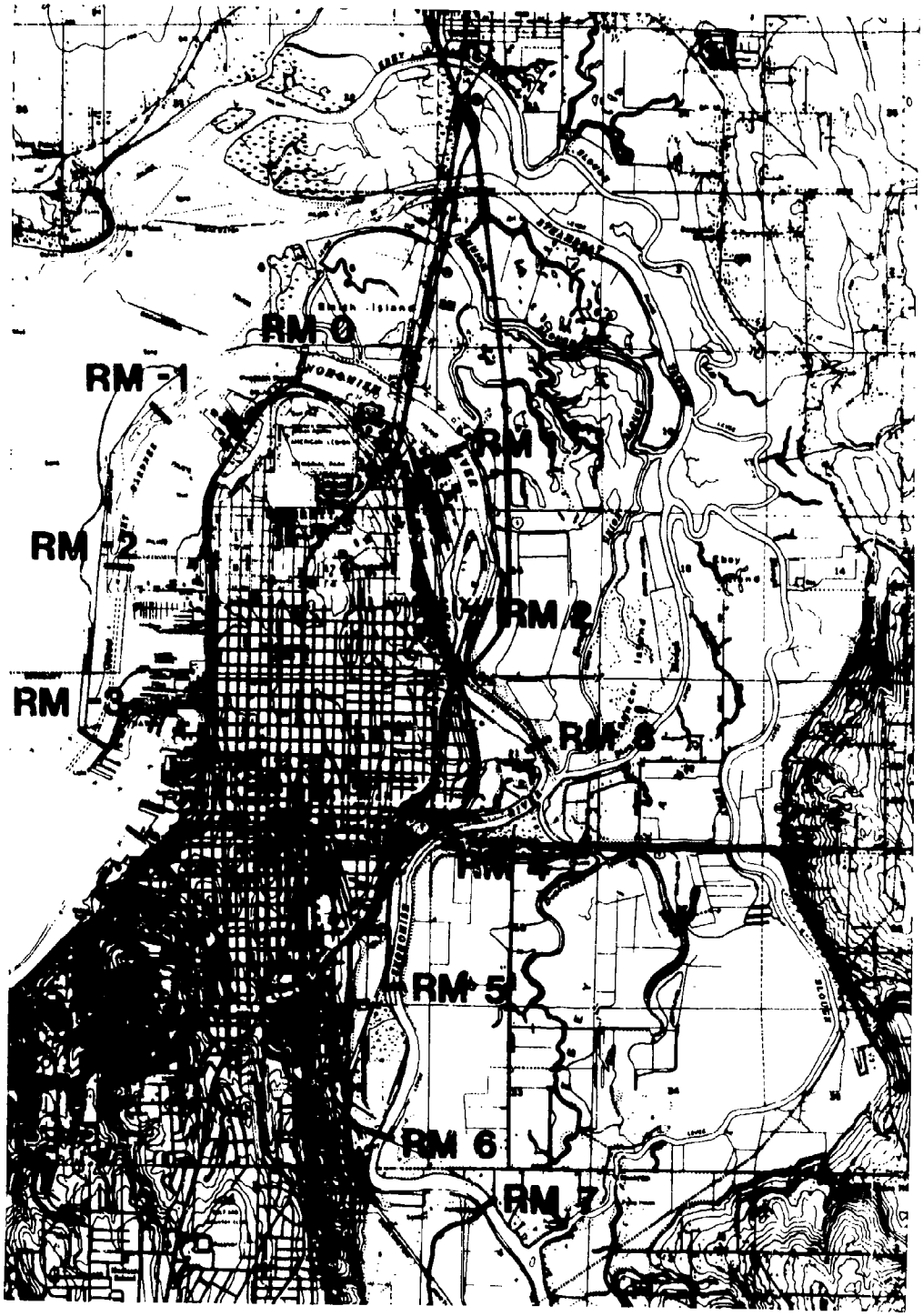


Figure VI-7b RIVER MILES IN SNOHOMISH RIVER

vertical homogeneous (at low discharge) to being partially stratified (at approximately average discharge).

10. In the absence of comprehensive current studies, it is not possible to quantify the dynamics of the Snohomish River. It is possible, however, to infer current movements from the results of studies in other similar estuaries which have been studied. From these studies it may be reasonable to infer that under average discharge conditions there is a net upstream current along the bottom over a tidal cycle (this is probably not true under flood conditions). If such a current does actually exist, it would provide an upstream pathway for contaminants introduced at depth in the Port of Everett. An upstream current might also provide a path for fine sediments from the river mouth area to enter the Main Channel. There is insufficient data to infer the type and extent of saline intrusion in the other sloughs.

Regional Significance

11. Oceanographic studies and modeling studies by the University of Washington Department of Oceanography (Barnes and Ebbesmeyer, 1977) suggest that an unusual tidal mixing and transport process occurs in Puget Sound. Because of this unusual situation some of the fresh water which leaves the Snohomish River does not move to Admiralty Inlet and then on to the Straits of Juan de Fuca and seaward. The data suggest instead that surface water entering the Admiralty Inlet is mixed with deep landward moving water and carried south toward Seattle and Tacoma.

12. In order to explain this process it is necessary to describe the water bodies involved and their physical characteristics. Whidbey Basin (into which the Snohomish River empties) is a highly stratified fjord with a shallow low salinity surface layer and low net transport. The main basin of Puget Sound is a well mixed fjord characterized by a deep surface layer and high net transport. Admiralty Inlet is a strait where the seaward flowing waters of the two basins mix with the deep water flowing landward from the Straits of Juan de Fuca.

13. Figure VI- 8 is a simplified vertical cross section of Puget Sound and Whidbey Basin from Deception Pass to the Nisqually River. Figure VI-9 shows the path of that cross section. In this discussion it should be remembered that movement of water refers to net transport and not tidal oscillation.

14. Deep, landward flowing water from the Straits of Juan de Fuca is mixed vigorously with surface water as it moves across the two sills in Admiralty Inlet. In the process, it entrains some of the surface water and refluxes it landward along the bottom. At the junction of Whidbey Basin, Puget Sound and Admiralty Inlet, at

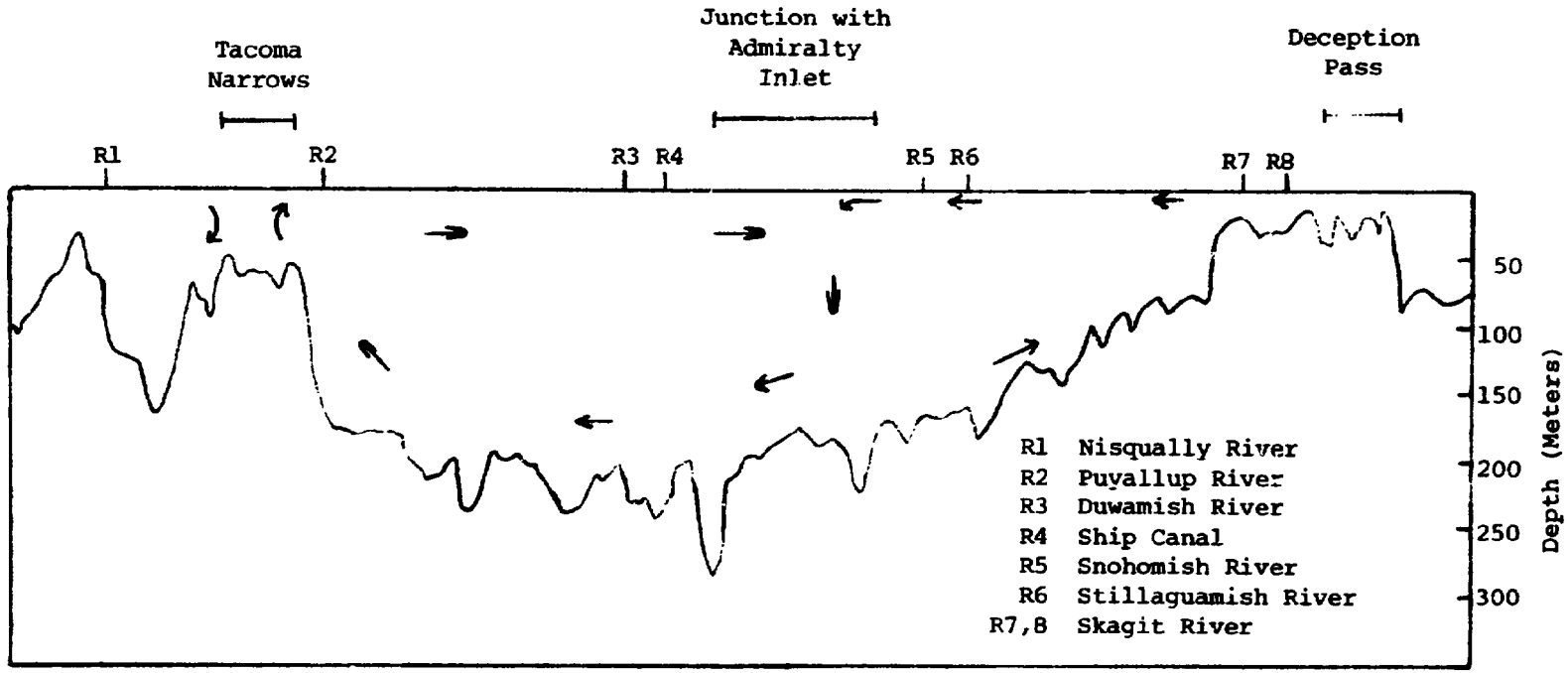
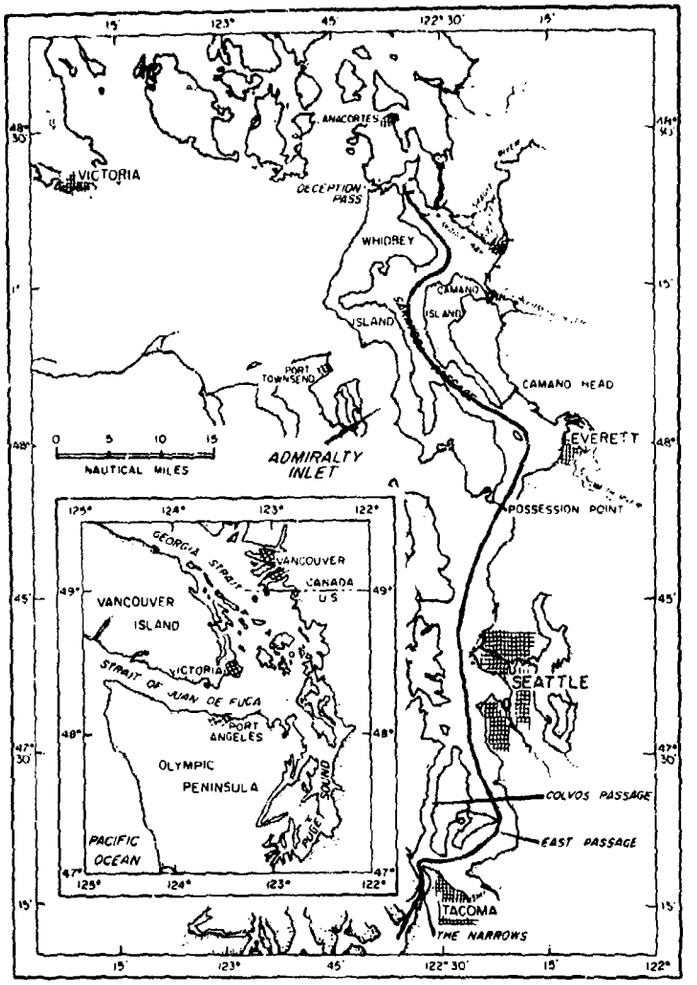


Figure VI-8

REGIONAL CIRCULATION IN PUGET SOUND AND WHIDBEY BASIN
(Adapted from Barnes and Ebbesmeyer, 1977)

Figure VI- 9

LOCATION OF CROSS SECTION OF REGIONAL CIRCULATION
(after Barnes and Ebbesmeyer, 1977)



least 60% of the transport is south along the bottom of Puget Sound; the remainder moves northward into the Whidbey Basin. The data indicate entrainment of Whidbey Basin surface water into the southward flowing deep water at this point. At the Tacoma Narrows the deep water is again vigorously mixed (in a manner similar to the process at Admiralty Inlet), and the surface water moves north toward Admiralty Inlet.

15. At the present, this process has been reasonably well substantiated. There is not, however, enough data with which to quantitatively analyze the process to determine the velocities, times and relative mixing involved. Nonetheless it is reasonable to assume that some Snohomish River water (and any associated long-lived contaminants) will move to Admiralty Inlet, be entrained with landward moving bottom water, and finally carried to Tacoma Narrows before mixing with seaward moving Puget Sound surface water.

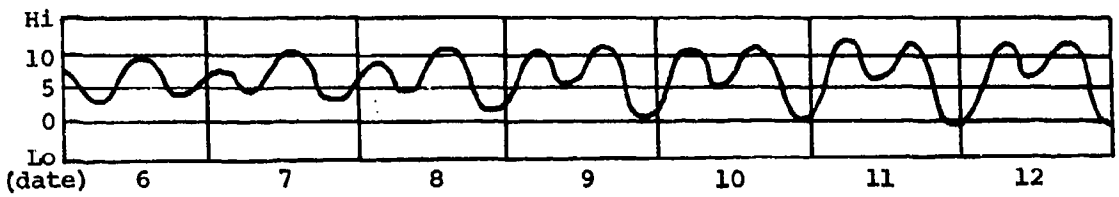
16. As previously mentioned, the mean annual flow from the Snohomish River is approximately 11,000 cfs. It has been estimated that the mean annual transport at Admiralty Inlet is approximately 1,000,000 cfs. Thus, there is approximately a 100 to 1 dilution of Snohomish River water entering Admiralty Inlet. Despite this dilution factor, the significance of this transport process should be evaluated when considering the discharge of highly toxic and long-lived contaminants into the Snohomish estuary.

I. TIDAL CHARACTERISTICS

1. The tides at Everett are characterized by a diurnal inequality; that is, successive high or low tides have different elevations. This inequality is shown in Figure VI-10. On extreme tides this inequality may amount to as much as a nine-foot difference in successive lows (e.g. 11 December 1977) or a four-foot difference in successive highs.

Figure VI-10

TIDES AT EVERETT
December 6-12, 1977



2. Elevations of various tidal datum planes are given in Table VI-8 as well as the associated tide ranges. These datums are based on 12 months of tidal records collected July 1952-June 1953 at the end of Pier 1, Port of Everett.

3. In addition to the Everett tide gauge NOAA established a gauge on Ebey Slough. This gauge, located near the mouth of Quilceda Creek, was monitored from April 5, 1977 to May 5, 1977. The tidal datums established for this station are shown in Table VI-9.

4. The rate and characteristics of tidal movement in the Snohomish River have not been studied. To date, no tide gauges have been established to provide the necessary data. There are, however, scattered data which can be used to infer some tidal characteristics in the estuary. These data include current velocities measured in 1973 and water level heights at Lowell on 23, 24 June 1977.

5. The current studies were carried out to provide data for the water quality model at the Snohomish River (Snohomish County, 1974). As is apparent in Figure VI-11, tidal currents at most stations in the river showed a slack after high water (HWS) approximately two hours after high water at Everett. Of particular interest is the minimal variation in time of HWS with location in the estuary. Further data will be necessary to verify and interpret this information.

Table VI-8

Tidal Computations at Everett

Datum	Elevation Above MLLW (feet)	
Extreme High Water	14.5	(estimated)
Mean Higher High Water (MHHW)	11.10	
Mean High Water (MHW)	10.20	
Mean Tide Level (MTL)	6.50	
Mean Low Water (MLW)	2.80	
Mean Lower Low Water (MLLW)	0.00	
Extreme Low Water	- 4.5	(estimated)
Range		
Mean Range [(MHW) - (MLW)]*	7.4 ft.	
Diurnal Range [(MHHW) - (MLLW)]*	11.1 ft.	
Other		
National Geodetic Vertical Datum- Mean Lower Low Water [(NGVD) - (MLLW)]**	6.13	

* The mean tide range is the difference between MHW and MLW. The diurnal range is the difference between MHHW and MLLW.

**The elevation of NGVD above MLLW according to tide records.

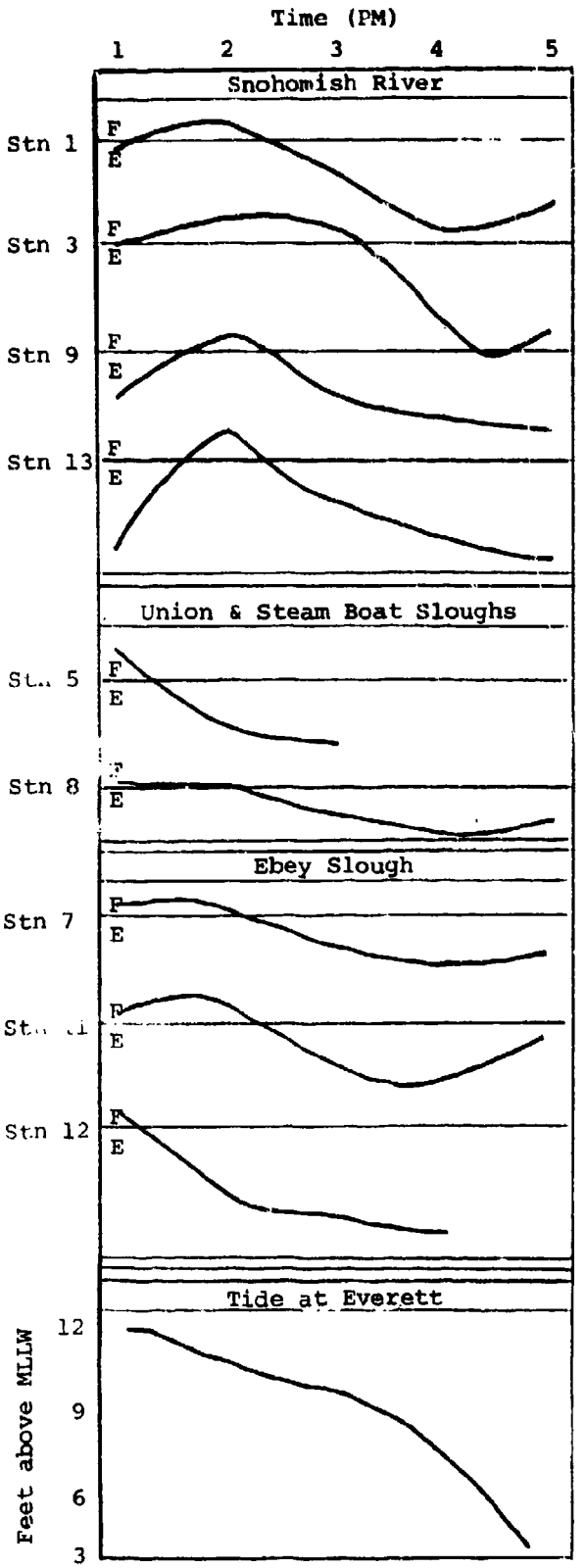
Table VI-9

Tidal Computations at Ebey Slough

Datums	Elevation Above MLLW (feet)
MHHW	10.4
MHW	9.7
MTL	5.9
MLW	2.0
MLLW	0.0
Ranges	
MHW - MLW	7.7
MHHW - MLLW	10.4
Other	
NGVD - MLLW	5.54

(These datums are interpreted from NOAA tide records and have not been officially published.)

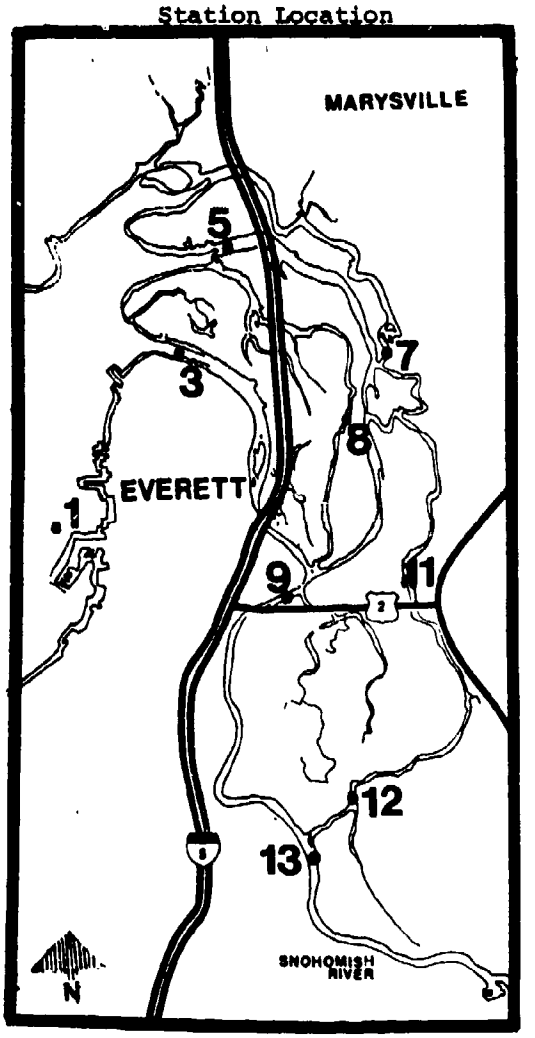
CURRENTS IN THE SNOHOMISH ESTUARY AND TIDES AT EVERETT ON NOVEMBER 19, 1973



F - Flood Current
E - Ebb Current

— 1 m/sec

Station Location



Source: Water Quality Management Plan for the Snohomish and Stillaguamish River Basins, Snohomish County, 1974

6. The water level heights at Lowell were measured in conjunction with a survey and river cross sections in the area. Water levels were measured at 16 sites along the Snohomish River between the Highway 2 crossing and the pump station at Marshland. The water levels were measured at approximately one hour intervals over two days. Figure VI-12 compares the tides at Everett to the water levels collected at Lowell for 23, 24 June 1977. From the figure it appears there is very little time difference between high tide at Lowell and high tide at Everett, but perhaps a one-hour lag between low tide at Everett and low tide at Lowell.

7. A final point to be considered is the interaction of river flow and tidal fluctuation. Water level in the estuary rises and falls in response to both tides and river flow. This has been noted at the USGS river gauge at Snohomish where a diurnal fluctuation resulting from tides must be accounted for in determining river discharge (Washington Division of Water Resources, 1962). Thus, the water level at any time or location within the estuary is a product of both tide and river discharge, and both aspects need to be considered in discussing water level characteristics.

8. This description of tides in the Snohomish estuary is based on minimal data. Installation of tide gauges in many areas will be necessary to fully describe the tidal characteristics of the area.

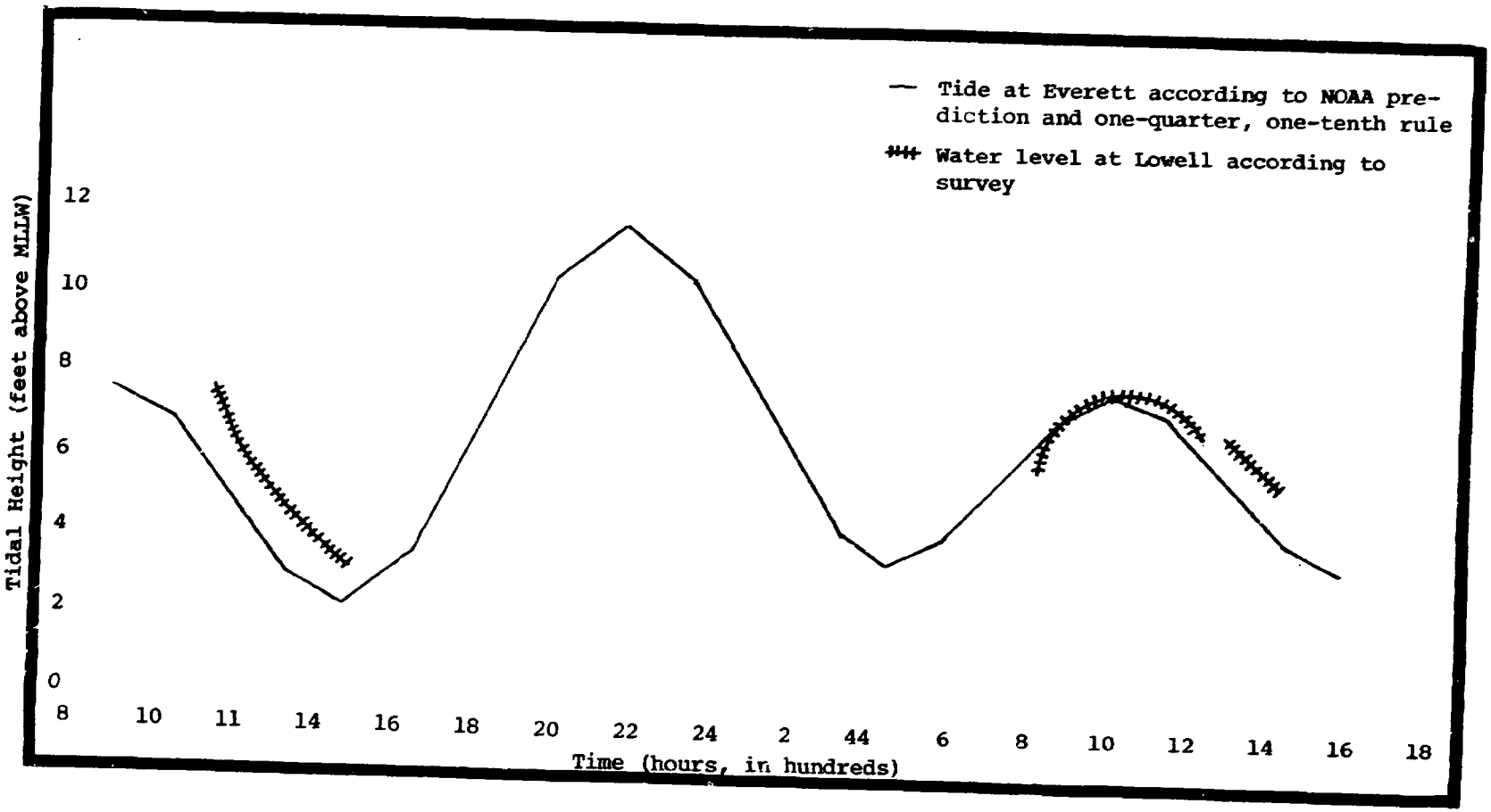


Figure VI-12

TIDES AT EVERETT, WATER LEVEL AT LOWELL
June 23-24, 1977

J. WATER QUALITY

1. A comprehensive water quality study in the Snohomish estuary-Port Gardner area has never been conducted. There have, however, been a number of studies of limited geographical and/or water quality interests. One generalized reconnaissance of the estuary and port area has been conducted as part of a larger water resources study (SCRD, 1974b) Following a discussion of water quality factors, the various water quality studies within the area will be reviewed. Finally, the results of these studies will be summarized and their significance considered.

2. Water quality is a concept used to describe and protect the resource value of water. It is defined by the minimum and/or maximum values of a variety of natural factors and constituents, and also contaminants. The use(s) of the water resource determines which water quality factors must be considered and to what extent; water quality is not an absolute. Water quality goals are not absolute either; for example, WAC 173-201 states "no further degradation which would interfere with or become injurious to existing beneficial uses will be allowed."

3. Water quality parameters for which data have been collected in the Snohomish Basin include: temperature, salinity, pH, dissolved oxygen, nutrients, and bacteria. Water quality standards have been established by the State of Washington for bacteria, dissolved oxygen, dissolved gases, temperature, pH, turbidity, and toxic materials. Table VI-10 presents the criteria for these standards for the various classes of water. The entire Snohomish estuary from the confluence of Ebey Slough to the mouth is designated class B; the shoreline from Priest Point northward, including Tulalip Bay, is designated class A.

4. Temperature is important to organisms that live in the water, and because of its effects on other water quality factors such as dissolved oxygen. It is usually measured in degrees celsius. Salinity is a measure of the intrusion of water from Puget Sound into the river. In streams and lakes above the saline intrusion, salinity indicates salts leached from the ground or agricultural areas. Salinity is usually reported as parts per 1,000 (PPT), a ratio of salt to water, or as conductivity (mhos/centimeter^2), a measure of the electrical conductivity of water. Conductivity increases as salt content increases. pH is a measure of the acidity or alkalinity of the water. A pH of 7 is neutral, less than 7 indicates acidic condition, greater than 7 indicates basic conditions.

5. Dissolved oxygen (DO) is a measure of the amount of oxygen in the water available to organisms for respiration. The maximum amount of DO water can contain is determined by the temperature of the water; as temperature increases, oxygen saturation decreases.

Table VI-10

CRITERIA FOR STATE OF WASHINGTON WATER QUALITY STANDARDS

Classification		Fecal Coliform Organisms MPN/100 ml (a)	Dissolved Oxygen, mg/l	Total Dissolved Gas, % Saturation	Temperature °C (b)	pH (c)	Turbidity, JTU (d)
AA Extraordinary	Freshwater	<50 (10% > 100)	>9.5	<110	<16 t=23/(T+5)	6.5-8.5 (0.2)	<5
	Marine	<14 (10% > 43)	>7.0	<110	<13 t=8/(T-4)	7.0-8.5 (0.2)	<5
A Excellent	Freshwater	<100 (10% > 200)	>8.0	<110	<18 t=28/(T+7)	6.5-8.5 (0.5)	<5
	Marine	<14 (10% > 43)	>6.0	<110	<16 t=12/(T-2)	7.0-8.5 (0.5)	<5
B Good	Freshwater	<200 (10% > 400)	>6.5 (g)	<110	<21 t=34/(T+9)	6.5-8.5 (0.5)	<10
	Marine	<100 (10% > 200)	>5.0 (g)	<110	<19 t=16/T	7.0-8.5 (0.5)	<10
C Fair	Freshwater	(0% > 1000)	>5.0 (e)	<110	<24 t=39/(T+11)	6.5-9.0 (0.5)	<10
	Marine	<200 (10% > 400)	>4.0 (e)	<110	<22 t=20/(T+2)	6.5-9.0 (0.5)	<10

(a) Shown in parenthesis are the maximum percentages of samples allowed to exceed values indicated.
(b) Water temperature shall not exceed values shown, due in part to measureable (0.5° C) increases resulting from human activities, nor shall such temperature increases at any time exceed the (t) value of the formula shown: t = permissive increase, T = water temperature due to all causes combined.
(c) Shall not be within the range shown, with an induced variation of less than units shown in parenthesis.
(d) The natural turbidity conditions shall not be exceeded by more than the value shown.
(e) Dissolved oxygen shall not exceed values shown, or 50% saturation, whichever is greater.
(f) No measureable decrease from natural conditions.
(g) Dissolved oxygen shall not exceed values shown, or 70% saturation, whichever is greater.

Closely related to DO is the biochemical oxygen demand (BOD), a measure of the DO being used for respiration by zooplankton or in chemical reactions with materials in the water. If the BOD is too high, the DO will decrease, and large organisms such as fish will die off. DO and BOD are measured as milligrams of oxygen per liter (mg/l).

6. Nutrients measured for water quality purposes are nitrates and phosphates. These nutrients are important to the growth of phytoplankton in the water. Increases in nutrient concentrations may lead to algal "blooms" and other water quality problems. The concentrations of both organic and inorganic forms of these nutrients are important limiting factors in the growth of phytoplankton and other aquatic organisms. These concepts are discussed further in Section VI, Nutrient Cycling.

7. Coliform and fecal coliform bacteria are used as indicators of pathogenic bacteria. Fecal coliforms are usually indicative of sewage effluent contamination. Coliforms are not necessarily indicative of sewage contamination, but may indicate agricultural or urban runoff contamination.

WATER QUALITY STUDIES

Port Gardner and Adjacent Waters

8. The earliest known study of water quality in the study area was an investigation of pulp mill wastes in Everett Harbor and the mouth of the Snohomish River (Orlob, et. al., 1951). Intensive studies in September-November 1949 indicated an oxygen deficiency at the mouth of the harbor which appeared to act as a block to upstream fish migration. The decreased DO presumably resulted from the discharge of spent sulphite liquor (SSL) in the harbor area. Following the 1949 study an outfall was established at a depth of about 300 feet. A reinvestigation of water properties in June 1951 indicated an apparent improvement in the quality of surface waters in Everett Harbor.

9. In order to assess any change in water quality a comparison was made of the surface water dissolved oxygen noted in 1949 and that observed between 1967-1977 by various investigators. Dissolved oxygen was chosen for comparison because its concentration varies in roughly inverse proportion to spent sulphite liquor concentration, especially, and because it is routinely observed. Near Lowell (mile 6.5) in both 1949 and 1967-1977 median DO concentrations were 10-12 mg/l (Figure VI-13). In 1949 median concentra-

tions decreased to 2-3 mg/l at river mouth, contrasted with 5-6 mg/l in 1967-1970. (The observations at the river mouth taken during 1967-1970 were made prior to reductions in discharge by the two pulp mills on Port Gardner.) Based on the median of observation taken during 1952-1970 (in September to October), DO concentrations increase from the mouth toward Possession Sound. Thus, between 1949 and 1970 the oxygen minimum at the river mouth appears to have decreased but has not been completely eliminated. There is insufficient data to determine whether this minimum has been completely eliminated with the reduction in discharge by the two pulp mills.

10. The Washington State Department of Ecology (DOE) has maintained a number of water quality monitoring stations in Possession Sound, Port Gardner, and the Snohomish River since the 1960's. Monitoring frequency is variable at some stations, and also varies between stations. Data developed from this monitoring program is available from the STORET computer storage and retrieval system which is maintained by EPA. DOE has not published, summarized, or interpreted the data in any other format.

11. The Ecological Baseline and Monitoring (ECOBAM) Study of Port Gardner and adjacent waters began in 1972 by the Washington State Department of Ecology at the request of Governor Evans to examine the relationships between reductions in pulp mill waste discharges and biological changes in Port Gardner. The objective of the study is to determine baseline descriptions of the study area prior to the reduction of waste discharges and to monitor expected changes in water quality conditions and biological population. A summary report of the first three years of the ECOBAM project has been published (DOE, 1976a) which describes monitoring of benthos, salmon and other fish, toxicity of the waters, general water quality, marine infauna, benthic macrofauna, and intertidal flora and fauna. The data suggest a recent improvement in water quality and decrease in toxicity.

12. In 1972 the Washington State Department of Fisheries began intensive investigations of water quality in Port Gardner as part of the ECOBAM study. Using the early development of Pacific oysters (Crassostrea gigas) for bioassay, a number of stations in Port Gardner, Port Susan, and Saratoga Passage were sampled for toxicity (Cardwell, et. al., 1976). The resulting data show extensive areas with greater than 50% abnormality throughout Possession Sound and Port Susan in 1972, but only a small area in Port Gardner with greater than 50% abnormality in 1975. Bioassays of deeper water showed little change between 1972 and August 1974 and a remarkable decrease in toxicity between August 1974 and August 1975.

13. A study of benthic invertebrates in the mouth of the Sno-

homish River (Smith, 1977) peripherially examined the effect of log rafting on water quality. Water quality data was obtained from the STORET data bank, using historical DOE monitoring. No serious problem associated with oxygen depletion was determined, and it was considered likely that tidal flushing is strong enough to alleviate any BOD exerted by log rafts. This investigation was concerned only with intertidal log rafting west of the old U.S. 99 bridges over the sloughs. No mention is made of log rafting in the channels east of the bridges where logs are rarely grounded and tidal flushing is less vigorous.

Snohomish Estuary

14. The Snohomish County Planning Department (SCPD) conducted a water quality reconnaissance of the Snohomish and Stillaguamish river basins (including Port Gardner) for the purposes of developing water quality management plans and mathematical models (SCPD, 1974b). This study accurately identified many of the potential pollution sources in the estuary and in Port Gardner: runoff from grazing lands and feed lots such as those on Ebey Island and in the Marshland area; solid waste leachate such as that from the municipal dump in the Tulalip Reservation (North Ebey Island); domestic sanitary sewage treatment plant (STP) effluent such as that from the Everett, Marysville, and Lake Stevens STP's; and sulphite pulp mill wastes, particularly in Port Gardner. As a result of this study a water quality index (on a scale 1-10) was developed and applied to various portions of the Snohomish Basin. Table VI-11 identifies this index value for the study area.

15. During the summer of 1977, the U.S. Environmental Protection Agency conducted a brief, detailed monitoring of four water quality parameters to test the water quality model developed for the lower Snohomish River by the Snohomish County Planning Department. The model was found to be at least partially inaccurate (Yearsley, 1977).

16. The Marshland watershed was the subject of a Washington Department of Game wildlife and water quality study (Engman and Stendal, 1976) for the U.S. Soil Conservation Service during 1974 and 1975. Although the Marshland watershed lies adjacent to, but not within, the study area, agricultural effluents from Marshland are discharged into the Snohomish River within the study area as a point source discharge. These effluents are typical of agricultural drainage in the Snohomish estuary. Results of this study are summarized below.

17. If the water quality of streams from the Marshland uplands is compared with water quality in the ditch and floodway system in

Table VI-11

SNOHOMISH ESTUARY WATER QUALITY INDEX RATING*

Sub Area		pH	DO	NO_3	Fecal Coli-form	OPO_4	Total Dissolved Solids	Turbi-dity	Total Coli-forms	Water Quality Index
Snohomish at Hewitt Bridge	Worst	8	6	--	--	--	--	4	4	5.72
	Mean	10	10	--	--	--	--	6	6	8.43
Snohomish at S. Smith Island	Worst	10	6	--	--	--	--	2	2	5.47
	Mean	10	10	--	--	--	--	6	4	8.01
Everett Harbor	Worst	10	2	--	--	--	--	4	2	4.37
	Mean	10	6	--	--	--	--	8	4	6.91
Ebey Slough	Worst	10	6	10	--	10	--	8	6	8.04
	Mean	10	10	10	--	10	--	10	8	9.40
Union Slough	Worst	8	8	10	--	8	--	8	6	8.00
	Mean	10	10	10	--	10	--	8	6	9.16
Deadwater Slough	Worst	10	6	10	--	4	--	8	8	6.48
	Mean	10	8	10	--	10	--	8	8	8.96
Steamboat Slough	Worst	Insufficient Data								
	Mean									

Water Quality Index Ratings:

9.5 - 10	Excellent	3.5 - 5.5	Polluted
7.5 - 9.5	Acceptable	1.5 - 3.5	Heavily Polluted
5.5 - 7.5	Slightly Polluted	0 - 1.5	Dead

Source: SCPD, 1974b

the lowlands, the effect of lowland agriculture on water quality is evident. Parameters most affected include dissolved oxygen, the mean value of which was decreased by almost 50% (10.0 mg/l to 5.8 mg/l) and oxygen saturation (reduced from 89% to 52%), indicating high levels of oxygen demanding organic wastes. Conductance increased by almost 170% (197 micromhos to 327), suggesting the introduction and/or leaching of salts. Nitrate nitrogen levels in uplands waters were already high (2.4 mg/l) and were increased only slightly (to 2.8 mg/l) by lowland agricultural drainage. Phosphate phosphorus was also found at high levels in uplands streams (0.18 mg/l), but unlike nitrate nitrogen, mean phosphorus levels more than doubled (to 0.42 mg/l) in the lowlands. Mean total and fecal coliform levels increased by 3100% and 9100% respectively. (Total coliforms from 1100/100 ml to 34470/100 ml; fecal coliforms from 145/100 ml to 13150/100 ml.) These values can be regarded as typical of all agricultural drainage of the study area. The discharge of these agricultural effluents into the Snohomish estuary constitute heavy loadings of nitrogen, phosphorus, coliform bacteria, salts, and oxygen demanding substances.

Tulalip Bay

18. Tulalip Bay has received little attention in previous water quality studies. It has been identified as the only region in the study area known to have septic tank failures (SCPD, 1974). Water quality data collected by DOE between August 1973 and June 1976 at the mouth of Tulalip Bay indicate generally acceptable water quality. Surface waters exceeded temperature standards only once, bottom waters were consistantly less than 61°F (16°C). Only three measurements of dissolved oxygen less than 6.0 mg/l were reported and those in bottom water. Only one violation of pH standards occurred, and that only 0.1 pH units over standards in bottom waters. Geometric mean values of total coliform levels are well below 70 organisms/100 ml, with less than 10% of all water samples exceeding 230 organisms/100 ml.

RESULTS AND SUMMARY

19. From the review of historical data and computer modeling, the Snohomish County Planning Department (1974) has identified many of the water quality problems in the Snohomish estuary. These include: agricultural runoff, solid waste leachate, domestic sewage treatment, and sulphite pulp mill wastes. Agricultural runoff from Marshland and Ebey Island adds nutrients, coliforms, and moderate BOD load to the river. Domestic sewage treatment from three treat-

ment plants contributes high coliforms, high nutrients, and high temperatures to the river. Pulp mill discharges are very warm and high in suspended solids and toxic chemicals. Despite these problems Snohomish County (1974) reports a mean water quality index of at least 8 for everywhere but Everett Harbor. In general low DO, high coliforms, and high turbidity appear to be the major water quality problems in the estuary according to this report.

20. The complex braiding of the Snohomish estuary in conjunction with variable fresh water flows and tidal fluctuations produces a hydrologic system for which development of water quality predictions is difficult. The seasonally and annually variable relative volumes of water diverted from the main Snohomish River channel down the sloughs is likely a principal reason for the inaccuracies identified in the water quality model developed by the Snohomish County Planning Department. Indeed, the flow in the main channel of the estuary (Snohomish River) has been reported to vary from 32% to 80% of the flow entering the sloughs (Douglas Houck, DOE, personal communication, 1977). One cause of this variability of flow divergence down the sloughs is probably the shifting of sand bars in the Snohomish River at the divergence of Ebey Slough.

21. Historically, Everett Harbor has been associated with water quality problems resulting from the discharge of SSL. With recent reductions in discharge, the DO has increased and toxicity decreased. These water quality improvements will probably contribute to increases in marine fauna populations in the near future, however, continued monitoring will be needed to verify this.

22. For all practical purposes, water quality at the mouth of Tulalip Bay meets state water quality standards. It is conceivable that water may not meet standards inside the bay due to septic tank failures, but this must remain pure conjecture in the absence of a detailed water quality study.

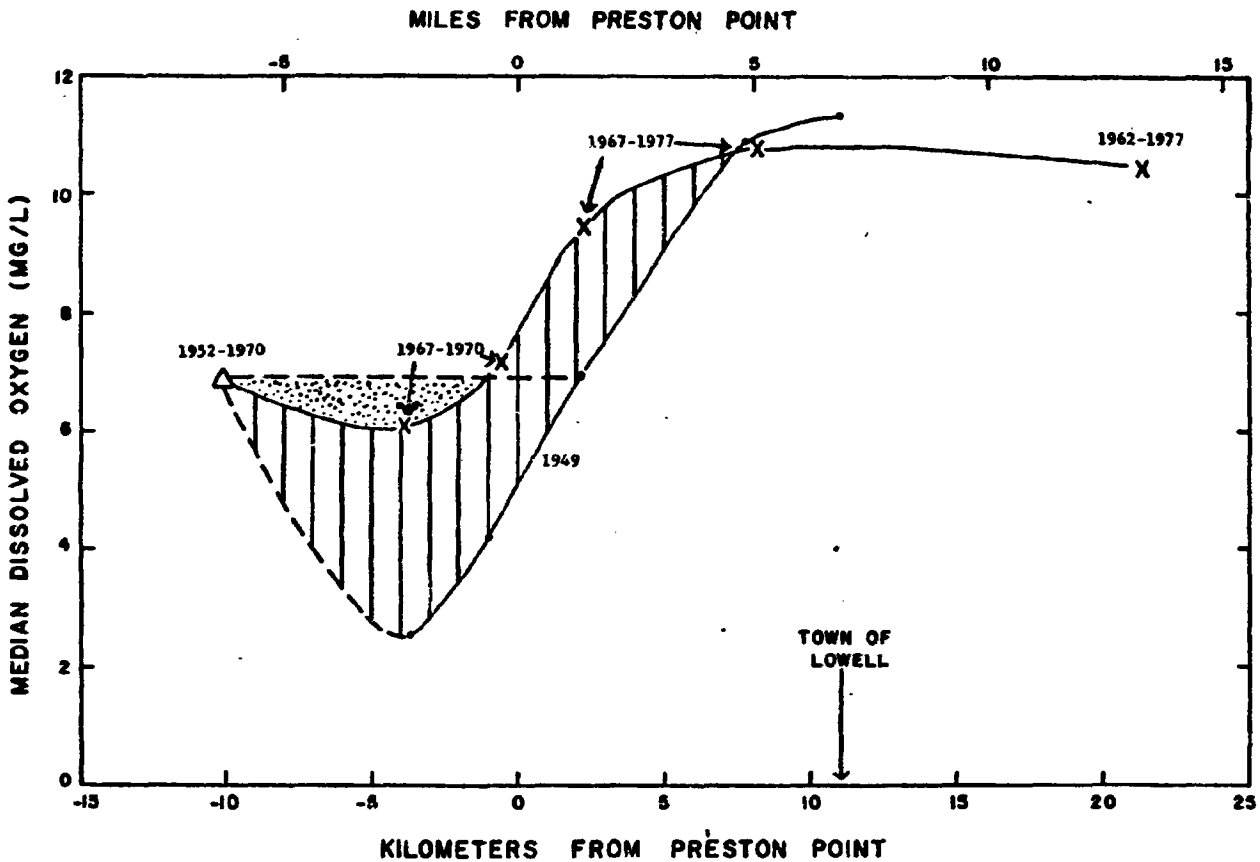


Figure VI-13 Median concentration of dissolved oxygen. Hatched area indicates difference between 1949 and post 1967 observations (note observational periods differ between stations). Stipled region denotes oxygen minimum based on 1967-1970 data taken at river mouth. Triangle represents University of Washington Port Gardner station.

BIOLOGICAL PROFILE

Introduction

1. In just 100 years the Snohomish estuary has developed from a broad expanse of wetlands surrounded by forested slopes to an important agricultural area supporting extensive urban activities. The evolution of this area has had profound impacts on the estuarine ecosystem. The purpose of this profile is to provide the reader with an understanding of the Snohomish estuarine system as it presently exists.

2. The biological profile begins with a discussion of habitat types found within the Snohomish estuary. Habitat types are plant communities or associations which are characteristic of certain physical and historical conditions. The description of each habitat type includes a discussion of the associated physical and historical conditions and the habitat distribution.

3. Following the description of the habitat types is a discussion of the flora and fauna associated with each habitat type. The flora discussion identifies the plant species characteristic of each habitat type. In the fauna discussion the major animal species found in the Snohomish estuary, and the habitat types with which they are most commonly associated, are identified.

4. The ecological processes discussion of the profile describes the productivity, food webs, and nutrient cycling aspects of the estuary. These are explained first in general terms, with respect to the entire estuarine ecosystem and then more specifically, identifying the role each habitat type plays within the ecosystem and the importance of that role to the functioning of the system.

K. HABITAT TYPES

1. It is important to distinguish between habitats, as defined in a classic ecological sense, and the habitat types described here. Habitat is defined as the place where an organism normally lives. Habitat type refers to a specific vegetation association classified and mapped by Burrell (1978) as Volume 3 of the Snohomish Estuary Wetland Study.

2. A habitat may be described in several different ways. In the case of a plant, habitat is often defined as a specific set of physical characteristics and, sometimes, associated plants. In the case of a terrestrial animal, habitat may be defined as a variety of plant communities (some with similar physical characteristics) or a variety of physical characteristics (some with similar plant communities).

3. A habitat type, on the other hand, is a plant community or plant association. Occasionally physical characteristics may be used to distinguish certain habitat types with similar plant associations (such as tidal versus non-tidal freshwater wetlands). In some parts of the study area habitat types are classified according to activity (urban) or substrate type (unvegetated aquatic lands). However, the plant community is the primary delineation of habitat type used in this discussion.

4. The term "habitat type" may apply to either a specific plant community or a general collection of specific plant communities logically grouped under a single heading. Such specific and general definitions follow the classification system used by Burrell (1978).

5. An example of the specificity the term "habitat type" may have is as follows:

> Forested uplands is a habitat type which includes all woodlands. Included in the forested uplands are coniferous forest, broadleaf forest, mixed forest, disturbed forest and riparian forest habitat types. The broadleaf forest habitat type can be further divided into regeneration broadleaf, immature broadleaf, and mature broadleaf habitat types. Finally, the mature broadleaf forest habitat type is a combination of the mature broadleaf/ successional shrub habitat type and the mature broadleaf (with no successional shrub present).

Thus, it is apparent that the term "habitat type" can be either a generalized plant community or a very specific plant community.

6. The habitat types in the Snohomish estuary are classified into seven general categories:

- Urban
- Agriculture
- Non-forested Vegetated Uplands
- Forested Uplands
- Water
- Aquatic Lands
- Other Lands (vegetated spit).

Each general habitat type can be divided according to more specific characteristics. The distribution of the habitat types is shown on Plate 9. Table VI-12 summarizes the distribution of habitat types within the land use study area described in Plate 9. The following discussion addresses each general habitat type and, where appropriate, more specific habitat types are considered.

7. Urban areas are comprised of residential and industrial habitat types that are found in areas of dense human habitation. These include transportation facilities, port and harbor structures, mines, gravel pits, and open areas which have been scraped or filled but are not otherwise being used. Generally urban areas support little wildlife since the vegetation is often sparse, exotic (non-native), and managed for aesthetic rather than wildlife uses. Exceptions are wooded residential areas, such as parks, where some urban tolerant birds and small mammals are found, and port areas where water-oriented birds, fish and shellfish may be found.

8. Urban habitat types are centered around the cities of Everett and Marysville, and the railroad/highway corridor which connects them. The Everett urban area includes the Port of Everett and the south and west shores of the Snohomish River upstream to Lowell. Urban habitat in Marysville extends from I-5 east along the north shore of Ebey Slough to the mouth of Allen Creek. The corridor between them includes the western portions of Smith, Spencer and North Ebey Islands. The uplands surrounding Tulalip Bay are made up primarily of urban residential habitat type.

9. The agriculture habitat types are those crop and pasture lands which are, or have been, used for commercial farming. Most of these areas are lowlands which were diked and drained in order to take advantage of the rich alluvial soils found in the floodplain. As a result, they can be used for agricultural purposes only as long as the dikes are maintained. Agricultural lands are found on extensive portions of Smith, Spencer, and Ebey Islands, on the north and east shores of Ebey Slough, upstream of Marysville, and on the west shore of the main channel upstream of Lowell.

Table VI-12

ACREAGE OF HABITAT TYPES IN THE SNOHOMISH ESTUARY LAND USE STUDY AREA*

	Aquatic Lands													
	Urban	Agriculture	Non-Forested Vegetation	Forested	Water**	Intertidal Swamps (611)	Freshwater Swamps (612)	Algal (621-622)	Eelgrass (623)	Salt Marsh (624)	Intertidal Marsh (625)	Fresh Marsh (626)	Unvegetated	TOTAL
Smith Island	582	756	108	280	17	19	0	-	-	82	15	39	6	1,904
Ebey Island	103	2,215	231	433	26	148	598	-	-	0	26	4	0	3,784
Spencer Island N.	33	379	23	4	12	10	0	-	-	4	72	8	0	545
Spencer Island S.	42	255	22	46	0	35	0	-	-	0	12	0	0	412
Otter Island	0	0	0	0	0	82	0	-	-	0	65	0	0	147
North Ebey Island	176	0	3	14	20	55	0	-	-	171	391	2	0	832
North Shore	92	549	30	26	20	100	0	-	-	146	112	1	30	1,106
East Shore	37	885	86	126	5	56	28	-	-	0	1	15	0	1,239
West Shore	324	66	24	54	3	23	18	-	-	0	25	14	0	551
TOTAL	1,389	5,105	527	983	103	528	644	-	-	403	719	83	36	10,520

* See Plate 9

** Does not include sloughs

10. Non-forested vegetated uplands are those grass and/or shrub dominated habitat types which are not being used by man for residential, agricultural, or industrial activities. The grassland areas are ungrazed lands where woody species are not present. They include meadows, beach dunes, and rocky promontories. The shrublands are dominated by woody perennials up to 20 feet in height. The shrub habitat type usually represents a sere (successional stage) of regenerating forest. In the Northwest this stage follows the pioneer grassland sere, and precedes the broadleaf sere.

11. Non-forested upland also includes a riparian habitat type, represented by those grassland or shrub communities which are found adjacent to and directly influenced by streams or standing water. Riparian areas are extremely important to wildlife and often provide a buffer between human dominated habitat types (urban and agriculture) and the water.

12. Non-forested uplands are found widely distributed throughout the study area. The principal grasslands are located on the beaches and dunes of Jetty Island. Successional shrub habitat types are found as scattered small parcels throughout the Snohomish estuary. These parcels are often located between forested upland and agriculture or urban habitat types. Riparian habitat types are common along the many streams, drainage ditches and blind channels which are found throughout the estuary.

13. Forested upland habitat types are the coniferous and deciduous woodlands which are so prevalent in the Northwest. There being no virgin forest in the estuary, most of the forested habitat types represent seres in the regeneration of forests which were logged up to 100 years ago. (Christmas trees or other planted woodlots do not represent natural seres in the regeneration of forests, but are included as forested uplands.) Broadleaf or deciduous habitat types are generally considered to be precursors to the coniferous stands.

14. Riparian forest is an important, though not extensive, habitat type found adjacent to ponds, streams, and ditches. As with its non-forested counterpart, this riparian habitat provides an important buffer between human dominated habitat types and open water.

15. There is very little coniferous forest within the Snohomish estuary. Several small parcels are located on the north end of Ebey Island and the east side of Smith Island. Deciduous forests are much more prevalent, with extensive tracts on Ebey Island and southern Smith Island. There are also some larger tracts along the east shore of Ebey Slough. Riparian forest habitat types occur

mostly as narrow zones along the numerous creeks, ditches, and sloughs. Such waterways are particularly numerous on Smith and Ebey Islands.

16. The water habitat type can be classified according to a variety of characteristics. Salinity, water velocity, tidal fluctuation, and man-made and natural characteristics have all been used to distinguish between different bodies of water. In the Snohomish Basin, the presence or absence of tidal fluctuations is an important factor. Even where salinity is not a factor, the diurnal fluctuations of tidal waters impact human activities and wildlife survival. Tidal waters may be classified along a salinity gradient, from high salinity marine waters, through brackish sloughs, to fresh river waters. Salinity variation is a significant factor controlling the distribution not only of plants and aquatic organisms, but also the numerous terrestrial animals dependent upon them for food and shelter. Non-tidal waters, such as streams, ponds, and man-made water bodies are important habitat types which lack diurnal variations in water level, and therefore provide an environment conducive to organisms less tolerant of periodic inundation.

17. The abundance and broad distribution of water habitat types in the Snohomish estuary is apparent from the fact that over 10% of the land use study area, about 2,000 acres, is a water habitat type (this does not include marinas, sewage facilities, or aquatic lands habitat types). The majority of this habitat type, characterized as estuarine river, is made up of Union, Steamboat, and Ebey Sloughs and the main channel of the Snohomish River.

18. The aquatic lands are those habitat types which are either intermittantly covered by water or strongly influenced by adjacent waters. They are divided into the following categories:

- Forested
  - Intertidal Freshwater/Brackish Swamp
  - Freshwater Swamp (non-tidal)
- Vegetated Non-forested
  - Algae
  - Eelgrass
  - Salt Marsh
  - Brackish/Freshwater Intertidal Marsh
  - Freshwater Marsh (non-tidal)
- Unvegetated

19. Forested aquatic lands are wetland areas dominated by shrubs and/or trees. Swamp habitat types may be either tidally influenced or non-tidal, but there is usually little variation in plant populations and associated fauna in the different types.

However, the different swamps have very different hydraulic interactions with the estuary, and therefore different impacts on the ecosystem.

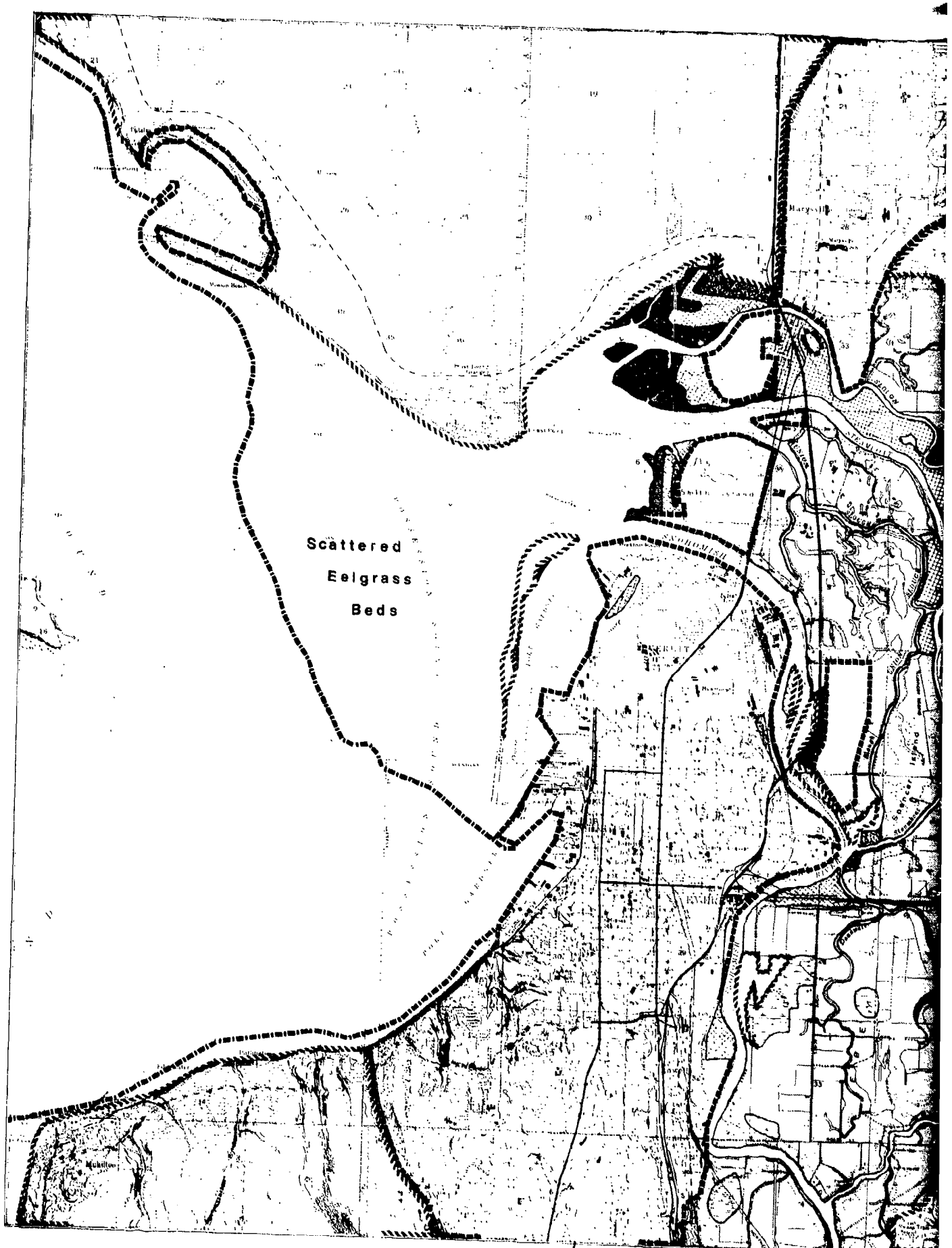
20. Aquatic lands are distributed throughout the estuary. Extensive swamps are found on Otter, Ebey, and North Ebey Islands. There are also several large swamps along the north and east shore of Ebey Slough, including some in the Quilceda Creek area. Smaller parcels are located on Smith and Spencer Islands. Swamp habitat types are found on many dikes, particularly where an adjacent flat or decaying dike creates a narrow zone inundated by the highest tides.

21. The vegetated, non-forested aquatic lands include some subtidal as well as intertidal and non-tidal habitat types. Algae are found in both shallow subtidal and intertidal situations wherever there is a suitable substrate for attachment. Eelgrass beds are primarily a shallow subtidal habitat type, but they also occur in lower intertidal areas. Both salt marsh and brackish/freshwater marsh are found in the upper reaches of the intertidal zone. Freshwater marshes are found only in non-tidal locations, usually behind dikes.

22. Non-forested aquatic lands are easily divided according to distribution. Algae and eelgrass habitat types are located primarily in Port Gardner, beyond the mouth of the Snohomish River and in scattered locations in Tulalip Bay. In contrast, salt marsh, brackish/freshwater marsh and fresh marsh are found within the estuary proper. Salt marsh is found in the Quilceda Creek area and on the west end of Smith and North Ebey Islands. The most extensive tract of brackish/freshwater marsh is on North Ebey Island. Spencer and Otter Islands and the Quilceda Creek area also have large areas of brackish/freshwater marsh. Small parcels are found on Ebey, Smith, and Weyco Islands, and near Lowell. The non-tidal freshwater marsh is not extensive but is found throughout the estuary, with Smith and Spencer Islands, the east shore of Ebey Slough, and the west shore of the main channel the primary sites. Only Otter Island and Spencer Island South have no examples of this habitat type.

23. The unvegetated or beach substrate habitat types are differentiated according to the substrate grain size characteristics. Throughout most of the study area sand, mud or muddy sand are the predominant unvegetated substrates. Unvegetated substrates are usually exposed at mid-tide levels or along beaches where wave activity precludes the establishment of vegetation.

24. Unvegetated aquatic lands are distributed throughout Port Gardner. Tide flats west of Jetty, Smith, and North Ebey Islands and certain areas in Everett Harbor and Tulalip Bay are the important locations of the beach substrate habitat type. Small parcels


Scattered
Eelgrass
Beds

HABITATS

PLATE NO 9

LEGEND

- Urban Boundaries
- Vegetated Uplands
- Agricultural
- Salt Marsh
- Brackish / Freshwater Marsh
- Brackish / Freshwater Swamp
- Freshwater Swamp
- Freshwater Marsh
- Approx Boundary Scattered Eelgrass Beds

N

SNOHOMISH ESTUARY WETLANDS STUDY

Source: Burrell 1977
Boule and Shea 1978

2

of unvegetated lands are also found along the shores of Quilceda Creek and the north shore of Ebey Slough west of I-5.

25. The only other habitat type which has been identified in the study area is the vegetated spit. Spits are shoreforms created by the deposition of longshore drift materials at the mouth of a bay. The spit located at the mouth of Tulalip Bay is the only one identified within the study area.

L. FLORA

1. The abundance and diversity of plant species within each habitat type is a product of both the physical conditions and the human activities associated with the location. Soil saturation, water salinity and shade are the primary natural physical conditions. Human activities include filling, diking, draining, clearing, and planting. Human activities often conflict with or counteract the physical conditions. The resulting plant community is an indicator of the relative dominance of physical conditions or human activities.

2. In this discussion the characteristic plant species of each habitat type are identified. In addition, any unusual or interesting species are noted. Most of the plant species identified in this section are based on the work of Burrell (1978) and Boulé & Shea (1978) (Volumes 3 and 4, Snohomish Estuary Wetlands Study).

3. Urban habitat types have resulted almost totally from human activities. Construction, paving, filling, and extraction have often eliminated any resemblance to former topography, vegetation, or habitat type. Where vegetation exists it often consists of exotic species dependent on extensive care for survival. Even native species, isolated or imported from their natural habitat type may require special care.

4. The exceptions to this trend in urban areas are wooded residential, port, and scraped area habitat types. Wooded residential is a low density housing area where the natural cover has been minimally altered by human activities. Parks and other urban preserves are also included in this habitat type. In these areas the trees remain but often the native shrubs have been cleared and replaced with grass or exotic annuals and shrubs. Port area habitat types include revetments, pilings, and dikes. The use of riprap or other material in the construction of breakwaters, revetments or dikes provides a suitable substrate for a wide variety of algae. Wood or metal posts used in piers and pilings also provide a solid substrate. In marine waters such as Port Gardner a diverse population of red, green, and brown algae may become established on solid substrates. In fresh waters filamentous diatoms and other unicellular algae may be found on piers and pilings.

5. Scraped areas refer to lands cleared for some purpose and left unused. Often these "back lots" or "waste areas" will undergo "open field succession," involving colonization by annuals (weeds) then perennial herbs, woody shrubs and ultimately trees. Succession procedes until the areas are again cleared for some use.

6. Agricultural lands often have a more strictly defined plant community than urban areas. In the Snohomish estuary both pasturage

and cultivated crops are found. Pasturage is often made up of a variety of grasses and legumes. Overgrazed areas, especially in the low, moist soils of the estuary, will have less diversity and an abundance of rushes (especially Juncus effusus). Cultivated crops are generally monotypic plant communities which may be supported with fertilizers, pesticides and herbicides. When cultivated fields are inactive for a season or more, diversity increases significantly as opportunistic annual and perennial species (weeds) invade.

7. Non-forested, vegetated upland habitat types are divided according to dominance of grasses or shrubs. Grassland habitats most common in the estuary are beach dune and riparian types. The beach dunes of Jetty Island are characterized by a wide variety of grasses and herbs. The most abundant species are dune grass (Elymus mollis), red fescue (Festuca rubra) and beach peavine (Lathyrus japonicus). Other common grassland species on Jetty Island are bighead sedge (Carex macrocephala), bent grass (Agrostis alba), and brome grass (Bromus tectorum). Riparian grasslands are common along many of the drainage ditches and streams in the estuary. Canary grass (Phalaris arundinacea), velvet grass (Holcus spp.) and Baltic rush (Juncus balticus) are common in this habitat type.

8. The shrub habitat type is usually a disturbed area undergoing succession toward a climax vegetation community. Species composition in both riparian and non-riparian shrub areas is similar, although the relative species abundance may vary. Blackberry (Rubus spp.), spiraea (Spiraea douglasii), and scotch broom (Cytisus scoparius) are commonly dominant species.

9. Forested uplands habitat types have been characterized according to relative dominance of coniferous or broadleaf trees. Coniferous trees most commonly found in forests of the study area are: Douglas Fir (Pseudotsuga menziesii), Western Hemlock (Tsuga heterophylla) and Western Red Cedar (Thuja plicata). Sitka Spruce (Picea sitchensis) may be found occasionally in the forested uplands. Broadleaf trees most common in forested uplands are red alder (Alnus rubra), maple (Acer spp.) and willow (Salix spp.), although cottonwood (Populus trichocarpa), crabapple (Pyrus fusca) and hawthorn (Crataegus spp.) may also be present.

10. Water habitat types are defined on the basis of physical characteristics rather than plant communities; most of the water areas with macroscopic flora have been classified as aquatic lands. Thus, few water habitat types exhibit associated vegetation. Phytoplankton, however, are associated with almost all water habitat types. The predominant phytoplankton species may vary with salinity, nutrients, temperature and season. Phytoplankton are the foundation of an important aquatic food web which is discussed in more detail later in this profile.

11. Aquatic lands exhibit a wide variety of plant communities from intertidal algae to non-tidal spruce swamp. Plant communities are discussed in the same order the habitat types were presented previously, i.e.:

- Forested
  - Intertidal Freshwater/Brackish Swamp
  - Freshwater Swamp (non-tidal)
- Vegetated Non-forested
  - Algae
  - Eelgrass
  - Salt Marsh
  - Brackish/Freshwater Intertidal Marsh
  - Freshwater Marsh (non-tidal)
- Unvegetated

12. Forested aquatic lands are usually a dense and diverse tangle of vegetation varying from 2 to 15 meters in height. Willow (Salix spp.), dogwood (Cornus stolonifera), wild rose (Rosa pisocarpa and R. nutkana), honeysuckle (Lonicera involucrata), ninebark (Physocarpus capitatus) and spiraea (Spiraea douglasii) are all common shrubs found in Snohomish estuary swamps. In the upper reaches of the swamp habitat type red alder (Alnus rubra), Western red cedar (Thuja plicata) and Sitka spruce (Picea sitchensis) may be found.

13. The intertidal freshwater/brackish swamp is usually found near the upper limit of aquatic lands and along dikes (especially multiple dike situations common in the Snohomish Basin). A freshwater swamp is a non-tidal area which is sufficiently wet to support a swamp habitat type. Freshwater swamps are found almost exclusively in low diked areas on Ebey Island. Lodgepole pine (Pinus contorta) is the only species found in the freshwater swamp habitat type but not identified in the intertidal swamps.

14. Vegetated unforested aquatic lands include a wide variety of habitat types. Algae and eelgrass beds are associated mostly with the low intertidal and subtidal areas. Salt and brackish/freshwater marshes are found in high intertidal areas, and freshwater marshes are non-tidal. As a result of the very different tidal characteristics, associated flora is also very different.

15. In the study area, algal communities are found mostly in the lower intertidal areas attached to shell, gravel, or other solid substrate. In protected areas, such as Tulalip Bay and behind Jetty Island, or areas of immobile substrate, such as bulkhead or pilings,

algae may be found in the mid to high intertidal zones. Ulvoids and fucoids are probably the most common algae in the study area.

16. Eelgrass beds, distributed over most of the subtidal and intertidal flats west of the river mouth, are comprised of both Zostera marina and Z. noltii. The relative abundance of the two species is not known.

17. The salt marsh has been divided into seven habitat types according to Burrell (1978). The low marsh communities are characterized by pickleweed (Salicornia virginica), sedge (Carex lyngbyei), arrowgrass (Triglochin maritimum) and saltgrass (Distichlis spicata). The upper salt marsh communities are dominated by sedge (C. lyngbyei), silver weed (Potentilla pacifica), bent grass (Agrostis alba) and hair grass (Deschampsia caespitosa). Other species common in the upper salt marsh are aster (Aster subspicatus), orache (Atriplex patula), jaumea (Jaumea carnosa), plantain (Plantago maritima) and lilaeopsis (Lilaeopsis occidentalis). Bulrush (Scirpus spp.) occasionally forms extensive monotypic communities in the upper salt marsh.

18. The brackish/freshwater intertidal marsh is a habitat type characterized by the influx of tidal water, either brackish or fresh. Bulrush (Scirpus validus) and cattail (Typha spp.) often form monotypic communities or a combination community with equal density in these habitat types. Along the slough banks a sedge (Carex lyngbyei) dominated habitat type is often found.

19. Some freshwater marsh habitat types have plant communities very similar to the brackish/freshwater marshes. Bulrush (Scirpus spp.) and cattail (Typha spp.) monotypic communities are both common. Freshwater marshes which are used for pasture are often dominated by rush (Juncus effusus).

20. Unvegetated aquatic lands have no macroscopic flora, however, diatoms and other phytoplankton are important primary producers in this habitat.

21. The vegetated spit at the mouth of Tulalip Bay has a sparse beach dune grassland habitat type. Dune grass (Elymus mollis), beach pea (Lathyrus japonicus) and searocket (Cakile edentula) are found at this location.

M. FAUNA

1. The fauna of the Snohomish estuary include mammals, birds, fish, shellfish and other invertebrates. Each of these groups is treated separately, first with a short discussion of the primary organisms of the group, and then with an identification of the habitat types in which the organisms are characteristically found.

MAMMALS

2. There has been very little study of the mammals inhabiting the estuary, with no known quantitative measure of the population size or distribution. Studies in the Marshland area south of Lowell (Engman and Stendal, 1976) and on the Tulalip Reservation (Shea, 1977a) provide the only known assessments of mammals in the lower Snohomish Basin. Burrell (1978) commented on the mammals which could be expected in the study area. General information on mammals and their habitats was gathered from the works of Nelson (1916, 1918), Rue (1968), and Stone and Cram (1903). The data presented here are summarized in Table VI-13.

Big Game

3. The black-tailed deer (Odocoileus hemionus columbianus) is the only large mammal expected to be found in the study area. This species is most prevalent in the lowland, humid coniferous forest regions of the Pacific Northwest. Deer have been observed near the Marshland Pump Station southeast of Lowell (Engman and Stendal, 1976).

4. Deer browse on a wide variety of shrubs, trees, and herbaceous plants. The "edge" or transition zone is an important feeding habitat throughout their range. Dense vegetation, such as forest and swamp, provide shelter for resting and breeding. Tall grasses and reeds are also important resting habitats, especially when located adjacent to forests or swamps.

Furbearers

5. In the Snohomish estuary furbearers are found both in wetland and in naturally vegetated upland habitats. The presence of muskrat (Ondatra zibethica) and mink (Mustela vison) is evidenced by occasional (though not extensive) trapping in the area. Beaver (Castor canadensis) have also been sighted, although their abundance is not known. River otter (Lutra canadensis) may also be found in the estuary, but population studies have not been carried out to ascertain this (Engman and Stendal, 1976).

6. The muskrat is an aquatic animal that inhabits a wide variety of marsh and swamp habitats. It feeds on the roots and

Table VI-13

HABITAT TYPES OF MAJOR MAMMALS IN THE SNOHOMISH ESTUARY

F = Feeding B = Breeding	Urban	Agricultural	Grassland	Shrub	Riparian shrub, Grassland	Forest	Water	Intertidal, non-tidal Swamp	Salt Marsh	Intertidal brackish/freshwater, Non-tidal freshwater Marsh	Unvegetated Beach
Blacktailed Deer		F		F		F,B		F,B	F	F	
Muskrat							F,B	F,B		F	
Mink			F	F,B	F,B	F,B	F	F,B		F	F
Otter					F,B		F	F,B	F	F	
Beaver						F	F,B	F,B		F	
Weasel			F	F	F	F,B			F	F	
Coyote			F	F,B		F,B				F	
Raccoon		F		F		F,B	F		F	F	F
Oppossum					F	F,B					
Skunk				F,B	F					F	
Rabbits		F,B	F	F,B							
Rodents	F,B	F,B	F,B	F,B	F,B	F,B		F,B		F,B	

stems of a variety of wetland plants such as cattails and bulrush (and also occasionally on small fish). Heavy use of bulrush and cattail habitats is often indicated by well-worn trails. In some locales they build lodges of twigs and cattail stalks; in other places they dig burrows in creek banks or swamps. The latter den type is probably more prevalent in the Snohomish area than are lodges.

7. The mink is an extremely efficient carnivore that feeds both underwater and in forested bottomlands. Its diet varies from small mammals such as muskrat, hare, and small rodents to a wide variety of birds, including waterfowl. They are also well known for their raids on henhouses. Along the water they feed on frogs, snakes, insects, and molluscs. They often nest in muskrat dens or hollow stumps or logs. The mink is a forest animal, preferring wooded bottomlands, swamps or riparian areas, where abundant vegetation provides shelter for a large variety of small mammals and birds.

8. Beaver were once very abundant in the Snohomish estuary, however, the present population is not known. The only positively identified activity is in a marsh near Lowell (personal communication, Burlington Northern employees). The beaver is famous for its dam building, for which it is also often regarded as a pest. Beaver dams are constructed of nearby trees which are felled both for construction purposes and for the bark, an important food source. Beaver also feed on roots and stems of herbaceous shrubby vegetation.

9. The otter is a semi-aquatic mammal which is always associated with streams and rivers. Although nowhere abundant, they are known to inhabit riparian and estuarine areas throughout Washington State. Otter dens are usually found in river banks, although the dens are also found in hollow logs, stumps, or tree trunks in swamps. Otters feed on fish, shellfish, frogs, insects, and small mammals.

Other Mammals

10. Numerous other mammals have been reported to occur in or near the Snohomish estuary, but there has been no analysis of population size or distribution. Long-tail and short-tail weasel (Mustela frenatra and M. erminea), coyote (Canis latrans), raccoon (Procyon lotor), opossum (Didelphis virginiana), porcupine (Erethizon dorsatum), and skunk (Spilogale gracilis, Mephitis mephitis) are some of the smaller mammals that have been noted. Of these, the weasels, raccoon, opossum, and porcupine are most commonly found in forested habitats. Skunk, on the other hand, appear to prefer shrub habitat types. Coyotes are more prevalent in grassland or sparse shrub habitats.

11. Rabbits, chipmunks, and rodents (mole, shrew, rat, mouse, vole) are also found in the estuary region, probably in great numbers. Most of these small mammals are found in shrub or forested habitats. They are either herbivores dependent on a variety of vegetation for food, or carnivores that feed on the small herbivores.

Distribution of Mammals by Habitat Type

12. The urban habitat type often represents a major alteration to both vegetation and terrain. Dense human and domestic animal populations, and construction of buildings and roads, create an unsuitable environment for most wild mammals. Rodents such as mice and rats, however, are found in and around some buildings and waste areas. In addition, moles and shrews may be found in lawns, parks and other grassy areas, and squirrels and chipmunks may be common in residential woodlands. Few other mammals are found in urban settings.

13. Agricultural areas may be used by a greater variety of mammal species due to abundant vegetation and minimal human populations. Small mammals, such as mice, rats, and rabbits, often feed in, and may nest in, cultivated fields. Other mammals, including raccoon, deer, and an occasional muskrat or beaver, may visit cultivated lands for food. Mink, weasel, and coyote are frequently blamed for henhouse raids, although the damage may often be exaggerated.

14. Grassland habitat types provide both feeding and nesting areas for a wide variety of small mammals, particularly rodents. These herbivorous and insectivorous species thrive on the grasses, herbs, and associated insects commonly found in meadows and beach dunes. Small mammals in turn are preyed upon by coyotes, weasels, mink, and other carnivores commonly found in upland habitats.

15. In the shrub habitat type the dense vegetation provides food and shelter for a large variety of mammals. Small rodents, rabbits and skunks all commonly nest here, feeding on vegetation and insects. Raccoons, mink, and weasels feed on these smaller mammals as well as on snakes and small birds. Deer often browse in these areas although the vegetation may sometimes be too thick to allow them to move freely.

16. Riparian shrub and grassland habitat types may be used more by mammals than are the non-riparian habitat types. The presence of water is an important consideration to prey and predator alike. As always, rodents are common, burrowing for roots and insects or feeding on seeds and leaves. These small mammals in turn are preyed upon by mink, weasels, skunks, and opossums, all of which

often nest near the water. Frogs, fish, crustaceans, and salamanders found in streams and lakes provide food for raccoons, muskrats, and otter, as well as the previously mentioned carnivores.

17. Forest habitat type is usually characterized by a dense overstory, often with a sparse shrub understory. It provides cover for deer and at the same time is sufficiently open to allow them mobility. Mink, weasel, coyote, raccoon, and opossum are all found here, feeding on small mammals and birds. They nest in hollow logs or stumps, or in dens. Rodents are common on the forest floor, and squirrels and chipmunks are often found in treetops.

18. There are no mammals in the study area adapted solely to water habitat. There are, however, semi-aquatic mammals such as beaver, otter, and muskrat that live and feed in lakes, rivers, and streams. Beaver and muskrat usually build lodges in the center of ponds and dammed streams. Muskrat and otter feed on fish and crustaceans (and also some non-aquatic organisms). Although not reported in the Snohomish Basin, minks have been seen feeding on fish and crustaceans, chasing them underwater as otters do (Stone and Cram, 1903).

19. Intertidal and non-tidal swamp habitat types provide important areas for resting, feeding and breeding for a wide variety of mammals. Small rodents are found inhabiting both the floor of the swamp and the numerous trees and shrubs. Minks, weasels, and muskrats commonly occupy dens in these swamps; raccoons, opossums and skunks often feed in these areas. Deer may be found browsing on shrubs and resting in sheltered sites. Beaver may establish dams and lodges in swamps.

20. The eelgrass and algal habitat types do not appear to be directly used by any mammals known in the Snohomish estuary.

21. The salt marsh habitat type may provide habitat for mice, voles, and shrews. It may also be used by the deer, raccoon, otter, or weasel found in neighboring swamps and forests. The use of the salt marsh by these larger mammals would probably be limited to fishing and hunting by carnivores and occasional browsing by deer.

22. In intertidal brackish/freshwater and non-tidal freshwater marsh habitat types a variety of mammals may be found. Deer often browse at the marsh-swamp or marsh-upland boundary; presumed evidence of deer resting has also been seen near this boundary in several locations. Mice, shrews, and other small rodents nest in freshwater marshes, feeding on insects and vegetation. Weasel, mink, skunk, raccoon and coyote may all hunt the small rodents (and each

other) in marsh areas. Evidence of beaver and muskrat has also been noted in marshes in the estuary and may be more common than reported.

23. Unvegetated beach substrates are not heavily used by mammals in the study area. They occasionally may be used by raccoons or minks for fishing.

24. The vegetated spit located in Tulalip Bay is probably too close to an urban area to be used heavily by mammals. Mice may be the only mammals found on the spit.

BIRDS

25. Comprehensive studies of avifauna in the Snohomish Basin are primarily waterfowl counts such as those performed by the U.S. Fish and Wildlife Service and Washington State Department of Game (Cornett, 1974). Limited studies in the basin include work in Marshland (Engman and Stendal, 1976) and in other estuary areas (Canning, 1977; Burrell, 1977). Regional studies have been carried out by several state and federal agencies (Salo, 1975; Woolley, 1970; Olsen, et. al., 1974), but these are generally too broad in scope to provide detailed data on the Snohomish estuary.

26. For the purposes of this report, avian fauna are divided into four groups: songbirds, shorebirds, raptors, and waterfowl. A discussion of each group, with notes on populations where known, is followed by a discussion of distribution by habitat type. Table 2 (Appendix E) provides a summary of species, habitats, seasonality, and observation records within the study area.

Songbirds

27. The songbird group is made up of a wide variety of herbivorous and insectivorous terrestrial birds. This group includes woodpeckers, swallows, sparrows, and wrens, as well as all birds not considered shorebirds, raptors, or waterfowl. There has been little study of their habitats in the Snohomish Basin, and only a few records of their presence or absence.

28. Songbirds are generally associated with upland habitats. However, many species are found in shrub swamp or forested swamp habitat types. A few species such as rails and redwing blackbirds prefer cattail marsh or other dense wetland habitat types.

Shorebirds

29. Shorebirds and wading birds are principally carnivorous

and feed on fish or invertebrates in shallow water and along tidal flats. As a result, they are important predators in the aquatic food chain. Herons, sandpipers, dowitchers, and sanderlings are significant members of this group. In addition to their usual aquatic diet, herons are also known to feed on gophers, mice and other rodents (Pearson, et. al., 1936). Many varieties of gulls and some common terns also use the tideflats and nearby water habitats.

Raptors

30. The birds of prey, or raptors, include hawks, eagles, and owls. They usually feed on fish, small birds, and rodents or other small mammals. Raptors commonly nest in the top of tall trees, but they may also be found nesting in towers, on building roofs, or on posts and piers. There are numerous raptors in the Snohomish Basin, especially red-tailed and marsh hawks, but they have received little attention or study.

Waterfowl

31. Waterfowl is a broad term that includes geese, mergansers, grebes, and the diverse group referred to as ducks. Many of these birds are herbivores, feeding on eelgrass or marsh vegetation. Others depend on crustaceans, insect larvae, molluscs, and fish for a major part of their diet. Most of these birds depend on marsh areas or near-shore locations for protective cover, nesting, and wintering.

32. The Snohomish River floodplain and the waters of Port Gardner and Possession Sound are important waterfowl wintering and resting areas (Woolley, 1970; Olsen, et. al., 1974). Birds from Port Susan, and Skagit and Padilla Bays, move south and east into the Snohomish River valley when heavy fall rains increase the standing water in lowland pastures and fields. River floodplains, saltwater and freshwater marshes, marine bays, lowland lakes, and adjacent agricultural lands throughout the basin west of North Bend and Sultan are all used by waterfowl.

33. The waterfowl group is the only bird group for which counts have been conducted. The Washington State Department of Game conducts annual counts in the Snohomish Basin; results are shown in Table VI-14. (It should be noted these counts include the entire Snohomish Basin and not just the estuary.) The U.S. Fish and Wildlife Service conducts waterfowl counts in the Possession Sound-Port Gardner area. Results of the 1977-78 counts are shown in Table VI-15. The Seattle-to-Everett and Port Susan data are presented to indicate relative population size and diversity in segments adjacent to the study area.

Table VI-14

FIVE YEAR AVERAGES OF WATERFOWL POPULATIONS*

YEARLY TOTALS OF DUCKS

1954 - 65,050	1960 - missing	1965 - missing	1970 - 8,035
1955 - 34,550	1961 - 16,100	1966 - 51,920	1971 - 7,050
1956 - 37,000	1962 - 52,410	1967 - missing	1972 - 5,230
1957 - 11,800	1963 - 39,010	1968 - 61,965	1973 - 3,115
1958 - 36,000	1964 - 27,150	1969 - 38,260	1974 - 1,000
1959 - 7,900			

FIVE YEAR POPULATION AVERAGES

Dates	Averages
1954 - 1958 (inclusive)	36,889
1959 - 1964 (inclusive)	29,897
1966 - 1971 (inclusive)	33,398
1972 - 1974 (inclusive)	3,115
1969 - 1974 (inclusive)	10,448

SPECIES POPULATION AVERAGE

Years	Mallard	Pintail	Wigeon	Green-winged Teal
1954 - 1958 (inclusive)	6,419	21,008	5,790	3,663
1959 - 1964 (inclusive)	6,770	9,666	9,700	1,646
1966 - 1971 (inclusive)	11,041	10,344	9,059	2,514
1972 - 1974 (inclusive)	965	1,175	752	223
1969 - 1974 (inclusive)	5,006	3,053	1,630	713

*Information from the Washington State Department of Game (Cornett, 1974)

Table VI-15

U.S. FISH AND WILDLIFE SERVICE WATERFOWL AERIAL COUNTS
(Refuge Management Division, Olympia - Winter, 1977)

Species	Tulalip Bay		Port Gardner		Seattle to Everett		Port Susan	
	21 Nov	20 Dec	21 Nov	20 Dec	21 Nov	Dec	21 Nov	20 Dec
Western Grebe	35	--	241	70	350		29	47
Canada Goose	--	--	--	--	--		40	--
Snow Goose	--	--	--	--	--		4518	7500
Black Brant	--	--	94	--	--		120	235
Whistling Swan	--	--	3	--	--		6	--
Mallard	--	--	94	--	--		1532	1529
Gadwall	--	--	--	--	--		--	--
Pintail	--	--	75	--	25		715	400
Green-wing Teal	--	--	35	--	--		42	65
American Wigeon	600	105	209	--	278		1011	615
No. Shoveler	--	--	--	--	--		--	--
Redhead	--	--	--	--	--		15	3
Canvasback	20	8	--	--	--		22	75
Scaup	10	45	--	125	5		559	867
Goldeneye	20	20	--	--	37		80	182
Bufflehead	10	--	33	--	40		65	245
Merganser	5	--	12	--	27		5	20
Scoter	--	30	104	60	239		378	1295
Oldsquaw	--	--	--	--	--		--	--
American Coot	--	20	--	--	--		--	--

No aerial counts made in this segment during December

Source: Ralph Boomer, Ecological Services, U.S. Fish and Wildlife Service, Olympia, WA

Distribution of Birds by Habitat Type

34. The urban area is used by some songbirds. Crows, pigeons, sparrows, and starlings are probably the most successful birds under urban conditions. However, swallows nest on buildings or under bridges and waterfowl may occasionally be found in urban ponds or lakes. Most other birds require a more specialized habitat type or are intolerant of most human activities.

35. The agricultural habitat type is used by a variety of songbirds, especially immediately after harvest, plowing, or broadcast seeding. Insect eaters, such as wrens and chickadees, often enter cultivated areas to feed. Even waterfowl and gulls are known to feed in cultivated fields and pastures. In addition, raptors hunt for rodents that feed in farm areas.

36. The diversity of vegetation in grassland habitat types provides food and shelter for numerous songbirds. Dense ground vegetation provides adequate cover for small birds that feed and/or nest on the ground, such as sparrows, quails, night hawks, and short-eared owls. In addition to seeds and insects consumed by songbirds, grasslands harbor numerous small mammals, a food resource for hawks, owls and other raptors. Snowy owls have been observed feeding in the grasslands near the Everett sewage ponds.

37. Of particular interest on Jetty Island are four glaucous-winged gull colonies and two common tern colonies (Peters, et. al., 1978). This is the first breeding record of common terns in the state, although they have been frequently observed migrating through Puget Sound. (Recently, Arctic terns have also been identified nesting on Jetty Island (K. Bruner, Corps).)

38. Shrub habitat types consist of dense, woody vegetation that provides food, shelter and nest support for small songbirds. For example, wrens, tits, and chickadees are common in shrub areas feeding primarily on insects. Small raptors, such as sharp-shinned hawks or short-eared owls, often feed on rodents or small birds in shrub areas.

39. The forest habitat type has a variety of characteristics that appeal to many kinds of birds. The forest floor offers feeding areas for seed eaters such as sparrows, and insect eaters such as wrens and chickadees. Quail, grouse, and pheasant feed and nest on the forest floor. Jays, woodpeckers, and wrens nest in trees and feed on the numerous insects found in the canopy. Woodpeckers need the dead trees (snags), often found in old forests, for feeding. Many raptors build nests in large trees and perch high above the ground when not hunting. A small woodland on West Smith Island has been reported as a perch area for the northern bald eagle, currently listed as a threatened species in Washington state (personal communication, Weyerhauser employees).

40. The extensive and varied open water of the Snohomish estuary is used by many waterfowl. Most of these are found in all water habitat types (including occasionally flood fields). These birds nest on land, usually adjacent to the water. Some waterfowl exhibit a restricted range of water habitat types. Cormorants and pelagic birds such as auklets are found only in the saline waters of Possession Sound. Wood ducks tend to remain in freshwater habitat types. In addition to waterfowl, kingfishers and herons feed in the open water of the sloughs.

41. Forested aquatic lands include both intertidal and non-tidal swamps. This diverse habitat type is used by a wide variety of songbirds, raptors, and waterfowl. As with shrub and forest habitat types, small insectivorous songbirds (wrens, tits, chickadees) are numerous and are found feeding on the myriad insects that breed in swampy areas. Some sparrows may nest in swamps, and many feed there. Woodpeckers are found in swamplands, especially old growth areas where snags are prevalent. Great blue herons, which are common in the estuary, usually nest in shrub swamp areas. Sitka spruce, found in many Snohomish swamps, provides a nesting and resting site for a variety of raptors that feed throughout the estuary. Kingfishers commonly perch on tree limbs overlooking the water to spot prey.

42. The algae habitat type offers an abundance of algae for consumption. Although dabbling ducks such as mallards and pintails probably feed here, the extent or importance of this food source to their diet has not been determined.

43. Eelgrass is a major food source for wigeon, pintail, brant, and scoters; it is also fed on by numerous other waterfowl. These birds feed on the rhizomes, leaves, and seeds of this aquatic plant. Eelgrass may be almost the only source of food for some birds, such as brant and wigeon.

44. The salt marsh habitat type is an important area for food and cover to many waterfowl. The sedge, arrow grass and invertebrates found here are important food sources to mallards, pintails and other plant eating ducks. In addition, many waterfowl use marsh areas for cover during moulting. Swallows are often seen feeding on flying insects associated with the marsh. Some small songbirds move into salt marshes at low tide to feed on seeds and insects. Raptors, especially marsh hawks, often hunt for small rodents or birds in marsh areas.

45. Intertidal brackish/freshwater and non-tidal freshwater marsh habitat types will be considered together because they are very similar in characteristics they offer to birds. Bulrushes, found in both habitat types, are good sources of food for a wide variety of waterfowl, including mallard and pintail ducks. Cattails

provide nesting area for redwing blackbirds, rails, bitterns, and marsh wrens. Swallows are common over marshes with high insect populations.

46. Non-vegetated aquatic lands are the sand and mudflats found at the river mouth and westward into Port Susan. These flats support large numbers and varieties of invertebrates, which are an important food resource for a wide variety of shorebirds. At low tide, dunlins, sanderlings, sandpipers and other wading birds strain the sediment for invertebrates. Herons also hunt on these flats, searching for small fish in the shallow water near the shore.

47. The only vegetated spit in the area (Tulalip Bay) is an important resting area for gulls and shorebirds. The isolation and unobstructed view offer security while the nearby bay and sound offer food resources. Small songbirds such as sparrows and finches probably feed here also, although there is only limited cover for nesting.

FISH

48. The importance of fish is related not only to their commercial and sports significance, but also to their trophic* role in the aquatic ecosystem. In the Snohomish estuary, fish species diversity and abundance are controlled primarily by:

- Habitat (and associated food sources)
- Water characteristics (temperature and salinity)
- Water Quality

These factors are modified by other conditions, such as weather and man's activities, to control the survival and reproduction of fish in the estuary and adjacent waters.

49. This discussion of fish in the study area considers first anadromous**, then non-anadromous fish. Anadromous fish, principally salmon, are an important harvestable resource in the region. Non-anadromous fish are divided into resource or non-resource fish; resource fish are those which are harvested, either for sport or commercial purposes, and non-resource fish are those not harvested. Table 3 (Appendix E) lists the resource and non-resource fish found in the Snohomish estuary and adjacent Possession Sound. Plate 10 identifies sport fishing areas and Plate 11 commercial fishing areas. It should be noted that the areas noted on the plates are not absolute boundaries but rather general fishing areas.

---

* Trophic - pertaining to nutrition
**Anadromous - oceangoing fish which migrate upstream to spawn

SPORT FISHING AREAS

PLATE NO 10

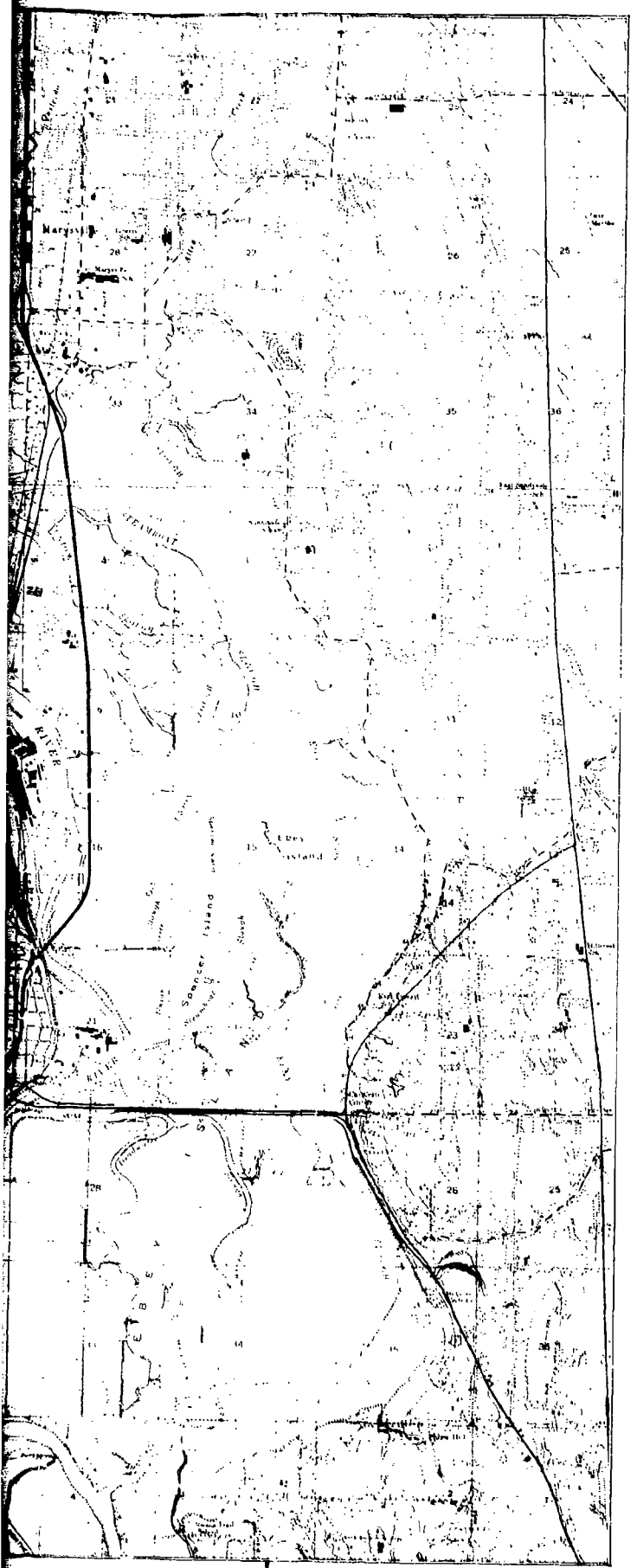
LEGEND

- Sport Fishing Access Points
- General Sport Salmon
- Concentrated Sport Salmon
- Non - Salmonid
- Sea-run Cutthroat Trout
- Shellfish
- Sport Crabs

N

SNOHOMISH ESTUARY WETLANDS STUDY

Source: Wash. Dept. of Natural Resources 1977
Williams et al. 1975
Miller and Borton 1974
Shea 1977
Wash. Dept. of Fisheries



COMMERCIAL FISHING AREAS

PLATE NO 11

LEGEND

- Salmon Net Fishing
- Bottom Fishing - Otter Trawl
- Hake Fishing
- Commercial Crabbing

N

SCALE 1:4000

SNOHOMISH ESTUARY WETLANDS STUDY

Source: Williams et al. 1975
Tyler 1962,1965
Miller and Borton 1974
Conley 1977
Wash. Dept. of Natural Resources 1977

2

PLATE NO 11

Anadromous Fish

50. The Snohomish River is a significant producer of anadromous fishes which are harvested by both the sport and commercial fishery. Four species of Pacific salmon, pink (Oncorhynchus gorbuscha), chum (O. keta), coho (O. kisutch), and chinook (O. tshawytsha), utilize the river system for spawning. Other salmonids with sizeable runs in the river include summer and winter steelhead trout (Salmo gardneri) and searun cutthroat trout (S. clarki). Searun Dolly Varden trout (Salvelinus malma) have also been reported, but run size has not been established. Approximate annual production data for Pacific salmon in the Snohomish River system for the period 1966-1976 are given in Table VI-16. Catch indicates the number of fish caught in the Port Susan-Port Gardner-Snohomish River mouth. Escapement is an estimate of the number of fish which succeeded in spawning.

51. Approximate average annual production data for summer and winter steelhead and searun cutthroat trout for the period 1970-1977 are given in Table VI-17.

52. The lower river, estuary and Possession Sound play an important role in the development of both salmon and trout stocks. During upstream migration salmon utilize all sloughs, with almost 60% of the fish moving through Union and Steamboat Sloughs and about 30% through the main channel (Snohomish County Planning Department, 1973). In addition, the river mouth and Port Gardner area are important as a physiological transition zone, nursery, and schooling habitat for juveniles before they move out to sea.

53. There is evidence that in past years the early seaward migration behavior of juvenile salmon had been considerably altered in the Snohomish flats area by degraded water quality conditions. Tyler (1965) found that juveniles were distributed in deep water (over 60 feet), at the onset of seaward migration, in a pattern which strongly suggested avoidance of spent sulfite liquor (SSL) concentrations which exceeded 20-25 ppm in the tide flats. Any unnatural avoidance of shoreline areas may seriously affect growth and condition of fry and expose pouplations to inordinantly high predation pressures. During the first weeks of nearshore schooling, salmon populations are particularly susceptible to adverse environmental conditions; mortality rates at this time will significantly determine the size of the adult return. More recent studies, however, indicate improved water quality conditions (Moore, 1976; Conley, 1977) which may have lessened the original contaminant impacts.

54. The Snohomish estuary is also important to other anadromous fish. The Washington Department of Ecology has noted that it may be a habitat area for American shad (Alosa sapidissima) (DOE, 1976). Shad spawning probably takes place in the lower river, and eggs and fry drift downstream to begin development in the estuary and sloughs prior to seaward migration. In other areas of Washington shad are considered a valuable marine resource for commercial harvest.

Table VI-16

COMMERCIAL CATCH AND ESCAPEMENT OF SALMON
IN THE VICINITY OF THE SNOHOMISH RIVER
(in thousands)

	Chinook		Pink		Chum		Coho	
Year	C[1]	E[2]	C[1]	E[2]	C[1]	E[2]	C[1]	E[2]
1966	6.8	--	--	--	7.6	--	86.5	42
1967	6.4	--	48.0	95	3.7	--	19.3	29
1968	4.0	--	--	--	11.6	7.6	23	60
1969	2.9	--	13.5	70	2.4	2.1	17.4	21
1970	4.9	--	--	--	6.7	11	52.4	64
1971	3.6	--	37.3	125	0.6	1.5	17.8	44
1972	2.9	--	--	--	10.9	2.4	39.9	20
1973	0.8	--	17.1	110	4.9	2.3	50	36
1974	.9	--	--	--	19.6	14.4	74	44
1975	2.4	--	18.2	65	1.3	1.9	58.8	43
1976	7.8	--	--	--	24.9	7.5	29.7	39

[1]Commercial catch for Port Gardner, Port Susan, and the mouth of the Snohomish River.

[2]Estimated escapement to spawning grounds in the Snohomish River.

Source: Washington Department of Fisheries, 1978

Table VI-17

ANNUAL CUTTHROAT AND STEELHEAD
PRODUCTION FIGURES

Species	Harvest	Estimated Escapement	Total
Steelhead	18,000	12,000	30,000
Cutthroat	4,000	2,000	6,000
Dolly Varden	1,200	1,300	2,500

Source: WDF, 1978

55. Herring (Clupea harengus pallasi) and longfin smelt (Spirinchus thalrichthys) use the lower Snohomish River and its estuarine areas extensively for spawning and as juvenile nursery areas. Eelgrass beds are important spawning areas for herring, and important nursery areas for longfin smelt. Large numbers of smelt larvae have been reported in the old river channel and lower ends of the major sloughs.

Non-anadromous Resource Fish

56. There is a wide variety of non-anadromous resource fish found in the Snohomish estuary (and adjacent Possession Sound). Many species, such as flat fish (Pleuronectidae), perch (Embiotoca), cod (Gadus), and many rockfish (Sebastes) are taken for both sport and commercial purposes. Some, such as dogfish (Squalus), ratfish (Hydrolagus), hake (Merluccius) and pollock (Theragra) are taken primarily for commercial purposes. Bottom fishing with trawl or net is probably the most common commercial fishing within the Port Gardner area. Sport fishing in the area occurs both from small boats and from shore. Small boat access is designated on Plate 10. Shoreline fishing is popular from bridges and piers, and also along riprapped slough banks.

Non-anadromous, Non-resource Fish

57. This group includes a variety of fish that are not sought for sport or commercial purposes. These are predominantly small fish such as sculpin and gobies, or sharks, eels and lampreys, all of which have little commercial value. Despite their lack of direct value to man these species are very important in the aquatic ecosystem. Many of these small fish are food for salmon or other resource fish, or for numerous fish-eating birds in the study area.

Distribution of Fish

58. As mentioned above, the Snohomish River and its sloughs are important migratory paths for anadromous fish, such as salmon, trout, shad, and smelt, that spawn in the estuary and in upstream areas. Many nearshore and shallow water species, such as starry flounder, staghorn sculpin, sand lance, tom cod, and perch have been reported in the estuarine portions of the river (Conley, 1977), as have the juveniles of other species, including sole, stickleback, and gunnel. Species which have been recorded in the freshwater portion of the river include chub (Mylocheilus), sculpin (Cottus), and sucker (Catostomus) (Engman and Stendal, 1976). Juvenile and small fish (such as stickleback, sculpin, flounder, and salmon) have been seen in the drainage channels of intertidal marshes in other areas

(NEC, 1975), but there has been no record of their presence in Snohomish marshes.

59. The intertidal mud and sand flats at the mouth of the Snohomish River, within Everett Harbor and west of Jetty Island are an important habitat for juvenile salmon and trout. Shallow areas along the north shore of Port Gardner are where young fish begin intensive feeding and schooling prior to their migration to Puget Sound. Flatfish, such as flounder and sole, are also common in these areas, as are sculpin, sand lance and skate.

60. Much of the intertidal flats west of Jetty Island is covered with eelgrass beds. These beds are important spawning areas for herring and skate. Juveniles of many species including salmon, steelhead, shad, cod, flounder, and sole are also found in these beds. In addition, adult pollock, perch, and sculpin have been found here.

61. Along the study area shorelines, especially in Everett Harbor and Tulalip Bay, numerous piers, pilings, and riprap structures provide a habitat for perch, rockfish, and probably other species associated with rock substrates.

62. Solid rock substrates and rock outcroppings are found at the south end of Gedney Island, and both around the mouth and inside Tulalip Bay. Very little information is available on the ichthyofauna associated with these particular areas, especially those within Tulalip Bay. Fish reported for the southeast end of Gedney Island and presumed associated with solid substrates include rockfish, bocaccio (Sebastes), ling cod (Ophiodon), rock sole (Lepidopsetta), decorated warbonnet (Chirolophis), prickleback, goby, painted greenling (Oxylebius), and a variety of sculpins. Fishes occupying the rock habitats of Tulalip Bay probably include many of those reported for Gedney Island. The open water area between the tide flats and Gedney Island is underlain primarily by soft sediments composed mostly of mud and sand. These waters yield an abundance of fish, many of which are harvested by commercial and sport fishermen. Important fish in this area include sole, flounder, rockfish, hake, pacific herring, dogfish, walleye pollock, sand lance, black cod, and ling cod. Areas of greatest abundance and diversity are generally near the steep slope between the open water and the tide flats, and along the nearshore slope around Gedney Island and the south shore of Port Gardner.

SHELLFISH AND OTHER INVERTEBRATES

63. Invertebrates in the Snohomish estuary and adjacent Possession Sound can be grouped in a non-taxonomic fashion that reflects

their functional distribution within the study area. The groups are:

- Molluscs
- Crabs and shrimp
- Sediment dwellers
- Insects (and spiders)
- Zooplankton

64. Although this is an artificial grouping, it emphasizes the distribution and trophic relationships of the various organisms. These groups are described in the first part of this discussion while their distribution in the study area is discussed in the latter portion.

65. The following discussion is based on several studies carried out in Port Gardner and Possession Sound, and on regional studies of Puget Sound. These include the works of Smith (1977), Smith, Conley and Detrick (1975), Parks and Lord (1973), the Pacific Northwest River Basins Commission (1970), Snohomish County Planning Department (1973), and Kozloff (1973c). These studies were conducted in the saline water areas and little information is available concerning freshwater invertebrates in the estuary.

Molluscs

66. The principal molluscs in the study area are clams, cockles, and mussels. In addition, a variety of snails and other gastropods inhabit some substrates. Oysters were probably present historically in the area. It is believed that degradation of water quality was a prime cause for their elimination, perhaps in coordination with other adverse environmental conditions.

67. Heart cockles (Clinocardium nuttallii) and bent-nosed clams (Macoma nasuta) are common in muddy sand substrate such as the substrate at the river mouth and in Possession Sound. Soft-shell clams (Mya arenaria) are also found in this substrate, especially where freshwater influx reduces salinity. Littleneck clams (Protothaca staminea) and butterclams (Saxidomus giganteus) are common in muddy sand substrates mixed with gravel. Geoducks (Panope generosa) and horse clams (Tresus capax) are also found in mixed sand and gravel substrates. Most of these shellfish are prized and are popular for either commercial and/or sports harvest.

68. The blue mussel (Mytilus edulis) is often found on pilings, rocky shores, or on isolated rocks and logs in the intertidal zone. Although not prized, the mussel is becoming more popular in the Puget Sound region.

Crabs and Shrimps

69. Both red rock crab (Cancer productus) and Dungeness crab (C. magister) occur in Possession Sound. Dungeness crabs are usually associated with sandy or muddy substrates and are also common in eel-grass beds. Although prevalent in Port Gardner, crabs are seldom found in the estuary proper, possibly due to the low salinity. Crabs are harvested for both commercial and sport purposes.

70. Spot shrimp (Pandalus platyceros) and pink shrimp (P. dorealis) have both been reported in the area. However, they are not sufficiently abundant to support a commercial fishery.

Sediment Dwellers

71. The sediment dwellers are a broad variety of benthic invertebrates including worms and crustaceans. (Molluscs are also sediment dwellers, but they have been discussed separately.) Some flatworms, nemerteans and annelids are detritus-feeding worms; they feed by consuming sediment, extracting organic detritus and then ejecting non-digestible mud and sand. The small crustaceans include a variety of amphipods and ostracods. The best known of these, Corophium spp., a filter feeding amphipod, is found in abundance on shallow mudflats. The sediment dwellers are important first order consumers in the detritus food chain. They are also a primary food source for many shorebirds, juvenile salmon, and other small fish.

Insects (and Spiders)

72. Insects are the only upland invertebrates which play a significant role in the aquatic ecosystems of the estuary. The larvae of many insects are found in marshes, swamps, and tideflats where they provide food for a variety of birds, small mammals, and fish. The adult form of many insects are also an important food source.

Zooplankton

73. The zooplankton are a diverse group of microscopic organisms that feed on phytoplankton, the open water primary producers. Zooplankton are first order consumers in the oceanic food chain, and therefore constitute an important food for a wide variety of fish.

Distribution of Invertebrates by Habitat Types

74. Since the invertebrates presented are almost all aquatic or intertidal organisms only water and aquatic lands habitat types are discussed here. Plate 10 shows the known distribution of shellfish in the study area.

75. The mudflats at the Snohomish River mouth, inside Everett Harbor, west of Jetty Island, and inside Tulalip Bay, are densely populated with sediment dwelling invertebrates. The shallow mudflats between Old 99 (SR 529) and the Tulalip Reservation on North Ebey Island probably also have abundant populations of these organisms. In addition, slough bottoms and tidal channels probably provide an important habitat for sediment dwellers. Invertebrate populations are diminished, however, where log rafting is extensive (Smith, 1977). These mudflats are important feeding areas for shorebirds and nursery areas for juvenile salmon.

76. Parks and Lord (1973) noted large populations of softshell clams and bent-nosed clams in the muddy shores east of the Jetty. Smith (1977) has reported mussels and clams (Macoma balthicus) in the intertidal flats west of Smith and North Ebey Islands. Along the shoreline from Priest Point to Mission Beach some soft shell and bent-nosed clams are found, along with more abundant littlenecks and butterclams. Crabs are also common along this beach. Many of these are found in harvestable populations.

77. The eelgrass habitat type supports a wide variety of invertebrates. Small snails graze on the blades, feeding on epiphytic algae. Some molluscs, particularly soft shell clams, have been found in eelgrass beds west of Jetty Island. Dungeness crabs are abundant in the beds, and use the beds for feeding and rearing habitat. The crabs are the basis of both a sport and commercial fishery in this area. Many sediment dwelling worms and crustaceans are also found in the eelgrass habitat type.

78. Marsh and swamp habitat types usually support abundant insect populations. Insect larvae feed in the sediment and on the plants, and provide food to a variety of birds. Insects flying over these wetlands are preyed upon by spiders, swallows and night hawks.

79. Zooplankton are found in both fresh and saline water habitat types. Their abundance is primarily related to the abundance of phytoplankton on which they feed. Species diversity, density and distribution undoubtedly varies between Port Gardner and upriver areas, but no known studies have been performed to describe these suspected variances. In estuaries plankton productivity is generally considered minor in comparison with wetland productivity (Odum, et. al., 1972).

N. ECOLOGICAL PROCESSES

1. This section describes the major ecological processes taking place within the Snohomish estuary ecosystem. The ecosystem is a very complex interdependent chemical, physical, and biological system. It is driven by solar energy which is not only the basic energy source for primary productivity but also the source of energy for the hydrologic cycle. Figure VI-14 illustrates the major components of the ecosystem. In the diagram each arrow represents the movement of energy. Energy is the link between and within the biotic components of the system.

2. The principal components of an ecosystem are energy, nutrients, producers and consumers. Solar energy enters the ecosystem, is converted to chemical energy, and flows through the system via plants, animals, river currents, tidal flow, wave action and gravity. Ultimately energy leaves the ecosystem as heat. Nutrients are chemical elements found in air, water and soil; they are incorporated into chemical compounds which make up the bodies of living organisms. Plants are the producers which absorb energy and nutrients to create the basic foodstuffs on which the remainder of the food webs are based. Consumers are all organisms which feed on plants, animals, or detritus to acquire the energy needed for survival.

3. Ecological processes are extremely complex and many aspects are poorly understood. Only a few of the major relationships and processes are discussed here: productivity, food webs, and nutrient cycling. The descriptions of the specific concepts come from the general literature on ecology and examples are drawn from the Snohomish estuary system.

PRODUCTIVITY

4. Biological production is the accumulation of nutrients and energy by an organism. In primary production plants accumulate solar energy through photosynthesis and convert it to chemical energy, forming complex organic compounds from simple nutrient compounds. Energy and nutrients which are stored in plants as organic compounds are available for use by other organisms through grazing or decomposition.

5. Energy and nutrients flow through a variety of food webs such as those illustrated in Figure VI-14. (A detailed discussion of food webs follows.) Plant materials are directly grazed, or undergo decompositon into soil sediments or waterborne detritus. The magnitude of transport and utilization of detritus in aquatic food webs has led many authors to agree that coastal estuaries are a primary source of nutrients for coastal food webs. However, since

URBAN AGRICULTURE
SHRUBLAND &
GRASSLAND
Detritus
FOREST
SWAMP
People
Cattle
Herbs and
Agriculture
Insects
Songbirds
Rodents
Insects
Songbirds
Rodents
Herbs and
Grasses
Owls
Hawks
Mink
Rabbits
Deer
Insects
Songbirds
Rodents
Skunk
Raccoons
Trees and
Shrubs
Owls
Hawks
Mink
Insects
Songbirds
Rodents
Trees and
Shrubs

People
Waterfowl
Small Fish
Large Fish
Small Crustaceans
Large Crustaceans
Shellfish
Muskrat Beaver
Owls Hawks
Mink
Insects Songbirds
Rodents
Cress and Shrubs
Insects Songbirds
Rodents
Herbs and Grasses
Shorebirds
Crustaceans
Detritus Feeders
Small Crustaceans
Eelgrass and Algae
WATER
Detritus
ALGAE & EELGRASS
MUD FLATS
SWAMP
MARSH

the net consumer production to net primary production ratio is usually less than 10% (Odum, 1960; Ricklefs, 1973) and since there are very few consumer productivity figures for this region, only primary productivity will be discussed for each habitat type.

6. Net primary productivity is the rate (in $g/m^2/yr$) of accumulation of energy and nutrients as plant material. Gross productivity is the rate of absorbtion of energy and nutrients prior to respiration. Thus,

Gross Productivity = Net Productivity + Respiration

There are no net primary productivity measurements for the habitat types in the study area. Within Puget Sound, Phillips (1972) reported productivity figures for eelgrass beds but there is concern that the values do not represent true net primary productivity. Disraeli (1977) estimated the net productivity of five estuarine marsh communities in Bellingham Bay, Washington, for one growing season, and Eilers (1975) has reported net primary productivity data for estuarine marsh communities in Nehalem Bay, Oregon, for one growing season. Productivity information will be drawn from these studies and from studies of plant communities at a latitude similar to that of the Pacific Northwest for the following discussion of habitat types.

7. Primary productivity has been measured by numerous authors in a variety of natural and cultivated ecosystems throughout the world. Some of this data has been summarized and is presented in Table VI-18.

Table VI-18

ANNUAL NET PRIMARY PRODUCTIVITY
FOR VARIOUS ECOSYSTEMS
(from Odum, 1972 and Ricklefs, 1973)

Ecosystem	Productivity ($g/m^2/yr$)
Wheat, world average	344
Wheat, area of highest yields (Netherlands)	1,250
Hay, U.S. average	420
Sugar cane, Hawaii average	3,430
Desert, Nevada	40
Tall grass prairies, Nebraska	446
Spartina salt marsh, Georgia	3,300
Temperate coniferous forest	2,800
Temperate deciduous forest	1,200
Seaweed beds, Nova Scotia	358

8. These figures are only meant to provide a perspective of the range of productivity and should not be considered absolute. For this discussion productivity of each habitat type will be reported in terms of the following ranges: Low = 0-600 $g/m^2/yr$; Medium = 600-1200 $g/m^2/yr$; High = 1200-1800 $g/m^2/yr$; Very High = 1800+ $g/m^2/yr$.

9. In addition to productivity, it is important to consider the interaction of each habitat type with the water of the estuary. This interaction is an important control on how high organic matter is transported as detritus to the aquatic ecosystem, and thus how much of the primary production of a habitat type is available as food to aquatic organisms. Aquatic interaction relates primarily to tidal interaction, although rivers and streams also contribute some organic matter from upland sources.

10. In this discussion uplands and non-tidal floodplain habitat types will be described as having low aquatic interaction, intertidal areas medium to high, and subtidal very high. Thus, a highly productive upland coniferous forest might contribute only small amounts of detritus to the aquatic ecosystem, since the aquatic interaction is low, while a less productive subtidal habitat type may contribute almost 100% of its total production. In this comparison the subtidal habitat type may actually be more valuable to the aquatic ecosystem in the area of detritus production. Unfortunatley there is no known research comparing the aquatic interaction of habitat types, so this part of the discussion is necessarily subjective.

Primary Productivity by Habitat Type

11. In the agricultural habitat type, factors such as soil condition, type and amount of fertilizer, and type of crop are important regulators of productivity. Estimates made by Golley (1960) for fields in Minnesota, and by Odum (1960) for United States and world averages of several crops, place agricultural productivity primarily in the "low" range with a few extending into the "high" range (see Table VI-18). Although these measurements are described as "net productivity" they generally do not identify the numerous artificial energy inputs, such as gasoline and fertilizer, usually associated with intensive agriculture. Agricultural productivity is primarily used directly by man. Some is used by birds and small herbivorous mammals, some remains in the fields, and some is exported to the estuary by flooding and runoff. Since man tries to minimize aquatic interaction by diking and draining, it is estimated that only a small amount of agricultural productivity reaches the estuary during river flooding and storm tides. Thus, the agricultural habitat type is in the low range for aquatic interaction. It

is useful to note at this point that there are examples of diked agricultural lands where active farming has stopped, the dikes have broken and not been repaired, and aquatic interaction has increased substantially, usually with a development of aquatic lands habitats (North Ebey Island east of I-5 is a good example). In other cases, dikes have not broken but because of the high water table aquatic lands habitats have still developed. In this case there is no corresponding increase in aquatic interaction.

12. Non-forested vegetated uplands and forested uplands can be very productive. Tamm (1975) estimated the net productivity of a coniferous forest in Sweden to be in the high range. Deciduous forests have an estimated net productivity in the medium range, as reported by Harris, et. al. (1975) for Tennessee forests and Ovington (1956) for English forests. These uplands habitat types surround the Snohomish estuary and extend throughout the entire drainage basin of the Snohomish River. Aquatic interaction occurs primarily when organic material is carried to the estuary by runoff and flooding. These habitats have low aquatic interaction.

13. The water habitat types in the study area include Port Gardner, Possession Sound, the Snohomish River and its sloughs, and Quilceda Creek. The primary plant production in the open freshwater of the river, sloughs, and saltwater areas is phytoplankton production in the water column. Productivity estimates by Ebbesmeyer and Helseth (1977) for central Puget Sound fall within the medium range. Within the estuary phytoplankton are able to respond quickly to changes in nutrient concentrations in the water when other primary producers such as vascular plants cannot respond or respond very slowly. Therefore, nutrients and energy that would otherwise be lost are made available to aquatic food webs through phytoplankton blooms.* Aquatic interaction of phytoplankton is very high.

14. The habitat classification of aquatic lands-forested contains two habitat types which when added together contain about one-third of the aquatic land acreage in the study area. The types are intertidal brackish/freshwater swamps and freshwater swamps (non-tidal). According to Eilers (1975) and Tamm (1975) the estimated net primary productivity for these habitat types in Oregon and Sweden is very high. The net production in an intertidal brackish/freshwater swamp either remains in the swamp and adds to the accumulation of peat or is exported by grazing animals or by tidal waters. In most cases, tidal interaction probably dominates export from swamps. In non-tidal swamps such as those behind dikes,

---

*Phytoplankton Bloom - Sudden and enormous increase in phytoplankton population and density; may often be due to sudden changes in environmental conditions.

aquatic interaction is low, being limited to floods and occasional storm tides. (This is further evidenced by thick layers of peat, suggesting retention of major portions of production over the years.) At Sunnyside Swamp the dike has been breached, but much of it is still intact; there is some tidal interaction, but probably only in the low to medium range. In the vicinity of Quilceda Creek there is no dike and the swamps are open to aquatic interaction along the entire perimeter; aquatic interaction is medium to high.

15. Kelp and other algal habitat types, such as those found in the intertidal and nearshore subtidal areas of Port Gardner and Possession Sound, are suspected of having low biomass densities but exceptionally high turnover rates (Kanwisher, 1966; Mann, 1972). Apparently the kelps and other algae go through several growth cycles as algal blades are broken off by water currents and waves, resulting in very high annual net primary productivity. In addition, almost 100% of the algal material lost to the water column decomposes and becomes detritus. Aquatic interaction of subtidal and intertidal algal communities is high to very high.

16. The extensive eelgrass beds in the shallow waters of Port Gardner, Possession Sound and Tulalip Bay appear to be very productive. Although net productivity measurements by Phillips (1972) in Puget Sound were low, they did not include the amount of organic material exported during the growing season as a result of grazing, tidal currents, and wave action. Therefore, reported productivity values probably do not adequately reflect production taking place, and should not be compared to the productivity estimates for other habitat types. It is estimated that over 95% of eelgrass productivity becomes detrital matter (Zieman, 1977). The aquatic interaction of eelgrass beds is high to very high.

17. Salt marsh habitat types occupy only a small acreage in the study area primarily on the marine fringe of the major islands west of Interstate 5 and in small patches along the inner shore of Tulalip Bay. The amount of net primary production available from salt marshes is high to very high as reported for Oregon salt marshes (Eilers, 1975). [Burg, et. al. (1976) reported low to high productivity for salt marsh associations in the Nisqually Delta. However, the sampling methods used may not have indicated total net productivity.] Salt marshes are normally inundated twice a day by the high tides and their aquatic interaction is high. Much of the salt marsh production is exported to the estuary as detritus.

18. The brackish/freshwater intertidal marsh is the most extensive aquatic habitat type in the study area, with the possible exception of eelgrass habitat. Net primary productivity of the brackish/freshwater marshes in Northern Puget Sound and New Jersey has been measured in the medium to very high range (Disraeli, 1977;

Jervis, 1964). The value of this production to the biological functioning of the estuary is closely related to the amount of aquatic interaction taking place at each location of the marsh. For example, it appears that the marsh on North Ebey Island has more aquatic interaction than a similar marsh along Highway 2. This results in more export of organic detritus to the aquatic food webs from the North Ebey Island marsh and increases its functional value. This habitat type falls in the medium to high aquatic interaction range.

19. The final habitat type to be considered is the non-tidal freshwater marsh. Auclair, et. al. (1976) estimate the net productivity of freshwater marshes in Quebec, Canada, to be medium to high. Since these marshes are non-tidal, little of the production is exported to the estuary. Therefore, aquatic interaction of this habitat type is low.

FOOD WEBS

20. Food webs are an ecological concept used to describe the movement of energy and nutrients through an ecosystem. A clear understanding of food webs is a prerequisite to comprehending the complexities of ecosystem function. The important aspects of food webs are energy, nutrients, and trophic levels. The first part of this discussion defines these characteristics and identifies their significance.

21. An ecosystem is a community of organisms and its physical environment. It may be as small as a fishbowl or as large as the planet. The larger the ecosystem, the more complex its food webs. To simplify the description of the estuarine ecosystem, the second portion of this discussion identifies the food webs within each of the habitat types of the estuary. The summary combines the habitat type into a single picture of the food web of the Snohomish estuary ecosystem.

Energy and Nutrients

22. Energy and nutrients, in the form of organic compounds, are the commodities that move through the ecosystem along pathways described as the food web. These are the components of every organism in the estuary.

23. Energy enters the ecosystem as both light and heat. Although visible light and heat differ only in wave length, their effects on the ecosystem are very different. Through photosynthe-

sis, the energy in sunlight is converted to chemical energy and stored as sugars and other organic compounds. This is perhaps the most important energy transformation taking place in the ecosystem; the entire food web is based on the amount of energy transformed and stored as primary production.

24. Energy entering the system as heat performs a variety of functions. Heat is absorbed by water, soil, and organisms. This heat, stored as thermal energy, creates a suitable environment in which organisms can function. For every organism there is an optimum functioning temperature. If available heat is such that the ambient temperature differs significantly from this optimum temperature, the organism does not function at its greatest efficiency. Thus heat, although not used directly by organisms within an ecosystem, is an important factor controlling the efficiency of those organisms.

25. There are several major and numerous minor elements which are identified as nutrients within an ecosystem. The major nutrients are carbon, nitrogen, and phosphorus. Water and oxygen are also vital for maintenance of normal physiologic functions. Other important elements include sulphur, calcium, sodium, potassium, and magnesium. These elements are incorporated in complex molecules which comprise all organisms in an ecosystem.

26. These elements move through a food web in the same manner as energy; i.e., they are incorporated in chemical compounds. Unlike energy, however, they are not eventually dissipated, but instead recycle through the ecosystem in both organic and inorganic aspects. (An expanded discussion of nutrient cycling is found on page 260.)

Trophic Levels

27. The transfer of energy and nutrients can be best defined in terms of trophic levels. A trophic level is a major step in a food web; it represents the number of times energy has been transformed after entering the system.

28. As mentioned earlier, energy enters the ecosystem as sunlight, is transformed by plants into chemical energy, and stored as sugars and other complex organic molecules. The energy and elements in these molecules are then either recombined to form the numerous complex compounds which comprise the plant, or they are returned to the ecosystem through various metabolic processes. This primary production, the synthesis of proteins, carbohydrates, and other chemical constituents of plant material, characterizes the first trophic level.

29. The second trophic level, comprised of the primary consumers, is based on the consumption of primary production. There are two different types of primary consumers: grazers or herbivores, which feed on living plant material, and detritovores, which feed on dead plant material. These two forms of primary consumers provide the second transfer of energy within the ecosystem and form the basis for two distinct food webs. In the following discussion references to grazing (or browsing) and detritus food webs will be based on these distinctions.

30. The remaining trophic levels are comprised exclusively of carnivores. The first order carnivores (third trophic level) feed on the detritovores and herbivores of the second trophic level. These carnivores in turn are fed upon by second order carnivores. In general, three levels of carnivores are recognized, although this is not an absolute limitation. For instance, the complex food webs of the ocean may include three levels of planktonic carnivores, as well as a top carnivore that feeds directly on the primary consumer (as is the case with whales and euphaiid shrimp). In most ecosystems, however, three levels of carnivores, and a total of five trophic levels, are sufficient to describe the food web.

31. A final, and extremely important, part of the food web is occupied by the decomposers. These are bacteria, fungi and other organisms that consume dead organic material, or excrement, and convert it to metabolic energy and inorganic nutrients. Decomposers feed on organisms from all trophic levels and therefore do not represent a specific trophic level.

32. It is important to note that many organisms may be included in more than one trophic level. Carnivores, in particular, might feed on other carnivores, herbivores, or occasionally even vegetation. Some plants, which are normally defined strictly as primary producers, might also occupy other trophic levels. For example, the parasitic dodder (Cuscuta spp.) and the carnivorous sundew (Drosera spp.) are representatives of the second and third trophic levels respectively.

Community Food Webs by Habitat Type

33. With a basic understanding of trophic levels it is possible to describe the food webs of the various habitat types found in the Snohomish estuary. The following discussion is a generalized view of the representatives of each trophic level found in the habitat types. The species mentioned are not necessarily found in every example of a habitat type, but are present with sufficient frequency to justify their inclusion in this discussion. Due to their similarity in various habitat types, decomposers will not be considered specifically in this discussion. Following this description will be

a discussion of the entire estuarine ecosystem and the relationship of the various habitat types to that ecosystem. Figure VI-14 is a graphic illustration of a food web for the estuary ecosystem. Figure I-15 represents in detail a single habitat type within the estuary.

34. The urban habitat type represents a highly altered and often artificial ecosystem. Nutrients are added as fertilizers, with excess quantities eventually leaching into the local runoff. Much of the primary production has been eliminated. Trees, shrubs and annuals which do exist are often protected from consumption by fences and insecticides. Insects and rodents are the common primary consumers; songbirds are the prevalent first order carnivores that prey on the insects. Domestic animals prey on the rodents. Decomposers may be found in lawns or gardens, but much of the dead and excretory material is carried to sanitary landfills or other locations.

35. Agricultural lands are also highly altered ecosystems. These are the primary production areas that support the human populations of urban areas. In addition to man's harvest, a small secondary food web is based on agricultural primary production. Rodents, such as mice and gophers, commonly inhabit crop lands and pastures, feeding on seeds and vegetation. Insects and small birds, such as sparrows, are important primary consumers in agricultural areas. With the exception of spiders or omnivorous rodents, there are few carnivores that live in the agriculture habitat type. Swallows and other insect-eating birds often enter the fields as first order carnivores. Mink, raccoon, and raptors may also enter, preying on rodents or small birds. A portion of the agricultural production is exported to the aquatic habitat as detritus.

36. The grassland habitat type supports a more varied and complete food web than its agricultural counterpart. A mixed population of grasses and herbs is the source of primary production. Mice, voles, gophers, sparrows, and insects are all important primary consumers. In addition, deer and pheasant may enter the grassland to feed. Resident first order carnivores include shrews, night hawks and short eared owls. Swallows are insectivores, and commonly visit grassland areas to feed. Minks, raccoons, and raptors all may prey on the small birds and mammals that inhabit grasslands. Some grassland detritus is exported to the estuary.

37. In the shrubland habitat type primary production appears as both woody and leafy material. Woody material provides a food source for certain worms and insects, while leafy vegetation and seeds are consumed by deer, rabbits, mice, insects, and songbirds. Resident first order carnivores include shrews, wrens, and creepers. Other carnivores found in the shrub habitat include snakes, skunks, minks, and raccoons. Dead leaves and branches may decompose in the area or may be exported to the aquatic habitat.

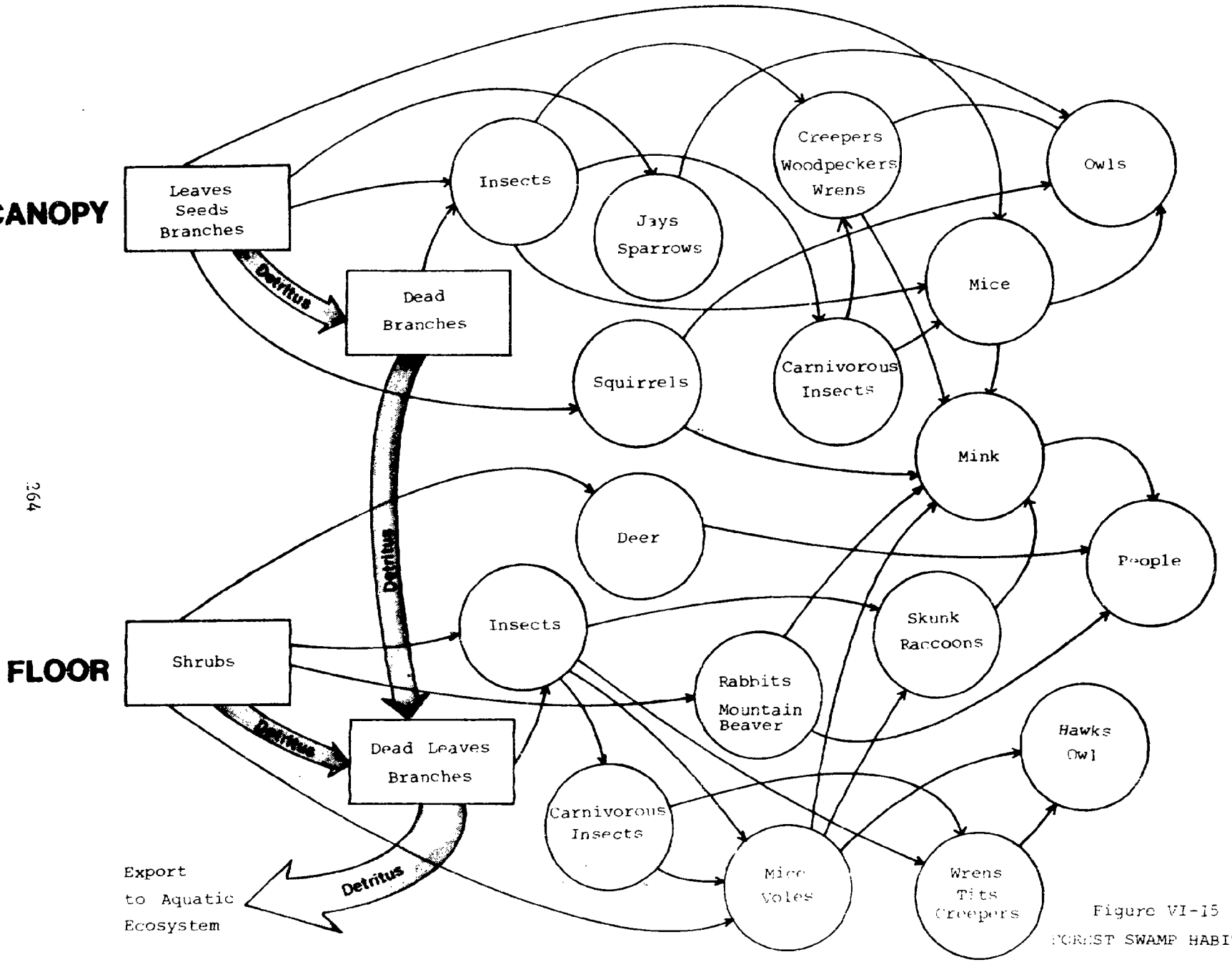


Figure VI-15

FOREST SWAMP HABIT

38. In the forested habitat type trees and shrubs are the primary producers, forming the basis of several different food webs. In the canopy there is a browsing food web based on leafy primary production and a detritus food web based on dead branches and trunks. On the forest floor there is also both a browsing and a detritus food web. The former is based on young trees, shrubs and herbs, the latter on leaf litter.

39. Primary consumers of the forest canopy browsing web are insects, squirrels, tree mice, jays, sparrows, and other seed-eating birds. Insectivorous birds such as wrens and tits are first order carnivores in this web. The detritus web of the forest canopy is characterized by termites and other insects which consume decomposing wood. These insects are preyed on primarily by woodpeckers, creepers, and other tree top insectivorous birds. Owls are the principal top carnivore in the forest canopy, although other raptors may feed there also.

40. On the forest floor, deer, mice, rabbits, voles, and mountain beaver browse on bark or leafy vegetation. Numerous insects are also primary consumers in this area. The primary consumers of the forest floor detrital web are mostly insects, although some small mammals may feed on this material also. Songbirds, such as wrens, tits, and creepers, are first order carnivores which feed on the numerous insects of the forest floor. Other carnivores include minks, skunks, raccoons, hawks, and owls. Man may be considered a carnivore in this habitat when hunting for deer.

41. The principal food web in the water habitat type is based on phytoplankton production and subsequent grazing by zooplankton (the benthic detrital food web is considered in the unvegetated aquatic lands discussion). In fresh water, insects (mostly larvae and numph stages) are the first order carnivores. Juvenile salmon and trout, stickleback, chub and other fish all feed on insect larvae and in turn are consumed by larger fish and birds, such as herons and kingfishers. In saline and brackish waters, primary consumers are represented by planktonic crustaceans, such as copepods, euphausiids, and amphipods, and the planktonic larval stages of innumerable benthic species. Some of these primary consumers are also first order carnivores. The larger zooplankton forms are fed upon by shrimp, comb jellyfish (ctenophores) and small fish. These in turn are consumed by larger fish. The diversity of size and form in the aquatic environment precludes the existence of a food web as simple as that of the forested ecosystem.

42. Saline, brackish and fresh marsh habitats display more simplified food webs than those just described. Marsh vegetation, including sedges, cattails and bulrushes, are the primary producers. Much of this organic material is exported as detritus, forming the basis for food webs in other habitat types (especially in unvegeta-

ted mud and sand flats). Primary marsh consumers are insects, herbivorous mammals, and birds. Muskrats, beaver, mice, voles, sparrows, mallards, and others feed on the seeds, leaves, and stems of marsh vegetation. Insects are preyed upon by swallows and wrens, the small mammals by herons, bitterns, and hawks. All but the largest of these may fall prey to mink that frequently enter the marsh to feed.

43. The brackish and freshwater swamps also support several food webs. Primary production of leaves and branches may be exploited in the habitat, deposited in the substrate or exported to the aquatic habitat. Within the canopy, grazing is carried out by insects and seed-eating animals such as sparrows, squirrels, and mice. Detritus feeding in the canopy is represented primarily by termites and other insects that feed on decomposed wood. Insects in the swamp canopy are fed upon by woodpeckers, creepers, wrens, and other birds. The top carnivore in this realm is the owl.

44. On the swamp floor both grazing and detritus feeding occur. Deer, rabbits, mice, muskrats, and insects are important browsers in this area. Detritus feeders include insects and rodents. Wrens, tits, and other insectivorous birds are the principal insect predators; carnivores include mink, raccoon, and various raptors. (Figure VI-15 illustrates the food web of this habitat type.)

45. Eelgrass habitat supports a diverse food web. This is based on eelgrass production, the production of numerous epiphytic organisms associated with eelgrass, and also on the detrital forms of both eelgrass and its epiphytes.

46. Eelgrass is directly grazed upon by waterfowl, especially black brant, widgeon, scaup, and mallard. Some small crustaceans, such as the beach isopod (Idothea resecata) also utilize eelgrass as a food source.

47. Eelgrass provides a substrate for a variety of diatoms and epiphytic macroalgae. These algae are consumed by zooplankton, small crustaceans, and grazing gastropods. Larger crustaceans, including shrimp, feed on the smaller organisms and all are preyed upon by crabs and small fish, such as herring and juvenile salmon. Crabs and small fish are a food source for large fish and man.

48. Detritus from eelgrass beds supports a large and diverse food web, perhaps more diverse than the standing crop food web. Detritus undergoes bacterial decomposition soon after disassociating from the plant, resulting in both physical decomposition and nutrient enhancement. Detritus either remains in the eelgrass habitat, or is exported by tidal action or currents to mudflats and other nearby habitats. In either case, it becomes a major food source for a wide variety of benthic invertebrates, including mol-

luscs, detritus feeding worms and crustaceans. Detritus feeders are fed upon by shorebirds, waterfowl, and fish (especially herring, juvenile salmon, and other small fish). Molluscs are subject to predation by crabs. Many molluscs, crustaceans, and fish are harvested by man for commercial and sport purposes.

49. The algae habitat type supports both grazing and detrital food webs. These food webs are based primarily on Ulva lactuca and Enteromorpha intestinalis as primary producers, although some red and brown algae may also be present. These algae are consumed by waterfowl, such as black brant and mallards, and small fish, including the buffalo sculpin. Waterfowl are popular game for man; small fish are preyed upon by larger fish, diving birds (such as grebes and mergansers) and wading birds such as herons. The detrital food web based on algae is similar to the eelgrass detrital web.

50. Unvegetated aquatic lands (mud and sand flats) exhibit variable primary production, and secondary production from detritus comsunption that is very high. Primary production in these habitats is principally from benthic diatoms and blue-green algae. These microscopic algae, and the zooplankton which feed upon them, are consumed (along with extensive amounts of detritus) by numerous sediment dwellers. These benthic detritovores include polycheate worms, amphipods (especially Corophium spp.) and various insect larvae. This diverse mudflat fauna is the principal food source for a wide variety of shorebirds, such as sanderlings, dunlin and sandpiper, and small fish, especially herring, smelt and juvenile salmon. Flounder, sole, and perch also feed on mudflats. Many of these fish are harvested by man, or consumed by fish harvested by man.

51. The unvegetated spit typically has a low primary production from sparse beach grass. Detrital material transported to the beach supports beach insects, but not in great numbers. These insects in turn are consumed by shorebirds that use the spit as a resting area.

Summary

52. Primary production in the Snohomish estuary is performed by terrestrial plants, wetland plants, aquatic macrophytes (including algae and eelgrass) and phytoplankton. Each of these primary production groups form the basis of food webs within the estuary ecosystem. These food webs interact and overlap, but may also be analyzed separately.

53. Terrestrial plants are the basis of an upland grazing food web. Numerous herbivores, including insects, rodents, song-

birds, and deer consume the leaves, seeds and stems of upland plants. These herbivores in turn are the prey of diverse carnivores, such as mink, raptors, and humans. The products of decomposition and excretion are metabolized in the soil as bacteria, fungi, and other organisms recycle the organic materials into inorganic nutrients. Upland production which is transported to the aquatic area contributes to the detrital food web.

54. Wetland plants are grazed lightly; most wetland production becomes detritus and is transported to aquatic areas (Gunnison, 1978). Detrivores in aquatic areas include molluscs and other filter feeders, and amphipods and other sediment feeders. Each of these benthic invertebrate groups are a major food source for crustaceans and a wide variety of fish. These carnivores, such as crabs, salmon, and sole are a food source for wading birds, raptors, and people.

55. Aquatic macrophytes, such as algae and eelgrass, are primary producers in both the aquatic grazing food web and the detritus based food web. Invertebrates and small fish graze directly on algae and eelgrass, and in turn are consumed by larger fish and crustaceans. These carnivores are also components of the detritus food web.

56. Phytoplankton form the basis for a second aquatic grazing web. These microscopic producers are the food source of zooplankton, which in turn are consumed by a variety of filter feeding fish and invertebrates. The aquatic grazing food web overlaps with the detritus and macrophytic food webs, since the same carnivores feed in all three food webs.

57. Thus, although the various food webs may be based on primary production from specific sources, they are not absolutely limited to those sources. In addition, many consumers may be found in a variety of food webs. It is apparent that the food webs of different habitat types are interrelated in a complex manner.

NUTRIENT CYCLING

58. A nutrient is any substance which is used by an organism for growth or sustenance. The significance of a nutrient to the ecosystem is determined primarily by its availability to and its need by organisms within the system. In most ecosystems, the principal nutrients are carbon, nitrogen, phosphorus, oxygen and hydrogen. Other nutrients required by organisms in measurable amounts are potassium, calcium, sulphur and magnesium. In addition, many sub-

stances are required only in trace amounts; some of these are: iron, manganese, copper, zinc, sodium, chlorine, cobalt and iodine.

59. Nutrients move through the ecosystem food webs in much the same way as energy. However, unlike energy, which is lost as heat, nutrients are recycled through a variety of pathways, ultimately to be returned to the food webs. This discussion will center on the recycling of nutrients in the estuarine ecosystem, and to some extent, the global ecosystem.

60. Although many nutrients have been identified, the cycles of only a few have been clearly delineated. Fewer still have been quantified in their movements through the global ecosystem. For these reasons only three of the most important nutrients will be considered. Carbon, nitrogen and phosphorus are the most often studied and the best understood of the nutrients. In addition, nitrogen and/or phosphorus are often considered "limiting".* It is the limiting characteristics of these nutrients which make an understanding of their movement through the ecosystem important. Description of nutrient pathways should provide a basic understanding of nutrient cycling in the estuarine ecosystem. Included with the discussion of each nutrient is a diagram illustrating the pathways described in the text.

Carbon

61. The carbon cycle is closely related to energy transfer through an ecosystem, since energy absorbed by primary producers during photosynthesis is incorporated into a variety of organic compounds created from CO_2, water and other compounds. Energy moves through the ecosystem, entering as light and leaving as heat during respiration. Carbon, however, is recycled, returning to the atmosphere as CO_2. The carbon cycle is illustrated in Figure VI-16.

62. The CO_2 assimilated in the photosynthetic reaction may be extracted from the atmosphere (in the case of terrestrial plants) or from water (in the case of phytoplankton). Carbon thus assimilated is used by the producer for maintenance (respiration), for the formation of structural materials, and for energy storage. If the plant is consumed, the herbivore converts the plant carbon compounds to animal carbon compounds which are used for maintenance (respiration), structural components and storage. If the herbivore is consumed, the organic compounds are used for maintenance, structural components and storage. In each step metabolism of organic compounds for maintenance results in the release of CO_2 which is returned to the atmosphere or water.

---

* Limiting nutrient - A nutrient substance, the shortage of which limits the population size of an organism or group of organisms.

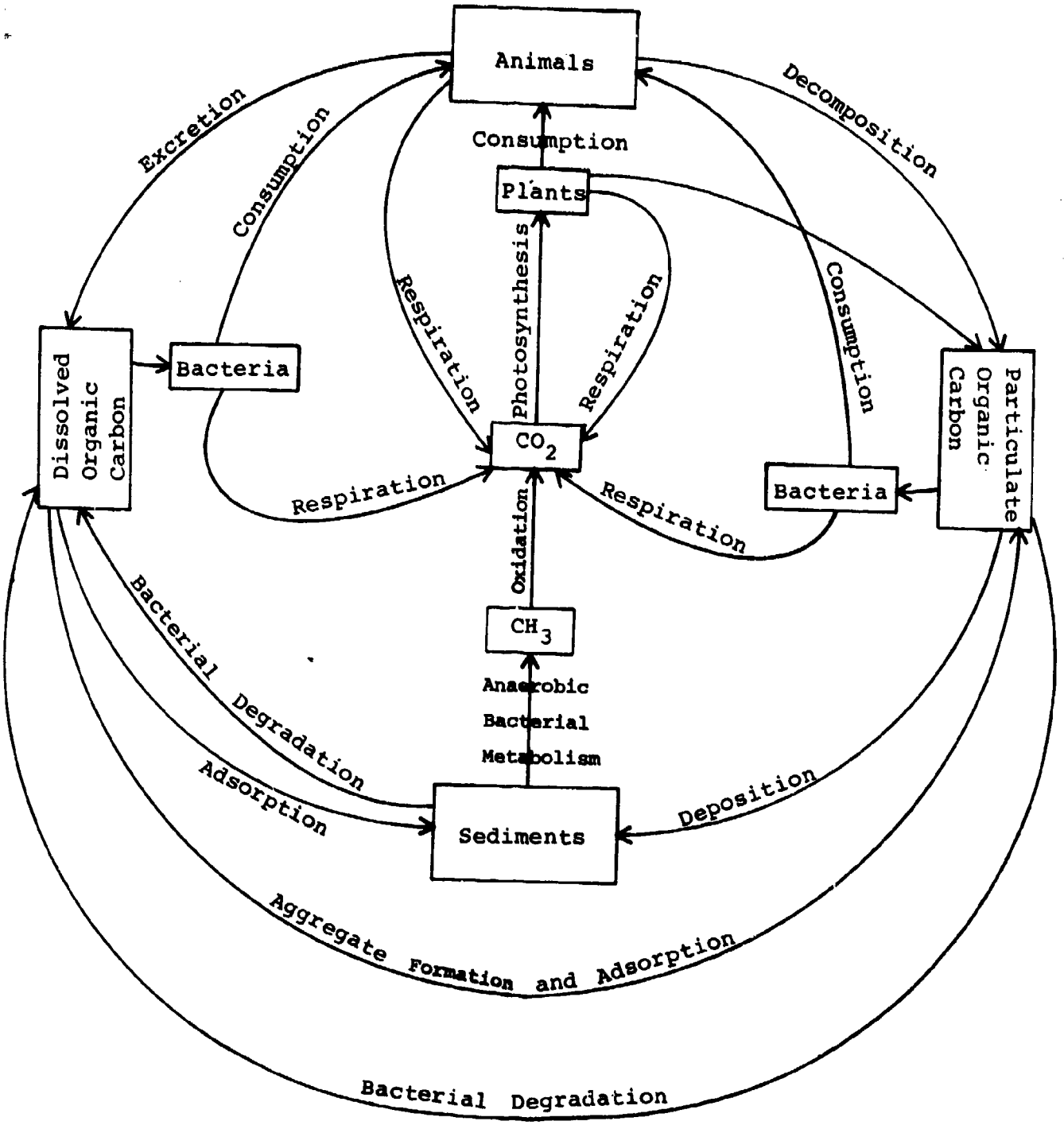


Figure VI-16

THE ESTUARINE CARBON CYCLE
(after Champ, 1977)

63. Any carbon consumed but neigher assimilated nor respired will be excreted. Any organism not consumed will eventually die, and its body tissues transformed through various physical and biological processes into detritus. Excrement and detritus ultimately become dissolved, or particulate, organic carbon. Both forms of organic carbon may reenter a food web through assimilation by bacteria, detritus feeders, or other organisms. They may also be incorporated into sediments and later enter a food web.

64. In addition to organic carbon, sediments may receive inorganic carbonates originally used as structural components by consumers or eroded from geologic sources. Shells, teeth and bones are broken up and deposited along with other carbonates and organic carbon. In aquatic environments particulate carbonate sediments may add to or remove dissolved inorganic carbonate and CO_2 in the water column through chemical reactions.

65. An estimated 90% of marsh production is converted to detritus (Gunnison, 1978) or assimilated by detritivores, forming the basis of a major aquatic food web. In upland and aquatic food webs, however, more plant production is converted to animal carbon through grazing.

66. Most organic carbon deposited in uplands is ultimately utilized by decomposers and returned to the food web; that which is deposited in marshes or swamps is often buried before decomposition, forming peat. Both organic carbon and inorganic carbonate may be buried in aquatic sediments.

Phosphorus

67. The phosphorus cycle is relatively simple. There is only one significant inorganic form of the nutrient, phosphate ($PO_4^{\equiv}$), and no atmospheric forms; as a result, its cycling is associated only with the soil and aquatic components of the ecosystem. In addition, virtually all organisms can convert organic phosphorus to phosphate.

68. Phosphorus is of fundamental importance to physiological functions and is required in relatively high concentrations by most organisms. Traditionally, phosphorus has been identified as the critical limiting nutrient in freshwater ecosystems. However, it is not considered to be limiting in marine waters. Figure VI-17 illustrates the estuarine phosphorus cycle.

69. The principal source of phosphorus is the erosion of phosphate-bearing rocks into various waters. In addition, it has been estimated that detergents and municipal wastes may represent 25-50% of the total land derived phosphates. Dissolved inorganic

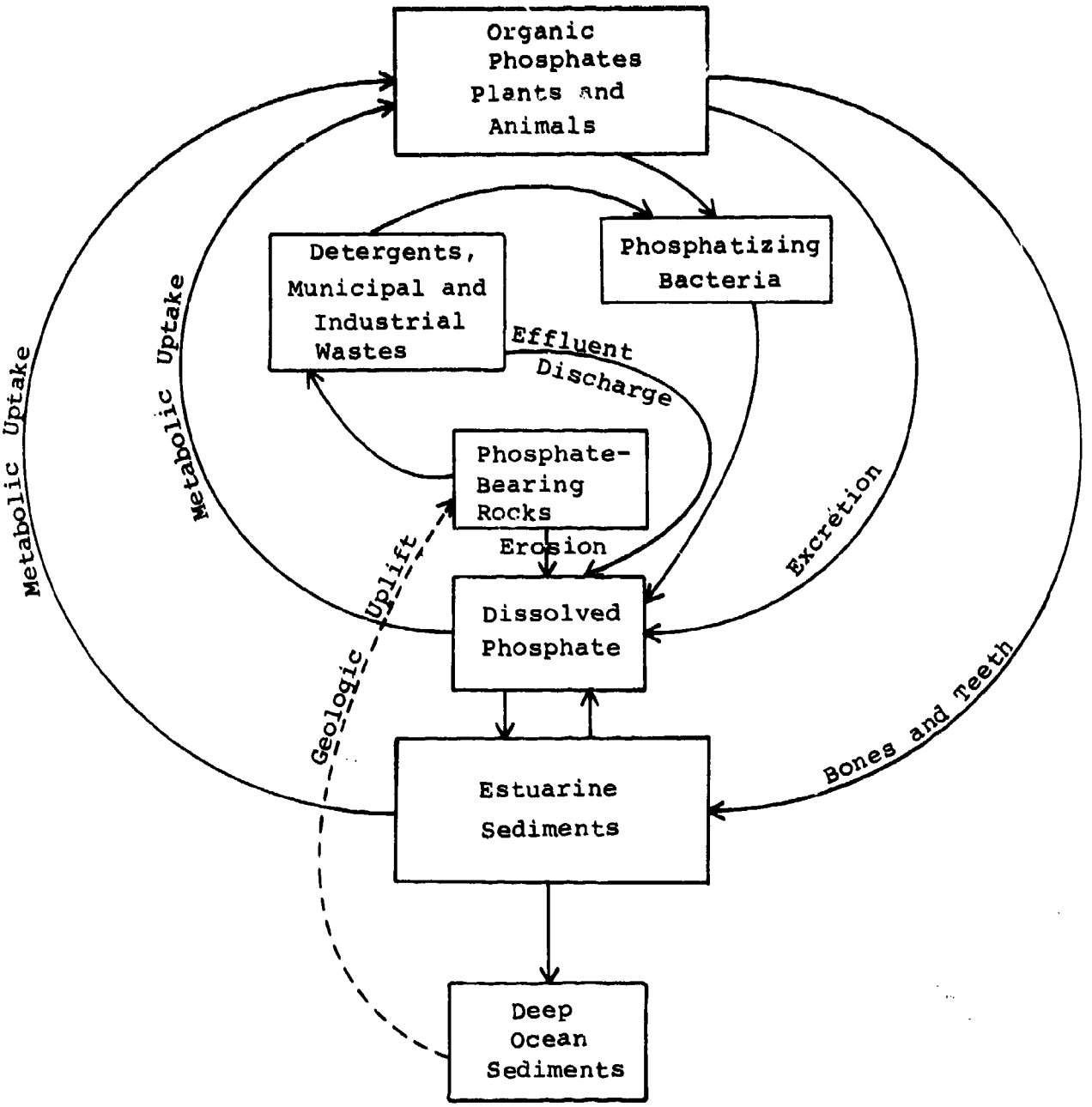


Figure VI-17

THE PHOSPHORUS CYCLE
(after Champ, 1977, and Odum, 1971)

phosphate is taken up by primary producers and micro-organisms; it is then moved up the food chain as organic phosphate. Dissolved phosphate which is not assimilated moves downstream and ultimately may be deposited in shallow estuarine sediments or deep ocean sediments. That which is deposited in shallow sediments such as marshes or tide flats may be assimilated by rooted plants or detritus feeders, thus reentering the food web. Additionally, in shallow systems there appears to be an exchange of phosphate between sediments and water (Gunnison, 1978). Phosphates deposited in deep ocean sediments are lost unless uplifted by geologic forces.

Nitrogen

70. Nitrogen is an important nutrient in biological ecosystems, since it is a major constituent of protein and other cellular constituents. Because of their predominantly protein, rather than carbohydrate, structure, animals tend to have greater amounts of nitrogen than plants. In marine waters, nitrogen, not phosphorus, is considered to be the limiting nutrient (Clark, 1974; Rhyther and Dunstan, 1971).

71. The nitrogen cycle is very complex, involving four inorganic forms of nitrogen and a variety of specialized bacteria. Figure VI-18 illustrates the various aspects of nitrogen recycling through the ecosystem.

72. Molecular nitrogen (N_2) in the atmosphere or dissolved in water is the most abundant form, but it can be used by only a few types of organisms. Nitrogen fixation, the conversion of N_2 to nitrates (NO_3), is accomplished only by certain algae and bacteria. Nitrates generated by these organisms may then be incorporated by primary producers into organic compounds. Nitrogen fixing organisms may also be incorporated into the food web through consumption, or death and decomposition.

73. Detritus, the product of decomposition, represents an estimated 50% of the non-gaseous nitrogen in the ecosystem (Ricklefs, 1973). Thus, the conversion of this material to biomass in the food web is an important process. Some is consumed by detritus feeders, the remainder undergoes complete decomposition, where the organic nitrogen is converted to ammonia (NH_3) by aminifying bacteria. Other bacteria convert ammonia to nitrites (NO_2) and nitrites to nitrates. The nitrates are then available for assimilation by primary producers. It should also be noted that some nitrate is converted to molecular nitrogen by anaerobic* bacteria

*Anaerobic - Literally without oxygen, environmental conditions where no free oxygen is available for use by organisms.

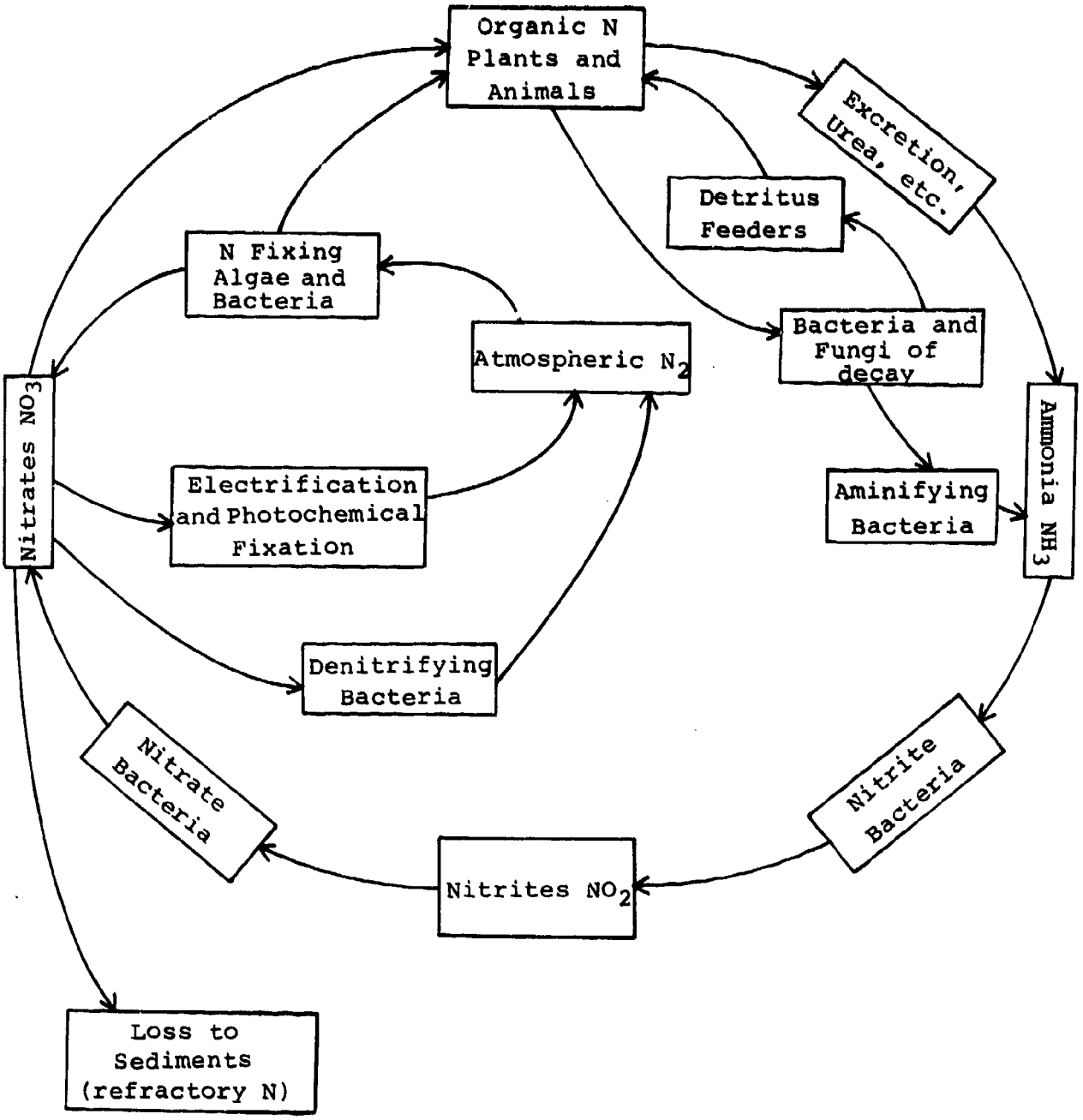


Figure VI-18

THE ESTUARINE NITROGEN CYCLE
(modified from Odum, 1971)

such as those found in some sediments.

Summary

74. The three principal nutrients, carbon, phosphorus and nitrogen, cycle through the estuarine ecosystem in very different and complex ways. The atmosphere is the primary source for carbon and nitrogen, but there is no major atmospheric form of phosphorus. All three nutrients can be lost to the ecosystem as a result of deposition in deep-ocean sediments.

75. Terrestrial primary producers acquire carbon directly from the atmosphere and absorb dissolved phosphorus and nitrogen from water and sediment (aquatic primary producers absorb all nutrients from water and sediments). Phosphorus is available directly from erosion and dissolution of rocks; nitrogen must be fixed from the atmosphere or extracted from detritus and converted to nitrate before it is available to most primary producers.

76. Once assimilated by primary producers, nutrients move through the food web in the same manner as energy. Respiration, decomposition and excretion processes, however, act to recycle nutrients. In respiration carbon is returned to the atmosphere as CO_2. Decomposition results in particulate organic carbon and particulate phosphate which may be deposited as sediments in marshes, swamps, tide flats and eelgrass beds. Decomposition also begins the process of converting organic nitrogen to nitrate. Excrement contains high concentrations of soluble nutrients which are immediately usable by some micro-organisms. Through these micro-organisms, nutrients either reenter the food web directly or are converted to compounds which can be utilized by primary producers.

77. Nutrients enter the estuary food web through a variety of means, and for each nutrient the movement through the food web is only a portion of the entire nutrient cycle. Decomposition and detritus formation are important aspects of the nutrient cycles, returning nutrients to the primary producers in a form they can use.

Section VII

PUBLIC AND LAND USE PROFILE

Section VII

PUBLIC AND LAND USE PROFILE

1. At the end of the last century the Snohomish estuary was an undeveloped area. Extensive wetlands in the river floodplain were surrounded by forested slopes. There was very little diked area and very little agriculture in the estuary delta. The floodplain was in a pristine state.

2. Today the study area is drastically different. Port Gardner and the Everett shoreline are heavily developed. The floodplain of the estuary is mostly diked and used for agriculture, with urban activities occurring on filled areas and on the slopes above the floodplain. Highways bisect the river floodplain. Sewer lagoons to serve the growing cities are now located in the delta and discharge effluent into the Snohomish River. There is continued pressure for new industrial, commercial, and residential development in and around the floodplain. Concern about wetlands and floodplain already lost to urbanization has grown, and a desire to preserve remaining wetlands free from urban encroachment is developing among agencies and the public alike.

3. It is the purpose of this profile to provide a picture of land use, cultural resources, and public policy in the Snohomish estuary. Such a picture is essential to an understanding of the pressure to further develop the delta and of the potential changes in the estuarine and delta ecosystems.

4. The Public and Land Use Profile begins with a discussion of existing (1977) land and water use in the study area and historic land use changes, particularly loss of wetlands, increase of diked areas, and industrial land use, since development began in the late 1800's. A description of 1977 land and tideland ownership, both public and private, follows.

5. The third section of the profile is the Institutional Profile, which is a detailed description of the various federal, state, regional, and local agencies with interest and/or jurisdiction in the study area and the expressed agency policies which may affect development of the study area. This section is particularly important as an expression of public interest in the estuary. Specific local plans (e.g. comprehensive plans and shoreline master programs) and general agency policies are discussed.

6. The fourth section is a description of cultural resources in the study area. This section includes archeologic and historic sites, recreational areas, and areas used for educational or scientific study. Finally, there is a brief description of visual/

aesthetic resources of the estuary.

7. This profile is designed to provide the reader both a basic understanding of the public and land use aspects of the study area and a source of data on land use and ownership, public policy, and cultural resources in the Snohomish estuary.

A. LAND AND WATER USE

1. As an area grows and develops, patterns and trends of land use change may be identified. A knowledge of these patterns and trends, and of the extent of land use change, is important in understanding how, when, and what sort of future changes in land use may occur.

2. The purpose of this section is four-fold:

1) To map existing (1977) land, water, and wetland use in the study area

2) To identify historic land use trends and changes

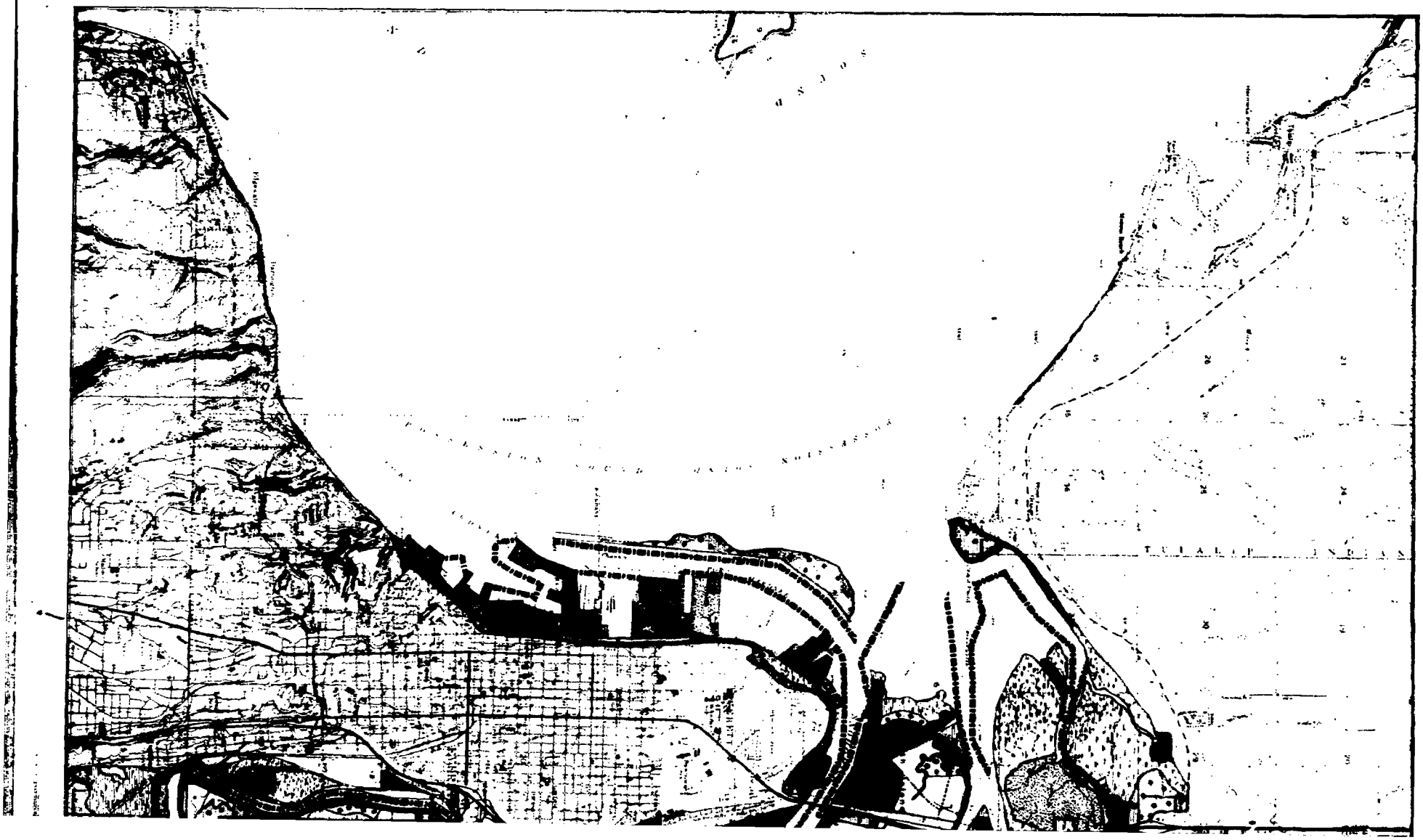
3) To identify existing wetlands and historic wetlands changes

4) To identify dikes and their development historically

The basic method used in obtaining this data was aerial photograph interpretation and planimetry. A detailed description of the methodology is given in the Technical Appendix, Section VIII.E. Briefly, aerial photographs of the study area for the years 1941, 1947, 1955, 1969-70, and 1977 were assembled, and photo interpretation maps of land use by year were made. These maps were then planimetered to obtain acreage amounts for the various types of land use. Topographic maps from 1884-85 and 1895-1911 were also planimetered for the same information. The categories of land use measured are listed and described in Table VII-0. Plate 12 shows the relationship, size, and location of 1977 land uses in the study area. Agriculture is a major land use east and south of I-5. The major wetlands are in the north and west portions of the estuary, with some smaller wetlands to the south. The industrial land uses occur in the I-5, SR 529 corridor and in the waterfront area in Port Gardner.

3. The following tables show land use by type and by island for the years 1977 (VII-1), 1969-70 (VII-2), 1955 (VII-3), 1947 (VII-4), 1941 (VII-5), and 1884-85 and 1895-1911 (VII-6). These tables also show land use in the Port of Everett for 1941 to 1977. Marinas have been included as land use, since they are essentially land oriented (but water dependent). The category of log storage shown in Tables VII-1 through VII-6 is log storage on land; there is only a very small amount of acreage in this use. Log storage is more usually a water use. The water acres devoted to log storage are shown by year and by waterway in Table VII-7.

4. Table VII-8 summarizes some of the trends in land use and Figure VII-1 shows the trends graphically. In 1884-85 virtually



LAND USE 1977

PLATE NO 12

LEGEND

- Agriculture
- Dike
- Fill
- Industry
- Log Storage
- Marina
- Open Space
- Sewage Treatment
- Wetlands

N

SCALE 1:4000

SNOHOMISH ESTUARY WETLANDS STUDY

the entire estuary was wetlands; by 1895-1911 approximately 30% of the wetlands had been diked for agricultural purposes. By 1941 or the beginning of World War II, about 80% of the estuary had been diked; more than half of the estuary land area was being used for agriculture. Industrial land use was minimal and remained so until the 1950's when the wood products industry began expanding. The amount of land in agriculture has not fluctuated significantly since 1941. Industrial land use has almost doubled, but is still a small percentage of the total land in the estuary.

5. Of an original 10,850 acres of wetland in the estuary, only 1,500 remained in 1941. This number dropped slightly over the next decade. Between 1955 and 1969-70, the dikes on North Ebey Island, the east and west shore, and Spencer Island North were breached; this added about 500 acres to the wetlands acreage. By 1977 the total wetlands acreage had decreased by about 100 acres. The detailed changes in wetlands by area are shown in Table VII-9.

Table VII-0

LAND USE CATEGORIES

Open Space (OS): Any woodland, or any grassland which was not agriculture. May include occasional houses in sparsely populated areas.

Wetland (W): Any marsh or swamp.

Open Space, probable Wetland (OS(W)): Open areas, especially woodlands which were suspected of being wetlands (swamp). This was limited to historic photos where area in question was a swamp at present but could not be distinguished from open space in photograph

Dike (D): An embankment constructed to prevent flooding of low areas. In some areas dikes have been enlarged considerably through the emplacement of wood waste fill.

Freeway (FW): Major local, state and federal highways; includes major county roads on Ebey and Smith Islands.

Agriculture (A): Any areas used for pasture or row crops. May include occasional houses in sparsely populated areas.

Industry (I): Any commercial or manufacturing business, includes port facilities, lumber mills, boat building, and parking areas associated directly with a specific business.

Public Services (PS): Sewage treatment ponds, pipeline corridors, power line corridors, military installations.

Residential (RS): Single family or multiple family dwellings, density greater than 1 unit per acre.

Recreation (RC): Parks and boat launch ramps. Does not include marinas.

Marina (M): Areas for mooring or storing boats.

Fill (F): Deposition of material, includes dredge material disposal; often difficult to identify because an industry or other use might be placed upon it.

Log Storage (LS): Log rafting and upland storage area. In-water rafting was included with water when calculating total areas.

Waterways (WW): All natural water bodies in the area such as sloughs, creeks and ponds. Mudflats and log rafting areas were included also.

Railroad (RR): Railroad tracks, switching yards and maintenance facilities.

Table VII-1

LAND USE IN THE SNOHOMISH ESTUARY, 1977
(Areas in Acres)

	OS	W	OS (W)	D	FW	A	I	PS	RS	RC	M	F	LS	WW	RR	Total Diked Area	Total Area
Smith Island	323	147	0	60	143	631	300	287	0	0	3	3	3	14	3	1770	1917
Ebey Island	1201	171	0	109	59	2442	0	0	0	0	0	12	0	35	0	3846	4029
Spencer Is. N.	20	88	0	24	30	247	6	0	0	0	1	3	0	9	1	427	529
Spencer Is. S.	23	30	0	66	0	321	0	0	0	0	0	0	0	0	0	400	440
Otter Island	0	153	0	0	0	0	0	0	0	0	0	0	0	0	0	0	153
N. Ebey Is.	0	660	0	0	40	0	9	0	0	0	0	158	0	0	0	0	867
North Shore	0	392	0	13	0	523	36	40	19	0	3	14	0	0	0	531	1040
East Shore	88	91	0	53	12	1044	0	12	0	0	0	0	0	0	0	1051	1300
West Shore	89	115	0	0	10	73	299	0	4	1	0	14	0	0	42	0	647
Weyco Island	8	15	0	0	0	0	0	0	0	0	0	7	0	0	0	0	30
	1752	1862	0	325	294	5381	650	339	23	1	7	211	3	58	46	8025	10,952
Port of Everett	27	3	0	0	3	0	298	3	0	12	32	22	403	453	0	0	1346

Table VII-2

LAND USE IN THE SNOHOMISH ESTUARY, 1969-70
(Areas in Acres)

	OS	W	OS (W)	D	FW	A	I	PS	RS	RC	M	F	LS	WW	RP	Total Diked Area	Total Area
Smith Island	189	160	0	61	125	978	216	142	0	0	3	30	0	5	8	1710	1917
Ebey Island	1310	186	0	86	56	2360	0	0	0	0	0	0	0	31	0	3810	4029
Spencer Is. N.	0	80	0	29	30	373	2	0	0	0	3	6	0	6	0	449	529
Spencer Is. S.	77	71	0	27	0	265	0	0	0	0	0	0	0	0	0	365	440
Otter Island	0	153	0	0	0	0	0	0	0	0	0	0	0	0	0	0	153
N. Ebey Island	19	749	0	0	25	0	0	0	0	0	0	59	0	9	6	0	867
North Shore	87	397	0	9	0	410	33	43	24	0	5	6	0	26	0	531	1040
East Shore	96	47	0	53	0	1104	0	0	0	0	0	0	0	0	0	1051	1300
West Shore	73	116	29	0	5	85	318	0	2	7	0	0	0	5	7	0	748
Weyco Island	15	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
	1866	1974	29	265	241	5575	569	185	26	7	11	101	0	82	21	7916	10,952
Port of Everett	28	0	0	0	6	0	256	0	0	0	17	14	556	479	0	0	1346

Table VII-3

LAND USE IN THE SNOHOMISH ESTUARY, 1955
(Areas in Acres)

	OS	W	OS (W)	D	FW	A	I	PS	RS	RC	M	F	LS	WW	RR	Total Diked Area	Total Area
Smith Island	110	134	0	71	13	1496	69	0	0	0	0	0	0	17	7	1764	
Ebey Island	1797	127	42	101	54	1872	0	0	0	0	0	0	0	36	0	3823	4029
Spencer Is. N.	9	4	0	40	9	439	3	0	0	0	5	10	0	10	0	500	529
Spencer Is. S.	108	65	0	29	0	238	0	0	0	0	0	0	0	0	0	385	440
Otter Island	0	153	0	0	0	0	0	0	0	0	0	0	0	0	0	0	153
N. Ebey Island	0	593	0	21	14	233	0	0	0	0	0	0	0	0	6	274	867
North Shore	144	342	0	11	0	485	22	0	1	0	3	12	0	20	0	531	1040
East Shore	137	1	0	53	0	1109	0	0	0	0	0	0	0	0	0	1051	1300
West Shore	127	9	133	0	21	23	276	0	2	0	0	5	0	6	45	0	647
Weyco Island	13	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
	2445	1445	175	326	111	5895	370	0	3	0	8	27	0	89	58	8328	10,952
Port of Everett	0	0	0	0	0	0	291	0	0	0	0	43	479	533	0	0	1346

Table VII-4

LAND USE IN THE SNOHOMISH ESTUARY, 1947
(Areas in Acres)

	OS	W	OS (W)	D	FW	A	I	PS	RS	RC	M	F	LS	WW	RR	Total Diked Area	Total Area
Smith Island	155	152	0	104	11	1489	0	0	0	0	0	0	0	0	5	1765	1917
Ebey Island	2056	169	0	101	54	1577	0	0	7	0	0	0	0	65	0	3840	4029
Spencer Is. N.	32	4	0	59	3	418	3	0	0	0	0	0	0	10	0	511	529
Spencer Is. S.	185	27	15	30	0	183	0	0	0	0	0	0	0	0	0	399	440
Otter Island	0	153	0	0	0	0	0	0	0	0	0	0	0	0	0	0	153
N. Ebey Island	8	536	0	63	7	246	0	0	0	0	0	0	0	0	7	292	867
North Shore	144	342	0	11	0	485	22	0	1	0	3	12	0	20	0	531	1040
East Shore (same as 1955)	137	1	0	53	0	1109	0	0	0	0	0	0	0	0	0	1051	1300
West Shore	332	0	0	0	0	5	264	0	0	0	0	0	0	0	45	0	647
Weyco Island	15	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
	3064	1399	15	421	75	5513	289	0	8	0	3	12	0	95	58	8389	10,952
Port of Everett	7	0	0	0	0	0	266	0	0	0	0	0	515	558	0	0	1346

Table VII-5

LAND USE IN THE SNOHOMISH ESTUARY, 1941
(Areas in Acres)

	OS	W	OS (W)	D	FW	A	I	PS	RS	RC	M	F	LS	WW	RR	Total Diked Area	Total Area
Smith Island	310	165	0	100	8	1327	0	0	0	0	0	0	0	0	7	1791	1917
Ebey Island	1909	177	0	108	54	1730	0	0	0	0	0	0	0	51	0	3845	4029
Spencer Is. N.	12	0	0	70	4	441	1	0	0	00	0	0	0	0	1	510	529
Spencer Is. S.	143	12	15	38	0	232	0	0	0	0	0	0	0	0	0	413	440
Otter Island	0	153	0	0	0	0	0	0	0	0	0	0	0	0	0	0	153
N. Ebey Island	0	453	32	66	0	309	0	0	0	0	0	0	0	0	7	383	867
North Shore	151	469	0	11	0	369	20	0	0	0	0	0	0	20	0	531	1040
East Shore	220	1	90	53	0	936	0	0	0	0	0	0	0	0	0	1051	1300
West Shore	189	56	8	0	0	0	323	0	0	0	0	0	0	0	71	0	647
Weyco Island	12	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
	2946	1504	145	446	66	5344	344	0	0	0	0	0	0	71	86	8524	10,952
Port of Everett	36	0	0	0	0	0	207	0	0	0	4	4	652	443	0	0	1346

Table VII-6

LAND USE IN THE SNOHOMISH ESTUARY, 1884 and 1895-1911
(Areas in Acres)

	1884				1895-1911		
	W	Ag	Diked	Total	W	Diked	Total
Smith Island	1917		0	1917	0	1917	1917
Ebey Island	4029		10	4029	4029	0	4029
Spencer Island North	459	70	41	529	0	529	529
Spencer Island South	440		0	440	440	0	440
Otter Island	153		0	153	0	153	153
North Ebey Island	867		0	8t7	693	174	867
North Shore	1040		0	1040	574	466	1040
East Shore	1277	23	23	1300	1300	0	1300
West Shore	634	13	0	647	647	0	647
Weyco Island	30		0	30	30	0	30
	10,846	106	74	10,952	7713	3239	10,952

W + Ag = Total
All Diked is Ag
But all Ag is not Diked

Table VII-7

LOG STORAGE IN THE SNOHOMISH ESTUARY
(Acres)

Location	1977	1969	1955	1947	1941	Total Waterway
West of Smith Is.	419	439	472	--	466	691
Union Slough	0	3	0	0	0	101
Steamboat Slough	40	0	78	61	56	233
Ebey Slough	115	128	33	--	38	472
Snohomish River	144	217	289	179	145	557
TOTAL	718	787	872	240	705	2,054

-- No data available

Table VII-8*

LAND USE SUMMARY TABLE

	Wetland	OS(W)	Diked	Agri-Culture	Industrial
1977	1,862	0	8,025	5,381	650
1969-70	1,974	29	7,916	5,575	569
1955	1,445	175	8,328	5,895	370
1947	1,399	15	8,389	5,513	289
1941	1,504	145	8,524	5,344	344
1895-1911	7,713	0	3,239	--	--
1984-85	10,846	0	74	106	--

-- No data available

*See footnote on P. 292.

Table VII-9*

WETLAND SUMMARY TABLE

	1977	1969-70	1955	1947	1941	1884-1885
Smith Island	147	160	134	152	165	1,917
Ebey Island	171	186	127	167	177	4,029
Spencer Is. North	88	80	4	4	0	459
Spencer Is. South	30	71	65	27	12	440
Otter Island	153	153	153	153	153	153
North Ebey Island	660	749	593	536	453	867
North Shore	392	397	342	342	469	1,040
East Shore	91	47	1	1	1	1,277
West Shore	115	116	9	0	56	634
Weyco Island	15	15	17	15	18	30
	1,862	1,974	1,445	1,399	1,504	10,846

*Tables VII-8 and VII-9 are based on analysis of aerial photographs available for the years between 1930 and 1977. For specific estimates of existing wetland acreages, readers should refer to Volume III which contains more precise estimates based on considerable field observation.

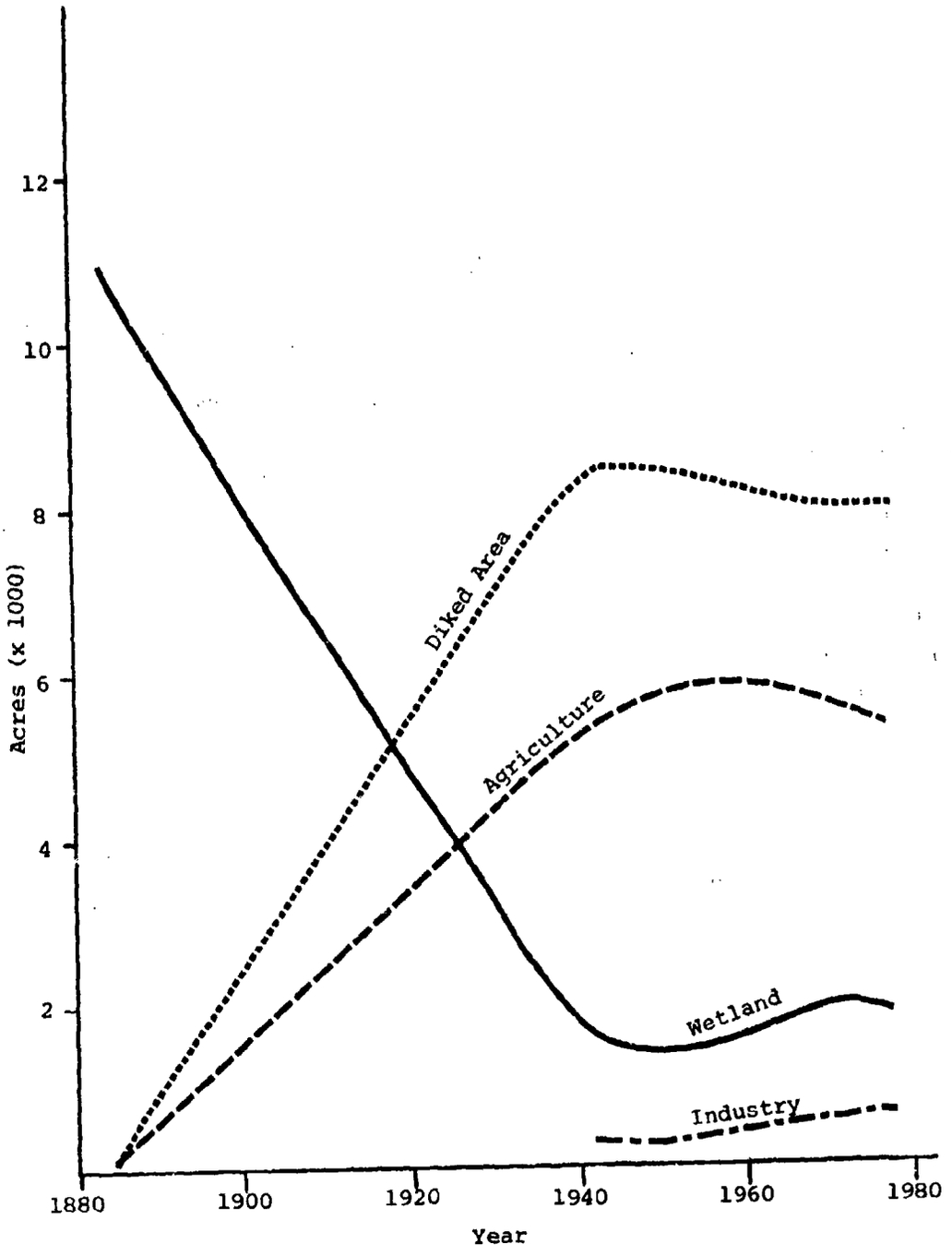


Figure VII-1

LAND USE IN THE SNOHOMISH ESTUARY
1884-1977

B. LAND OWNERSHIP

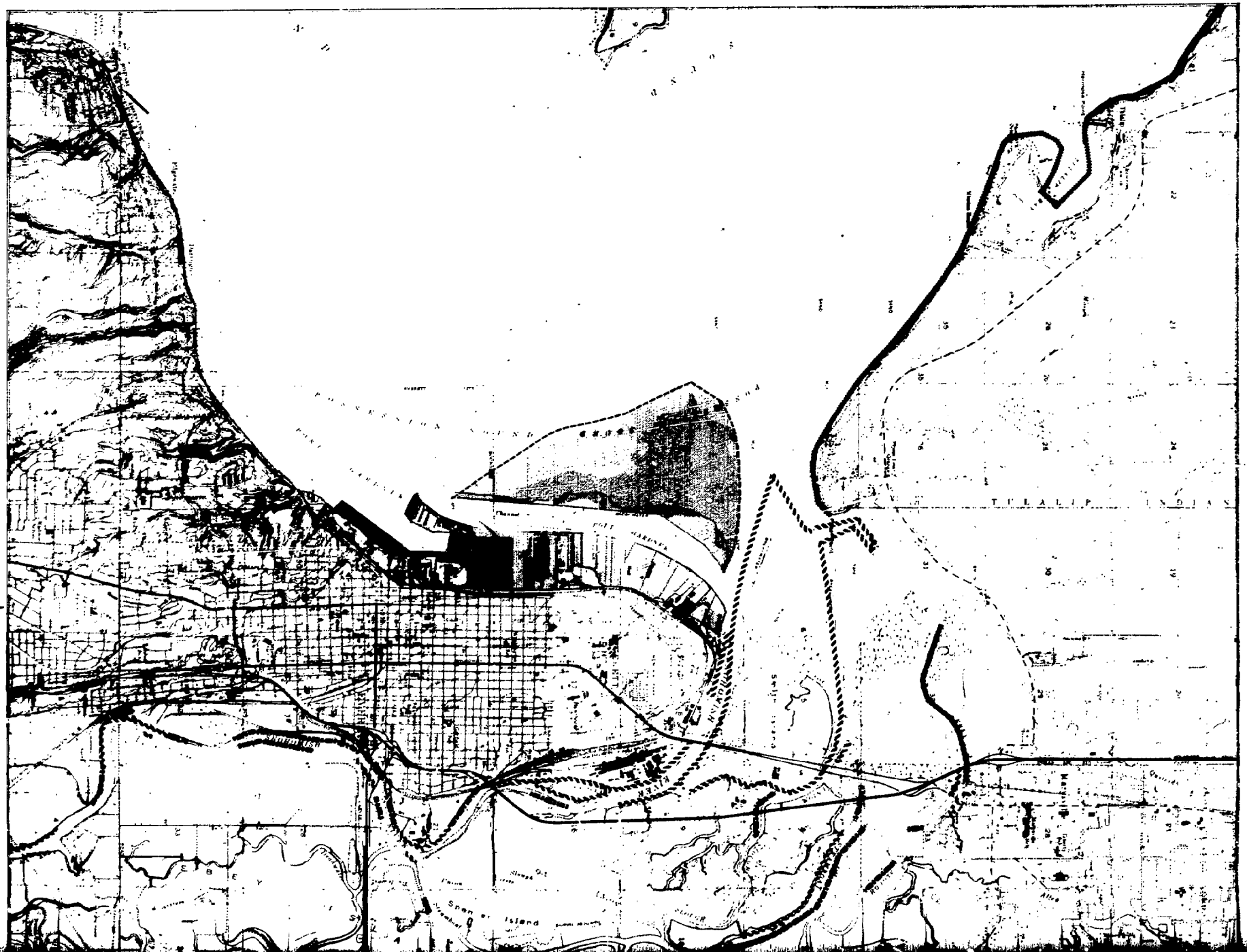
1. The ownership and control of land areas, including tidelands, is one of the factors which determine when, where, and how much development pressure there will be. Ownership in the Snohomish estuary study area is shown in two plates. Plate 13 shows ownership of tidelands (bedlands) and areas within the Port boundaries. Plate 14 shows upland ownerships. These plates concentrate on the 100 year floodplain area as most important for this study.

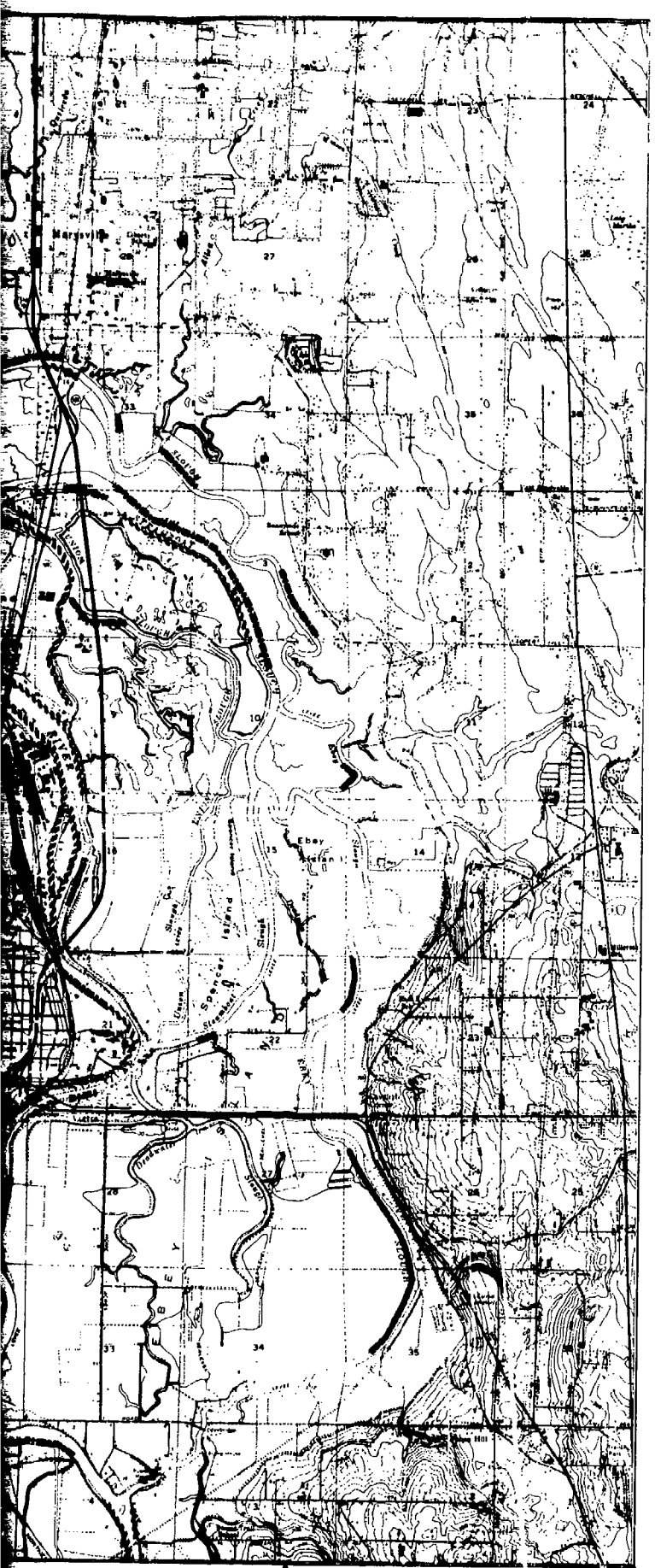
2. Within the estuary 100 year floodplain (east of Priest Point/Preston Point) there are about 73 miles of shorelines, including 6 in Deadwater Slough (Plate 13). Along 60 miles (82%) of these shorelines, the tidelands/bedlands are owned by the state (or state agencies). The Department of Game and the Department of Natural Resources (DNR) own (and/or manage) 2.6 miles of tidelands adjacent to uplands also under state ownership and management. About 6 miles of tidelands owned by the State are leased by DNR to private companies or individuals, primarily for log rafting purposes. The remaining 51 miles of state-owned tidelands are managed by DNR under their marine land management policies (see Institutional Profiles).

3. About 13 miles of tidelands/bedlands in the estuary floodplain area were identified as in private ownership. The State was given ownership of all tidelands/bedlands at the time of entering statehood, but over the years tidelands were sold to private owners. This practice was stopped in 1971, and the DNR now only leases tidelands/bedlands.

4. Plate 13 also shows ownership patterns in the Port area. There are about 815 acres within the Port area shown in Plate 13; of these, about 385 (47%) are in private ownership. The Port owns about 345 acres (42%), of which about 150 are leased to private companies. In the Port area, approximately 5 acres are federally owned (Navy, Coast Guard) and 80 acres are state-owned. The Port claims ownership of the 255 acres of Jetty Island uplands and an additional approximate 2,000 acres of tideland/bedland west of Jetty Island. The Port has leased about 200 acres to the state for a marine park, according to a personal communication from the Port Manager.

5. Plate 14 shows upland ownership in the estuary floodplain area. Much of the floodplain is in large private ownerships; there are two privately owned contiguous parcels of about 1,000 and 1,100 acres, and there are 3 other privately owned parcels of between 400 and 600 acres. About 600 acres in the floodplain have been platted. The Department of Game owns one large parcel of 400-450 acres on Ebey Island and two other small parcels in the floodplain. DNR owns a small parcel just south of Highway 2 west of the Snohomish River. The Tulalip reservation encompasses the northern end of Ebey Island (about 400 acres).


TULALIP INDIAN



OWNERSHIP: PORT & TIDELAND

PLATE NO13

LEGEND

Port of Everett Ownership:

- Federally Owned
- State Owned
- Port Owned
- Port Owned (leased)
- Privately Owned

Tideland Ownership:

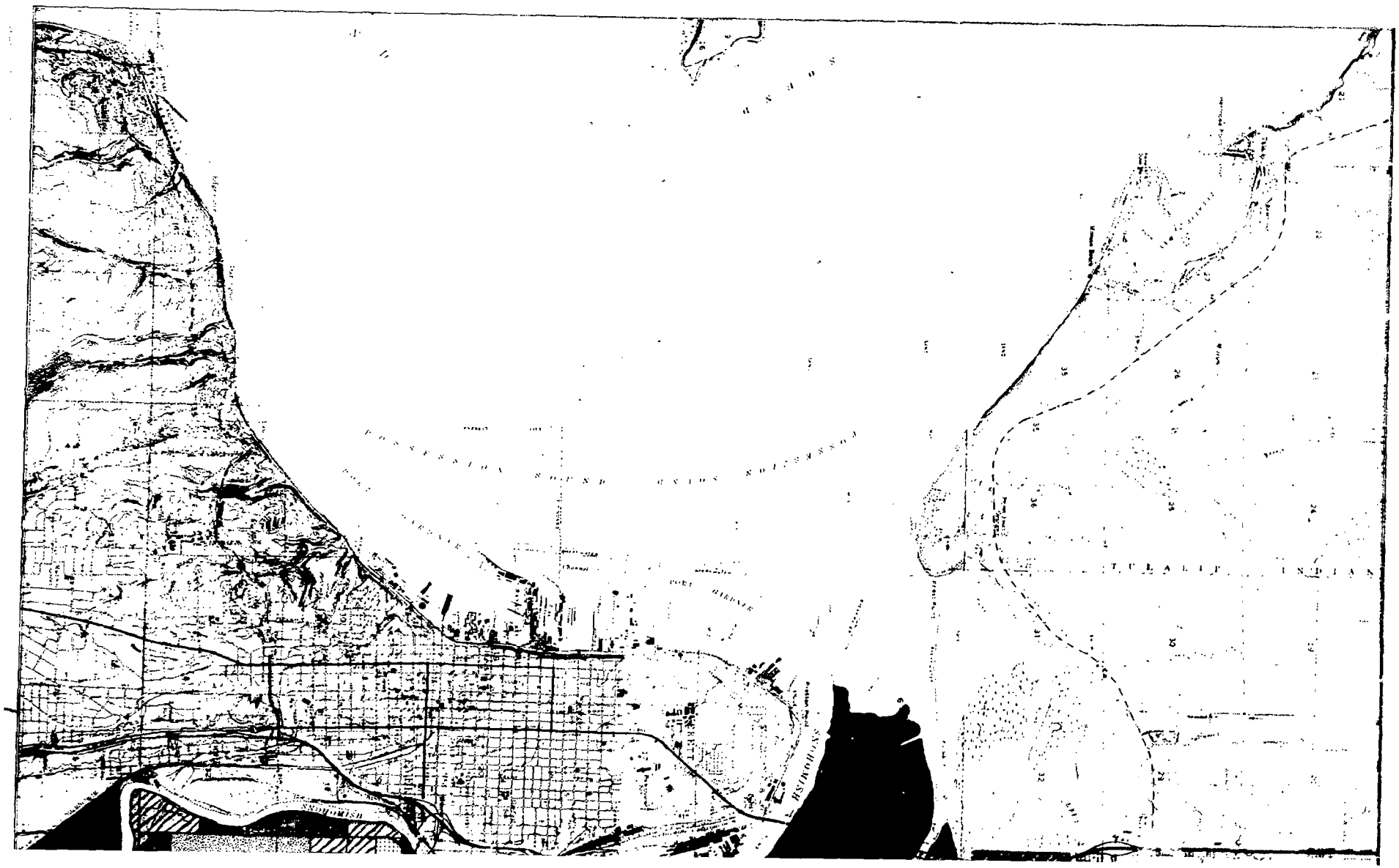
- State Owned (unmarked)
- State Owned (tideland w/ upland)
- State Owned (leased)
- Tribal Owned
- Privately Owned

N

SCALE 1:24000

SNOHOMISH ESTUARY WETLANDS STUDY

Source: Port Maps
Maps & Lease Records, DNR



LAND OWNERSHIP

PLATE NO 14

LEGEND

- Public Owned
- Plats
- Small Property Owners
- Large Property Owners

N

SCALE 1:24000

SNOHOMISH ESTUARY WETLANDS STUDY

Source: Snohomish Co. Assessor's Office

e

C. INSTITUTIONAL PROFILE

1. This section discusses the plans and policies of the various government interests that interact with the Corps of Engineers during the permit process. Some of these governmental entities are specific to the Snohomish estuary study area; others, including federal and state agencies, have review responsibility for Corps permit applications throughout the Seattle District.

2. Section IV, THE PERMIT PROCESS, describes the review process for each Corps permit application. That section identifies the points at which public and agency review is initiated and the points at which decisions on permit issuance are made. A summary of federal, state and local agencies, public groups, private industry, and individuals to whom Corps permit applications are normally sent for review and comment is also included.

3. Corps permit regulations (33 CFR 320-329) require an evaluation of the extent to which a proposed permit activity is in the public interest. This is the most important criterion applied in the decision to issue a permit. For any permit application the Corps must consider all applicable official state, regional, or local land use plans and/or policies as reflecting local factors of the public interest (33 CFR 320.4(j)(2)); thus, the Corps will request review of permit applications in the study area by local governments. In addition, the Corps is required by permit regulations to coordinate and consult with certain Federal and state agencies (33 CFR 320.4) so that permit decisions will reflect factors of the national and statewide public interest. In the Snohomish estuary study area, plans, policies, and proposed activities are of mutual interest to the Corps and the following principal federal agencies:

1. U.S. Department of the Interior (DOI)

   Fish and Wildlife Service
   Bureau of Indian Affairs
   National Park Service

2. U.S. Department of Commerce (DOC)

   National Oceanic and Atmospheric Administration/
   National Marine Fisheries Service

3. U.S. Environmental Protection Agency (EPA)

4. U.S. Council on Environmental Quality

5. U.S. Department of Transportation (DOT)

   U.S. Coast Guard

6. U.S. Department of Defense (DOD)

   U.S. Navy

7. U.S. Department of Agriculture (USDA)

   Soil Conservation Service
   Agricultural Stabilization and Conservation Service

8. Heritage, Conservation, and Recreation Service

9. Advisory Council on Historic Preservation

10. Federal Power Commission

In addition, the following principal state and local agencies are interested in Corps plans, policies, and permit activities:

1. Washington State Agencies:

   Department of Ecology
   Department of Game
   Department of Fisheries
   Department of Natural Resources
   Department of Highways
   Department of Social and Health Services
   Parks and Recreation Commission
   Office of Archeology and Historic Preservation
   Energy Facility Site Evaluation Council

2. Puget Sound Council of Governments

3. Local Government:

   Snohomish County (including County-wide special districts)
   City of Everett
   City of Marysville

4. Local Special Districts:

   Port of Everett
   Diking Districts
   Drainage Districts
   Sewer and Water Districts
   Flood Control Districts
   School Districts
   Fire Districts

5. Tulalip Tribes of Washington

Besides the above, there are many other agencies, public and private organizations, and individuals who receive notification of and may make comments on permit applications. The agencies listed above represent the governmental entities with the most specific interest in the Snohomish estuary study area.

4. For this study, the most important plans and policies of these agencies are as follows:

- Special policies relating to wetlands or habitat preservation in general or in particular parts of the study area.
- Special policies on Corps permit activities.
- Special concerns of the particular agency which may be affected by a Corps permit activity (e.g., fish and wildlife habitat is a particular concern of USFWS, NMFS, and the State Fish and Game Departments.

These will be noted and documented to agency regulations or programs wherever possible.

Federal Agencies

5. Of the federal agencies listed above, those with most acute interest in proposed activities and who most frequently comment on Corps permit applications are the Fish and Wildlife Service (DOI), The National Marine Fisheries Service (DOC), and the Environmental Protection Agency. These three are discussed in some detail below.

U.S. Fish and Wildlife Service (DOI, FWS)

6. The U.S. Fish and Wildlife Service is responsible for the federal interest in conservation, enhancement, and protection of fish and wildlife habitat and resources. Under the Fish and Wildlife Coordination Act (16 USC 661-666c), any federal agency proposing to modify or control any body of water must first consult with FWS; thus, this Act provides the basic authority under which FWS reviews Corps permit applications. In the Corps permit review process, FWS must be consulted in the evaluation of the possible effects of the permit activity on fish and wildlife resources. FWS has guidelines for the review of fish and wildlife aspects of proposals in or affecting navigable waters (CFR, 40, 231, Dec. 1, 1975, pp 55810-55823); these guidelines contain the criteria used in review of Corps permits. One important criterion used by FWS is water dependency; if an activity is non-water dependent, particu-

larly where biologically productive wetlands are involved, and upland sites are available, FWS may recommend denial of the permit unless the public interest requires otherwise. Even for water dependent uses, FWS discourages the use of biologically productive wetlands and shallows (p. 55813). Wetlands, estuarine habitats, and certain species are of particular concern to FWS. Public interest is another important criterion; it may be indicated by an approved land use plan or by weighing all factors as described in 33 CFR 320.4(a). All proposals are evaluated for adverse environmental effects, need, benefits, water dependency, long-time and cumulative effects, and possible mitigating measures. In general, any encroachment which would significantly damage biologically productive shallows and wetlands or unreasonably infringe on public rights of access, use, and enjoyment will be discouraged by FWS. The FWS also has specific policies for review of Corps permit activities including docks and piers, moorage, platform structures, marinas and port facilities, bulkheads and seawalls, cables, pipelines, transmission lines, bridges and causeways, jetties, groins, breakwaters, lagoons, navigation channels, drainage ditches, dredging and filling, mineral exploration, log handling and storage, and facilities needing cooling waters. The FWS has specific guidelines for coordination with the Corps and other governmental agencies (CFR 40, 231, p. 55820).

National Marine Fisheries Service (DOC, NMFS)

7. The National Marine Fisheries Service is part of the National Oceanic and Atmospheric Administraton (NOAA). NMFS is the federal agency administering programs for development and preservation of marine fish and wildlife resources, including estuarine and anadromous fish. Like FWS, NMFS reviews all Corps permit applications under the basic authority of the Fish and Wildlife Coordination Act and Reorganization Plan No. 4 of 1970, which transferred responsibility for certain fish and wildlife-water resources coordination from DOI to DOC. The agency has an environmental assessment program, the objective of which is to conserve, protect, and enhance the marine, estuarine, and anadromous habitats of living marine resources (Living Coastal Resources, p. 28)*. Corps permit applications are reviewed under this program to analyze impacts on these habitats. NOAA (NMFS) has regulations dealing with federal grants under sections 305 and 306 of the Coastal Zone Management Act (15 CFR 920 and 15 CFR 923); under these regulations "areas of particular concern" are designated. These areas have characteristics such as unique, scarce, or vulnerable habitat, high natural

* This is a document summarizing the regulations of FWS and NMFS; it was published by NOAA and FWS in July 1976.

productivity, substantial recreational value, unique geology or topography, significant physical hazard potential, or value as protection for coastal resources (aquifer recharge, etc.). Permit applications in such areas will be particularly scrutinized by NMFS. Under the Endangered Species Act of 1973 (16 USC 1531-1543) NMFS (and FWS) may designate critical habitats and coordinate federal agency activity to prevent modificaiton of these habitats.

U.S. Environmental Protection Agency (EPA)

8. The Snohomish estuary study area lies within Region X of the Environmental Protection Agency. EPA is responsible for the administration of the Federal Water Pollution Control Act (Pl 92-500) and its Amendments (FWPCA). Under Title III of PL 92-500, water quality standards and effluent limitations are established. Discharges into navigable waters are regulated under Title IV of this act. In general, EPA will evaluate all Corps permit applications to determine the possible impacts on water quality (and air quality, toxic substances, and radiation).

9. Under Section 404 of FWPCA, the authority for issuance of permits for discharges of dredged or fill material into navigable waters is given to the Corps, but the disposal sites must meet EPA criteria. Under EPA guidelines for discharge of dredged and fill material pursuant to Section 404 (40 CFR 230) EPA can deny or restrict the use of any area as a disposal site if such use would have an unacceptable adverse effect on municipal water supplies, shellfish beds, fishery areas (including spawning and breeding), wildlife, recreational areas, endangered species, benthic life, or wetlands. Criteria for wetlands of importance under 40 CFR 230 are very similar to those in Corps permit regulations (33 CFR 320-329). Submerged vegetation and the size of the disposal site are to be considered. The need for the porposed discharge, alternative sites, and water quality standards must also be considered. In addition to 40 CFR 230, EPA has a policy statement on Protection of the Nations' Wetlands, designed to protect wetlands from the adverse effects of dredge and fill operations and solid waste management. Corps permit applications will be reviewed by EPA for consistency with this policy.

10. Under Section 403, FWPCA, and 40 CFR 220-229, EPA promulgated guidelines for the granting of permits for ocean dumping; the Corps may issue permits for transport of dredged material for ocean dumping under Part 225 of 40 CFR 220-229 if the application meets the established EPA criteria.

11. EPA also issues permits for the discharge of pollutants (e.g. sewage outfalls) to aquaculture products. Such discharges are evaluated as to their value as food sources for aquatic organisms (40 CFR 115).

12. Proposed Corps permit applications are also reviewed by EPA under their guidelines for the implementation of NEPA (40 CFR Part 6). Activities are examined for specific impacts on the physico-chemical and biological environment and for secondary impacts, such as induced growth.

Other Federal Agencies

13. The Bureau of Indian Affairs helps manage Indian tribal lands. The National Park Service administers national parks and recreation areas. The Council on Environmental Quality administers the National Environmental Policy Act. The U.S. Coast Guard regulates vessel traffic for safety in navigable waters and is responsible for navigation aids and for permits for bridges over navigable waters. The U.S. Navy is primarily for national defense, but also operates programs relating to oil spills, solid waste disposal, research, and navigation/communication. The Agricultural Stabilization and Conservation Service has resource conservation programs for preventing loss of wetlands and preserving, restoring, and improving water areas. The Soil Conservation Service (SCS) also has water resource conservation and development programs; in the Snohomish estuary study area the Soil Conservation Service is closely tied to the Snohomish Conservation District (see descriptions of local agencies).

14. The Heritage, Conservation, and Recreation Service (HCRS) is an agency formed in 1978; it has assumed all the functions of the Bureau of Outdoor Recreation and the Natural Landmarks Program and Historic Register functions of the National Parks Service and Office of Archeology and Historic Preservation. The HCRS thus participates directly in the planning, and coordination of policies relating to recreation and fish and wildlife benefits (a former Bureau of Outdoor Recreation function) and administers the National Register of Historic Places. This latter function overlaps that of the Advisory Council on Historic Preservation. The Advisory Council on Historic Preservation reviews proposed activities for effects on historic sites. The Federal Power Commission issues licenses for construction of dams, powerhouses, and other project works necessary for development and use of power from navigable waters; the Corps must approve such licenses which affect the navigable capacity of any navigable waters of the United States.

Washington State Agencies

15. The State has established a Corps permit application review procedure involving seven state agencies and the local governmental jurisdiction under which the permit application is sought.

The state agencies discussed below include those under this procedure. In addition, the Office of Archeology and Historic Preservation and the Energy Facility Site Evaluation Council are also discussed, although they are not yet listed as part of the state's coordinated review procedure.

Department of Ecology (DOE)

16. The Department of Ecology is the coordinator for the Corps permit review process. When a Corps permit application is reviewed, DOE receives all comments from the other state agencies and provides a coordinated response on behalf of the State of Washington.

17. DOE is the state agency responsible for the administration of the Coastal Zone Management Act (CZMA), the State Environmental Policy Act (SEPA), and the Shoreline Management Act (SMA). The agency has the basic regulatory authority for protection of air and water resources and water quality. For Corps permits, DOE must provide two certifications: the first a certification under Section 401, FWPCA, that discharges into navigable water will comply with the effluent standards and water quality provisions of Sections 301, 302, 306, and 307, FWPCA; and the second, a certification that the proposed activity meets requirements of the state's coastal zone management program (33 CFR 320.3(b)). Although most review for compliance with SMA takes place at the local level, DOE will be particularly concerned about activities proposed in areas designated "Shorelines of Statewide Significance." Under SMA, all substantial shoreline development (defined in detail in SMA) and shoreline modifications require a permit granted locally but subject to state review and comment. Many Corps permit activities will also require a permit by the State of Washington under SMA. Types of activities requiring permits under SMA include agricultural and aquacultural practices, marinas, utilities, port facilities, shore defense structures, dredging and filling, piers and docks, forest management practices and log storage, and urban type development.

18. Permit activities will be reviewed under the policies and regulations for specific activities in the local jurisdiction Shoreline Management Program and the policies of SMA. When DOE reviews a Corps permit application, SEPA guidelines (WAC 197-10) are also used as a framework for evaluation of environmental effects.

19. Under CZMA, areas of particular concern are defined as those shorelines and water areas where options and alternative uses of the coastal resource are possible. Areas such as those dedicated for national parks or major harbor/industrial port areas are not areas of particular concern under CZMA. The fundamental principle for areas of particular concern is that such areas must offer

a live issue of competing uses and management options. The Snohomish River estuary has been designated an area of particular concern in the state coastal zone management program (CZMA, June 1976, pp. 12-16). The two major issues identified in this area are the problem of maintaining a functioning estuary while allowing some fill and loss of wetlands to industrial development, and the problem of declining water quality in the Snohomish River and Port Gardner Bay.

20. The Snohomish River, the Snohomish River estuary, Port Gardner, and Possession Sound are shorelines of statewide significance under SMA (tidelands are excluded from this designation in the Snohomish County Shoreline Master Program). For shorelines of statewide significance, order of preference is given to uses and activities which protect statewide over local interest, preserve the natural shoreline character, result in long-term over short-term benefit, protect shoreline resources and ecology, and increase public access and recreational opportunities.

21. Under RCW 90.48.260, DOE is designated the State Water Pollution Control Agency for the FWPCA. In addition to 401 certification, DOE administers the National Pollutant Discharge Elimination System under WAC 173-220 and grants NPDES permits for pollutant discharges into navigable waters. DOE is in charge of the State's Water Quality Planning Program under Section 303e, FWPCA. Under this program DOE classifies water bodies in the state for purposes of maintaining water quality and develops water quality criteria for each class. These criteria cover coliform organisms, dissolved oxygen, total dissolved gas, temperature, pH, turbidity, toxic, radioactive, or deleterious materials, and materials which may impair aesthetic values. DOE also administers the Snohomish Flood Control Zone No. 5, and grants permits for activities in this zone.

Department of Game/Game Commission (Game)

22. Management of game, fish and wildlife in the study area is within the jurisdiction of the Department of Game. The objective of the Game Commission is sustained yield of game resources; to accomplish this, Game is concerned with the protection and development of habitat for game resources. Although Game has extensive regulatory authority over wildlife and human aspects of game resources (RCW 77.04 and WAC Title 232), the agency has little direct control over the preservation and maintenance of fish or wildlife habitat except on lands which it owns. Because of this, Game uses its environmental review authority to make known its concerns for protection of game habitat and resources. In the study area Game is particularly concerned about development impacts on tideland marshes affecting the survival of fish and wildlife. Under RCW 75.20.100, Game (and the Department of Fisheries) must review (and may issue hydraulic project approval for) any work that will change in any way the natural flow or bed of any river or stream, or that

will use any of the waters of the state or material from the stream beds. Corps permit activities in the study area may require hydraulic project approval by Game. The agency has timing restrictions on dredging or other activities which produce siltation; proposals are reviewed on a case-by-case basis, but in general, silt-producing activities will not be allowed in March, April, or May because of adverse effects on fish. The agency owns about 450 acres of land in the Snohomish estuary floodplain (see Land and Water Use); about 400 acres is a freshwater spruce swamp. Activities about which Game has specific regulations or policies include dams, diversion ditches and canals, and water intake pipes.

Department of Fisheries (Fisheries)

23. The Department of Fisheries is responsible for the preservation, protection, perpetuation, and management of the state's food fish and shellfish resources. Among other things, Fisheries is concerned with management and enhancement of fish habitat and review (and approval) of applications for marine construction and hydraulic projects. Together with Game, Fisheries must approve hydraulic projects under RCW 75.20.100, and the Fisheries Code (RCW Title 75) regulates all food fish and shellfish resource management. In review of Corps permit applications, Fisheries will be concerned about any projects which may adversely affect shellfish beds or the spawning, feeding, and/or rearing of food fish such as salmon, herring, or smelt, either by changes in hydraulic regime or by water quality degradation or destruction of habitat. Like Game, Fisheries has timing restrictions on dredging and other silt-producing activities; such activities will not be allowed in April, May, or June because of possible adverse effects on out-migrating fish. Fisheries has identified some surf smelt spawning areas in Puget Sound, none of which are in the study area, but there may be other areas not yet documented. The agency has developed criteria for the design of bulkheads, land fills, and marinas in Puget Sound, Hood Canal, and the Straits of Juan de Fuca for protection of fish and shellfish resources, adopted in 1971. In 1974 a supplement to these criteria was developed; it contains specific bulkhead criteria for surf smelt spawning beaches. These latter criteria were revised in June 1977. The agency makes recommendations for mitigation if a project potentially adversely affects harvest of resources under its jurisdiction.

Department of Natural Resources (DNR)

24. The Department of Natural Resources is the State's major owner and manager of marine and upland property. The properties are managed as a public trust. Marine lands are managed for the maximum public benefit, while uplands are under mandate to be man-

aged to provide maximum revenue. For management of both marine lands and uplands, DNR must practice and enforce good environmental and conservation techniques (RCW 43.30, 76, and 79, WAC 332).

25. Although all tidelands were originally state-owned, many were sold to private owners. In 1971, this practice was discontinued and DNR now will only lease tidelands for various marine-related uses (see the section on Land and Water Use).

26. DNR principally manages its lands for multiple use, to avoid permanent single purpose use of state lands. In 1973 DNR published a statement of policies and guidelines constituting a land management plan for marine lands (The Land Use Allocation Plan, DNR, Managed Marine Land, and Marine Land Management in Washington, both February 1973). These documents contain policy statements, criteria, and resource allocations for public use beaches, aquaculture, commercial use, reserves (environmental, educational, and scientific), anchorage use, limited use (no public use) and unobstructed multiple use (submerged lands with unobstructed water surface). DNR has a specific policy to protect and enhance the quality of the natural marine environment, which includes guidelines for particular structures and activities including filling. The agency also has specific policies on designation of reserves, installation and design of piers and docks, installation of swim floats and mooring buoys, marina and moorage design, log booming and rafting, sand and gravel removal, dredge material disposal (deep water sites selected and evaluated by the Interagency Siting Committee), withdrawal of lands for waste outfalls, and removal of aquatic plants from state-owned lands. In evaluation and review of Corps permit applications, DNR will consider multiple use, public use (including recreation), environmental protection, and specific activity policies. The agency itself must issue a dredging permit for removal of rock, gravel, sand, and silt from state-owned marine lands.

27. The Interagency Siting Committee has recommended a deep-water disposal site for dredge materials near the south end of Port Gardner (longitude 122°15'10", latitude 47°51'00", just outside the study area). It is on a steep gradient which is naturally sloughing off. Although material planted there degrades the sediment quality, the committee felt that the deposit material would likely be covered by natural sloughing of the site. The site may be considered withdrawn from multiple use since deposition of dredge material could preclude the site returning to its original ecological state.

Department of Highways

28. The Department of Highways is one of the state's major developers and is responsible for land highways, bridges, and the

ferry system. The agency evaluates environmental effects under guidelines in the Federal Highway Program Manual, which require consideration of impacts of wetlands and assessment of the consistency of its projects with existing or planned wetland or coastal zone management programs. The agency prepares many EIS's and has applied for and received many substantial development permits. The Highway Department's review of Corps permit applications may use the same guideines as apply to its preparation of EIS's.

29. There are three state highways in the study area; these are Interstate 5, State Route 529 (99), and State Route 2. There are no extensions of any roadways planned by Highways.

Department of Social and Health Services (DSHS)

30. The Department of Social and Health Services is the public health authority for the state under RCW 43.20. DSHS management activities in the coastal zone relate to protecting public water supplies, controlling solid and liquid waste disposal, monitoring radiation, ensuring protection from pesticide poisoning, preventing public health hazards from recreational facilities, and providing sanitary control of shellfish for human consumption. DSHS monitors and assesses operating sewage disposal programs and regulates (with DOE and local health agencies) the implementation of on-site sewage disposal systems (e.g. septic tanks). The agency reviews marina operations for compliance with its marina design guidelines for adequate waste disposal and solid waste management. DSHS must certify commercial shellfish beds (but has no authority over recreational shellfish beds); the agency may deny or rescind certification of shellfish beds in the vicinity of waste outfalls or marinas if it appears the beds would be adversely impacted. In reviewing Corps permit applications, DSHS will consider the health aspects of the proposed activity, including its location and pollution potential in relation to commercial shellfish beds.

Parks and Recreation Commission (Parks)

31. The primary purpose of the Parks and Recreation Commission is to acquire, develop, operate and maintain parks and recreation areas for general public use and enjoyment. Parks may acquire tidelands for park purposes under RCW 43.51.040 and determines which lands should be acquired; much of the agency's plan for parks development is included in the State Comprehensive Outdoor Recreation and Open Space Plan (SCORP) prepared and updated by the Interagency Committee for Outdoor Recreation. Parks reviews all Corps permit activities for consistency with the goals and policies of SCORP. Until the establishment of the Office of Archeology and Historic Preservation in 1977 (Subs. HB 70, Chapt. 195), Parks housed the

State Conservator and the state's Historic Preservation unit. One of the principal functions of the Historic Preservation unit was to review all Corps permit applications; if any proposed activity was expected to affect an archeological or historic site, the Historic Preservation unit had an advisory and regulatory role under 36 CFR 800. The functions of this unit have been moved to the Office of Archeology and Historic Preservation, an office separate from Parks.

32. Under RCW 352.32.180, significant water quality degradation of waters over and adjacent to Parks jurisdictional boundaries is prohibited; Parks will review Corps permit activities to determine if water degradation may occur. Parks is authorized to establish small boat basins (marinas) on Puget Sound (RCW 43.51.220) and must apply for Corps permits for these. The agency has detailed criteria for the location and design of boat launching ramps.

33. Parks and other state agencies receive funds for property acquisition and recreational development from the Interagency Committee for Outdoor Recreation (IAC). General IAC funding priorities include the acquisition of fresh and saltwater shorelands for multiple use and public beaches, critical, scenic, and unique lands, and areas for boating, fishing, and other outdoor recreation. The IAC also maintains and updates SCORP, the comprehensive plan for development of outdoor recreation facilities in the state. SCORP has several recommendations and findings relating to the preservation and management of wetland habitats and floodplains, for example (SCORP, Vol. I, 1973, pp. 10-11):

Finding	Recommendation
Floodplains and wetland areas along "rivers of statewide significance" are valued open space and outdoor recreation resources.	....First priority should be given to prohibiting further encroachment of residential, commercial, and industrial developments on flood hazardous land along the banks of "rivers of statewide significance".
Swamps, marshes and other wetlands provide critical habitat for wildlife, as well as opportunities for scientific, educational, and recreational experiences.	Those swamp, marsh, or bog sites with natural qualities and having unique value for wildlife conservation, scientific, educational, or recreational purposes should be retained in their natural state.

34. These policies would be used to some extent as criteria in any IAC funding, and would be used in any review by agencies who are members of the IAC. This includes Parks, DOE, Game, Fisheries, Highways, DNR, and Commerce and Economic Development.

35. SCORP inventories indicate that the Central Puget Sound area (which includes Snohomish County) is well endowed with recreation sites; however, none are mentioned in the study area. The highest priority under SCORP for this area is the acquisition of shorelines.

Office of Archeology and Historic Preservation (OAHP)

36. Established in 1977 by Substitute House Bill 70, Chapt. 195, Laws of 1977, this office is now responsible for the maintenance of a register of archeological and historic sites in the state and for the promotion and enhancement of preservation and conservation efforts. The law also establishes an advisory council on historic preservation to advise on and encourage public interest in archeology and historic preservation and to perform the duties of review. Substitute HB 70 explicitly prohibits any digging or other activity at archeologic or historic sites without a permit from the OAHP, except when such sites are below ordinary high water or within the intertidal zone.

37. All Corps permit applications are reviewed by OAHP (and/or the Advisory Council) for any effects on archeological or historical sites. The Schooner Equator, 14th Street Yacht Basin, Everett, and the Jack Knife Bridge are on the National Register of Historic Places (see also Cultural Resources).

Energy Facility Site Evaluation Council (EFSEC)

38. Established under the State Energy Act of 1976 (RCW 80.50 et seq.), EFSEC reviews and makes recommendations for new construction or reconstruction of energy facilities including energy plants, transmission facilities and energy transmission corridors. EFSEC's regulatory program is designed to establish a single certification procedure state-wide for energy facilities. EFSEC also issues permits for point source waste or pollution discharges under the State Water Pollution Control Act for energy facilities subject to RCW 80.50.

Puget Sound Council of Governments (PSCOG)

39. This agency is the regional governmental unit and covers the four Central Puget Sound counties (King, Pierce, Snohomish, and

Kitsap). Its member governments include the counties and most of the large and small cities in its area. In the study area, Snohomish County and the cities of Everett and Marysville are PSCOG members.

40. PSCOG has an adopted policy statement (Goals and Policies for Regional Development, February 1977), which represents the regional plan (RDP). All Corps permit applications will be reviewed by PSCOG for consistency with the RDP policies. The RDP has specific policies on activity centers, agriculture, economy, housing, natural environment and amenities, public services, and transportation. PSCOG is also the local clearinghouse for coordination of interagency review of applications for federal funding under grant-in-aid programs under Circular A-95 of the Office of Management and Budget. Policies of particular interest for the Snohomish estuary include those on maintenance of agriculture (RDP, pp. 8-9) and the following policies on the natural environment (RDP, 16-18):

- Publicly owned tidelands should be retained in public use.
- Local jurisdictions are encouraged to acquire those swamp, marsh, bog, and other wetland sites with locational and/or natural qualities which have value for wildlife conservation, scientific, educational, or recreational purposes, or otherwise accomplish open space land preservation and natural drainage function objectives.
- Permanent structures designed for human habitation, commerce, employment, or public assembly should not be located within high risk zones including 100-year floodways...

Local Government

41. In the Snohomish estuary study area, there are three local governmental entities which may review Corps permit applications, depending on the location of the proposed action; these are Snohomish County, the City of Everett, and the City of Marysville. The institutional boundaries of each of these governmental entities are shown in Plate 15. Each reviews Corps permit applications within its jurisdiction and may also review particular applications outside its boundaries. These reviews will be made using the comprehensive plan, zoning, and shoreline master program for each jurisdiction as statements of plans and policies about proposed activities. In addition, there are a number of ancillary documents describing policies and plans for water pollution control and river basin management in the study area which may be used by all jurisdictions in the review process.

42. In the following discussion, each governmental entity and its specific plans and policies are described. A map showing composit shoreline environment designations for the three jurisdictions (Plate 16) is included. A composite comprehensive plan map was not made, because the various comprehensive plans are in different stages of development. The ancillary plans and policy documents which may be used by all jurisdictions are listed and very briefly described.

Snohomish County

43. Snohomish County has several departments and County-wide special purpose districts which may submit and/or review Corps permit applications. These include the Departments of Planning, Public Works, Parks, Engineering, and Public Health (Snohomish Health District), the Snohomish County Public Utility District #1, Snohomish County Metropolitan Municipal Corporation (SNOMET), Snohomish Conservation District, and Snohomish Cooperative Extension Service.

44. The Snohomish County Planning Department reviews Corps permit applications for consistency with (1) the Snohomish County Comprehensive Plan, (2) the zoning of the area, and (3) the Snohomish County Shoreline Management Master Program.

45. (1) Snohomish County Comprehensive Plan. Snohomish County is divided into planning areas for purposes of revising and updating the County comprehensive plan. Goals and objectives adopted at the county level are expressed at an area level in an area comprehensive plan. Those planning areas in Snohomish County which cover the study area are Tulalip, Marysville, and Snohomish/Lake Stevens (Plate 17). The Tulalip Comprehensive Plan will be discussed in the section on Tulalip Tribes of Washington. The Marysville area plan is dated 1970, while the Snohomish/Lake Stevens plan is 1966; the latter plan covers an area on North Ebey Island which has since been annexed to the City of Marysville.

46. Adopted goals and objectives of the general county land use plan that are particularly pertinent to the Snohomish estuary study include conservation of open space, retention of good quality agricultural land in agricultural use, and protection of important scenic areas (Tech. Rept 8, 1970, pp. 27, 48, 51). The Marysville Area Plan, developed to be consistent with the goals and objectives of the City of Marysville Comprehensive Plan, describes the floodplain and poorly drained soils of the Ebey Slough area as unbuildable. The plan recommends the maintenance of agriculture in the area, and the plan map shows greenbelt (park, open space, agriculture) along the entire east bank of Ebey Slough and along Quilceda Creek (Marysville Area Plan, 1970, pp. 19, 21, 32, 43). The exist-

ing Snohomish/Lake Stevens Area Plan (although considered outdated by the Snohomish County Planning Department) recommends the continuation of agricultural use in the Snohomish River floodplain and recommends an agricultural zone be imposed in this area.

47. (2) Snohomish County Zoning. In the 100-year floodplain, zoning is principally in four categories, as described in the Snohomish County Zoning Code:

- Agriculture 10 Acre (A-10): To preserve prime agricultural soils for agricultural uses; allowed uses are all agricultural and residential at one unit/10 acres.

- Rural Use (RU): To allow minimum of controls without adversely affecting public health, safety, and welfare, or the comprehensive plan policies. Zoning changes are anticipated as area loses rural character.

- Light Industry (LI): To promote, provide for, and protect areas for heavy industry. Permitted uses are those such as pulp manufacturing, cement manufacturing, tanneries, and so on.

48. The A-10 zone covers the floodplain south of Highway 2 and the east bank of Ebey Slough north of Highway 2 to north of Otter Island. The area between Ebey Slough and S mboat Slough just west of I-5 is also zoned A-10, as is a large portion of Section 34 (T30N, R5E) adjacent to Marysville.

49. The RU zone covers Ebey Island, Spencer Island South, and Smith Island north of Highway 2 and east of I-5. It also covers Otter Island and the area between Steamboat and Ebey Sloughs in Sections 3, 4, and 33. West of I-5, Smith Island is a mixture of RU and LI zones. Spencer Island North is completely in LI zoning.

50. ere are in addition two small areas of RR 12,500 and RR 20,000 (rural residential at 12,500 and 20,000 square foot lots) on the east bank of Ebey Slough in Sections 3 and 11 (T29N, R5E).

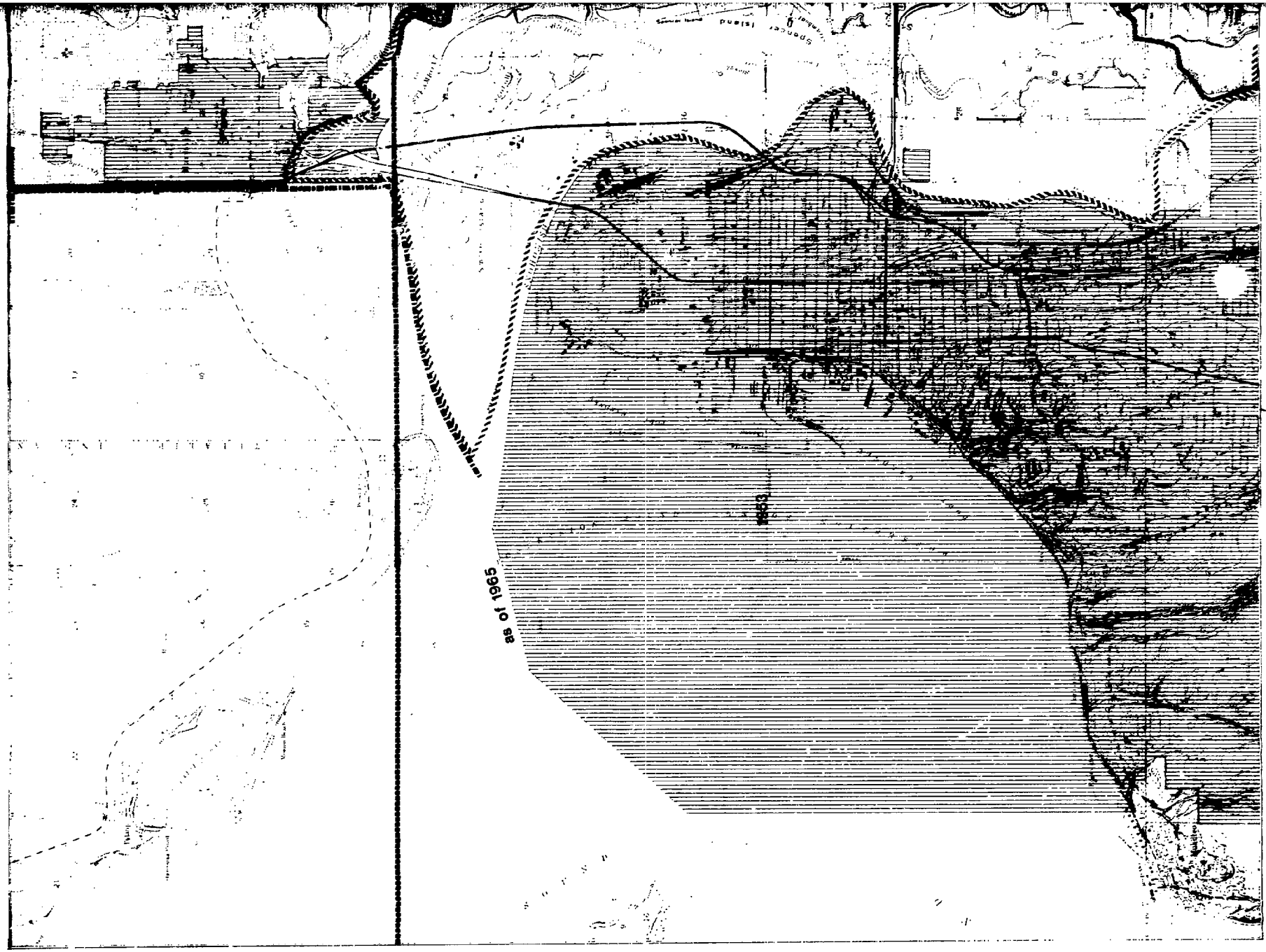
51. The entire 100-year floodplain is overlain by the Flood Hazar one (FH); this is a zone to promote the safe development of flood-prone lands and to prevent establishment of structures in areas in danger of flooding. Among other reasons, this zone was established to meet the requirement of the National Flood Insurance Program. Its general provisions are use limitations in the floodway and special construction provisions in floodway fringe and flood hazard areas.

52. (3) Snohomish County Shoreline Management Master Program. Because of the agricultural use of most of Snohomish County's developed shorelines and the economic importance of agriculture in Snohomish County, the shoreline master program calls out agriculture as an element to be particularly considered. Policies of particular interest on agriculture include the prohibition of filling that causes hydraulic pressure to adversely affect existing or potential agricultural or aquacultural areas or that threatens natural or existing drainage from existing or potential agricultural or aquacultural areas.

53. Shoreline environment designations in the Snohomish estuary area are mostly Rural, designed to protect agriculture, restrict intensive development, and maintain open space and recreational opportunities. The entire estuary floodplain under county jurisdiction east of I-5 is designated Rural, with the exceptions of a few areas of Conservancy environment and one area of Natural environment (see Plate 16). Conservancy is a resource enhancement and management designation, while the Natural designation is meant to preserve those resource systems which are free of man's influence. The Smith and Spencer Island area west of I-5 is designated Urban, to provide for intensive development and multiple uses. Quilceda Creek is Conservancy. The SMP policies on specific activities include policies on log rafting, marinas, dredging and filling, jetties, bulkheads, utilities, and flood protection. The program also has guidelines for the management of Shorelines of Statewide Significance; all shorelines in the estuary area are designated as Shorelines of Statewide Significance.

54. The Departments of Public Works, Parks, and Engineering may review Corps permit applications which are particularly related to their functions (for example, Public Works is concerned with solid waste disposal, Parks with park and recreation facilities, and Engineering with supervision of river impoundment projects). These departments may also make applications for Corps permits for development in the area under Corps jurisdiction.

55. The Snohomish Health District is concerned with water quality monitoring, enforcement of sewage disposal regulations, handling of solid waste, and review of health aspects of proposals for all kinds of activity in the study area. The Health District has detailed regulations on storage, collection, and landfill disposal of solid wastes. The agency requires a woodwaste landfill permit for any landfill in which the proposed fill material contains 50% or more of woodwaste. It is the agency's policy to refuse approval of this type of fill within the floodplain. The agency opposes filling with any biodegradable material if there is a possibility of water quality degradation.


as of 1965

INSTITUTIONAL BOUNDARY

PLATE NO 15

LEGEND

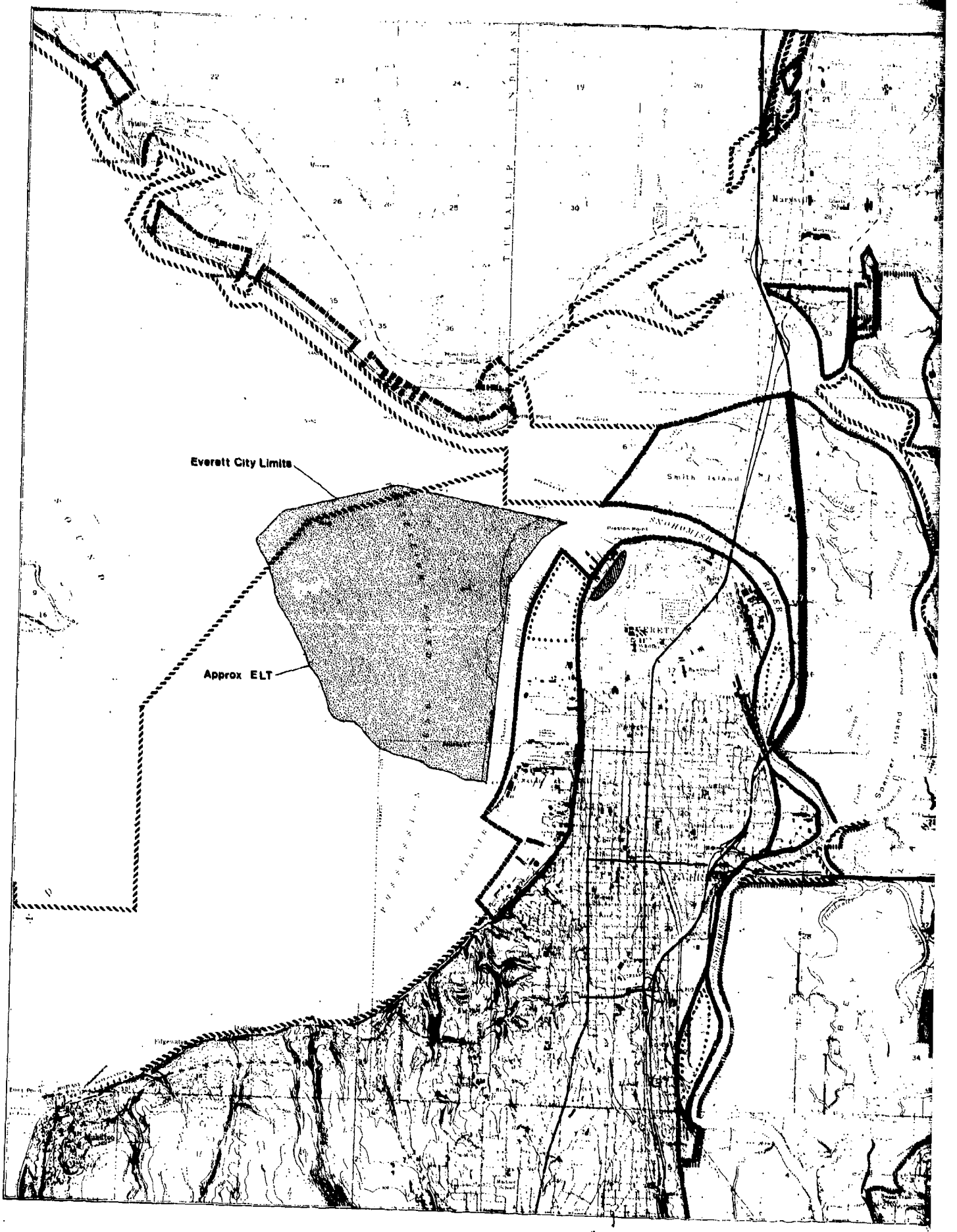
- City Boundary
- Port of Everett Boundary
- Snohomish/Lk Stevens Planning Area
- Tulalip Indian Reservation
- Marysville Planning Area

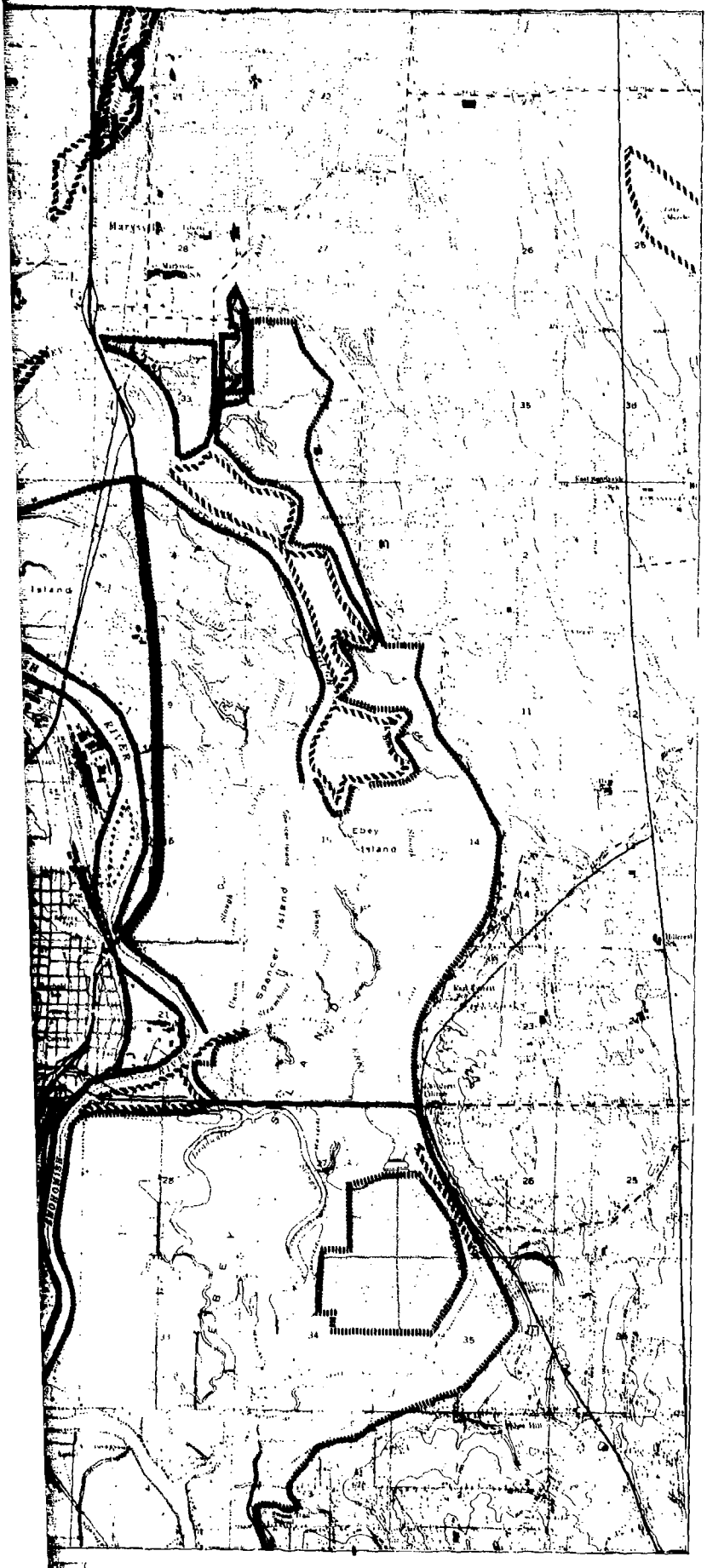
N

SCALE 1:24000

SNOHOMISH ESTUARY WETLANDS STUDY

Source: Local City, Port & Co. Maps


Everett City Limits
Approx ELT



SHORELINE MANAGEMENT DESIGNATIONS

PLATE NO 16

LEGEND

- Urban (Undeveloped)
- Urban (Developed)
- Suburban
- Rural
- Conservancy
- Conservancy (Resource Protection)
- Diverse Resource Mgt Area
- Natural

N

SCALE 1 INCH

SNOHOMISH ESTUARY WETLANDS STUDY

Source: City & Co. Shoreline Master Program

2

PLATE NO 1

56. The Snohomish County Public Utility District No. 1 (PUD) is actively involved in maintaining the regional water and electricity supply. The PUD purchases water from the City of Everett by tapping the main city transmission line. The George Culinback Dam on the Sultan River was constructed by the PUD and the City of Everett. The PUD has one 55kv transmission line crossing the estuary floodplain near Highway 2 and a 115kv line crossing Ebey Island toward Everett from the south. The only line proposed in the estuary study area is a 55kv line to the Everett sewer lagoons from the west bank of the Snohomish River; any other lines would be 12kv distribution only. Although the PUD is sent public notices of permit applications by the Corps, most of its Corps-related activity appears to be in permit applications for overhead lines which cross sloughs in the estuary. (Clearance is the principal issue with these lines.) The PUD has submitted such applications since 1968.

57. The Snohomish County Metropolitan Municipal Corporation (SNOMET) is the water quality planning agency for the Snohomish County under Section 208, FWPCA. The agency, together with King County, issued a plan describing how local governments acting together can control the problems of non-point source pollution of area waters; this plan is called The Areawide Waste Treatment Management Plan. SNOMET's principal concern is water quality control. The SNOMET Council has members from many local governments, and review of Corps permit applications would be done at local government level.

58. The Snohomish Conservation District, authorized under RCW 89.08 and in existence since 1941, was organized to guide and assist land owners in use, development and conservation of renewable natural resources. The District interacts with other agencies, including the Corps, in development of plans, review of proposals, and general environmental program implementation. There is a memorandum of understanding between the District and SNOMET that the District will be the lead agency for educational and technical assistance in the abatement of agricultural water pollution in the area.

59. District policies include the retention of prime agricultural land for agriculture and the retention and preservation of unique lands, natural scenic areas and historical sites. A goal of the District is to allocate adequate land and water for developed areas, roads, wetlands, wilderness, fish and wildlife, recreation, etc. The protection of fish and wildlife habitat and enhancement of environmental quality are concerns of the District. Protection of land and water from erosion, preservation or restoration of shoreline vegetation and stream resting areas are some of the District goals. The District also sponsors small watershed projects to solve flooding and drainage problems.

60. The Snohomish County Cooperative Extension Service, an educational arm of Washington State University, performs educational and informational functions for the agricultural sector of Snohomish County. This agency is one identified as providing information about "Best Management Practices" for farmers to control agricultural runoff pollutants under the SNOMET program.

City of Everett

61. In the City of Everett, The City of Everett Planning Department is the principal reviewer of Corps permit applications. The Everett Community Plan, area zoning, and the Everett Shoreline Master Program are used in the review process. Any proposed activity is also checked against the City's Open Space, Park and Recreation Plan.

62. Everett Community Plan. This plan, completed in 1972, contains policies on the natural environment, open space, infrastructure, commerce and finance, industry, and residential patterns. Some of the most pertinent of these include:

. Natural Environment (p. 27)

5. Prohibit development in a buffer strip alongside all open surface water, on each side of streams and centerlines of areas of restricted surface drainage (swales). This buffer strip should be heavily vegetated, preferably forested.

6. Limit development on areas particularly valuable as recharge areas to groundwater sources.

10. Prohibit development on land liable to flooding.

12. Limit development on good farmland, create agricultural preserves.

13. Prohibit filling of tidal flats.

. Open Space (p. 34)

1. Preserve the entire Jetty Island in its natural state for open space, educational use, and public recreation.

1A (alternative to #1). Retain all but the southern portion of the Jetty Island (which would be developed for the Port of Everett) for open space, educational use, and public recreation.

2. The river floodplain shall be reserved for recreational use, agricultural use, and/or natural open space.

3. Presently undeveloped banks of the Snohomish River shall be reserved for recreational use and/or open space, except for the west bank adjoining industrial Area III (in the Lowell area).

8. Encourage development of a major river park on the west bank of the Snohomish River.

. Industry (p. 92)

3. Industrial development on river floodplain and/or on and by extension of the Jetty Island to the west by filling in Port Gardner Bay is unacceptable, especially in lieu of a thorough exploration of alternative sites both within and outside of the study area by appropriate planning agencies.

5. Encourage efforts to alter the location of log storage sites from water to land sites so that valuable waterfront lands might be developed for other uses.

9. The preferred location for future water-related new industry within the study area should be in Area III along the west bank of the Snohomish River from Pacific Avenue south to Lowell.

12. In general new industrial development (other than deep-water, port-related industry) on Bay Waterfront from Weyerhaeuser Mill A to Preston Pt. should be discouraged. Port expansion should take place on lands already in industrial or related uses. No industrial use should be developed on the Jetty Island unless there is demonstrable need and all other alternatives have been exhausted.

13. In general, new industrial development along the Snohomish River from Preston Pt. to Hewitt Avenue, including floodplain should be discouraged. In particular no further industrial development should be permitted in the river floodplain.

63. Everett Shoreline Master Program. This document has been adopted as the shoreline element of the city's comprehensive plan (of which the Everett Community Plan is the policy statement). One of its most notable features is the creation of special environment

designations for Jetty Island and Maulsby Swamp (Plate 16). Jetty Island from the training dike to the line of extreme low tide is designated a Diverse Resource Management Area, and specific management policies, including the development of a comprehensive plan for the management of the island's resources, must be implemented before any activity can occur there. Maulsby Swamp is designated Conservancy (Resource Protection), because of its biological and ecological qualities; activities allowed there include educational and scientific investigation and public enjoyment of a natural area. Most of the remainder of Everett's shoreline is Urban, except for Conservancy in Possession Sound. Everett has three areas designated Urban Undeveloped; the purpose of this designation is to provide areas for expansion of existing Port activities and for new industrial activities. As with all shoreline programs, the Everett program emphasizes water-dependent uses for shorelines and recommends areas to be preserved because of their unique, fragile, and valuable biological resources. At the present time, only utility rights-of-way and recreation are permitted (conditional) uses in Maulsby Swamp. Dredging (and disposal), log rafting, and piers are allowed conditional uses on Jetty Island; all other uses must await compliance with the management policies.

City of Marysville

64. The City of Marysville is responsible for review of Corps permit applications using the Marysville Comprehensive Plan policies, Marysville zoning, and the Marysville Shoreline Master Program. The only existing comprehensive plan for Marysville is so outdated that it was viewed by Marysville staff to be unsuitable for inclusion in this study. It is being revised, and drafts may be available by summer of 1978. The Marysville policies have been checked against the Marysville Area Plan (see Snohomish County) for consistency.

65. Marysville Shoreline Management Master Program. This program encourages the preservation of fragile natural resources, vegetation and wildlife in the city and is directed at enhancement of shorelines rather than restriction of uses. Under goals for recreation, the City is encouraged to provide for a park and marina site along Ebey Slough. Goals for conservation include the preservation of areas with rare or unique estuarine vegetation or habitats of rare or endangered species. Marysville has a specific policy on dike location; dikes shall be placed landward of the waterway, including associated swamps, marshes, and other wetlands related to the river. Marysville has only two environment designations: Urban and Conservancy. The City's Conservancy designation is principally in the Quilceda Creek area. The environment designations have not been finalized for the portion of Marysville which is on North Ebey

Island (Plate 16). This area was designated as mostly Urban in the Marysville program, but the State Department of Ecology wants a designation of mostly Conservancy.

Composite Shorelines Management

66. The composite Shorelines Management map is shown in Plate 16. The categories have been combined to show Urban, Rural, Conservancy, Natural, as the same for all the jurisdictions in the estuary. This map shows where specific designations are located; greater details can be obtained from the individual SMP's. Note that the Tulalip reservation conforms to the shoreline designations of Snohomish County; although ownership and control of certain shorelands are in dispute, the Tulalip Tribes have agreed to Snohomish County's master program for the majority of their shorelines.

Ancillary Plans and Studies

67. There are a number of other plans and studies which are used in reviewing Corps permit applications in the Snohomish estuary area. One of these, Recommendations for the Snohomish River Basin, may ultimately be used by all agencies; the others may be applicable only for certain projects or agencies.

68. Recommendations for the Snohomish River Basin. In early 1975, a document entitled "Recommendations for Comprehensive Land Use Planning and Flood Control for the Snohomish River Basin" was developed by a committee of citizens of the Snohomish River Basin. This document is referred to as the Mediated Agreement because it is an agreement reached by mediation between citizens representing different interests. (Note: there is also a separate mediated agreement for the Port of Everett; it is described in the discussion on the Port.) The principal recommendations of the Mediated Agreement for the Snohomish River include the following:

- Support a Snohomish County Planning Department feasibility study to design an economic development plan for the area west of I-5....

- In the Snohomish delta, maintain the "delta lobes" and biologically functioning surge plains in an undeveloped and natural state.

- From I-5 to the confluence of the Snoqualmie, permit only those developments on agricultural land which are required to maintain, develop, and enhance viable agri-

cultural enterprises. Prohibit filling and development of wetlands essential to the biological and hydrological nature of the river.

The Mediated Agreement recommended establishing a permanent Basin Coordinating Council (BCC), responsible for planning and implementation of a basin-wide plan for water resources, development, and recreation. The Governor appointed an Interim Snohomish Basin Coordinating Committee to design the BCC structure and composition, to explore the need for new legislation and planning efforts in the basin and to recommend ways to bring current comprehensive plans in line with any land use changes necessary to achieve the intent of the Mediated Agreement. The Interim Committee published its report in December 1975. One of the principal recommendations of that report was a means of preserving the delta lobes and biologically functioning surge plains in the Snohomish delta in an undeveloped and natural state; this is recommended to be done by the purchase of development rights and/or land in fee title. Plate 17 shows the areas considered to be the delta lobes and biologically functioning surge plains in the Snohomish delta in an undeveloped and natural state; this is recommended to be done by the purchase of development rights and/or land in fee title. Plate 17 shows the areas considered to be the delta lobes and biologically functioning surge plains of the Mediated Agreement; these are the areas to be studied for acquisition.

69. The Corps conducted a reconnaissance study of the recommendations of the Mediated Agreement and concluded that it was economically feasible (Snohomish River Basin Mediated Plan, Reconnaissance Report, November 1976, p. 21). In addition, the Corps report concluded that "it would be expected to result in a net gain in the Snohomish Basin's environmental quality" (p. 28).

70. Snohomish County has agreed to consider the recommendations of the Mediated Agreement and the Interim Committee in its planning and review process, according to a representative of the Snohomish County Planning Department.

71. Other Documents. WASH-USE-1 is a sewer and water facilities plan for the urban areas of Snohomish County. Snohomish County also has a Farm Home Administration Facilities Plan for rural areas of the county, covering sewer and water service and titled Rural Water and Sewerage Facilities Plan (1973). Another report, The Water Quality Management Plan for the Snohomish River Basin (1974), contains extensive data on water quality problems in the basin and alternative plans for control of water quality degradation. The Lower Snohomish Basin 201 Study (1977) indicates a facilities plan for the construction of municipal sewage treatment works for a planning area including Everett. The Area-wide Waste Treatment Management Plan (SNOMET/King County 208 plan) treats the problem of non-point source water pollution and possible solutions to it.

Local Special Districts

72. There are many special purpose districts in the Snohomish estuary study area. Probably the most influential single district is the Port of Everett, but there are numerous others, each of which may have input into the Corps permit review process.

Port of Everett

73. The Port of Everett is located on the west shores of Everett, in the Snohomish River, and Port Gardner Bay. The Port is a large landowner and developer (see Land and Water Use) in the area and engages in many activities involving Corps permits, notably piers and marina construction, navigation channel work, dredging and dredge material disposal, and so on.

74. Because Port plans and activities can affect the entire Everett/Snohomish estuary area, a citizens' planning/mediation committee, composed of interested citizens of the Everett area, has developed consensus guidelines for future development of the Port of Everett; the consensus guidelines represent the mediated agreement for the Port of Everett. These guidelines were adopted by the Port Commissioners on 31 October 1977 and will serve as the basis for the development of a Port comprehensive plan. The priorities and policies from these guidelines judged most pertinent to the Snohomish estuary study are as follows:

. Priorities (pp. 1, 2)

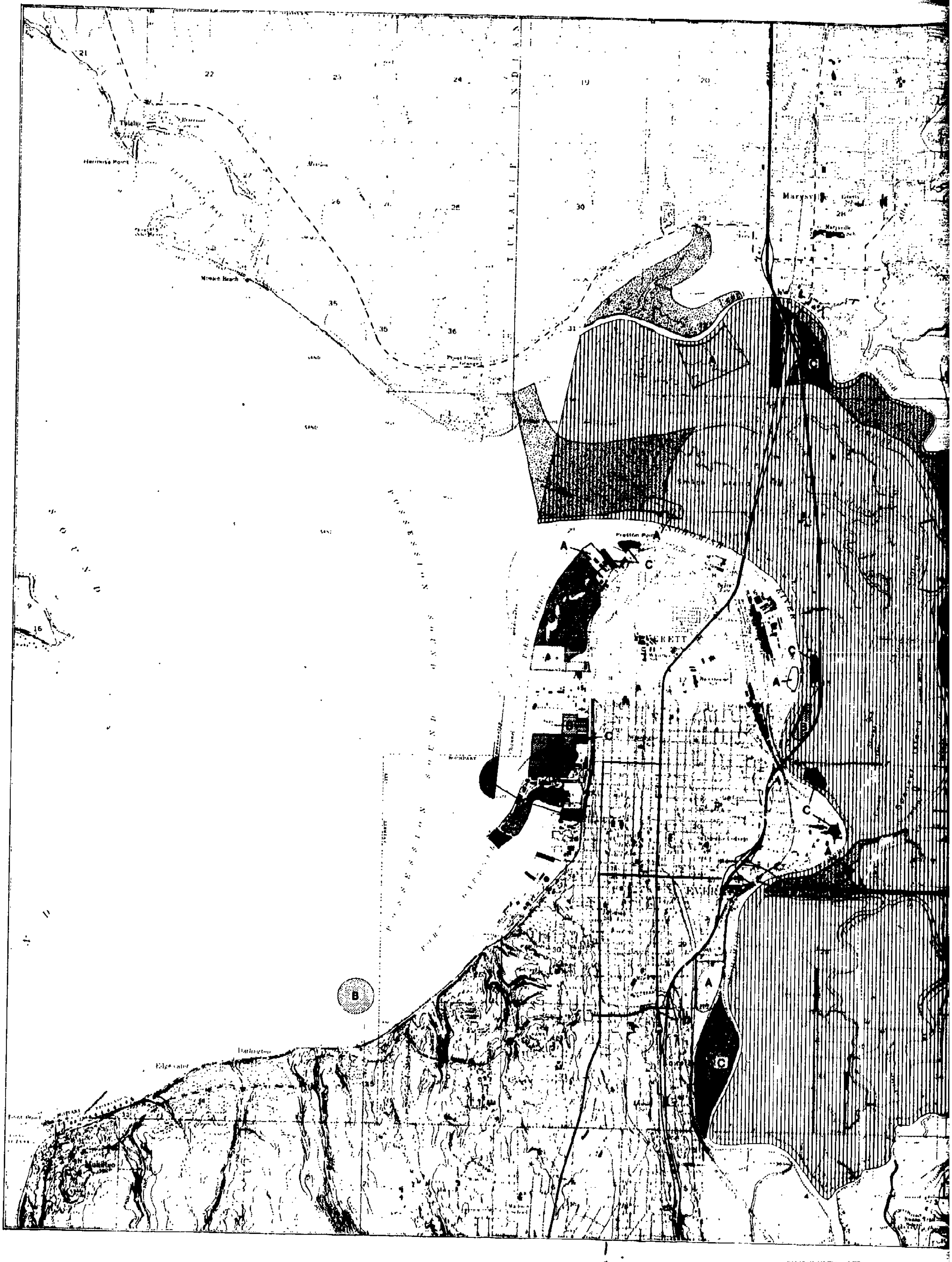
1. The shorelines will be reserved for water-dependent development and activities.

4. The Port should seek and give priority to clients and developments which minimize negative environmental impacts.

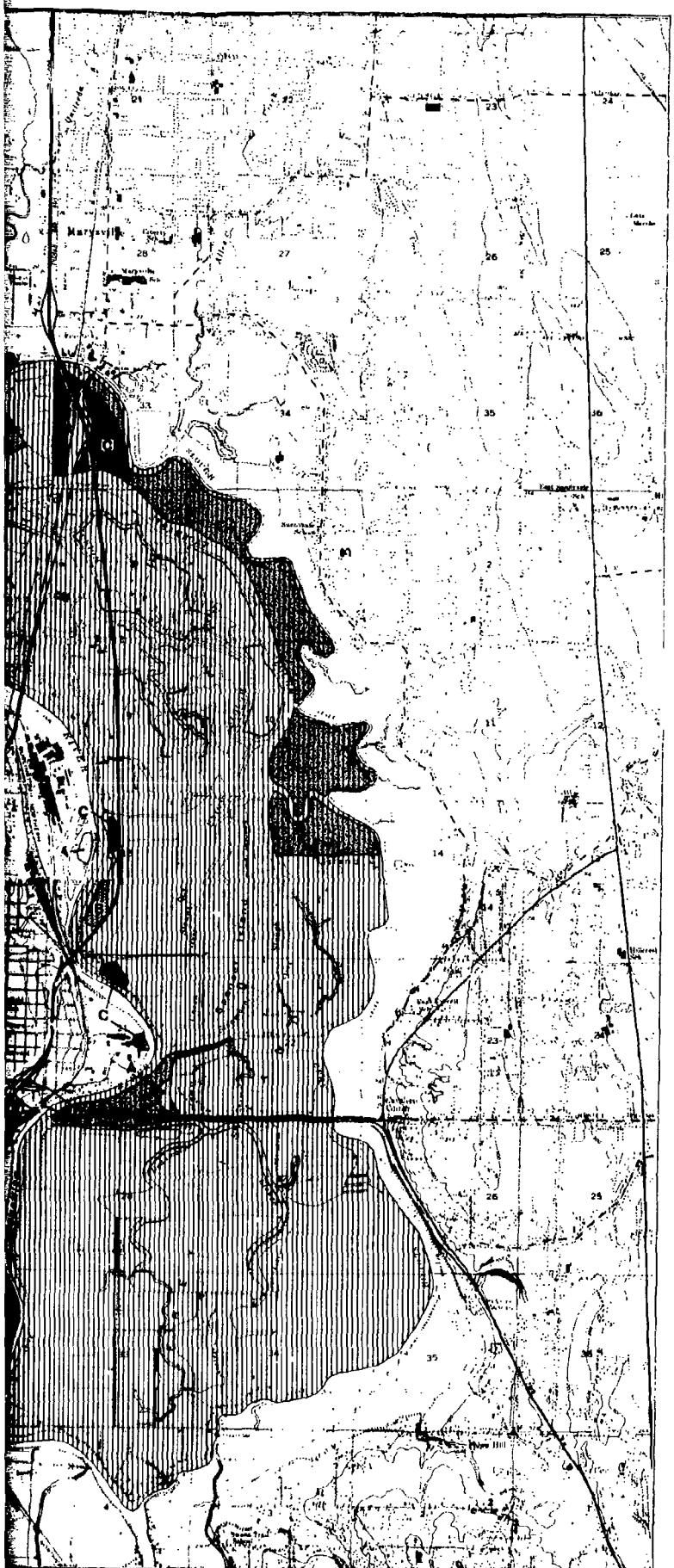
5. The Port should protect the fragile and critical estuarine environment.

6. Visual and physical access to the shoreline should be provided by the Port where appropriate.

7. The Port will not support development of the wetlands, delta lobes and surge plain of the Snohomish River estuary which lie and are situated north of Preston Point.



Tulalip
Hermosa Point
Mission Beach
TULALIP INDIAN
Marysville
Preston Point
Darlington
Edgewater
Mukilteo
A
B
C



MEDIATED PLANS & DISPOSAL SITES

PLATE NO 17

LEGEND

Snohomish River Basin Preservation Areas

Port of Everett Non-Disposal Area

Disposal Sites:

A — Past

B — Present

C — Proposed

N

SCALE 1:24000

SNOHOMISH ESTUARY WETLANDS STUDY

Source: Recommendations for the Snohomish Estuary 1975

Port Consensus Guidelines 1977

Port Disposal Site Map

2

PLATE NO 17

. Location, Type, and Sequence of Development (p. 3-5)

1. Continue to develop the Norton Avenue boat launch, the Norton Avenue terminal as an industrial/marina/ recreation site, and the East Waterway site for deep-water dependent industrial and commercial uses.

2. Consider alternatives of deep/shallow draft shipping, public area design, and reservation of the river channel and sites upstream of the North Avenue terminal site for shallow draft access.

3. After the Norton Avenue development, for which permits have not been secured, the future development of tidelands through filling by the Port of Everett will be mitigated by the Port designating after consultation with appropriate federal, state and local agencies, on Jetty Island at the time of each filling an equal area of wetlands and/or tideflats and/or uplands for marine park use, with identified recreation and/or conservation areas. A reasonable mix of uplands, tidelands and wetlands, reflective of community needs will be committed.

. Dredge Materials Disposal (p. 5, 6)

As local sponsor for the Corps navigational maintenance project on the Snohomish River, the Port of Everett is required to designate maintenance dredge material disposal sites.

1. [The citizen's group and the Port] support the placing of dredge materials on areas identified for development in the central waterfront. The Port agrees not to designate placement of maintenance dredge materials on wetlands north and east of the main channel of the Snohomish River estuary. (Plate 17 shows the estuary area in which no dredge material disposal will be designated).

2. Economics permitting, the Port will continue to encourage private development of and/or seek public acquisition of the Lowell Industrial Site for development and for gradual deposition of maintenance dredge materials from the upper settling basin.

3. A map of recommended maintenance dredge materials disposal sites is shown in Plate 17 along with the area to be preserved from dredge material dis-

posal. Past disposal sites and those in current use are also shown in this plate.

. Jetty Island (p. 6-8)

The Jetty is here defined as about 230 acres of uplands and 1,650 acres of wetlands and tide flats.

1. The Shoreline Master Program requires that a comprehensive plan for the Island, accompanied by public hearings, local authoritative comment and thorough consideration, be completed before any action or commitment is made toward development and/or preservation of Jetty Island's diverse resources.

2. The Port of Everett will not plan any development on the Jetty until after exhausting suitable sites on the east side of the waterway, and then only at such time as there is obvious regional demand and financial feasibility for a specific facility.

3. Dredge materials storage or disposal:

   a. Before any storage or disposal of dredge materials shall take place on the Jetty, there shall be a testing program to determine the beneficial and negative effects of such dredge material placement. The test shall be jointly designed and monitored by appropriate federal, state, and local agencies, including the Port, and shall take place on a site not to exceed 25 acres. Further filling can take place only after and in accordance with the Port's forthcoming comprehensive plan.

   b. This test shall be designed in such a manner as to provide criteria for the amount, location and manner of placement of any future dredge materials and should be permitted under the terms of the Diverse Resource Management Area designation without requiring the preparation of a comprehensive plan for the Jetty.

   c. Dredge material placement should be on the southernmost part of the Jetty and should be an extension in form and in character of the existing island. The placement process should be without diked edges, if acceptable to fisheries and other affected agencies. The filled

area should be long and thin along the east edge of the south end, filling in existing rip-rap. The west edge should be a continuation of and undulate as the existing shoreline. The overall approach is for natural compatibility and ecological and habitat enhancement.

4. No permanent access to the Jetty, other than for recreational use, shall be established by the Port or other agencies until such time as a comprehensive plan for the Jetty is approved.

5. Until such comprehensive plan is approved, the existing uplands and wetlands will continue to be available for recreational and preservation uses.

6. Leasing, transfer, and other funding arrangements from appropriate public and private agencies should be sought to recognize the commitment of this major Port-owned resource to non-development use. The objective of this would be to balance existing and future economic/industrial development with a proportional commitment to recreation, natural habitat, and ecological preservation of the Jetty.

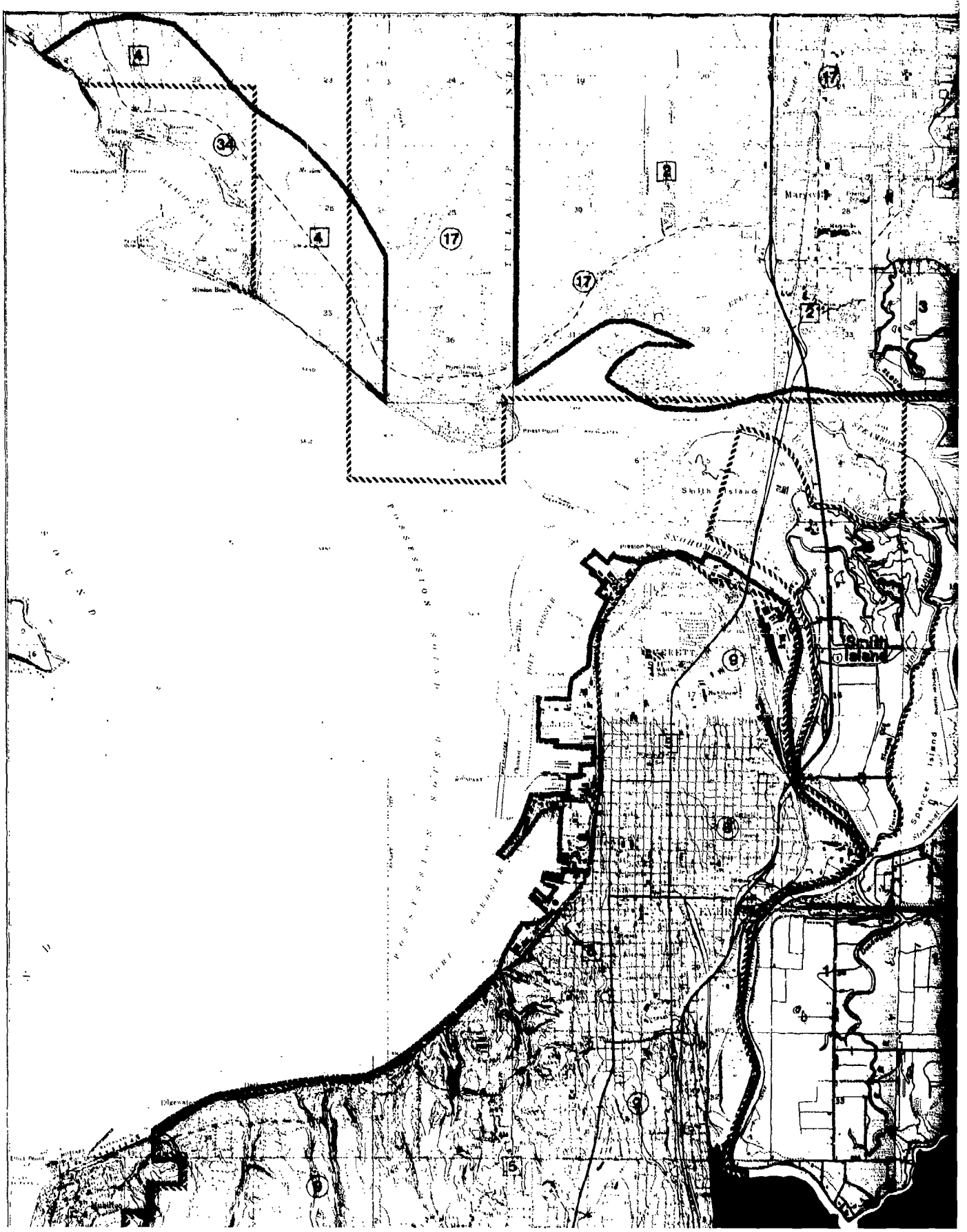
75. The Port-adopted guidelines also speak to the provision of recreational use and access in future individual Port projects and in the Port comprehensive plan.

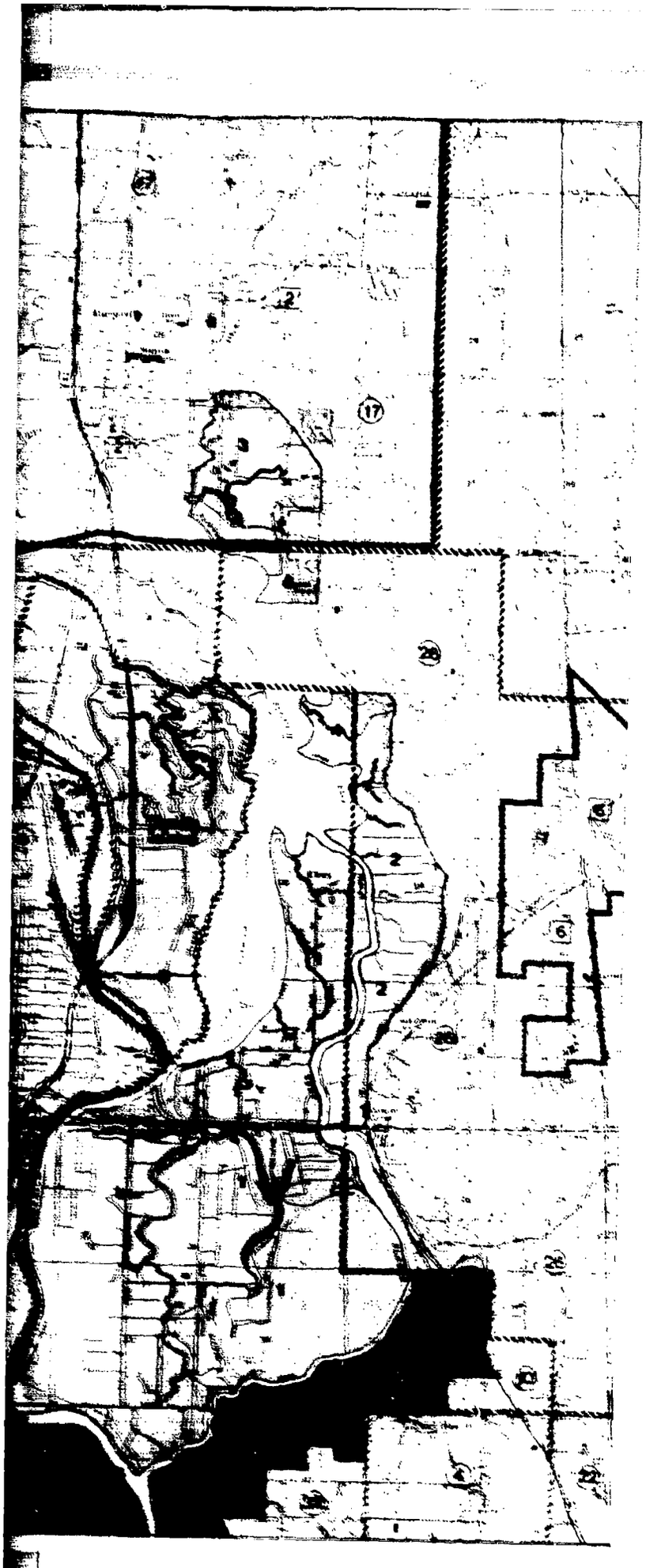
Diking Districts

76. Authorizing legislation for diking districts is RCW 85.05. Under this legislation, diking districts may be formed for the purposes of straightening, widening or otherwise improving rivers and streams causing overflow damage to district land and to construct the necessary dike systems. These districts have eminent domain rights and may contract for construction and maintenance of dike facilities. Funding may be through special assessment levies and by issuance of district bonds. Diking districts in the Snohomish estuary area are Districts Nos. 1, 2, 3, 4, and 5 of Snohomish County, shown in Plate 18. No plans other than maintenance have been identified for these districts.

Drainage Districts

77. Authorizing legislation for drainage districts is RCW 85.06. Drainage districts are similar in their organizational


Smith Island
Spencer Island



SPECIAL PURPOSE DISTRICTS

PLATE NO 18

LEGEND

- Diking
- Drainage
- Sewer
- Water

N

SNOHOMISH ESTUARY WETLANDS STUDY

Source: Districts & Co. Maps

structure and powers to diking districts, except that their principal purpose is to operate a drainage system. To this end, they may construct ditches, drains, and diversion dams, pumps, tide gates, and so on, and may operate and maintain these facilities. Those districts in the study area are Nos. 6, 13, and 14 of Snohomish County (Plate 18). Drainage districts (and diking districts) were identified in the Water Quality Management Plan for the Snohomish River Basin as contributors to water quality degradation through discharges of agricultural contaminants in storm runoff.

Sewer and Water Districts

78. Sewer districts (RCW 56) and water districts (RCW 57) are authorized to construct, operate, maintain, and regulate sewer and water systems. Sometimes one district will provide both services. These districts must adopt comprehensive plans for their service areas and may acquire property, establish connection charges and rates, and provide service to landowners outside the district. Water and sewer districts identified in the study area are shown in Plate 18. The City of Marysville provides sewer and water service (Nos. 2 and 17), as does the City of Everett (Nos. 5 and 9). The only other sewer district in the area is the Lake Stevens Sewer District (No. 6). Other water districts are Smith Island, serving 3 or 4 families (clustered around Highway 99) and the property between Highway 99 and I-5 (a line extends across Union Slough on the Burlington Northern railroad track), the Snohomish County PUD No. 1 (26), Fobes Water Association (10), Schluter Water Association (22), Cross Valley Water Association (4), and Swans Trail Water District (32). Of these, the PUD and the Cross Valley Water Association are the largest; the others are relatively small.

79. Maps of existing water and sewer lines from Snohomish County, Marysville, and Everett do not show any extensions into the estuary floodplain proper except those that lead to (and from) the Everett and Marysville sewer lagoons and to the Lake Stevens treatment plant. Except for Smith Island Water District lines, no water distribution lines extend into the estuary floodplain. However, the floodplain is crossed at two points by Everett's major water supply lines: one set just south of Highway 2, and another line north of the confluence of Ebey Slough and the Snohomish River. No planned extensions of sewer or water lines into the Snohomish esturay floodplain area have been identified.

Flood Control Zones

80. The Snohomish floodplain has been designated a state flood control zone, administered by DOE. This means proposed activ-

ity must meet the requirements of the National Flood Insurance program before DOE will grant a permit for the activity in the floodplain.

School Districts

81. Three school districts cover the study area; these are the Everett School District, the Snohomish School District, and the Marysville School District. These districts have particular areas in the Snohomish estuary study area which are used for educational purposes (see Educational Resources). The school districts have expressed a vital interest in the maintenance of marine and freshwater habitat in the study area, because of the varied nature of the biological resources and the easy access for educational purposes.

Fire Districts

82. There are two fire departments (Everett and Marysville) and four fire districts (Nos. 4, 8, 12, and 15) covering the study area. However, the majority of the floodplain lands are not in a fire district. Districts No. 4, 8, and 12 border the floodplain, and No. 4 covers the southernmost part of Ebey Island. Any structure not in a fire district can contract with an adjacent district for service.

Tulalip Tribes of Washington

83. The Tulalip Tribes are an independent entity, granted the Tulalip Reservation in 1872. According to the Comprehensive Plan for the Tulalip Reservation, the line of demarcation between the rights and duties of the federal, state, county, local, and tribal governments is not precisely defined. Under the Indian Reorganization Act of 1934 (225 USC 468; 48 Stat 984) and the Tribal Constitution, Indian people residing on the Reservation were given authority to veto any disposition or encumbrance of tribal lands, to lease and purchase lands, and to regulate the use and disposition of land. Tribal lands include tidelands and uplands totaling some 22,000 acres, vested in three different ways: 1) about 5,000 acres of uplands and tidelands are held by the United States in trust for the Tulalip Tribes; 2) individual Indians hold title to over 3,000 acres (these lands are restricted against alienation); and 3) the remainder have become vested in white and Indian persons and are not restricted. A legal study of the issue of Tulalip authority over their lands is contained in the 1972 Comprehensive Plan for the Tulalip Reservation. In general, the authority of the

Tulalip Tribes to control uses of Reservation lands is accepted by other governmental entities.

84. The Tulalip Reservation Comprehensive Plan is used by the Tulalip Tribes in considering various land uses. This document describes the natural resources of the Reservation and states goals and objectives which express the interest of the Tulalip Reservation citizens. These include:

- The protection and conservation of the natural assets of the Reservation (drainageways, fish and wildlife, outdoor recreation, etc.)
- The development of economic activity on the Reservation (industry, commerce)
- Maintenance of Tribal heritage and Indian cultural identity

85. The Reservation land use plan shows residential development along the shorelines of Tulalip Bay, Possession Sound, and up the estuary toward Quilceda Creek. The portion of North Ebey Island west of I-5 is planned for industry and a portion of Tulalip Bay is planned for a marina complex.

86. In the Snohomish County Shoreline Management Master Program, the shorelines of the Tulalip Reservation were given environment designations. In the Tulalip Reservation Comprehensive Park Plan, the Tulalip Tribes have recognized that the County's designations are for the most part in concert with the Tribes' goals and objectives for shoreline development. Virtually the entire shoreline from Tulalip Bay to Priest Point is designated Conservancy (tidelands) and Suburban (shorelands). The area of Quilceda Creek is also designated Conservancy (see Plate 16). The Tulalip Tribes' park plan emphasizes the retention of open space.

87. The Comprehensive Plan for the Tulalip Reservation, Appendix B, contains a study of the feasibility of a Tulalip water system and shows existing and planned Marysville water lines throughout the Reservation. A preliminary design for sewage collection and treatment facilities is shown in Appendix C of this document. The preliminary design shows a treatment plant outfall to Possession Sound near the south peninsula of Tulalip Bay.

D. CULTURAL RESOURCES

Prehistoric

1. The earliest recorded history of the aboriginal inhabitants of the Snohomish estuary came from Captain Vancouver in the late 1700's. There is agreement among historians of this period that the Snohomish Tribe occupied the Snohomish estuary as well as portions of Whidbey and Camano Islands. The Snohomish lived in four bands, three of which wintered on the mainland. One village was on Preston Point and was called Hebolb, another was on Priest Point, another at Sandy Point opposite Tulalip, and the fourth was on the southern point of Whidbey Island. At this time the Snohomish numbered between 300 and 500 people.

2. By the time the Snohomish were relocated on the reservation in the late 1850's it is thought they were living in two winter villages, one on Priest Point and the other on Preston Point (Hebolb).

3. Evidence of the Native American prehistoric settlements has been recorded by a number of archeologists in the past several decades. In 1953 and 1954, Alan Bryan identified eleven archeological sites along the northern edge of the estuary floodplain. In 1961 John Mattson investigated Site 45-SN-17, Hebolb village on Preston Point. A 1975 report by Jerry Jermann, titled Archeological Resource Potential in Tulalip Bay Area, Snohomish County, Washington, reviews the state of Sites 45-SN-5 and 6.

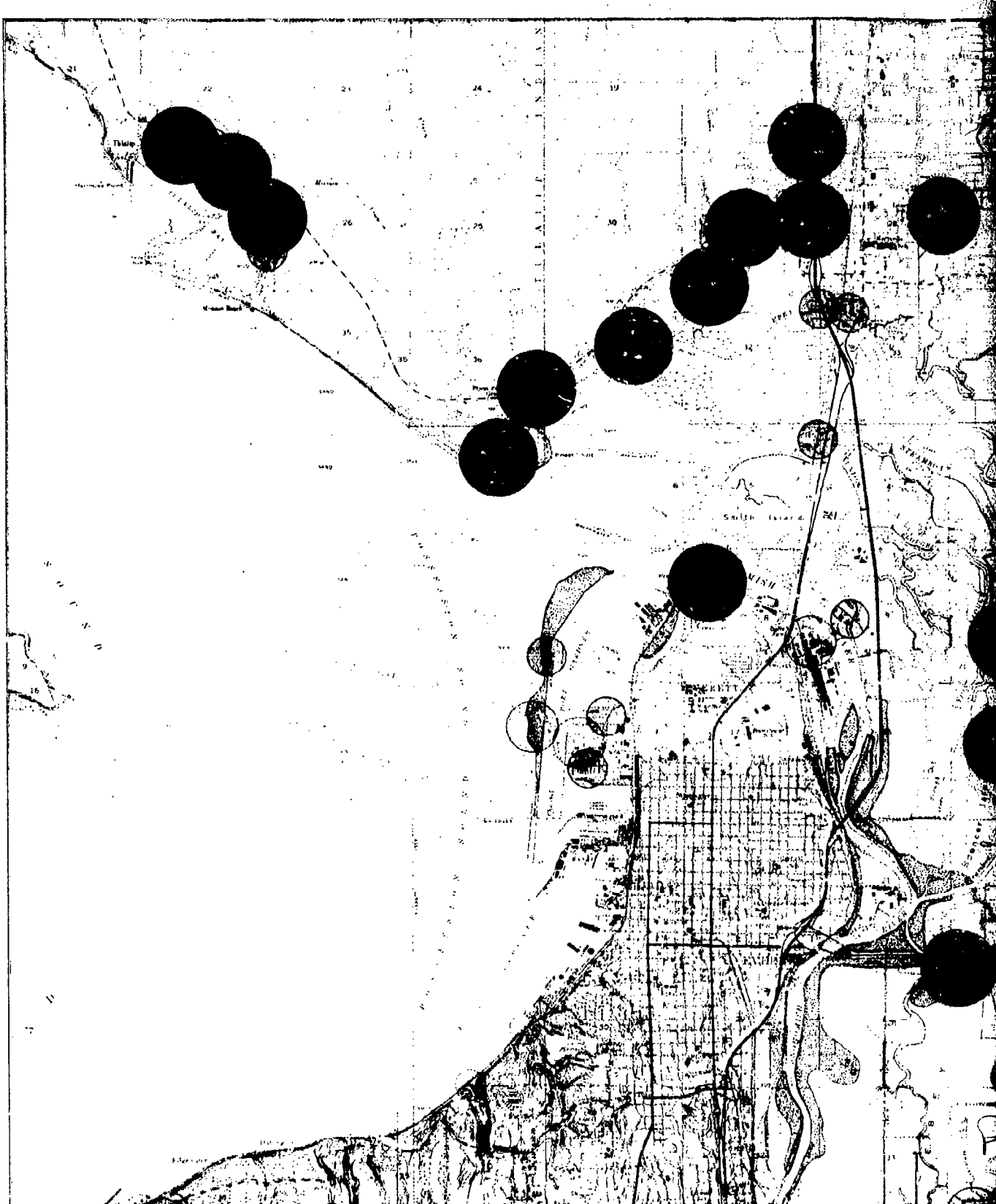
4. A 1975 study for the Corps of Engineers (Dunnell and Fuller, 1975) deals specifically with archeological sites in the Snohomish estuary study area. The approximate locations of the sites are shown in Plate 19. To protect the sites, exact locations are not shown; however, information about them can be obtained from the State Historic Preservation Officer on a need-to-know basis.

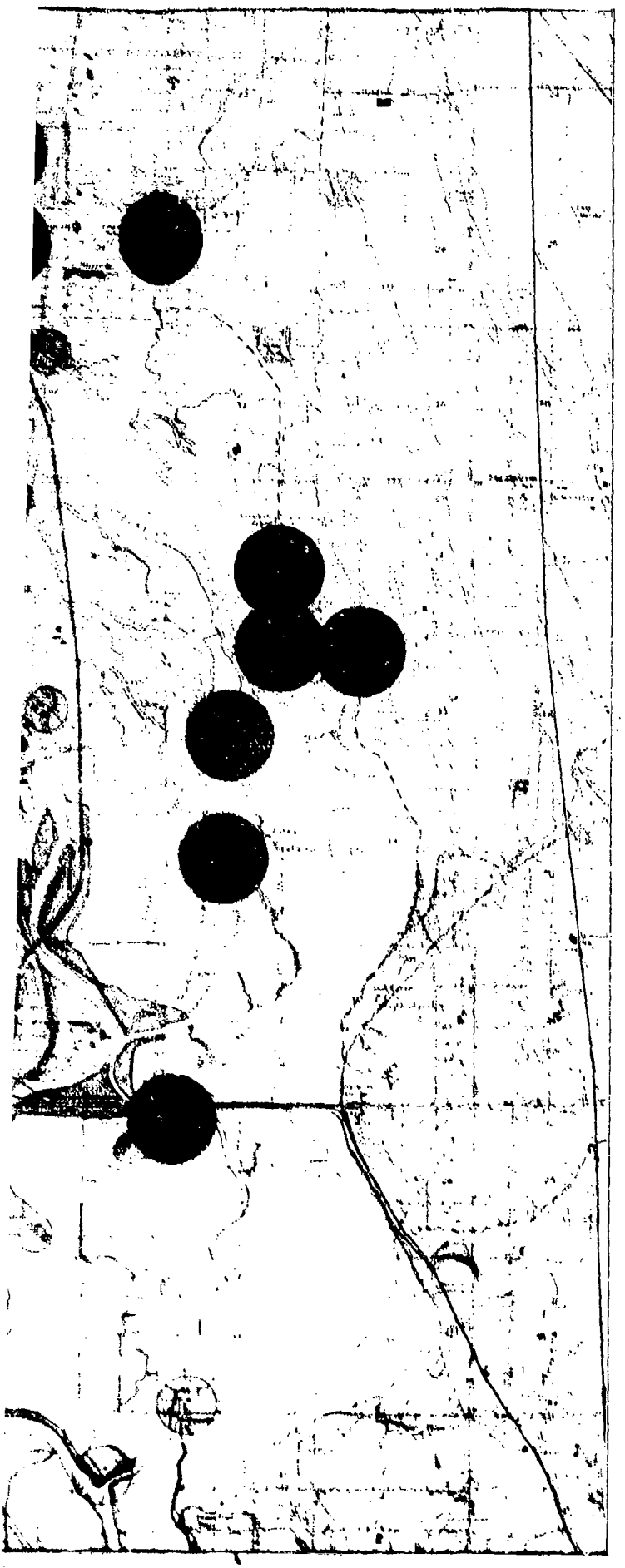
5. There are no prehistoric cultural resources sites on the National Register within the study area.

Historic

6. Settlement of the study area began in the latter part of the 19th century. In the period between 1878 and 1890, both Marysville and Everett were established. Timber was the mainstay of the local economy; mills were developed and the estuary was logged in the late 1800's.

7. Designated and proposed historic sites in the study area are described in the report A Survey of Everett's Historical Properties. Two sites, the Schooner Equator (14th Street Yacht Basin) and





CULTURAL RESOURCE & RECREATION SITES

PLATE NO 19

LEGEND

- Archeological Sites
- Historic Sites
- Recreation Sites
- City of Everett Recommended for Open Space and / or Park

N

SNOHOMISH ESTUARY WETLANDS STUDY

Source: City, Co. & Tulalip Park Plan

Private Comm. w/ School Districts & Interest Groups

Dunnell & Fuller 1975

Everett Historic Study

PLATE NO 19

the Jack Knife Bridge, are listed on the National Register of Historic Places. The Fort Ebey site, one mile southeast of the small community of Lowell, is listed in the State Historic Register. Other sites in the study area include the Jetty, built in 1895, and the Whaleback Launch Site (1894), now Weyerhauser Mill B. All these sites are shown in Plate 19. There are also many upland sites in Everett; these are not shown on Plate 19, as they are clearly outside the jurisdiction of the Corps of Engineers.

Recreation

8. This profile identifies those sites in the estuary study area used for recreation. They include marinas, boat launches, park sites and beach access points. Plate 19 shows existing recreation sites. All sites shown are located near water areas or in the estuary floodplain. Other recreation sites upland from the water are not identified here; they are identified and discussed in the City of Everett Comprehensive Park Plan.

9. The following is a list of recreation areas and public access points for Everett, Tulalip and Marysville.

1) Port of Everett Boat Launch at 10th and Norton
2) City of Everett Waterfront Park (Howarth Park)
3) Norton Avenue Marine Expansion Project at 16th and Norton
4) Everett Boathouse and Marina
5) Jetty Island land leased by the State Parks Department from the Port of Everett for boat landing access
6) Smith Island public access boat launch
7) Small private marina on the western tip of Spencer Island North
8) Potlatch Grounds of the Tulalip Tribes in Tulalip Bay (private facility)
9) Public fishing access under I-5 in Marysville
10) Small marina in Marysville east of I-5

10. In addition to existing sites, the City of Everett has some proposed park and recreation sites. These are also shown in Plate 19. The Tulalip Tribes propose a marina in Tulalip Bay. The Snohomish County Park Plan shows the estuary as part of a recreation corridor. Also shown is a trail system traveling through the estuary and connecting Snohomish with the Tulalip Reservation.

11. Discussions with Department of Natural Resources representatives indicate that a Smith Island Recreation Site #A58219 was leased in 1966 with no apparent funds to develop the land. The State of Washington Department of Game indicates that their 400 acre parcel on Ebey Island is for habitat preservation. The current belief is that little or no hunting occurs on this land. The Wash-

ington State Department of Parks has no long-range plans for the estuary.

Educational and Research Uses

12. Certain areas in the Snohomish estuary study area are used for educational and research purposes by various groups, as follows:

- The Everett School District uses Jetty Island for aquatic biology classes and study. In addition, the school has class visits to Smith Island, Quilceda Creek and Priest Point.

- The Marysville School District has regular trips to Tulalip Bay, Quilceda Creek and several ponds in the vicinity of Quilceda Creek and Allen Creek. These ponds are used for fresh water fauna collection. Tulalip Bay provides intertidal flora and fauna study areas for Marysville students.

- The Audubon Society uses the Everett sewer lagoon area for water bird observation since it has good walking access. The remainder of the trips the Audubon Society takes in the area are field trips by water.

- The Edmonds School District conducts boat trips in Ebey Island, Union Slough, and Steamboat Slough areas.

No specific areas were indicated as in regular use by colleges and universities; however, field trips are probably made occasionally to accessible areas. There seems to be no significant amount of on-going research by any institution or organization in this area.

13. In sum, there are more educational resources than are currently being used, access apparently being the major obstacle to greater use. However, proposals such as that of the County Parks Department for an interpretive self-guided walk on upper Otter Island may mean greater educational use in the future.

Refuges and Reserves

14. There are no formally designated refuges or reserves within the study area. The Department of Game has stated that it has no plans to develop the large parcel of Department-owned land that is on the west side of Ebey Slough toward its confluence with the Snohomish. This parcel could be considered a refuge since it is undeveloped and Game has stated that it is for habitat preservation.

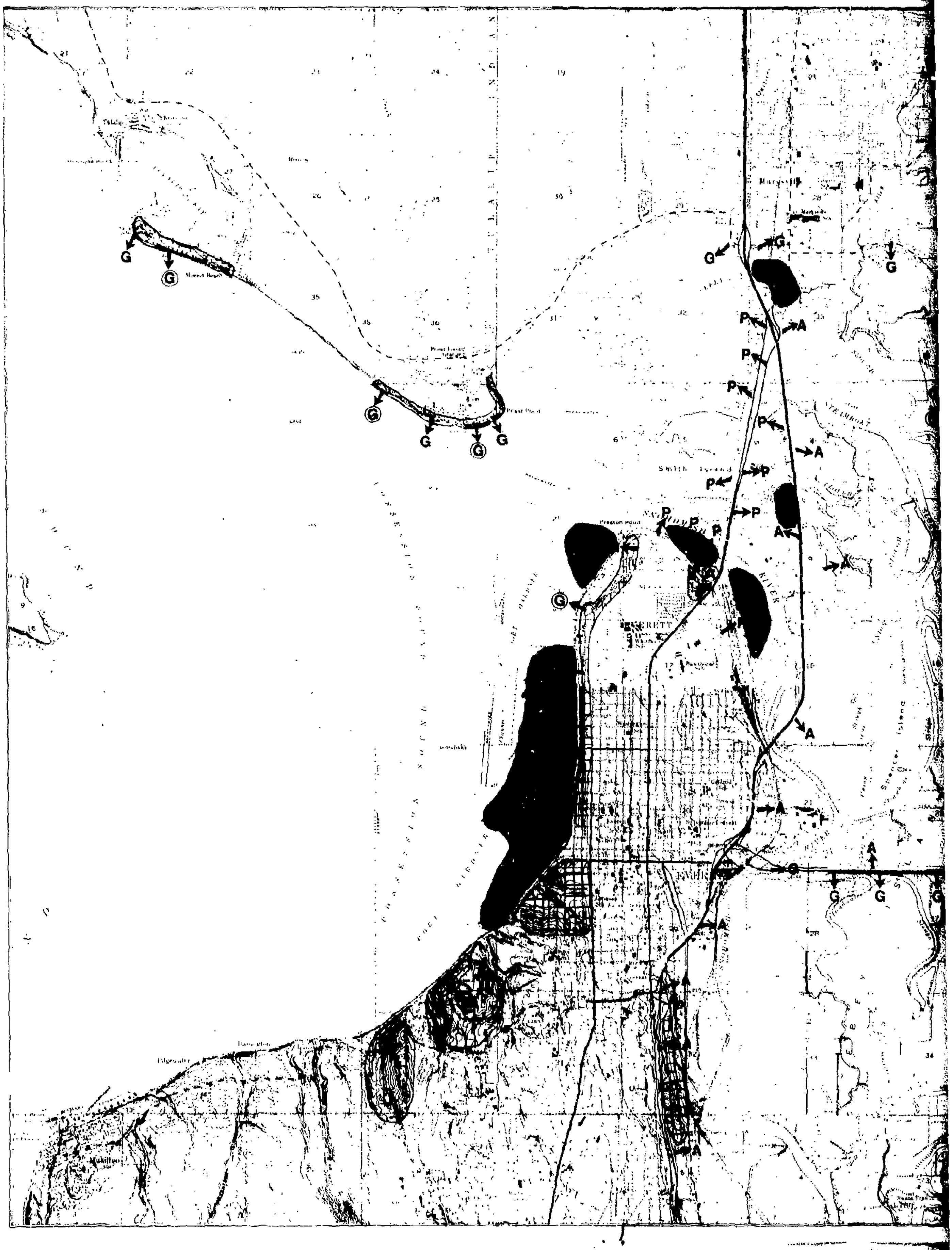
E. AESTHETIC PROFILE

1. This profile discusses the results of a general viewshed study for the Snohomish estuary. Viewsheds were determined by an urban planner who made a visual survey of the estuary and recorded the findings both on film and on a base map. Plate 20 shows the viewsheds and the rating assigned for each "view" area.

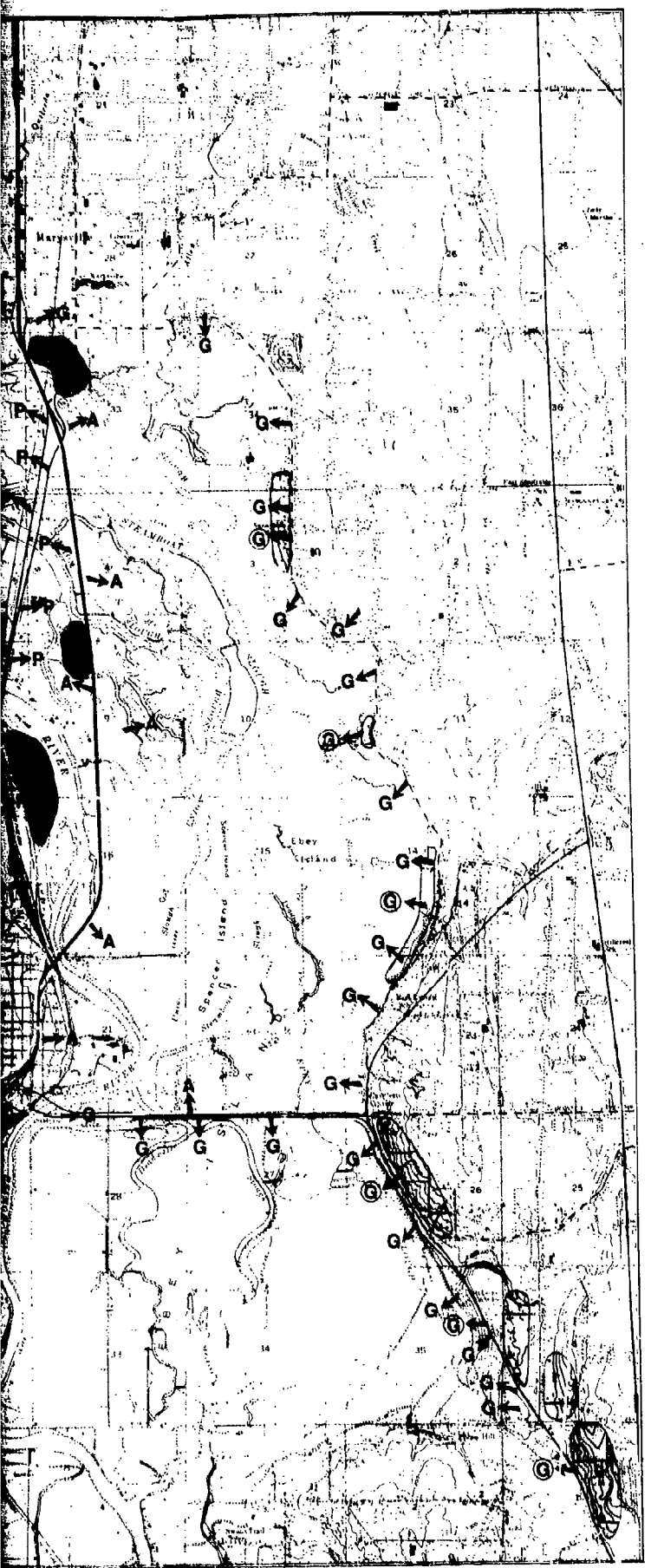
2. Viewscapes and vistas are categorized for this study in two ways. The first is as views from the road, and the second is as views from buildings. The roads used in the study include I-5, SR 529, SR 2 and various local roads and streets. Buildings with views include but are not limited to residential houses, apartments, offices, and hospitals. As shown in Plate 20, viewscapes are indicated by arrows that point from the observation point towards the view itself. Views are ranked as good (G), average (A) and poor (P). Different symbols are used to indicate views from roads and from buildings.

3. Plate 20 shows that the estuary is highly visible from surrounding observation areas. In general, views from roads and buildings on the east side of the estuary are better than those from I-5 and SR 529 to the west. Viewsheds looking towards industrial areas are average to poor with the notable exception of views from homes to the east and above the port. For these the view rating is good.

4. Views are one part of the total aesthetic experience which includes sun, wind, water, smells, vegetation, and land forms. To evaluate the total aesthetic experience all these factors must be considered. Using these factors as value indicators, the industrialized portions of the estuary would be judged as having less aesthetic value than the more natural parts of the estuary.



Smith Island
Preston Point
RIVER
STEAMBOAT
Spencer Island



AESTHETICS

PLATE NO 20

LEGEND

- Industrial Areas +
- Residential Areas +

View from Roads

- G — Good
- A — Average
- P — Poor

View from Buildings

- (G) — Good
- (A) — Average

\+ Existing Use

N

SCALE 1:24000

SNOHOMISH ESTUARY WETLANDS STUDY

Section VIII

APPENDICES

A. WETLAND POLICY

B. STANDARD FORM - PERMIT APPLICATION AND GENERAL PERMIT CONDITIONS

C. LEGISLATIVE AUTHORITY OF THE CORPS

   1. Direct Corps Authority

   2. Related Legislation

D. CORPS REGULATIONS 33 CFR 320-329; 33 CFR 239

E. TECHNICAL APPENDIX

   1. Methodology for Evaluation of Land Use from Aerial Photos

   2. Summary of Bird Distribution in the Snohomish Estuary

   3. Summary of Fish Distribution in the Snohomish Estuary and Adjacent Port Gardner

F. BIBLIOGRAPHY AND REFERENCES

Appendix A

WETLAND POLICY

1. Chief of Engineers' Policy on Wetlands

a. Wetlands are vital areas that constitute a productive and valuable public resource, the unnecessary alteration or destruction of which should be discouraged as contrary to the public interest.

b. Wetlands considered to perform functions important to the public interest include:

1) Wetlands which serve important natural biological functions, including food chain production, general habitat, and nesting, spawning, rearing and resting sites for aquatic or land species;

2) Wetlands set aside for study of the aquatic environment or as sanctuaries or refuges;

3) Wetlands the destruction or alteration of which would affect detrimentally natural drainage characteristics, sedimentation patterns, salinity distribution, flushing characteristics, current patterns, or other environmental characteristics;

4) Wetlands which are significant in shielding other areas from wave action, erosion, or storm damage. Such wetlands are often associated with barrier beaches, islands, reefs and bars;

5) Wetlands which serve as valuable storage areas for storm and flood waters;

6) Wetlands which are prime natural recharge areas. Prime recharge areas are locations where surface and ground water are directly interconnected; and

7) Wetlands which through natural water filtration processes serve to purify water.

c. Although a particular alteration of wetlands may constitute a minor change, the cumulative effect of numerous such piecemeal changes often results in a major impairment of the wetland resources. Thus,

the particular wetlands site involved in a Federal Project will be evaluated with the recognition that it is part of a complete and interrelated wetland area. In addition, the District Engineer may undertake reviews of particular wetland areas in consultation with the appropriate Regional Director of the Fish and Wildlife Service, the Regional Director of the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration, the Regional Administrator of the Environmental Protection Agency, the local representative of the Soil Conservation Service of the Department of Agriculture, and the head of the appropriate State agency to assess the cumulative effect of activities in such areas.

d. No construction activity will be performed in wetlands identified as important by subparagraph b above, unless the District Engineer concludes that the benefits of the proposed alteration outweigh the damage to the wetlands resource and the proposed alteration is necessary to realize those benefits. In evaluating whether a particular alteration is necessary, the District Engineer shall consider whether the proposed activity is primarily dependent on being located in, or in close proximity to the aquatic environment and whether feasible alternative sites are available. The District Engineer must demonstrate the need to locate the proposed activity in the wetland and must evaluate the availability of feasible alternative sites.

e. In addition to these policies, the Congressional policy expressed in the Estuary Protection Act, PL 90-454, and State regulatory laws or programs for classification and protection of wetlands will be given great weight.

2. Executive Order No. 11988

Floodplain Management

Statement by the President Accompanying Executive Order 11988. May 24, 1977

The floodplains which adjoin the Nation's inland and coastal waters have long been recognized as having special values to our citizens. They have provided us with wildlife habitat, agricultural and forest products, stable ecosystems, and park and recreation areas. However, unwise use and development of our riverine, coastal, and other floodplains not only destroy many of the special qualities of these areas but pose a severe threat to human life, health, and property.

Since the adoption of a national flood control policy in 1936, the Federal Government has invested about $10 billion in flood protection works. Despite substantial efforts by the Federal Government to reduce flood hazards and protect floodplains, annual losses from floods and adverse alteration of floodplains continue to increase.

The problem arises mainly from unwise land use practices. The Federal Government can be responsible for or can influence these practices in the construction of projects, in the management of its own properties, in the provision of financial or technical assistance including support of financial institutions, and in the uses for which its agencies issue licenses or permits. In addition to minimizing the danger to human and nonhuman communities living in floodplains, active floodplain management represents sound business practice by reducing the risk of flood damage to properties benefiting from Federal assistance.

Because unwise floodplain development can lead to the loss of human and other natural resources, it is simply a bad Federal investment and should be avoided. In order to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative, I have issued an Executive order on floodplain management.

No. 11988

May 24, 1977, 42 F.R. 26951

FLOODPLAIN MANAGEMENT

By virtue of the authority vested in me by the Constitution and statutes of the United States of America, and as President of the United States of America, in furtherance of the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.), the National Flood Insurance Act of 1968, as amended (42 U.S.C. 4001 et seq.), and the Flood Disaster Protection Act of 1973 (Public Law 93-234, 87 Stat. 975), in order to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative, it is hereby ordered as follows:

Section 1. Each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities for (1) acquiring, managing, and disposing of Federal lands and facilities; (2) providing Federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

Sec. 2. In carrying out the activities described in Section 1 of this Order, each agency has a responsibility to evaluate the potential effects of any actions it may take in a floodplain; to ensure that its planning programs and budget requests reflect consideration of flood hazards and floodplain management; and to prescribe procedures to implement the policies and requirements of this Order, as follows:

(a)(1) Before taking an action, each agency shall determine whether the proposed action will occur in a floodplain—for major Federal actions significantly affecting the quality of the human environment, the evaluation required below will be included in any statement prepared under Section 102(2)(C) of the National Environmental Policy Act. This determination shall be made according to a Department of Housing and Urban Development (HUD) floodplain map or a more detailed map of an area, if available. If such maps are not available, the agency shall make a determination of the location of the floodplain based on the best available information. The Water Resources Council shall issue guidance on this information not later than October 1, 1977.

(2) If an agency has determined to, or proposes to, conduct, support, or allow an action to be located in a floodplain, the agency shall consider alternatives to avoid adverse effects and incompatible development in the floodplains. If the head of the agency finds that the only practicable alternative consistent with the law and with the policy set forth in this Order requires siting in a floodplain, the agency shall, prior to taking action, (i) design or modify its action in order to minimize potential harm to or within the floodplain, consistent with regulations issued in accord with Section 2(d) of this Order, and (ii) prepare and circulate a notice containing an explanation of why the action is proposed to be located in the floodplain.

(3) For programs subject to the Office of Management and Budget Circular A-95, the agency shall send the notice, not to exceed three pages in length including a location map, to the state and areawide A-95 clearinghouses for the geographic areas affected. The notice shall include: (i) the reasons why the action is proposed to be located in a floodplain; (ii) a statement indicating whether the action conforms to applicable state or local floodplain protection standards and (iii) a list of the alternatives considered. Agencies shall endeavor to allow a brief comment period prior to taking any action.

(4) Each agency shall also provide opportunity for early public review of any plans or proposals for actions in floodplains, in accordance with Section 2(b) of Executive Order No. 11514, as amended, including the development of procedures to accomplish this objective for Federal actions whose impact is not significant enough to require the preparation of an environmental impact statement under Section 102(2)(C) of the National Environmental Policy Act of 1969, as amended.

(b) Any requests for new authorizations or appropriations transmitted to the Office of Management and Budget shall indicate, if an action to be proposed will be located in a floodplain, whether the proposed action is in accord with this Order.

(c) Each agency shall take floodplain management into account when formulating or evaluating any water and land use plans and shall require land and water resources use appropriate to the degree of hazard involved. Agencies shall include adequate provision for the evaluation and consideration of flood hazards in the regulations and operating procedures for the licenses, permits, loan or grants-in-aid programs that they administer. Agencies shall also encourage and provide appropriate guidance to applicants to evaluate the effects of their proposals in floodplains prior to submitting applications for Federal licensee, permits, loans or grants.

(d) As allowed by law, each agency shall issue or amend existing regulations and procedures within one year to comply with this Order. These procedures shall incorporate the Unified National Program for Floodplain Management of the Water Resources Council, and shall explain the means that the agency will employ to pursue the nonhazardous use of riverine, coastal and other floodplains in connection with the activities under its authority. To the extent possible, existing processes, such as those of the Council on Environmental Quality and the Water Resources Council, shall be utilized to fulfill the requirements of this Order. Agencies shall prepare their procedures in consultation with the Water Resources Council, the Federal Insurance Administration, and the Council on Environmental Quality, and shall update such procedures as necessary.

Sec. 3. In addition to the requirements of Section 2, agencies with responsibilities for Federal real property and facilities shall take the following measures:

(a) The regulations and procedures established under Section 2(d) of this Order shall, at a minimum, require the construction of Federal structures and facilities to be in accordance with the standards and criteria and to be consistent with the intent of those promulgated under the National Flood Insurance Program. They shall deviate only to the extent that the standards of the Flood Insurance Program are demonstrably inappropriate for a given type of structure or facility.

(b) If, after compliance with the requirements of this Order, new construction of structures or facilities are to be located in a floodplain, accepted floodproofing and other flood protection measures shall be applied to new construction or rehabilitation. To achieve flood protection, agencies shall, wherever practicable, elevate structures above the base flood level rather than filling in land.

(c) If property used by the general public has suffered flood damage or is located in an identified flood hazard area, the responsible agency shall provide on structures, and other places where appropriate, conspicuous delineation of past and probable flood height in order to enhance public awareness of and knowledge about flood hazards.

(d) When property in floodplains is proposed for lease, easement, right-of-way, or disposal to non-Federal public or private parties, the Federal agency shall (1) reference in the conveyance those uses that are restricted under identified Federal, State or local floodplain regulations; and (2) attach other appropriate restrictions to the uses of properties by the grantee or purchaser and any successors, except where prohibited by law; or (3) withhold such properties from conveyance.

Sec. 4. In addition to any responsibilities under this Order and Sections 202 and 205 of the Flood Disaster Protection Act of 1973, as amended (42 U.S.C. 4106 and 4128), agencies which guarantee, approve, regulate, or insure any financial transaction which is related to an area located in a floodplain shall, prior to completing action on such transaction, inform any private parties participating in the transaction of the hazards of locating structures in the floodplain.

Sec. 5. The head of each agency shall submit a report to the Council on Environmental Quality and to the Water Resources Council on June 30, 1978, regarding the status of their procedures and the impact of this Order on the agency's operations. Thereafter, the Water Resources Council shall periodically evaluate agency procedures and their effectiveness.

Sec. 6. As used in this Order:

(a) The term "agency" shall have the same meaning as the term "Executive agency" in Section 105 of Title 5 of the United States Code and shall include the military departments; the directives contained in this Order, however, are meant to apply only to those agencies which perform the activities described in Section 1 which are located in or affecting floodplains.

(b) The term "base flood" shall mean that flood which has a one percent or greater chance of occurrence in any given year.

(c) The term "floodplain" shall mean the lowland and relatively flat areas adjoining inland and coastal waters including floodprone areas of offshore islands, including at a minimum, that area subject to a one percent or greater chance of flooding in any given year.

Sec. 7. Executive Order No. 11296 of August 10, 1966,[29] is hereby revoked. All actions, procedures, and issuances taken under that Order and still in effect shall remain in effect until modified by appropriate authority under the terms of this Order.

Sec. 8. Nothing in this Order shall apply to assistance provided for emergency work essential to save lives and protect property and public health and safety, performed pursuant to Sections 305 and 306 of the Disaster Relief Act of 1974 (88 Stat. 148, 42 U.S.C. 5145 and 5146).

Sec. 9. To the extent the provisions of Section 2(a) of this Order are applicable to projects covered by Section 104(h) of the Housing and Community Development Act of 1974, as amended (88 Stat. 640, 42 U.S.C. 5304(h)), the responsibilities under those provisions may be assumed by the appropriate applicant, if the applicant has also assumed, with respect to such projects, all of the responsibilities for environmental review, decisionmaking, and action pursuant to the National Environmental Policy Act of 1969, as amended.

JIMMY CARTER

THE WHITE HOUSE,
May 24, 1977.

3. **Executive Order No. 11990**

Protection of Wetlands

Statement by the President Accompanying Executive Order 11990. May 24, 1977

The Nation's coastal and inland wetlands are vital natural resources of critical importance to the people of this country. Wetlands are areas of great natural productivity, hydrological utility, and environmental diversity, providing natural flood control, improved water quality, recharge of aquifers, flow stabilization of streams and rivers, and habitat for fish and wildlife resources. Wetlands contribute to the production of agricultural products and timber, and provide recreational, scientific, and aesthetic resources of national interest.

The unwise use and development of wetlands will destroy many of their special qualities and important natural functions. Recent estimates indicate that the United States has already lost over 40 percent of our 120 million acres of wetlands inventoried in the 1950's. This piecemeal alteration and destruction of wetlands through draining, dredging, filling, and other means has had an adverse cumulative impact on our natural resources and on the quality of human life.

The problem of loss of wetlands arises mainly from unwise land use practices. The Federal Government can be responsible for or can influence these practices in the construction of projects, in the management of its own properties, and in the provisions of financial or technical assistance.

In order to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative, I have issued an Executive order on the protection of wetlands.

No. 11990

May 24, 1977, 42 F.R. 26961

PROTECTION OF WETLANDS

By virtue of the authority vested in me by the Constitution and statutes of the United States of America, and as President of the United States of America, in furtherance of the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.), in order to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative, it is hereby ordered as follows:

Section 1. (a) Each agency shall provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for (1) acquiring, managing, and disposing of Federal lands and facilities; and (2) providing Federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

(b) This Order does not apply to the issuance by Federal agencies of permits, licenses, or allocations to private parties for activities involving wetlands on non-Federal property.

Sec. 2. (a) In furtherance of Section 101(b)(3) of the National Environmental Policy Act of 1969 (42 U.S.C. 4331(b)(3)) to improve and coordinate Federal plans, functions, programs and resources to the end that the Nation may attain the widest range of beneficial uses of the environment without degradation and risk to health or safety, each agency, to the extent permitted by law, shall avoid undertaking or providing assistance for new construction located in wetlands unless the head of the agency finds (1) that there is no practicable alternative to such construction, and (2) that the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use. In making this finding the head of the agency may take into account economic, environmental and other pertinent factors.

(b) Each agency shall also provide opportunity for early public review of any plans or proposals for new construction in wetlands, in accordance with Section 2(b) of Executive Order No. 11514,[31] as amended, including the development of procedures to accomplish this objective for Federal actions whose impact is not significant enough to require the preparation of an environmental impact statement under Section 102(2)(C) of the National Environmental Policy Act of 1969, as amended.

Sec. 3. Any requests for new authorizations or appropriations transmitted to the Office of Management and Budget shall indicate, if an action to be proposed will be located in wetlands, whether the proposed action is in accord with this Order.

Sec. 4. When Federally-owned wetlands or portions of wetlands are proposed for lease, easement, right-of-way or disposal to non-Federal public or private parties, the Federal agency shall (a) reference in the conveyance those uses that are restricted under identified Federal, State or local wetlands regulations; and (b) attach other appropriate restrictions to the uses of properties by the grantee or purchaser and any successor, except where prohibited by law; or (c) withhold such properties from disposal.

Sec. 5. In carrying out the activities described in Section 1 of this Order, each agency shall consider factors relevant to a proposal's effect on the survival and quality of the wetlands. Among these factors are:

(a) public health, safety, and welfare, including water supply, quality, recharge and discharge; pollution; flood and storm hazards; and sediment and erosion;

(b) maintenance of natural systems, including conservation and long term productivity of existing flora and fauna, species and habitat diversity and stability, hydrologic utility, fish, wildlife, timber, and food and fiber resources; and

(c) other uses of wetlands in the public interest, including recreational, scientific, and cultural uses.

Sec. 6. As allowed by law, agencies shall issue or amend their existing procedures in order to comply with this Order. To the extent possible, existing processes, such as those of the Council on Environmental Quality and the Water Resources Council, shall be utilized to fulfill the requirements of this Order.

Sec. 7. As used in this Order:

(a) The term "agency" shall have the same meaning as the term "Executive agency" in Section 105 of Title 5 of the United States Code and shall include the military departments; the directives contained in this Order, however, are meant to apply only to those agencies which perform the activities described in Section 1 which are located in or affecting wetlands.

(b) The term "new construction" shall include draining, dredging, channelizing, filling, diking, impounding, and related activities and any structures or facilities begun or authorized after the effective date of this Order.

(c) The term "wetlands" means those areas that are inundated by surface or ground water with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mud flats, and natural ponds.

Sec. 8. This Order does not apply to projects presently under construction, or to projects for which all of the funds have been appropriated through Fiscal Year 1977, or to projects and programs for which a draft or final environmental impact statement will be filed prior to October 1, 1977. The provisions of Section 2 of this Order shall be implemented by each agency not later than October 1, 1977.

Sec. 9. Nothing in this Order shall apply to assistance provided for emergency work, essential to save lives and protect property and public health and safety, performed pursuant to Sections 305 and 306 of the Disaster Relief Act of 1974 (88 Stat. 148, 42 U.S.C. 5145 and 5146).

Sec. 10. To the extent the provisions of Sections 2 and 5 of this Order are applicable to projects covered by Section 104(h) of the Housing and Community Development Act of 1974, as amended (88 Stat. 640, 42 U.S.C. 5304(h)), the responsibilities under those provisions may be assumed by the appropriate applicant, if the applicant has also assumed, with respect to such projects, all of the responsibilities for environmental review, decisionmaking, and action pursuant to the National Environmental Policy Act of 1969, as amended.

JIMMY CARTER

THE WHITE HOUSE,
May 24, 1977.

Appendix B

STANDARD FORM PERMIT APPLICATION AND GENERAL PERMIT CONDITIONS

Application No. _____

Name of Applicant _____

Effective Date _____

Expiration Date (If applicable) _____

DEPARTMENT OF THE ARMY
PERMIT

Referring to written request dated _____ for a permit to:

( ) Perform work in or affecting navigable waters of the United States, upon the recommendation of the Chief of Engineers, pursuant to Section 10 of the Rivers and Harbors Act of March 3, 1899 (33 U.S.C. 403);

( ) Discharge dredged or fill material into navigable waters upon the issuance of a permit from the Secretary of the Army acting through the Chief of Engineers pursuant to Section 404 of the Federal Water Pollution Control Act (86 Stat. 816, P.L. 92-500);

( ) Transport dredged material for the purpose of dumping it into ocean waters upon the issuance of a permit from the Secretary of the Army acting through the Chief of Engineers pursuant to Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (86 Stat. 1052; P.L. 92-532);

◄ (Here insert the full name and address of the permittee)

is hereby authorized by the Secretary of the Army:

to ◄ (Here describe the proposed structure or activity, and its intended use. In the case of an application for a fill permit, describe the structures, if any, proposed to be erected on the fill. In the case of an application for the discharge of dredged or fill material into navigable waters or the transportation for discharge in ocean waters of dredged material, describe the type and quantity of material to be discharged.)

in ◄ (Here to be named the ocean, river, harbor, or waterway concerned.)

at ◄ (Here to be named the nearest well-known locality—preferably a town or city—and the distance in miles and tenths from some definite point in the same, stating whether above or below or giving direction by points of compass.)

in accordance with the plans and drawings attached hereto which are incorporated in and made a part of this permit (on drawings: give file number or other definite identification marks);

subject to the following conditions:

I. General Conditions:

a. That all activities identified and authorized herein shall be consistent with the terms and conditions of this permit; and that any activities not specifically identified and authorized herein shall constitute a violation of the terms and conditions of this permit which may result in the modification, suspension or revocation of this permit, in whole or in part, as set forth more specifically in General Conditions j or k hereto, and in the institution of such legal proceedings as the United States Government may consider appropriate, whether or not this permit has been previously modified, suspended or revoked in whole or in part.

b. That all activities authorized herein shall, if they involve a discharge or deposit into navigable waters or ocean waters, be at all times consistent with applicable water quality standards, effluent limitations and standards of performance, prohibitions, and pretreatment standards established pursuant to Sections 301, 302, 306 and 307 of the Federal Water Pollution Control Act of 1972 (P.L. 92-500; 86 Stat. 816), or pursuant to applicable State and local law.

c. That when the activity authorized herein involves a discharge or deposit of dredged or fill material into navigable waters, the authorized activity shall, if applicable water quality standards are revised or modified during the term of this permit, be modified, if necessary, to conform with such revised or modified water quality standards within 6 months of the effective date of any revision or modification of water quality standards, or as directed by an implementation plan contained in such revised or modified standards, or within such longer period of time as the District Engineer, in consultation with the Regional Administrator of the Environmental Protection Agency, may determine to be reasonable under the circumstances.

d. That the permittee agrees to make every reasonable effort to prosecute the work authorized herein in a manner so as to minimize any adverse impact of the work on fish, wildlife and natural environmental values.

e. That the permittee agrees to prosecute the work authorized herein in a manner so as to minimize any degradation of water quality.

f. That the permittee shall permit the District Engineer or his authorized representative(s) or designee(s) to make periodic inspections at any time deemed necessary in order to assure that the activity being performed under authority of this permit is in accordance with the terms and conditions prescribed herein.

g. That the permittee shall maintain the structure or work authorized herein in good condition and in accordance with the plans and drawings attached hereto.

h. That this permit does not convey any property rights, either in real estate or material, or any exclusive privileges; and that it does not authorize any injury to property or invasion of rights or any infringement of Federal, State, or local laws or regulations, nor does it obviate the requirement to obtain State or local assent required by law for the activity authorized herein.

i. That this permit does not authorize the interference with any existing or proposed Federal project and that the permittee shall not be entitled to compensation for damage or injury to the structures or work authorized herein which may be caused by or result from existing or future operations undertaken by the United States in the public interest.

j. That this permit may be summarily suspended, in whole or in part, upon a finding by the District Engineer that immediate suspension of the activity authorized herein would be in the general public interest. Such suspension shall be effective upon receipt by the permittee of a written notice thereof which shall indicate (1) the extent of the suspension, (2) the reasons for this action, and (3) any corrective or preventative measures to be taken by the permittee which are deemed necessary by the District Engineer to abate imminent hazards to the general public interest. The permittee shall take immediate action to comply with the provisions of this notice. Within ten days following receipt of this notice of suspension, the permittee may request a hearing in order to present information relevant to a decision as to whether his permit should be reinstated, modified or revoked. If a hearing is requested, it shall be conducted pursuant to procedures prescribed by the Chief of Engineers. After completion of the hearing, or within a reasonable time after issuance of the suspension notice to the permittee if no hearing is requested, the permit will either be reinstated, modified or revoked.

k. That this permit may be either modified, suspended or revoked in whole or in part if the Secretary of the Army or his authorized representative determines that there has been a violation of any of the terms or conditions of this permit or that such action would otherwise be in the public interest. Any such modification, suspension, or revocation shall become effective 30 days after receipt by the permittee of written notice of such action which shall specify the facts or conduct warranting same unless (1) within the 30-day period the permittee is able to satisfactorily demonstrate that (a) the alleged violation of the terms and the conditions of this permit did not, in fact, occur or (b) the alleged violation was accidental, and the permittee has been operating in compliance with the terms and conditions of the permit and is able to provide satisfactory assurances that future operations shall be in full compliance with the terms and conditions of this permit; or (2) within the aforesaid 30-day period, the permittee requests that a public hearing be held to present oral and written evidence concerning the proposed modification, suspension or revocation. The conduct of this hearing and the procedures for making a final decision either to modify, suspend or revoke this permit in whole or in part shall be pursuant to procedures prescribed by the Chief of Engineers.

l. That in issuing this permit, the Government has relied on the information and data which the permittee has provided in connection with his permit application. If, subsequent to the issuance of this permit, such information and data prove to be false, incomplete or inaccurate, this permit may be modified, suspended or revoked, in whole or in part, and/or the Government may, in addition, institute appropriate legal proceedings.

m. That any modification, suspension, or revocation of this permit shall not be the basis for any claim for damages against the United States.

n. That the permittee shall notify the District Engineer at what time the activity authorized herein will be commenced, as far in advance of the time of commencement as the District Engineer may specify, and of any suspension of work, if for a period of more than one week, resumption of work and its completion.

o. That if the activity authorized herein is not started on or before _____ day of _____, 19_____, (one year from the date of issuance of this permit unless otherwise specified) and is not completed on or before _____ day of _____, 19_____, (three years from the date of issuance of this permit unless otherwise specified) this permit, if not previously revoked or specifically extended, shall automatically expire.

p. That no attempt shall be made by the permittee to prevent the full and free use by the public of all navigable waters at or adjacent to the activity authorized by this permit.

q. That if the display of lights and signals on any structure or work authorized herein is not otherwise provided for by law, such lights and signals as may be prescribed by the United States Coast Guard shall be installed and maintained by and at the expense of the permittee.

r. That this permit does not authorize or approve the construction of particular structures, the authorization or approval of which may require authorization by the Congress or other agencies of the Federal Government.

s. That if and when the permittee desires to abandon the activity authorized herein, unless such abandonment is part of a transfer procedure by which the permittee is transferring his interests herein to a third party pursuant to General Condition v hereof, he must restore the area to a condition satisfactory to the District Engineer.

t. That if the recording of this permit is possible under applicable State or local law, the permittee shall take such action as may be necessary to record this permit with the Register of Deeds or other appropriate official charged with the responsibility for maintaining records of title to and interests in real property.

u. That there shall be no unreasonable interference with navigation by the existence or use of the activity authorized herein.

v. That this permit may not be transferred to a third party without prior written notice to the District Engineer, either by the transferee's written agreement to comply with all terms and condition of this permit or by the transferee subscribing to this permit in the space provided below and thereby agreeing to comply with all terms and conditions of this permit. In addition, if the permittee transfers the interests authorized herein by conveyance of realty, the deed shall reference this permit and the terms and conditions specified herein and this permit shall be recorded along with the deed with the Register of Deeds or other appropriate official.

The following Special Conditions will be applicable when appropriate:

STRUCTURES FOR SMALL BOATS: That permittee hereby recognizes the possibility that the structure permitted herein may be subject to damage by wave wash from passing vessels. The issuance of this permit does not relieve the permittee from taking all proper steps to insure the integrity of the structure permitted herein and the safety of boats moored thereto from damage by wave wash and the permittee shall not hold the United States liable for any such damage.

DISCHARGE OF DREDGED MATERIAL INTO OCEAN WATERS: That the permittee shall place a copy of this permit in a conspicuous place in the vessel to be used for the transportation and/or dumping of the dredged material as authorized herein.

ERECTION OF STRUCTURE IN OR OVER NAVIGABLE WATERS: That the permittee, upon receipt of a notice of revocation of this permit or upon its expiration before completion of the authorized structure or work, shall, without expense to the United States and in such time and manner as the Secretary of the Army or his authorized representative may direct, restore the waterway to its former conditions. If the permittee fails to comply with the direction of the Secretary of the Army or his authorized representative, the Secretary or his designee may restore the waterway to its former condition, by contract or otherwise, and recover the cost thereof from the permittee.

MAINTENANCE DREDGING: (1) That when the work authorized herein includes periodic maintenance dredging, it may be performed under this permit for _____ years from the date of issuance of this permit (ten years unless otherwise indicated); and (2) That the permittee will advise the District Engineer in writing at least two weeks before he intends to undertake any maintenance dredging.

II. Special Conditions (Here list conditions relating specifically to the proposed structure or work authorized by this permit):

This permit shall become effective on the date of the District Engineer's signature.

Permittee hereby accepts and agrees to comply with the terms and conditions of this permit.

_____ _____

PERMITTEE DATE

BY AUTHORITY OF THE SECRETARY OF THE ARMY:

_____ _____

DATE

DISTRICT ENGINEER,
U.S. ARMY, CORPS OF ENGINEERS

Transferee hereby agrees to comply with the terms and conditions of this permit.

_____ _____

TRANSFEREE DATE

Appendix C

LEGISLATIVE AUTHORITY OF U.S. ARMY CORPS OF ENGINEERS

1. Direct Corps Authority. Brief descriptions of the various laws giving permit authority to the Corps.

Section 9 of the River and Harbor Act of 1899

Section 9 of the River and Harbor Act approved March 3, 1899 (30 Stat. 1151; 33 U.S.C. 401) prohibits the construction of any dam or dike across any navigable water of the United States in the absence of Congressional consent and approval of the plans by the Chief of Engineers and the Secretary of the Army. Where the navigable portions of the waterbody lie wholly within the limits of a single State, the structure may be built under authority of the legislature of that State, if the location and plans or any modification thereof, are approved by the Chief of Engineers and by the Secretary of the Army. The instrument of authorization is designated a permit. Section 9 also pertains to bridges and causeways but the authority of the Secretary of the Army and Chief of Engineers with respect to bridges and causeways was transferred to the Secretary of Transportation under the Department of Transportation Act on October 16, 1966 (80 Stat. 941, U.S.C., 40 1165g(6)(a)).

Section 10 of the River and Harbor Act of 1899

Section 10 of the River and Harbor Act approved March 3, 1899 (30 Stat. 1151; 33 U.S.C. 403) prohibits the unauthorized obstruction or alteration of any navigable water of the United States. The construction of any structure in or over any navigable water of the United States, the excavation from or depositing of material in such waters, or the accomplishment of any other work affecting the course, location, condition, or capacity of such waters are unlawful unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of the Army. The instrument of authorization is designated a permit or letter of permission. The authority of the Secretary of the Army to prevent obstructions to navigation in the navigable waters of the United States was extended to artificial islands and fixed structures located on the outer continental shelf by section 4(f) of the Outer Continental Shelf Lands Act of 1953 (67 Stat. 463; 43 U.S.C. 1333(f)).

Section 11 of the River and Harbor Act of 1899

Section 11 of the River and Harbor Act approved March 3, 1899 (30 Stat. 1151; 33 U.S.C. 404) authorizes the Secretary of the Army to establish harbor lines channelward of which no piers, wharves, bulkheads, or other works may be extended or deposits

made without approval of the Secretary of the Army. Regulations (ER 1145-2-304) have been promulgated relative to this authority and published at 209.150. By policy stated in those regulations effective May 27, 1970, harbor lines are guidelines only for defining the offshore limits of structures and fills insofar as they impact on navigation interests. Except as provided in paragraph (e)(1) of this section below, permits for work shoreward of those lines must be obtained in accordance with Section 10 of the same Act, cited above.

Section 13 of the River and Harbor Act of 1899

Section 13 of the River and Harbor Act approved March 3, 1899 (30 Stat. 1152; 33 U.S.C. 407) provides that the Secretary of the Army, whenever the Chief of Engineers determines that anchorage and navigation will not be injured thereby, may permit the discharge of refuse into navigable waters. In the absence of a permit, such discharge of refuse is prohibited. While the prohibition of this section, known as the Refuse Act, is still in effect, the permit authority of the Secretary of the Army has been superseded by the permit authority provided the Administrator, Environmental Protection Agency, under sections 402 and 405 of the Federal Water Pollution Control Act (PL 92-500, 86 Stat. 816, 33 U.S.C. 1342 and 1345).

Section 14 of the River and Harbor Act of 1899

Section 14 of the River and Harbor Act approved March 3, 1899 (30 Stat. 1152; 33 U.S.C. 408) provides that the Secretary of the Army on the recommendation of the Chief of Engineers may grant permission for the temporary occupation or use of any seawall, bulkhead, jetty, dike, levee, wharf, pier, or other work built by the United States. This permission will be granted by an appropriate real estate instrument in accordance with existing real estate regulations.

Section 404 of the Federal Water Pollution Control Act Amendments of 1972

Section 404 of the Federal Water Pollution Control Act (PL 92-500, 86 Stat. 816, 33 U.S.C. 1344) authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits, after notice and opportunity for public hearings, for the discharge of dredged or fill material into the waters of the U.S. at specified disposal sites. The selection of disposal sites will be in accordance with guidelines developed by the Administrator of the Environmental Protection Agency (EPA) in conjunction with the Secretary of the Army. Furthermore, the Administrator can prohibit or restrict the use of any defined area as a disposal site

whenever he determines, after notice and opportunity for public hearings, that the discharge of such materials into such areas will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas, wildlife or recreational areas.

Section 103 of Marine Protection, Research and Sanctuaries Act of 1972

Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (PL 92-532, 86 Stat. 1052, 33 U.S.C. 1413) authorizes the Secretary of the Army to issue permits, after notice and opportunity for public hearings, for the transportation of dredged material for the purpose of dumping it in ocean waters. However, similar to the EPA Administrator's limiting authority cited in paragraph (b)(7) of this section, the Administrator can prevent the issuance of a permit under this authority if he finds that the dumping of the material will result in an unacceptable adverse impact on municipal water supplies, shellfish beds, wildlife, fisheries or recreational areas.

Section 67 of the Clean Water Act of 1977

Section 67 of the Clean Water Act of 1977 (91 Stat. 1600; 33 U.S.C. 1344) is an amendment to Section 404 of the FWPCA: it affirms the authority of the Secretary of the Army, acting through the Chief of Engineers, to issue permits for the discharge of dredged or fill material into navigable waters. Section 67 specifies conditions for the issuance of general permits by the Secretary of the Army and establishes exemptions from the permit requirements. Section 67 also authorizes the development and administration of permit programs by the states to cover the discharge of dredged or fill material into the navigable waters (other than those waters which are presently used, or are susceptible to use in their natural condition or by reasonable improvement as a means to transport interstate or foreign commerce shoreward to their ordinary high water mark, including all waters which are subject to the ebb and flow of the tide shoreward to their mean higher high water mark on the west coast, including wetlands adjacent thereto). This section limits Corps 404 authority for permit issuance to Category 1 waters (33 CFR 323,329; FR 42, 138, 14 July 1977) in states with approved individual and general permit programs.

2. Related Legislation. Brief description of other legislation requiring coordination or review during the Corps permit process.

Section 401 of the Federal Water Pollution Control Act Amendments of 1972

Section 401 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500; 86 Stat. 816, 33 U.S.C. 1341) requires any non-Federal applicant for a Federal license or permit to conduct any activity that may result in a discharge of a pollutant into waters of the United States to obtain a certification from the state in which the discharge is occurring, or from the interstate water pollution control agency having jurisdiction over the discharge location. Federal agencies were exempt from certification requirements under Section 401, but the Clean Water Act of 1977, Section 61(b), changed this to make federal agencies subject to certification requirements.

Section 307(c) of the Coastal Zone Management Act of 1972

Section 307(c) of the Coastal Zone Management Act of 1972, as amended (PL 94-370, 90 Stat. 1013, 16 U.S.C. 1456(c)) requires that Federal agencies conducting activities directly affecting a state's coastal zone to comply, to the maximum extent practicable, with an approved state coastal zone management program. In addition, non-federal applicants for federal licenses or permits to conduct activities in the coastal zone must have a state certification that the proposed activity will comply with the state's CZM program.

Section 302 of the Marine Protection, Research, and Sanctuaries Act of 1972

Section 302 of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended (PL 92-532, 86 Stat. 1052, 16 U.S.C. 1432), authorizes the Secretary of Commerce to designate as marine sanctuaries those areas of ocean waters and Great Lakes or of other coastal waters which he deems necessary for the purpose of preserving or restoring such areas for their conservation, recreational, ecological, or aesthetic values. Activities in the sanctuary authorized by other authorities are valid only if certified by the Secretary of Commerce as consistent with Title III of the Act.

The National Environmental Policy Act of 1969

The National Environmental Policy Act of 1969 (42 U.S.C. 4321-4347) declares in Section 102 that "...all agencies of the Federal Government shall...insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations..."

The Fish and Wildlife Coordination Act of 1934

Under the Fish and Wildlife Coordination Act (16 U.S.C. 661-666c) as amended, the Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) review and report on

projects receiving federal funds or those permitted under Sections 9 and 10 of the River and Harbor Act of 1899 and under Sections 402 and 404 of FWPCA. Under this Act, any federal agency proposing to control or modify any body of water must consult with FWS, NMFS, and the head of the appropriate state agency exercising administration over the wildlife resources of the affected state.

The Fish and Wildlife Act of 1956

The Fish and Wildlife Act of 1956 (16 U.S.C. 742a et seq.) authorizes the use of funds by FWS and NMFS for research, acquisition of refuge lands, and development of existing facilities to conserve and manage fish and wildlife.

The Marine Migratory Game Fish Act of 1959

The Marine Migratory Game Fish Act of 1959 (16 U.S.C. 760a et seq.) supports marine game fish research on migration, identity of stocks, mortality rates, and environmental influences including pollution under the authority of NMFS.

The Anadromous Fish Conservation Act of 1974

The Anadromous Fish Conservation Act of 1974 (16 U.S.C. 757a) as amended has as its objective the conservation, development, and enhancement of anadromous fishery resources. Under this Act FWS and NMFS conduct research, operate facilities, acquire lands, and make agreements with states for management and operation of facilities pursuant to meeting the objectives of the Act.

Fishery Conservation and Management Act of 1976

Under the Fishery Conservation and Management Act of 1976 (PL 94-265), NMFS conducts biological fishery research on the impacts of pollution and wetlands and estuary degradation. The objective of the Act is to conserve and manage fishery resources. For anadromous fish, authority extends beyond the 200-mile limit.

The Federal Power Act of 1920

The Federal Power Act of 1920 (41 Stat. 1063; 16 U.S.C. 791a et seq.) as amended, allows the Federal Power Commission to permit construction of certain plysical structures related to a power project. If the navigability of a waterway is affected, all plans must be approved by the Secretary of the Interior. In all cases involving the discharge of dredged or fill material or the transportation of dredged material for the purposes of dumping in ocean waters, Section 404 or Section 103 will be applicable.

The National Historic Preservation Act

The National Historic Preservation Act of 1966 (80 Stat. 915, 16 U.S.C. 470), created an Advisory Council on Historic Preservation. The council reviews and comments upon activities licensed by the Federal Government which will have an effect upon properties listed in the National Register of Historic Places.

The Endangered Species Act

The Endangered Species Act of 1973 (16 U.S.C. 1531 et. seq.) states that Federal agencies must carry out programs for the conservation of endangered or threatened species, and take any action necessary to insure that any actions authorized by that Agency will not jeopardize the continued existence of these endangered or threatened species or their habitats.

The Deepwater Port Act

The Deepwater Port Act of 1974 (33 U.S.C. 1501 et. seq.) prohibits ownership, construction, or operation of a deepwater port beyond territorial seas without a license issued by the Secretary of Transportation. A permit from this authority must be concurrent with the issuance of the necessary permits from the Department of the Army pursuant to the authorities listed in Section 320.2.

The Marine Mammal Protection Act

The Marine Mammal Protection Act of 1972 (16 U.S.C. 1361 et. seq.) perpetually prohibits the harassment, hunting, capturing, or killing of marine mammals or the importation of marine mammals and marine mammal products without a permit from either the Secretary of the Interior or the Secretary of Commerce, depending upon the species involved.

Section 7(a) of the Wild and Scenic Rivers Act

This Act states that no department or agency of the United States shall recommend authorizing of any water resources project that would have a direct and adverse effect on the values for which such river was established, as determined by the Secretary charged with its administration. Also, no requests to begin construction of any such project shall be made without advising the Secretary of the Interior or the Secretary of Agriculture.

Section 6(f) of the Land and Water Conservation Fund Act

This Section provides that no property acquired or developed with assistance from the Land and Water Conservation Fund shall, without the approval of the Secretary of the Interior, be converted to other than public outdoor recreational uses.

The Estuary Protection Act of 1968

The Estuary Protection Act of 1968 (PL 90-454, 82 Stat. 625-628) is a declaration of the Congressional policy to preserve, protect, and restore estuaries. The Act authorized a study and inventory of the nation's estuaries, including coastal marshlands, bays, sounds, and lagoons to determine their physical, biological, and economic values.

Appendix D

CORPS REGULATIONS 33 CFR 320-329; 33 CFR 239

1. The authorities of the Corps to review permits for certain types of activities and construction in or affecting navigable waters were consolidated into the River and Harbor Act of 1899. Section 9 of this Act requires a permit from the Corps of Engineers to construct any dam or dike in a navigable water of the United States, and Section 10 identifies other types of structures or work in or affecting navigable waters of the U.S. that are prohibited unless permitted by the Corps.

2. The 1899 Act was administered only for protection of navigation until 1968, when the following factors were included: fish and wildlife, conservation, pollution, aesthetics, ecology, and the general public interest (33 CFR 209.120).

3. On September 9, 1972 the Corps published a revised administrative definition of the term "navigable waters of the United States" in the Federal Register (33 CFR 209.260). This definition is used to administer Sections 9 and 10 of the River and Harbor Act of 1899.

4. On April 7, 1971, the Corps implemented a nationwide waste permit program based on Section 13 of the 1899 Act, commonly known as "The Refuse Act". The permit program was enjoined by the District Court for the District of Columbia in the case of *Kalur v. Resor*, 335 F. Supp. 1, (D.D.C. 1971) on December 24, 1971. It remained suspended until the enactment of the FWPCA on October 18, 1972. Section 402 of the FWPCA subsumed the Refuse Act permit program with the establishment of the National Pollutant Discharge Elimination System, although earlier Refuse Act prohibitions can only be lifted by the issuance of a FWPCA permit.

5. Section 404 of the FWPCA created a permit program which is administered by the Secretary of the Army, acting through the Corps of Engineers. This program is to regulate the discharge of dredged material and of those pollutants that comprise fill material into the waters of the United States. The regulations then established by the Department of the Army limited the Section 404 permit program to the same waters regulated by the River and Harbor Act of 1899. These regulations were challenged by the Natural Resources Defense Council and the National Wildlife Federation as being inconsistant with the intent of Congress to regulate "all waters of the United States." (A major portion of the coastal wetlands were outside the permit review requirements of Section 404 by the Army's regulations.)

6. On March 27, 1975, the District Court for the District of Columbia ordered the revocation and revision of the Department of

the Army's original regulations concerning boundaries to be used in granting permits under Section 404. The Court also ordered publication of new proposed regulations within 40 days.

7. The interim final regulation was published on July 25, 1975, and included definitions for "navigable water," "dredged material," "fill material," and "headwaters." It also adopted a phase-in schedule for implementation of the permit requirements for Section 404.

8. The following document is the final regulations adopted by the Department of the Army on July 19, 1977 for administration of of its regulatory program. In it, the following regulations were rescinded: 33 CFR 209.120, 33 CFR 209.125, 33 CFR 209.131, 33 CFR 209.133, 33 CFR 209.150, and 33 CFR 209.260. New regulations were also published, all included in Parts 320 to 329.

federal register

TUESDAY, JULY 19, 1977
PART II

DEPARTMENT OF DEFENSE

Department of the Army, Engineers Corps

■

REGULATORY PROGRAM OF THE CORPS OF ENGINEERS

PART 209—ADMINISTRATIVE PROCEDURES

§§ 209.120, 209.125, 209.131, 209.133, 209.150, and 209.260 [Reserved]

1. The above sections are revoked and reserved.

2. The following parts 320 through 329 are added:

PART 320—GENERAL REGULATORY POLICIES

Sec.
320.1 Purpose and scope.
320.2 Authorities to issue permits.
320.3 Related legislation.
320.4 General policies for evaluating permit applications.

AUTHORITY: 33 U.S.C. 401 et seq.; 33 U.S.C. 1344; 33 U.S.C. 1413.

§ 320.1 Purpose and scope.

(a) *Types of activities regulated.* This regulation and the regulations that follow (33 CFR 321–329) prescribe the statutory authorities, and general and special policies and procedures applicable to the review of applications for Department of the Army permits for various types of activities that occur in waters of the United States or the oceans. This part identifies the various Federal statutes that require Department of the Army permits before these activities can be lawfully undertaken; the related Federal legislation applicable to the review of each activity that requires a Department of the Army permit; and the general policies that are applicable

to the review of all activities that require Department of the Army permits. Parts 321–324 address the various types of activities that require Department of the Army permits, including special policies and procedures applicable to those activities, as follows:

(1) Dams or dikes in navigable waters of the United States (Part 321);

(2) All other structures or work including excavation, dredging, and/or disposal activities, in navigable waters of the United States (Part 322);

(3) All activities that alter or modify the course, condition, location, or capacity of a navigable water of the United States (Part 323);

(4) Construction of fixed structures and artificial islands on the outer continental shelf (Part 322);

(5) All discharges of dredged or fill material into the waters of the United States (Part 323); and

(6) All activities involving the transportation of dredged material for the purpose of dumping it in ocean waters (Part 324).

(b) *Forms of authorization.* Department of the Army permits for the above described activities are issued under various forms of authorization. These include individual permits; letters of permission that are issued following a review of an individual application for a Department of the Army permit; general permits that authorize the performance of a category or categories of activities in a specific geographical region after it is determined that these activities will cause only a minimal individual and cumulative adverse environmental impact; and nationwide permits that authorize the performance of certain specified activities throughout the Nation. The nationwide permits are found in 33 CFR 323.4 and 323.4. If an activity is covered by a general or nationwide permit, an application for a Department of the Army permit does not have to be made. In such cases, a person must only comply with the conditions contained in the general or nationwide permit to satisfy the requirements of law.

(c) *General instructions.* The procedures for processing all letters of permission, individual permits, and general permits are contained in 33 CFR 325. However, before reviewing those procedures, a person desiring to perform any activity that requires a Department of the Army permit is advised to review the general and special policies that relate to the particular activity as outlined in this Part 320 and Parts 321 through 324. The terms "navigable waters of the United States" and "waters of the United States" are used frequently throughout these regulations, and it is important that the reader understand the difference from the outset. "Navigable waters of the United States" are defined in 33 CFR 329. These are the traditional waters where permits are required for work or structures pursuant to sections 9 and 10 of the River and Harbor Act of 1899. "Waters of the United States" are defined in 33 CFR 323.2(a). These waters include more than navigable waters of the United States and are the waters where permits are required for the discharge of dredged or fill material pursuant to section 404 of the Federal Water Pollution Control Act Amendments of 1972.

§ 320.2 Authorities to issue permits.

(a) Section 9 of the River and Harbor Act approved March 3, 1899 (30 Stat. 1151; 33 USC 401) (hereinafter referred to as Section 9) prohibits the construction of any dam or dike across any navigable water of the United States in the absence of Congressional consent and approval of the plans by the Chief of Engineers and the Secretary of the Army. Where the navigable portions of the waterbody lie wholly within the limits of a single State, the structure may be built under authority of the legislature of that State, if the location and plans or any modification thereof, are approved by the Chief of Engineers and by the Secretary of the Army. The instrument of authorization is designated a permit. Section 9 also pertains to bridges and causeways but the authority of the Secretary of the Army and Chief of Engineers with respect to bridges and causeways was transferred to the Secretary of Transportation under the Department of Transportation Act of October 15, 1966 (80 Stat. 941, 49 USC 1655g (6)(A)). See also 33 CFR Part 321. A Department of the Army authorization is required for the discharge of dredged or fill material into waters of the United States associated with bridges and causeways pursuant to Section 404 of the Federal Water Pollution Control Act Amendments of 1972 (33 USC 1344). See CFR Part 323.

(b) Section 10 of the River and Harbor Act approved March 3, 1899 (30 Stat. 1151; 33 USC 403) (hereinafter referred to as Section 10) prohibits the unauthorized obstruction or alteration of any navigable water of the United States. The construction of any structure in or over any navigable water of the United States, the excavation from or depositing of material in such waters, or the accomplishment of any other work affecting the course, location, condition, or capacity of such waters is unlawful unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of the Army. The instrument of authorization is designated a permit, general permit, or letter of permission. The authority of the Secretary of the Army to prevent obstructions to navigation in the navigable waters of the United States was extended to artificial islands and fixed structures located on the outer continental shelf by Section 4(f) of the Outer Continental Shelf Lands Act of 1953 (67 Stat. 463; 43 U.S.C. 1333(f)). See also 33 CFR Part 322.

(c) Section 11 of the River and Harbor Act approved March 3, 1899 (30 Stat. 1151; 33 U.S.C. 404) authorizes the Secretary of the Army to establish harbor lines channelward of which no piers, wharves, bulkheads or other works may be extended or deposits made without approval of the Secretary of the Army. By policy stated in 33 CFR 328, effective May 27, 1970, harbor lines are guidelines only for defining the offshore limits of structures and fills insofar as they impact on navigation interests. Permits for work shoreward of those lines must be obtained in accordance with Section 10 and, if applicable, Section 404.

(d) Section 13 of the River and Harbor Act approved March 3, 1899 (30 Stat. 1152; 33 U.S.C. 407) provides that the Secretary of the Army, whenever the Chief of Engineers determines that anchorage and navigation will not be injured thereby, may permit the discharge of refuse into navigable waters. In the absence of a permit, such discharge of refuse is prohibited. While the prohibition of this section, known as the Refuse Act, is still in effect, the permit authority of the Secretary of the Army has been superseded by the permit authority provided the Administrator, Environmental Protection Agency, and the States under Sections 402 and 405 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500, 86 Stat. 816, 33 U.S.C. 1342 and 1345). See 40 CFR Parts 124 and 125.

(e) Section 14 of the River and Harbor Act approved March 3, 1899 (30 Stat. 1153; 33 U.S.C. 408) provides that the Secretary of the Army on the recommendation of the Chief of Engineers may grant permission for the temporary occupation or use of any sea wall, bulkhead, jetty, dike, levee, wharf, pier, or other work built by the United States. This permission will be granted by an appropriate real estate instrument in accordance with existing real estate regulations.

(f) Section 1 of the River and Harbor Act of June 13, 1902 (32 Stat. 371; 33 U.S.C. 565) allows any persons or corporations desiring to improve any navigable river at their own expense and risk to do so upon the approval of the plans and specifications by the Secretary of the Army and the Chief of Engineers. Improvements constructed under this authority, which are primarily in Federal project areas, remain subject to the control and supervision of the Secretary of the Army and the Chief of Engineers.

(g) Section 404 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500, 86 Stat. 816, 33 U.S.C. 1344) (hereinafter referred to as Section 404) authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits, after notice and opportunity for public hearings, for the discharge of dredged or fill material into the waters of the United States at specified disposal sites. See 33 CFR 323. The selection and use of disposal sites will be in accordance with guidelines developed by the Administrator of the Environmental Protection Agency (EPA) in conjunction with the Secretary of the Army, published in 40 CFR Part 230. If these guidelines prohibit the selection or use of a disposal site, the Chief of Engineers may consider the economic impact on navigation of such a prohibition in reaching his decision. Furthermore, the

Administrator can prohibit or restrict the use of any defined area as a disposal site whenever he determines, after notice and opportunity for public hearings and after consultation with the Secretary of the Army, that the discharge of such materials into such areas will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas, wildlife, or recreational areas.

(h) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended (PL 92-532, 86 Stat. 1052, 33 U.S.C. 1413) (hereinafter referred to as Section 103) authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits, after notice and opportunity for public hearings, for the transportation of dredged material for the purpose of dumping it in ocean waters where it is determined that the dumping will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological system, or economic potentialities. The selection of disposal sites will be in accordance with criteria, developed by the Administrator of the EPA in consultation with the Secretary of the Army, published in 40 CFR Parts 220-229. However, similar to the EPA Administrator's limiting authority cited in subparagraph (g), above, the Administrator can prevent the issuance of a permit under this authority if he finds that the dumping of the material will result in an unacceptable adverse impact on municipal water supplies, shellfish beds, wildlife, fisheries or recreational areas. See also 33 CFR Part 324.

§ 320.3 Related legislation.

(a) Section 401 of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500; 86 Stat. 816, 33 U.S.C. 1341) requires any non-Federal applicant for a Federal license or permit to conduct any activity that may result in a discharge of a pollutant into waters of the United States to obtain a certification from the State in which the discharge originates or will originate, or, if appropriate, from the interstate water pollution control agency having jurisdiction over the affected waters at the point where the discharge originates or will originate, that the discharge will comply with the applicable effluent limitations and water quality standards. A certification obtained for the construction of any facility must also pertain to the subsequent operation of the facility.

(b) Section 307(c) of the Coastal Zone Management Act of 1972, as amended (PL 94-370, 90 Stat. 1013, 16 U.S.C. 1456(c)) requires Federal agencies conducting activities, including development projects, directly affecting a State's coastal zone, to comply, to the maximum extent practicable, with an approved State coastal zone management program. It also requires any non-Federal applicant for a Federal license or permit to conduct an activity affecting land or water uses in the State's coastal zone to furnish a certification that the proposed activity will comply with the State's coastal zone management program. Generally, no permit will be issued until the State has concurred with the non-Federal applicant's certification. This provision becomes effective upon approval by the Secretary of Commerce of the State's coastal zone management program. See also 15 CFR Part 930.

(c) Section 302 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended, (PL 92-532, 86 Stat. 1052, 16 U.S.C. 1432) authorizes the Secretary of Commerce, after consultation with other interested Federal agencies and with the approval of the President, to designate as marine sanctuaries those areas of the ocean waters or of the Great Lakes and their connecting waters or of other coastal waters which he determines necessary for the purpose of preserving or restoring such areas for their conservation, recreational, ecological, or aesthetic values. After designating such an area, the Secretary of Commerce shall issue regulations to control any activities within the area. Activities in the sanctuary authorized under other authorities are valid only if the Secretary of Commerce certifies that the activities are consistent with the purposes of Title III of the Act and can be carried out within the regulations for the sanctuary.

(d) The National Environmental Policy Act of 1969 (42 U.S.C. 4321-4347) declares the national policy to encourage a "productive and enjoyable harmony between man and his environment. Section 102 of that Act directs that "to the fullest extent possible: (1) The policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act, and (2) all agencies of the Federal Government shall * * * insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical considerations * * *". See also 33 CFR Part 325 and 33 CFR 209.410.

(e) The Fish and Wildlife Act of 1956 (16 U.S.C. 742a, et seq.), the Migratory Marine Game-Fish Act (16 U.S.C. 760c-760g) and the Fish and Wildlife Coordination Act (16 U.S.C. 661-666c) and other acts express the concern of Congress with the quality of the aquatic environment as it affects the conservation, improvement and enjoyment of fish and wildlife resources. Reorganization Plan No. 4 of 1970 transferred certain functions, including certain fish and wildlife-water resources coordination responsibilities, from the Secretary of the Interior to the Secretary of Commerce. Under the Fish and Wildlife Coordination Act and Reorganization Plan No. 4, any Federal agency that proposes to control or modify any body of water must first consult with the United States Fish and Wildlife Service, the National Marine Fisheries Service, as appropriate, and with the head of the appropriate State agency exercising administration over the wildlife resources of the affected State.

(f) The Federal Power Act of 1920 (41 Stat. 1063; 16 U.S.C. 791a et seq.), as amended, authorizes the Federal Power Commission (FPC) to issue licenses for the construction, operation and maintenance of dams, water conduits, reservoirs, power houses, transmission lines, and other physical structures of a power project. However, where such structures will affect the navigable capacity of any navigable waters of the United States (as defined in 16 U.S.C. 796), the plans for the dam or other physical structures affecting navigation must be approved by the Chief of Engineers and the Secretary of the Army. In such cases, the interests of navigation should normally be protected by a recommendation to the FPC for the inclusion of appropriate provisions in the FPC license rather than the issuance of a separate Department of the Army permit under 33 U.S.C. 401 et seq. As to any other activities in navigable waters not constituting construction, operation and maintenance of physical structures licensed by the FPC under the Federal Power Act of 1920, as amended, the provisions of 33 U.S.C. 401 et seq. remain fully applicable. In all cases involving the discharge of dredged or fill material into waters of the United States or the transportation of dredged material for the purpose of dumping in ocean waters, Section 404 or Section 103 will be applicable.

(g) The National Historic Preservation Act of 1966 (80 Stat. 915, 16 U.S.C. 470) created the Advisory Council on Historic Preservation to advise the President and Congress on matters involving historic preservation. In performing its function the Council is authorized to review and comment upon activities licensed by the Federal Government which will have an effect upon properties listed in the National Register of Historic Places, or eligible for listing. The concern of Congress for the preservation of significant historical sites is also expressed in the Preservation of Historical and Archeological Data Act of 1974 (16 U.S.C. 469 et seq.), which amends the Act of June 27, 1960. By this Act, whenever a Federal construction project or Federally licensed project, activity or program alters any terrain such that significant historical or acheological data is threatened, the Secretary of the Interior may take action necessary to recover and preserve the data prior to the commencement of the project. See also 33 CFR Part 305.

(h) The Interstate Land Sales Full Disclosure Act (15 USC 1701 et seq.) prohibits any developer or agent from selling or leasing any lot in a subdivision (as defined in 15 USC 1701(3)) unless the purchaser is furnished in advance a printed property report containing information which the Secretary of Housing and Urban Development may, by rules or regulations, require for the protection of purchasers. In the event the lot in question is part of a project that requires Department of the Army authorization, the Property Report is required by Housing and Urban Development regulation to state whether or not

a permit has been applied for, issued, or denied by the Corps of Engineers for the development under Section 10 or Section 404. The Property Report is also required to state whether or not any enforcement action has been taken as a consequence of non-application for or denial of such permit.

(i) The Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.) declares the intention of the Congress to conserve threatened and endangered species and the ecosystems on which those species depend. The Act provides that Federal agencies must utilize their authorities in furtherance of its purposes by carrying out programs for the conservation of endangered or threatened species, and by taking such action necessary to insure that any action authorized by that Agency will not jeopardize the continued existence of such endangered or threatened species or result in the destruction or modification of habitat of such species which is determined by the Secretaries of Interior or Commerce, as appropriate, to be critical. See also 50 CFR Part 17.

(j) The Deepwater Port Act of 1974 (33 U.S.C. 1501 et seq.) prohibits the ownership, construction, or operation of a deepwater port beyond the territorial seas without a license issued by the Secretary of Transportation. The Secretary of Transportation may issue such a license to an applicant if he determines, among other things, that the construction and operation of the deepwater port is in the national interest and consistent with national security and other national policy goals and objectives. An application for a deepwater port license constitutes an application for all Federal authorizations required for the ownership, construction, and operation of a deepwater port, including applications for Section 10, Section 404 and Section 103 permits which must also be issued by the Department of the Army pursuant to the authorities listed in § 320.2. The Secretary of Transportation must obtain the views and recommendations of all Federal agencies having jurisdiction over any aspect of the deepwater port construction and operation prior to issuing a license.

(k) The Marine Mammal Protection Act of 1972 (16 U.S.C. 1361 et seq.) expresses the intent of Congress that marine mammals be protected and encouraged to develop in order to maintain the health and stability of the marine ecosystem. The Act imposes a perpetual moratorium on the harassment, hunting, capturing, or killing of marine mammals and on the importation of marine mammals and marine mammal products without a permit from either the Secretary of the Interior or the Secretary of Commerce, depending upon the species of marine mammal involved. Such permits may be issued only for purposes of scientific research and for public display if the purpose is consistent with the policies of the Act. The appropriate Secretary is also empowered in certain restricted circumstances to waive the requirements of the Act.

(l) Section 7(a) of the Wild and Scenic Rivers Act (82 Stat. 906, 16 U.S.C. 1278 et seq.) provides that no department or agency of the United States shall assist by loan, grant, license, or otherwise in the construction of any water resources project that would have a direct and adverse effect on the values for which such river was established, as determined by the Secretary charged with its administration. No department or agency of the United States shall recommend authorizing of any water resources project that would have a direct and adverse effect on the values for which such river was established, as determined by the Secretary charged with its administration, or request appropriations to begin construction of any such project, whether heretofore or hereafter authorized, without advising the Secretary of the Interior or the Secretary of Agriculture, as the case may be, in writing of its intention so to do at least sixty days in advance, and without specifically reporting to the Congress in writing at the time it makes its recommendation or request in what respect construction of such project would be in conflict with the purposes of this Act and would affect the component and the values to be protected by it under this Act.

(m) Section 6(f) of the Land and Water Conservation Fund Act of 1965 (78 Stat. 897, 16 USC 460 *l*-4, *et seq.*) provides that no property acquired or developed with assistance from the Land and Water Conservation Fund shall, without the approval of the Secretary of the Interior, be converted to other than public outdoor recreation uses. The Secretary shall approve such conversion only if he finds it to be in accord with the then existing comprehensive statewide outdoor recreation plan and only upon such conditions as he deems necessary to assure the substitution of other recreation properties of at least equal fair market value and of reasonably equivalent usefulness and location.

§ 320.4 General policies for evaluating permit applications.

The following policies shall be applicable to the review of all applications for Department of the Army permits. Additional policies specifically applicable to certain types of activities are identified in Parts 321–324 of this chapter.

(a) *Public interest review.* (1) The decision whether to issue a permit will be based on an evaluation of the probable impact of the proposed activity and its intended use on the public interest. Evaluation of the probable impact which the proposed activity may have on the public interest requires a careful weighing of all those factors which become relevant in each particular case. The benefit which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. The decision whether to authorize a proposal, and if so, the conditions under which it will be allowed to occur, are therefore determined by the outcome of the general balancing process (e.g., see 33 CFR 209.400, Guidelines for Assessment of Economic, Social and Environmental Effects of Civil Works Projects). That decision should reflect the national concern for both protection and utilization of important resources. All factors which may be relevant to the proposal must be considered; among those are conservation, economics, aesthetics, general environmental concerns, historic values, fish and wildlife values, flood damage prevention, land use, navigation, recreation, water supply, water quality, energy needs, safety, food production, and, in general, the needs and welfare of the people. No permit will be granted unless its issuance is found to be in the public interest.

(2) The following general criteria will be considered in the evaluation of every application:

(i) the relative extent of the public and private need for the proposed structure or work;

(ii) the desirability of using appropriate alternative locations and methods to accomplish the objective of the proposed structure or work;

(iii) the extent and permanence of the beneficial and/or detrimental effects which the proposed structure or work may have on the public and private uses to which the area is suited; and

(iv) the probable impact of each proposal in relation to the cumulative effect created by other existing and anticipated structures or work in the general area.

(b) *Effect on wetlands.* (1) Wetlands are vital areas that constitute a productive and valuable public resource, the unnecessary alteration or destruction of which should be discouraged as contrary to the public interest.

(2) Wetlands considered to perform functions important to the public interest include:

(i) Wetlands which serve important natural biological functions, including food chain production, general habitat, and nesting, spawning, rearing and resting sites for aquatic or land species;

(ii) Wetlands set aside for study of the aquatic environment or as sanctuaries or refuges;

(iii) Wetlands the destruction or alteration of which would affect detrimentally natural drainage characteristics, sedimentation patterns, salinity distribution, flushing characteristics, current patterns, or other environmental characteristics;

(iv) Wetlands which are significant in shielding other areas from wave action, erosion, or storm damage. Such wetlands are often associated with barrier beaches, islands, reefs and bars;

(v) Wetlands which serve as valuable storage areas for storm and flood waters;

(vi) Wetlands which are prime natural recharge areas. Prime recharge areas are locations where surface and ground water are directly interconnected; and

(vii) Wetlands through natural water filtration processes serve to purify water.

(3) Although a particular alteration of wetlands may constitute a minor change,

the cumulative effect of numerous such piecemeal changes often results in a major impairment of the wetland resources. Thus, the particular wetland site for which an application is made will be evaluated with the recognition that it is part of a complete and interrelated wetland area. In addition, the District Engineer may undertake reviews of particular wetland areas in consultation with the appropriate Regional Director of the Fish and Wildlife Service, the Regional Director of the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration, the Regional Administrator of the Environmental Protection Agency, the local representative of the Soil Conservation Service of the Department of Agriculture, and the head of the appropriate State agency to assess the cumulative effect of activities in such areas.

(4) No permit will be granted to work in wetlands identified as important by subparagraph (2), above, unless the District Engineer concludes, on the basis of the analysis required in paragraph (a), above, that the benefits of the proposed alteration outweigh the damage to the wetlands resource and the proposed alteration is necessary to realize those benefits. In evaluating whether a particular alteration is necessary, the District Engineer shall consider whether the proposed activity is primarily dependent on being located in, or in close proximity to the aquatic environment and whether feasible alternative sites are available. The applicant must provide sufficient information on the need to locate the proposed activity in the wetland and must provide data on the basis of which the availability of feasible alternative sites can be evaluated.

(5) In addition to the policies expressed in this subpart the Congressional policy expressed in the Estuary Protection Act, PL 90-454, and State regulatory laws or programs for classification and protection of wetlands will be given great weight.

(c) *Fish and wildlife.* In accordance with the Fish and Wildlife Coordination Act (§ 320.3(e) above) Corps of Engineers officials will consult with the Regional Director, U.S. Fish and Wildlife Service, the Regional Director, National Marine Fisheries Service, and the head of the agency responsible for fish and wildlife for the State in which the work is to be performed, with a view to the conservation of wildlife resources by prevention of their direct and indirect loss and damage due to the activity proposed in a permit application. They will give great weight to these views on fish and wildlife considerations in evaluating the application. The applicant will be urged to modify his proposal to eliminate or mitigate any damage to such resources, and in appropriate cases the permit may be conditioned to accomplish this purpose.

(d) *Water quality.* Applications for permits for activities which may affect the quality of a water of the United States will be evaluated for compliance with applicable effluent limitations, water quality standards and management practices during the construction, operation, and maintenance of the proposed activity. Certification of compliance with applicable effluent limitations and water quality standards required under provisions of Section 401 of the Federal Water Pollution Control Act will be considered conclusive with respect to water quality considerations unless the Regional Administrator, Environmental Protection Agency (EPA), advises of other water quality aspects to be taken into consideration. Any permit issued may be conditioned to implement water quality protection measures.

(e) *Historic, scenic, and recreational values.* (1) Applications for permits covered by this regulation may involve areas which possess recognized historic, cultural, scenic, conservation, recreational or similar values. Full evaluation of the general public interest requires that due consideration be given to the effect which the proposed structure or activity may have on the enhancement, preservation, or development of such values. Recognition of those values is often reflected by State, regional, or local land use classifications, or by similar Federal controls or policies. In both cases, action on permit applications should, insofar as possible, be consistent with, and avoid adverse effect on, the values or purposes for which those classifications, controls, or policies were established.

(2) Specific application of the policy in subparagraph (1) above, applies to:

(i) Rivers named in Section 3 of the Wild and Scenic Rivers Act (82 Stat. 906, 16 U.S.C. 1273 et seq.); those proposed for inclusion as provided by Sections 4 and 5 of the Act, or by later legislation; and wild, scenic, and recreational rivers established by State and local entities;

(ii) Historic, cultural, or archeological sites or practices as provided in the National Historic Preservation Act of 1966 (83 Stat. 852, 42 U.S.C. 4321 et seq.) (see also Executive Order 11593, May 13, 1971, and Statutes there cited). Particular attention should be directed toward any district, site, building, structure, or object listed or eligible for listing in the National Register of Historic Places;

(iii) Sites included in or determined eligible for listing in the National Registry of Natural Landmarks which are published periodically in the FEDERAL REGISTER;

(iv) Sites acquired or developed with the assistance of the Land and Water Conservation Fund (78 Stat. 897, 16 U.S.C. 460, 1-4, et seq.) or the Recreational Demonstrations Projects Act of 1942 (PL 77-594, 56 Stat. 326) and other public parks and recreation areas; and

(v) Any other areas named in Acts of Congress or Presidential Proclamations as National Rivers, National Wilderness Areas, National Seashores, National Recreation Areas, National Lakeshores, National Parks, National Monuments, and such areas as may be established under Federal law for similar and related purposes, such as estuarine and marine sanctuaries.

(f) *Effect on limits of the territorial sea.* Structures or work affecting coastal waters may modify the coast line or base line from which the three mile belt is measured for purposes of the Submerged Lands Act and International Law. Generally, the coast line or base line is the line of ordinary low water on the mainland; however, there are exceptions where there are islands or low-tide elevations offshore. (The Submerged Lands Act, 67 Stat. 29, U.S. Code Section 1301(c), and United States vs. California, 381 U.S. 139 (1965), 382 U.S. 448 (1966).) All applications for structures or work affecting coastal waters will therefore be reviewed specifically to determine whether the coast line or base line might be altered. If it is determined that such a change might occur, coordination with the Attorney General and the Solicitor of the Department of the Interior is required before final action is taken. The District Engineer will submit a description of the proposed work and a copy of the plans to the Solicitor, Department of the Interior, Washington, D.C. 20240, and request his comments concerning the effects of the proposed work on the outer continental rights of the United States. These comments will be included in the file of the application. After completion of standard processing procedures, the file will be forwarded to the Chief of Engineers. The decision on the application will be made by the Secretary of the Army after coordination with the Attorney General.

(g) *Interference with adjacent properties or water resource projects.* Authorization of work or structures by the Department of the Army does not convey a property right, nor authorize any injury to property or invasion of other rights.

(1) Because a landowner has the general right to protect his property from erosion, applications to erect protective structures will usually receive favorable consideration. However, if the protective structure may cause damage to the property of others, the District Engineer will so advise the applicant and inform him of possible alternative methods of protecting his property. Such advice will be given in terms of general guidance only so as not to compete with private engineering firms nor require undue use of government resources. A significant probability of resulting damage to nearby properties can be a basis for denial of an application.

(2) A landowner's general right of access to navigable waters of the United States is subject to the similar rights of access held by nearby landowners and to the general public's right of navigation on the water surface. Proposals which create undue interference with access to, or use of, navigable waters will generally not receive favorable consideration.

(3) Where it is found that the work for which a permit is desired is in navigable waters of the United States (see 33 CFR Part 329) and may interfere with an authorized Federal project, the applicant should be apprised in writing

of the fact and of the possibility that a Federal project which may be constructed in the vicinity of the proposed work might necessitate its removal or reconstruction. The applicant should also be informed that the United States will in no case be liable for any damage or injury to the structures or work authorized by Sections 9 or 10 of the River and Harbor Act of 1899 (see 33 CFR Parts 321 and 322) which may be caused by or result from future operations undertaken by the Government for the conservation or improvement of navigation, or for other purposes, and no claims or right to compensation will accrue from any such damage.

(4) Proposed activities which are in the area of a Federal project which exists or is under construction will be evaluated to insure that they are compatible with the purposes of the project.

(h) *Activities affecting coastal zones.* Applications for Department of the Army permits for activities affecting the coastal zones of those States having a coastal zone management program approved by the Secretary of Commerce will be evaluated with respect to compliance with that program. No permit will be issued to a non-Federal applicant until certification has been provided that the proposed activity complies with the coastal zone management program and the appropriate State agency has concurred with the certification or has waived its right to do so. However, a permit may be issued to a non-Federal applicant if the Secretary of Commerce, on his own initiative or upon appeal by the applicant, finds that the proposed activity is consistent with the objectives of the Coastal Zone Management Act of 1972 or is otherwise necessary in the interest of national security. Federal agency applicants for Department of the Army permits are responsible for complying with the Coastal Zone Management Act's directives for assuring that their activities directly affecting the coastal zone are consistent, to the maximum extent practicable, with approved State coastal zone management programs.

(i) *Activities in marine sanctuaries.* Applications for Department of the Army authorization for activities in a marine sanctuary established by the Secretary of Commerce under authority of Section 302 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended, will be evaluated for impact on the marine sanctuary. No permit will be issued until the applicant provides a certification from the Secretary of Commerce that the proposed activity is consistent with the purposes of Title III of the Marine Protection, Research and Sanctuaries Act of 1972, as amended, and can be carried out within the regulations promulgated by the Secretary of Commerce to control activities within the marine sanctuary. Authorizations so issued will contain such special conditions as may be required by the Secretary of Commerce in connection with his certification.

(j) *Other Federal, state, or local requirements.* (1) Processing of an application for a Department of the Army permit normally will proceed concurrently with the processing of other required Federal, State, and/or local authorizations or certification. Where the required Federal State and/or local certification and/or authorization has been denied, the application for a Department of the Army permit will be denied without prejudice to the right of the applicant to reinstate processing of his application if subsequent approval is received from the appropriate Federal, State and/or local agency. Even if official certification and/or authorization is not required by State or Federal law, but a State, regional, or local agency having jurisdiction or interest over the particular activity comments on the application, due consideration shall be given to those official views as a reflection of local factors of the public interest.

(2) Where officially adopted State, regional, or local land-use classifications, determinations, or policies are applicable to the land or water areas under consideration, they shall be presumed to reflect local factors of the public interest and shall be considered in addition with the other national factors of the public interest identified in § 320.4(a).

(3) A proposed activity may result in conflicting comments from several agencies within the same State. While many States have designated a single State agency or individual to provide a single and coordinated State position regarding pending permit applications, where a State has not so designated a single source, District Engineers will elicit from the Governor an expression of his views and desires concerning the application or, in the alternative, an expression from the Governor as to which State agency represents the official State position in this particular case.

(4) In the absence of overriding national factors of the public interest that may be revealed during the processing of the permit application, a permit will generally be issued following receipt of a favorable State determination provided the concerns, policies, goals, and requirements as expressed in 33 CFR Parts 320–324, and the following statutes have been followed and considered: The National Environmental Policy Act; the Fish and Wildlife Coordination Act; the Historical and Archaeological Preservation Act; the National Historic Preservation Act; the Endangered Species Act; the Coastal Zone Management Act; the Marine Protection, Research and Sanctuaries Act of 1972, as amended; and the Federal Water Pollution Control Act (see § 320.3, above).

(5) If the responsible Federal, State, and/or local agency fails to take definitive action to grant or deny required authorizations or to furnish comments as provided in subparagraph (3) above, within three months of the issuance of the public notice, the District Engineer shall process the application to a conclusion.

(6) Permits will not be issued where certification or authorization of the proposed work is required by Federal, State and/or local law and that certification or authorization has been denied.

(7) The District Engineer may, in those States with ongoing permit programs for activities regulated by Department of the Army permits, enter into an agreement with the States to jointly process and evaluate Department of the Army and State permit applications. This may include the issuance of joint public notices; the conduct of joint public hearings, if held; and the joint review and analysis of information and comments developed in response to the public notice, public hearing, the environmental assessment and the environmental impact statement (if necessary), the Fish and Wildlife Coordination Act, the Historical and Archaeological Preservation Act, the National Historic Preservation Act, the Endangered Species Act, the Coastal Zone Management Act, the Marine Protection, Research and Sanctuaries Act of 1972, as amended, and the Federal Water Pollution Control Act. In such cases, applications for Department of the Army permits may be processed concurrently with the processing of the State permit to an independent conclusion and decision by the District Engineer and appropriate State agency.

(k) *Safety of impoundment structures.* Unless an adequate inspection program is required by another Federal licensing agency or will be performed by another Federal agency, the District Engineer will condition permits for impoundment structures to require that the permittee operate and maintain the structure properly to insure public safety. The District Engineer may condition such permits to require periodic inspections and to indicate that failure to accomplish actions to assure the public safety will be considered cause to revoke the permit.

(l) *Floodplains.* Executive Order 11988, dated May 24, 1977, requires each Federal agency, in its conduct of Federal programs that affect land use including the regulation of water resources, to take action to reduce the risk of flood loss; to minimize the impact of floods on human safety, health and welfare; and to restore and preserve the natural and beneficial values served by floodplains. In evaluating whether activities located in a floodplain that require Department of the Army permits are in the public interest, available alternatives to avoid adverse effects from and incompatible development in floodplains shall be considered.

PART 321—PERMITS FOR DAMS AND DIKES IN NAVIGABLE WATERS OF THE UNITED STATES

Sec.
321.1 General.
321.2 Definitions.
321.3 Special policies and procedures.

AUTHORITY: 33 U.S.C. 401.

§ 321.1 General.

This regulation prescribes, in addition to the general policies of 33 CFR 320.4 and procedures of 33 CFR Part 325, those special policies, practices, and procedures to be followed by the Corps of En-

gineers in connection with the review of applications for Department of Army permits to authorize the construction of a dike or dam in a navigable water of the United States pursuant to Section 9 of the River and Harbor Act of 1899 (33 U.S.C. 401). See 33 CFR 320.2(a). Dams and dikes in navigable waters of the United States also require Department of the Army permits under Section 404 of the Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. 1344). Applicants for Department of the Army permits under this Part should also refer to 33 CFR Part 323 to satisfy the requirements of Section 404.

§ 321.2 Definitions.

For the purpose of this regulation, the following terms are defined:

(a) The term "navigable waters of the United States" means those waters of the United States that are subject to the ebb and flow of the tide shoreward to the mean high water mark (mean higher high water mark on the Pacific coast), and/or are presently used, or have been used in the past, or may be susceptible to use to transport interstate or foreign commerce. See 33 CFR Part 329 for a more complete definition of this term.

(b) The term "dam" means an impoundment structure that completely spans a navigable water of the United States and that may obstruct interstate waterborne commerce.

(c) The term "dike" means an embankment, low dividing wall, or other protective barrier that completely spans a navigable water of the United States and that may obstruct interstate waterborne commerce.

§ 21.3 Special policies and procedures.

The following additional special policies and procedures shall be applicable to the evaluation of permit applications under this regulation:

(a) The Secretary of the Army will decide whether Department of the Army authorization for a dam or dike in a navigable water of the United States will be issued, since this authority has not been delegated to the Chief of Engineers. The conditions to be imposed in any instrument of authorization will be recommended by the District Engineer when he forwards his report to the Secretary of the Army, through the Chief of Engineers, pursuant to 33 CFR 325.11.

(b) A Department of the Army application under Section 9 will not be processed until the approval of the United States Congress has been obtained if the navigable water of the United States is an interstate waterbody, or until the approval of the appropriate State legislature has been obtained if the navigable water of the United States is solely within the boundaries of one State.

PART 322—PERMITS FOR STRUCTURES OR WORK IN OR AFFECTING NAVIGABLE WATERS OF THE UNITED STATES

Sec.
322.1 General.
322.2 Definitions.
322.3 Activities requiring permits.
322.4 Structures and work permitted by this regulation.
322.5 Special policies and procedures.
Appendix A.—U.S. Coast Guard/Chief of Engineers Memorandum of Agreement.
Appendix B.—Delegation of Authority.

AUTHORITY: 33 U.S. 403.

§ 322.1 General.

This regulation prescribes, in addition to the general policies of 33 CFR 320.4 and procedures of 33 CFR Part 325 those special policies, practices and procedures to be followed by the Corps of Engineers in connection with the review of applications for Department of Army permits to authorize structures or work in or affecting navigable waters of the United States pursuant to Section 10 of the River and Harbor Act of 1899 (33 U.S.C. 403) (hereinafter referred to as Section 10). See 33 CFR 320.2(b). Certain structures or work in or affecting navigable waters of the United States are also regulated under other authorities of the Department of the Army. These include discharges of dredged or fill material into waters of the United States, including the territorial seas, pursuant to Section 404 of the Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. 1344; see 33 CFR Part 323) and the transportation of dreged material by vessel for purposes of dumping in ocean waters, including the territorial seas, pursuant to Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended (33 U.S.C. 1413; see 33 CFR Part 324). A Department of the Army permit will also be required under these additional authorities if they are applicable to structures or work in or affecting navigable waters of the United States. Applicants for Department of the Army permits under this part should refer to the other cited authorities and implementing regulations for these additional permit requirements to determine whether they also are applicable to their proposed activities.

§ 322.2 Definitions.

For the purpose of this regulation, the following terms are defined:

(a) The term "navigable waters of the United States" means those waters of the United States that are subject to the ebb and flow of the tide shoreward to the mean high water mark (mean higher high water mark on the Pacific coast), and/or are presently used, or have been used in the past, or may be susceptible to use to transport interstate or foreign commerce. See 33 CFR Part 329 for a more complete definition of this term.

(b) The term "structure" shall include, without limitation, any pier, wharf, dolphin, weir, boom, breakwater, bulkhead, revetment, jetty, permanent mooring structure, power transmission lines, permanently moored floating vessels, piling, aids to navigation, or any other permanent or semi-permanent obstacle or obstruction.

(c) The term "work" shall include, without limitation, any dredging or disposal of dredged material, excavation, filling, or other modification of a navigable water of the United States.

(d) The term "letter of permission" means an individual permit issued in accordance with the abbreviated procedures of 33 CFR 325.5(b).

(e) The term "individual permit" means a Department of the Army authorization that is issued following a case-by-case evaluation of a specific structure or work in accordance with the procedures of this regulation and 33 CFR Part 325 and a determination that the proposed structure or work is in the public interest pursuant to 33 CFR Part 320.

(f) The term "general permit" means a Department of the Army authorization that is issued for a category or categories of structures or work in a specified region of the country, when those structures or work are substantially similar in nature and cause only minimal individual and cumulative adverse environmental impact. A general permit is issued following an evaluation of the proposed category of activities that it will authorize in accordance with the procedures of this regulation (322.5(b)), 33 CFR Part 325, and a determination that the proposed discharges will be in the public interest pursuant to 33 CFR Part 320.

(g) The term "nationwide permit" means a Department of the Army authorization that has been issued by this regulation in § 322.4 to permit certain structures or work in or affecting navigable waters of the United States throughout the Nation.

§ 322.3 Activities requiring permits.

(a) *General.* Department of the Army permits are required under Section 10 for all structures or work in or affecting navigable waters of the United States except for bridges and causeways (see Appendix A) and structures or work licensed under the Federal Power Act of 1920. Activities that were commenced or completed shoreward of established Federal harbor lines before May 27, 1970 (see 33 CFR Part 328) also do not require Section 10 permits; however, if those activities involve the discharge of dredged or fill material into waters of the United States after October 18, 1972, a Section 404 permit is required (see 33 CFR Part 323).

(1) Structures or work are in the navigable waters of the United States if they are within limits defined in 33 CFR Part 329. Structures or work outside these limits are subject to the provisions of law cited in paragraph (a) above, if these structures or work affect the course, location, or condition of the waterbody in such a manner as to impact on the navigable capacity of the waterbody. For purposes of a Section 10 permit, a tunnel or other structure under or over a navigable water of the United States is considered to have an impact on the navigable capacity of the waterbody.

(2) Pursuant to Section 154 of the Water Resource Development Act of 1976 (PL 94-587), Department of the Army permits will not be required under Section 10 to construct wharves and piers in any waterbody, located entirely within one State, that is a navigable water of

the United States solely on the basis of its historical use to transport interstate commerce. Section 154 applies only to the construction of a single pier or wharf and not to marinas. Furthermore, Section 154 is not applicable to any pier or wharf that would cause an unacceptable impact on navigation.

(b) *Outer continental shelf.* Department of the Army permits will also be required for the construction of artificial islands and fixed structures on the outer continental shelf pursuant to Section 4(f) of the Outer Continental Shelf Lands Act (see 33 CFR 320.2(b)).

(c) *Activities of Federal agencies.* Except as specifically provided in this subparagraph, activities of the type described in (a) and (b), above, done by or on behalf of any Federal agency, other than any work or structures in or affecting navigable waters of the United States that are part of the Civil Works activities of the Corps of Engineers, are subject to the authorization procedures of this regulation. Agreement for construction or engineering services performed for other agencies by the Corps of Engineers does not constitute authorization under this regulation. Division and District Engineers will therefore advise Federal agencies accordingly, and cooperate to the fullest extent in expediting the processing of their applications.

(1) Congress has delegated to the Secretary of the Army and the Chief of Engineers in Section 10 the duty to authorize or prohibit certain work or structures in navigable waters of the United States. The general legislation by which Federal agencies are empowered to act generally is not considered to be sufficient authorization by Congress to satisfy the purposes of Section 10. If an agency asserts that it has Congressional authorization meeting the test of Section 10 or would otherwise be exempt from the provisions of Section 10, the legislative history and/or provisions of the Act should clearly demonstrate that Congress was approving the exact location and plans from which Congress could have considered the effect on navigable waters of the United States or that Congress intended to exempt that agency from the requirements of Section 10. Very often such legislation reserves final approval of plans or construction for the Chief of Engineers. In such cases evaluation and authorization under this regulation are limited by the intent of the statutory language involved.

(2) The policy provisions set out in 33 CFR 320.4(j) relating to State or local certifications and/or authorizations, do not apply to work or structures undertaken by Federal agencies, except where compliance with non-Federal authorization is required by Federal law or Executive policy.

§ 322.4 Structures and work permitted by this regulation.

The following structures or work are hereby permitted for purposes of Section 10 and do not require separate Department of the Army permits:

(a) The place next of aids to navigation by the U.S. Coast Guard, see § 322.5 (e), below;

(b) Structures constructed in artificial canals within principally residential developments where the connection of the canal to a navigable water of the United States has been previously authorized; See § 322.5(g), below;

(c) The repair, rehabilitation, or replacement of any previously authorized currently serviceable, structure or of any currently serviceable structure constructed prior to the requirement for authorization; provided such repair, rehabilitation, or replacement does not result in a deviation from the plans of the original structure, and further provided that the structure to be maintained has not been put to uses differing from uses specified for it in any permit authorizing its original construction;

(d) Marine life harvesting devices such as pound nets, crab traps, eel pots, lobster traps, provided there is no interference with navigation;

(e) Staff gages, tide gages, water recording devices, water quality testing and improvement devices, and similar scientific structures provided there is no interference with navigation;

(f) Survey activities, including "core sampling" and

(g) Structures or work completed before 18 December 1968 or in waterbodies over which the District Engineer has not asserted jurisdiction provided there is no interference with navigation.

§ 322.5 Special policies.

The Secretary of the Army has delegated to the Chief of Engineers the authority to issue or deny Section 10 permits. (See Appendix B). The following additional special policies and procedures shall also be applicable to the evaluation of permit applications under this regulation.

(a) *General.* Department of the Army permits will be required for structures or work in or affecting navigable waters of the United States. Certain structures or work specified in § 322.4 are permitted by this regulation. If a structure or work is not permitted by this regulation, an individual or general Section 10 permit will be required.

(b) *General Permits.* The District Engineer may, after compliance with the other procedures of 33 CFR Part 325, issue general permits for certain clearly described categories of structures or work requiring Department of the Army permits. After a general permit has been issued, individual activities falling within those categories will not require individual permit processing by the procedures of 33 CFR Part 325 unless the District Engineer determines, on a case-by-case basis, that the public interest requires such individual review.

(1) District Engineers will include only those activities that are substantially similar in nature, that cause only minimal adverse environmental impact when performed separately, and that will have only a minimal adverse cumulative effect on the environment as categories which are candidates for general permits.

(2) In addition to the conditions prescribed in Appendix C of 33 CFR Part 325, any general permit issued by the District Engineer shall prescribe the following conditions:

(i) The maximum quantity of material that may be discharged and the maximum area that may be modified by structures or work that are authorized for a single or incidental operation (if applicable);

(ii) A description of the category or categories of activities included in the general permit; and

(iii) The type of water(s) into which the activity may occur.

(3) The District Engineer may require reporting procedures.

(4) A general permit may be revoked if it is determined that the cumulative effects of the activities authorized by it will have an adverse impact on the public interest provided the procedures of 33 CFR 325.7 are followed. Following revocation, application for any future activities in areas covered by the general permit shall be processed as applications for individual permits.

(c) *Non-Federal dredging for navigation.*—(1) The benefits which an authorized Federal navigation project are intended to produce will often require similar and related operations by non-Federal agencies (e.g., dredging an access channel to dock and berthing facilities or deepening such a channel to correspond to the Federal project depths). These non-Federal activities will be considered by Corps of Engineers officials in planning the construction and maintenance of Federal navigation projects and, to the maximum practical extent, will be coordinated with interested Federal, State, regional and local agencies and the general public simultaneously with the associated Federal projects. Non-Federal activities which are not so coordinated will be individually evaluated in accordance with this regulation. In evaluating the public interest in connection with applications for permits for such coordinated operations, equal treatment will, therefore, be accorded to the fullest extent possible to both Federal and non-Federal operations. Furthermore, permits for non-Federal dredging operations will contain conditions requiring the permittee to comply with the same practices or requirements utilized in connection with related Federal dredging operations with respect to such matters as turbidity, water quality, containment of material, nature and location of approved spoil disposal areas (Non-Federal use of Federal contained disposal areas will be in accordance with laws authorizing such areas and regulations governing their use), extent and period of dredging, and other factors relating to protection of environmental and ecological values.

(2) A permit for the dredging of a channel, slip, or other such project for navigation will also authorize the periodic maintenance dredging of the

project. Authority for maintenance dredging will be subject to revalidation at regular intervals to be specified in the permit. Revalidation will be in accordance with the procedures prescribed in 33 CFR 325.6. The permit, however, will require the permittee to give advance notice to the District Engineer each time maintenance dredging is to be performed. Where the maintenance dredging involves the discharge of dredged material into waters of the United States or the transportation of dredged material for the purpose of dumping in the ocean waters, the procedures in 33 CFR Parts 323 and 324 respectively shall also be followed.

(d) *Structures for small boats.* As a matter of policy, in the absence of overriding public interest, favorable consideration will generally be given to applications from riparian owners for permits for piers, boat docks, moorings, platforms and similar structures for small boats. Particular attention will be given to the location and general design of such structures to prevent possible obstructions to navigation with respect to both the public's use of the waterway and the neighboring proprietors' access to the waterway. Obstructions can result from both the existence of the structure particularly in conjunction with other similar facilities in the immediate vicinity, and from its inability to withstand wave action or other forces which can be expected. District Engineers will inform applicants of the hazards involved and encourage safety in location, design and operation. Corps of Engineers officials will also encourage cooperative or group use facilities in lieu of individual proprietor use facilities.

(1) Letters transmitting permits for structures for small boats will, where applicable, include the following language: "Notice is hereby given that a possibility exists that the structure permitted may be subject to damage by wave wash from passing vessels. Your attention is invited to special condition _____ of the permit." The appropriate designation of the permit condition placing responsibility on the permittee and not on the United States for integrity of the structure and safety of boats moored thereto will be inserted.

(2) Floating structures for small recreational boats or other recreational purposes on lakes controlled by the Corps of Engineers under a Resources Manager are normally subject to permit authorities cited in § 322.3, above, when those waters are regarded as navigable waters of the United States. However, such structures will not be authorized under this regulation but will be regulated under applicable regulations of the Chief of Engineers published in 36 CFR 327.19 if the land surrounding those lakes is under complete Federal ownership. District Engineers will delineate those portions of the navigable waters of the United States where this provision is applicable and post notices of this designation in the vicinity of the lake Resources Manager's office.

(e) *Aids to navigation.* The placing of fixed and floating aids to navigation in a navigable water of the United States is within the purview of Section 10 of the River and Harbor Act of 1899. Furthermore, these aids are of particular interest to the U.S. Coast Guard because of their control of marking, lighting and standardization of such navigation aids. Applications for permits for installation of aids to navigation will, therefore, be coordinated with the appropriate District Commander, U.S. Coast Guard and permits for such aids will include a condition to the effect that the permittee will conform to the requirements of the Coast Guard for marking, lighting, etc. Since most fixed and floating aids to navigation will not ordinarily significantly affect environmental values, the usual form of authorization to be used will be a letter of permission (See 33 CFR 325.1(b)).

(f) *Outer continental shelf.* Artificial islands and fixed structures located on the outer continental shelf are subject to the standard permit procedures of this regulation. Where the islands or structures are to be constructed on lands which are under mineral lease from the Bureau of Land Management, Department of the Interior, that agency, in cooperation with other Federal agencies, fully evaluates the potential effect of the leasing program on the total environment. Accordingly, the decision whether to issue a permit on lands which are under mineral lease from the Department of the Interior will be limited to an evaluation of the impact of the proposed work on navigation and national security. The public notice will so identify the criteria.

(g) *Canals and other artificial waterways connected to navigable waters of the United States.* (1) A canal or similar artificial waterway is subject to the regulatory authorities discussed in § 322.3, above, if it constitutes a navigable water of the United States, or if it is connected to navigable waters of the United States in a manner which affects their course, condition, or capacity. In all cases the connection to navigable waters of the United States requires a permit. Where the canal itself constitutes a navigable water of the United States, evaluation of the permit application and further exercise of regulatory authority will be in accordance with the standard procedures of this regulation. For all other canals the exercise of regulatory authority is restricted to those activities which affect the course, condition, or capacity of the navigable waters of the United States. Examples of the latter may include the length and depth of the canal; the currents, circulation, quality and turbidity of its waters, especially as they affect fish and wildlife values; and modifications or extensions of its configuration.

(2) The proponent of canal work should submit his application for a permit, including a proposed plan of the entire development, and the location and description of anticipated docks, piers and other similar structures which will be placed in the canal, to the District Engineer before commencing any form of work. If the connection to navigable waters of the United States has already been made without a permit, the District Engineer will proceed in accordance with 33 CFR Part 326. Where a canal connection is proposed, an application for a Section 10 permit should be made at the earliest stage of planning. Where the canal construction has already begun, the District Engineer will, in writing, advise the proponent of the need for a permit to connect the canals to navigable waters of the United States. He will also ask the proponent if he intends to make such a connection and will request the immediate submission of the plans and permit application if it is so intended. The District Engineer will also advise the proponent that any work is done at the risk that, if a permit is required, it may not be issued, and and that the existence of partially completed excavation work will not be allowed to weigh favorably in evaluation of the permit application.

(h) *Facilities at the borders of the United States.* (1) The construction, operation, maintenance, or connection of facilities at the borders of the United States are subject to Executive control and must be authorized by the President, Secretary of State, or other delegated official.

(2) Applications for permits for the construction, operation, maintenance, or connection at the borders of the United States of facilities for the transmission of electric energy between the United States and a foreign country, or for the exportation or importation of natural gas to or from a foreign country, must be made to the Federal Power Commission. (Executive Order 10485, September 3, 1953, 18 U.S.C. 3(a)(2), 15 U.S.C. 717(b), and 18 CFR Parts 32 and 153).

(3) Applications for the landing or operation of submarine cables must be made to the Federal Communications Commission. (Executive Order 10530, May 10, 1954, 47 U.S.C. 34 to 39, and 47 CFR 1.766).

(4) The Secretary of State is to receive applications for permits for the construction, connection, operation, or maintenance, at the borders of the United States, of pipelines, conveyor belts, and similar facilities for the exportation or importation of petroleum products, coals, minerals, or other products to or from a foreign country; facilities for the exportation or importation of water or sewage to or from a foreign country; and monorails, aerial cable cars, aerial tramways and similar facilities for the transportation of persons or things, or both, to or from a foreign country (Executive Order 11423, August 16, 1968).

(5) A Department of the Army permit under Section 10 of the River and Harbor Act of 1899 is also required for all of the above facilities which affect the navigable waters of the United States, but in each case in which a permit has

been issued as provided above, the decision whether to issue the Department of the Army permit will be based primarily on factors of navigation, since the basic existence and operation of the facility will have been examined and permitted as provided by the Executive orders. Furthermore, in those cases where the construction, maintenance, or operation at the above facilities involves the discharge of dredged or fill material in waters of the United States or the transportation of dredged material for the purpose of dumping it into ocean waters, appropriate Department of the Army authorizations under Section 404 of the Federal Water Pollution Control Act or under Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended, are also required (See 33 CFR Parts 323, 324).

(i) *Power transmission lines.* (1) Permits under Section 10 of the River and Harbor Act of 1899 are required for power transmission lines crossing navigable waters of the United States unless those lines are part of a water power project subject to the regulatory authorities of the Federal Power Commission under the Federal Water Power Act of 1920. If an application is received for a permit for lines which are part of a water power project, the applicant will be instructed to submit his application to the Federal Power Commission. If the lines are not part of a water power project, the application will be processed in accordance with the procedures prescribed in this regulation.

(2) The following minimum clearances are required for aerial electric power transmission lines crossing navigable waters of the United States. These clearances are related to the clearances over the navigable channel provided by existing fixed bridges, or the clearances which would be required by the U.S. Coast Guard for new fixed bridges, in the vicinity of the proposed power line crossing. The clearances are based on the low point of the line under conditions which produce the greatest sag, taking into consideration temperature, load, wind, length or span, and type of supports as outlined in the National Electrical Safety Code.

Minimum additional clearance above clearance required for bridges

Nominal system voltage kilovolt:	Feet [1]
115 and below	20
138	22
161	24
230	26
350	30
500	35
700	42
750 to 765	45

[1] Above clearance required for bridges.

(3) Clearances for communication lines, stream gaging cables, ferry cables, and other aerial crossings are usually required to be a minimum of ten feet above clearances required for bridges. Greater clearances will be required if the public interest so indicates.

(j) *Seaplane operations.* (1) Structures in navigable waters of the United States associated with seaplane operations require Department of the Army permits, but close coordination with the Federal Aviation Administration (FAA), Department of Transportation, is required on such applications.

(2) The FAA must be notified by an applicant whenever he proposes to establish or operate a seaplane base. The FAA will study the proposal and advise the applicant, District Engineer, and other interested parties as to the effect of the proposal on the use of airspace. The District Engineer will therefore refer any objections regarding the effect of the proposal on the use of airspace to the FAA, and give due consideration to their recommendations when evaluating the general public interest.

(3) If the seaplane base will serve air carriers licensed by the Civil Aeronautics Board, the applicant must receive an airport operating certificate from the FAA. That certificate reflects determination and conditions relating to the installation operation, and maintenance of adequate air navigation facilities and safety equipment. Accordingly, the District Engineer may, in evaluating the general public interest, consider such matters to have been primarily evaluated by the FAA.

(k) *Foreign Trade Zones.* The Foreign Trade Zones Act (48 Stat. 998–1003, 19 U.S.C. 81a to 81u, as amended) authorizes the establishment of foreign-trade zones in or adjacent to United States ports of entry under terms of a grant and regulations prescribed by the Foreign-Trade Zones Board. Pertinent regulations are published in 15 CFR Part 400. The Secretary of the Army is a member of the Board, and construction of a zone is under the supervision of the District Engineer. Laws governing the navigable waters of the United States remain applicable to foreign-trade zones, including the general requirements of this regulation. Evaluation by a District Engineer of a permit application may give recognition to the consideration by the Board of the general economic effects of the zone on local and foreign commerce, general location of wharves and facilities, and other factors pertinent to construction, operation, and maintenance of the zone.

APPENDIX A—U.S. COAST GUARD/CHIEF OF ENGINEERS, MEMORANDUM OF AGREEMENT

1. PURPOSE AND AUTHORITY

A. The Department of Transportation Act, the Act of October 15, 1966, P.L. 89-670, transferred to and vested in the Secretary of Transportation certain functions, powers and duties previously vested in the Secretary of the Army and the Chief of Engineers. By delegation of authority from the Secretary of Transportation (49 CFR 1.46(c)) the Commandant, U.S. Coast Guard, has been authorized to exercise certain of these functions, powers and duties relating to bridges and causeways conferred by:

(1) The following provision of law relating generally to drawbridge operating regulations: Section 5 of the Act of August 18, 1894, as amended (38 Stat. 362; 33 U.S.C. 499);

(2) The following law relating generally to obstructive bridges: The Act of June 21, 1940, as amended (The Truman-Hobbs Act) (54 Stat. 497; 33 U.S.C. 511 et seq.);

(3) The following laws and provisions of law to the extent that they relate generally to the location and clearances of bridges and causeways in the navigable waters of the United States:

(a) Section 9 of the Act of March 3, 1899, as amended (30 Stat. 1151; 33 U.S.C. 401);

(b) The Act of March 23, 1906, as amended (34 Stat. 84; 33 U.S.C. 491 et seq.); and

(c) The General Bridge Act of 1946, as amended (60 Stat. 847; 33 U.S.C. 525 et seq.) except Sections 502(c) and 503.

B. The Secretary of the Army and The Chief of Engineers continue to be vested with broad and important authorities and responsibilities with respect to navigable waters of the United States, including, but not limited to, jurisdiction over excavation and filling, design flood flows and construction of certain structures in such waters, and the prosecution of waterway improvement projects.

C. The purposes of this agreement are:

(1) To recognize the common and mutual interest of the Chief of Engineers and the Commandant, U.S. Coast Guard, in the orderly and efficient administration of their respective responsibilities under certain Federal statutes to regulate certain activities in navigable waters of the United States;

(2) To clarify the areas of jurisdiction and the responsibilities of the Corps of Engineers and the Coast Guard with respect to:

(a) The alteration of bridges,

(1) In connection with Corps of Engineers waterway improvement projects, and

(2) Under the Truman-Hobbs Act;

(b) The construction, operation and maintenance of bridges and causeways as distinguished from other types of structures over or in navigable waters of the United States;

(c) The closure of waterways and the restriction of passage through or under bridges in connection with their construction, operation, maintenance and removal; and

(d) The selection of an appropriate design flood flow for flood hazard analysis of any proposed water opening.

(3) To provide for coordination and consultation on projects and activities in or affecting the navigable waters of the United States.

In furtherance of the above purposes the undersigned do agree upon the definitions, policies and procedures set forth below.

2. ALTERATION OF BRIDGES IN OR ACROSS NAVIGABLE WATERS WITHIN CORPS OF ENGINEERS PROJECTS

A. The Chief of Engineers agrees to advise and consult with the Commandant on navigation projects contemplated by the Corps of Engineers which require the alteration of bridges across the waterways involved in such projects. The Chief of Engineers also agrees to include in such project proposals the costs of alterations exclusive of betterments of all bridges within the limits of the designated project which after consultation with the Commandant he determines to require alteration to meet the needs of existing and prospective navigation. Under this concept the federal costs would be furnished under the project.

B. The Commandant of the Coast Guard agrees to undertake all actions and assumes all responsibilities essential to the determination of navigational requirements for horizontal and vertical clearances of bridges across navigable waters necessary in connection with any navigation project by the Chief of Engineers. Further, the Commandant agrees to conduct all public proceedings necessary thereto and establish guide clearance criteria where needed for the project objectives.

3. ALTERATION OF BRIDGES UNDER THE TRUMAN-HOBBS ACT

The Commandant of the Coast Guard acknowledges and affirms the responsibility of the Coast Guard, under the Truman-Hobbs Act, to program and fund for the alteration of bridges which, as distinct from project related alterations described in paragraph 2 herein, become unreasonable obstructions to navigation as a result of factors or changes in the character of navigation and this agreement shall in no way affect, impair or modify the powers or duties conferred by that Act.

4. APPROVAL, ALTERATION AND REMOVAL OF OTHER BRIDGES AND CAUSEWAYS

A. *General Definitions.* For purposes of this Agreement and the administration of the statutes cited in 1.A.(3) above, a "bridge" is any structure over, on or in the navigable waters of the United States which (1) is used for the passage or conveyance of persons, vehicles, commodities and other physical matter and (2) is constructed in such a manner that either the horizontal or vertical clearance, or both, may affect the passage of vessels or boats through or under the structure. This definition includes, but is not limited to, highway bridges, railroad bridges, foot bridges, aqueducts, aerial tramways and conveyors, overhead pipelines and similar structures of like function together with their approaches, fenders, pier protection systems, appurtenances and foundations. This definition does not include aerial power transmission lines, tunnels, submerged pipelines and cables, dams, dikes, dredging and filling in, wharves, piers, breakwaters, bulkheads, jetties and similar structures and works (except as they may be internal features of a bridge and used in its construction, maintenance, operation or removal) or except when they are affixed to the bridge and will have an effect on the clearances provided by the bridge) over which jurisdiction remains with the Department of the Army and the Corps of Engineers under Sections 9 and 10 of the Act of March 3, 1899, as amended (33 U.S.C. 401 and 403). A "causeway" is a raised road across water or marshy land, with the water or marshy land on both sides of the road, and which is constructed in or affects navigation, navigable waters and design flood flows.

B. *Combined Structures and Appurtenances.* For purposes of the Acts cited in 1.A.(3) above, a structure serving more than one purpose and having characteristics of either a bridge or causeway, as defined in 4.A., and some other structure, shall be considered as a bridge or causeway when the structure in its entirety, including its appurtenances and incidental features, has or retains the predominant characteristics and purpose of a bridge or causeway. A structure shall not be considered a bridge or causeway when its primary and predominant characteristics and purpose are other than those set forth above and it meets the general definitions above only in a narrow technical sense as a result of incidental features. This interpretation is intended to minimize the number of instances which will require an applicant for a single project to secure a permit or series of permits from both the Department of Transportation and the Department of the Army for each separate feature or detail of the project when it serves, incidentally to its primary purpose, more than one purpose and has features of either a bridge or causeway and features of some other structure. However, if parts of the project are separable and can be fairly and reasonably characterized or classified in an engineering sense as separate structures, each such structure will be so treated and considered for approval by the agency having jurisdiction thereover.

C. *Alteration of the Character of Bridges and Causeways.* The jurisdiction of the Secretary of Transportation and the Coast Guard over bridges and causeways includes authority to approve the removal of such structures when the owners thereof desire to discontinue their use. If the owner of a bridge or causeway discontinues its use and wishes to remove or alter any part thereof in such a manner that it will lose its character as a bridge or causeway, the Coast Guard will normally require removal of the structure from the waterway in its entirety. However, if the owner of a bridge or a causeway wishes to retain it in whole or in part for use other than for operation and maintenance as a bridge or causeway, the proposed structure will be considered as coming within the jurisdiction of the Corps of Engineers. The Coast Guard will refer requests for such uses to the Corps of Engineers for consideration. The Corps of Engineers agrees to advise the Commandant of the receipt of an application for approval of the conversion of a bridge or causeway to another structure and to provide opportunity for comment thereon. If the Corps of Engineers approves the conversion of a bridge or causeway to another structure, no residual jurisdiction over the structure will remain with the Coast Guard. However, if the Corps of Engineers does not approve the proposed conversion, then the structure remains a bridge subject to the jurisdiction of the Coast Guard.

5. CLOSURE OF WATERWAYS AND RESTRICTION OF PASSAGE THROUGH OR UNDER BRIDGES

Under the statutes cited in Section 1 of this Memorandum of Agreement, the Commandant must approve the clearances to be made available for navigation through or under bridges. It is understood that this duty and authority extends to and may be exercised in connection with the construction, alteration, operation, maintenance and removal of bridges, and includes the power to authorize the temporary restriction of passage through or under a bridge by use of falsework, piling, floating equipment, closure of draws, or any works or activities which temporary reduce the navigation clearances and design flood flows, including closure of any or all spans of the bridge. Moreover, under the Ports and Waterways Safety Act of 1972, Public Law 92-340, 86 Stat. 424, the Commandant exercises broad powers in waterways to control vessel traffic in areas he determines to be especially hazardous and to establish safety zones or other measures for limited controls or conditional access and activity when necessary to prevent damage to or the destruction or loss of, any vessel, bridge, or other structure on or in the navigable waters of the United States. Accordingly, in the event that work in connection with the construction, alteration or repair of a bridge or causeway is of such a nature that for the protection of life and property navigation through or in the vicinity of the bridge or causeway must be temporarily prohibited, the Coast Guard may close that part of the affected waterway while such work is being performed. However, it is also clear that the Secretary of the Army and the Chief of Engineers have the authority, under Section 4 of the Act of August 18, 1894, as amended, (33 U.S.C. 1) to prescribe rules for the use, administration and navigation of the navigable waters of the United States. In recognition of that authority, and pursuant to Section 102(c) of the Ports and Waterways Safety Act, the Coast Guard will consult with the Corps of Engineers when any significant restriction of passage through or under a bridge is contemplated to be authorized or a waterway is to be temporarily closed.

6. COORDINATION AND COOPERATION PROCEDURES

A. District Commanders, Coast Guard Districts, shall send notices of applications for permits for bridge or causeway construction, modification, or removal to the Corps of Engineers Divisions and Districts in which the bridge or causeway is located.

B. District Engineers, Corps of Engineers, shall send notices of applications for permits for other structures or dredge and fill work to local Coast Guard District Commanders.

C. In cases where proposed structures or modifications of structures do not clearly fall within one of the classifications set forth in paragraph 4.A. above, the application will be forwarded with recommendations of the reviewing officers through channels to the Chief of Engineers and the Commandant of the Coast Guard who shall, after mutual consultation, attempt to resolve the questions.

D. If the above procedures fail to produce agreement, the application will be forwarded to the Secretary of the Army and Secretary of Transportation for their determination.

E. The Chief of Engineers and the Commandant, Coast Guard pledge themselves to mutual cooperation and consultation in making available timely information and data, seeking uniformity and consistency among field offices, and providing timely and adequate review of all matters arising in connection with the administration of their responsibilities governed by the Acts cited herein.

Dated: March 21, 1973.

C. R. BENDER.

Dated: April 12, 1973.

F. J. CLARKE.

APPENDIX B—DELEGATION OF AUTHORITY TO ISSUE OR DENY PERMITS FOR CONSTRUCTION OR OTHER WORK AFFECTING NAVIGABLE WATERS OF THE UNITED STATES

MAY 24, 1971.

Pursuant to the authority vested in me by the Act of March 3, 1899, c.425, Sections 10 and 14, 30 Stat. 1151, 1152 33 U.S.C. Sections 403 and 408, and the Act of June 13, 1902, c.1079, Section 1, 32 Stat. 371, 33 U.S.C. Section 565, I hereby authorize the Chief of Engineers and his authorized representatives to issue or deny permits for construction or other work affecting navigable waters of the United States. Except in cases involving applications for permits for artificial islands or fixed structures on Outer Continental Shelf lands under mineral lease from the Department of the Interior, the Chief of Engineers shall in exercising such authority, evaluate the impact of the proposed work on the public interest. In cases involving applications for permits for artificial islands or fixed structures on Outer Continental Shelf lands under mineral lease from the Department of the Interior, the Chief of Engineers shall, in exercising such authority, evaluate the impact of the proposed work on navigation and national security. The permits so granted may be made subject to such special conditions as the Chief of Engineers or his authorized representatives may consider necessary in order to effect the purposes of the above Acts.

The Chief of Engineers and his authorized representatives shall exercise the authority hereby delegated subject to such conditions as I or my authorized representative may from time to time impose.

STANLEY R. RESOR,
Secretary of the Army.

PART 323—PERMITS FOR DISCHARGES OF DREDGED OR FILL MATERIAL INTO WATERS OF THE UNITED STATES

Sec.

AUTHORITY: 33 U.S.C. 1344.

§ 323.1 General.

This regulation prescribes, in addition to the general policies of 33 CFR 320.4 and procedures of 33 CFR Part 325, those special policies, practices, and procedures to be followed by the Corps of Engineers in connection with the review of applications for Department of the Army permits to authorize the discharge of dredged or fill material into waters of the United States pursuant to Section 404 of the Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. 1344) (hereinafter referred to as Section 404). See 33 CFR 320.2(g). Certain discharges of dredged or fill material into waters of the United States are also regulated under other authorities of the Department of the Army. These include dams and dikes in navigable waters of the United States pursuant to Section 9 of the River and Harbor Act of 1899 (33 U.S.C. 401; see 33 CFR 321) and structures or work in or affecting navigable waters of the United States pursuant to Section 10 of the River and Harbor Act of 1899 (33 U.S.C. 403; see 33 CFR 322). A Department of the Army permit will also be required under these additional authorities if they are applicable to activities involving discharges of dredged or fill material into waters of the United States. Applicants for Department of the Army permits under this Part should refer to the other cited authorities and implementing regulations for these additional permit requirements to determine whether they also are applicable to their proposed activities.

§ 323.2 Definitions.

For the purpose of this regulation, the following terms are defined:

(a) The term "waters of the United States" means:[1]

(1) The territorial seas with respect to the discharge of fill material. (The transportation of dredged material by vessel for the purpose of dumping in the oceans, including the territorial seas, at an ocean dump site approved under 40 CFR 226 is regulated by Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended (33 USC 1413). See 33 CFR 324. Discharges of dredged or fill material into the territorial seas are regulated by Section 404.);

(2) Coastal and inland waters, lakes, rivers, and streams that are navigable waters of the United States, including adjacent wetlands;

(3) Tributaries to navigable waters of the United States, including adjacent wetlands (manmade nontidal drainage and irrigation ditches excavated on dry land are not considered waters of the United States under this definition).

(4) Interstate waters and their tributaries, including adjacent wetlands; and

(5) All other waters of the United States not identified in paragraphs (1)–(4) above, such as isolated wetlands and lakes, intermittent streams, prairie potholes, and other waters that are not part of a tributary system to interstate waters or to navigable waters of the United States, the degradation or destruction of which could affect interstate commerce.[2]

The landward limit of jurisdiction in tidal waters, in the absence of adjacent wetlands, shall be the high tide line and the landward limit of jurisdiction on all other waters, in the absence of adjacent wetlands, shall be the ordinary high water mark.

(b) The term "navigable waters of the United States" means those waters of the United States that are subject to the ebb and flow of the tide shoreward to the mean high water mark (mean higher high water mark on the Pacific coast) and/or are presently used, or have been used in the past, or may be susceptible to use to transport interstate or foreign commerce. (See 33 CFR 329 for a more complete definition of this term.)

(c) The term "wetlands" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

(d) The term "adjacent" means bordering, contiguous, or neighboring. Wetlands separated from other waters of the United States by man-made dikes or barriers, natural river berms, beach dunes and the like are "adjacent wetlands."

(e) The term "natural lake" means a standing body of open water that occurs in a natural depression fed by one or more streams and from which a stream may flow, that occurs due to the widening or natural blockage of a river or stream, or that occurs in an isolated natural depression that is not a part of a surface river or stream.

(f) The term "impoundment" means a standing body of open water created by artificially blocking or restricting the flow of a river, stream, or tidal area. As used in this regulation, the term does not include artificial lakes or ponds created by excavating and/or diking dry land to collect and retain water for such purposes as stock watering, irrigation, settling basins cooling, or rice growing.

(g) The term "ordinary high water mark" means the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of soil, destruction of terrestrial vegetation; the presence of litter and debris; or other appropriate means that consider the characteristics of the surrounding areas.

(h) The term "high tide line" means a line or mark left upon tide flats, beaches, or along shore objects that indicates the intersection of the land with the water's surface at the maximum height reached by a rising tide. The mark may be determined by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The term includes spring high tides and other high tides that occur with periodic frequency, but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast

[1] The terminology used by the FWPCA is "navigable waters" which is defined in Section 502(7) of the Act as "waters of the United States including the territorial seas." For purposes of clarity, and to avoid confusion with other Corps of Engineers regulatory programs, the term "waters of the United States" is used throughout this regulation.

[2] In defining the jurisdiction of the FWPCA as the "waters of the United States," Congress, in the legislative history to the Act, specified that the term "be given the broadest constitutional interpretation unencumbered by agency determinations which would have been made or may be made for administrative purposes." The waters listed in paragraphs (a)(1)–(4) fall within this mandate as discharges into those waterbodies may seriously affect water quality, navigation, and other Federal interests; however, it is also recognized that the Federal government would have the right to regulate the waters of the United States identified in paragraph (a)(5) under this broad Congressional mandate to fulfill the objective of the Act: "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Section 101(a)). Paragraph (a)(5) incorporates all other waters of the United States that could be regulated under the Federal government's Constitutional powers to regulate and protect interstate commerce, including those for which the connection to interstate commerce may not be readily obvious or where the location or size of the waterbody generally may not require regulation through individual or general permits to achieve the objective of the Act. Discharges of dredged or fill material into waters of the United States identified in paragraphs (a)(1)–(4) will generally require individual or general permits unless those discharges occur beyond the headwaters of a river or stream or in natural lakes less than 10 acres in surface area. Discharges into these latter waters and into most of the waters identified in paragraph (a)(5) will be permitted by this regulation, subject to the provisions listed in paragraph 323.4-2(b) unless the District Engineer develops information, on a case-by-case basis, that the concerns for the aquatic environment as expressed in the EPA Guidelines (40 CFR 230) require regulation through an individual or general permit. (See 323.4-4).

by strong winds such as those accompanying a hurricane or other intense storm.

(i) The term "headwaters" means the point on a non-tidal stream above which the average annual flow is less than five cubic feet per second.[1] The District Engineer may estimate this point from available data by using the mean annual area precipitation, area drainage basin maps, and the average runoff coefficient, or by similar means.

(j) The term "primary tributaries" means the main stems of tributaries directly connecting to navigable waters of the United States up to their headwaters, and does not include any additional tributaries extending off of the main stems of these tributaries.

(k) The term "dredged material" means material that is excavated or dredged from waters of the United States.

(l) The term "discharge of dredged material" means any addition of dredged material into the waters of the United States. The term includes, without limitation, the addition of dredged material to a specified disposal site located in waters of the United States and the runoff or overflow from a contained land or water disposal area. Discharges of pollutants into waters of the United States resulting from the onshore subsequent processing of dredged material that is extracted for any commercial use (other than fill) are not included within this term and are subject to Section 402 of the Federal Water Pollution Control Act even though the extraction and deposit of such material may require a permit from the Corps of Engineers. The term does not include plowing, cultivating, seeding and harvesting for the production of food, fiber, and forest products.

(m) The term "fill material" means any material used for the primary purpose of replacing an aquatic area with dry land or of changing the bottom elevation of a waterbody. The term does not include any pollutant discharged into the water primarily to dispose of waste, as that activity is regulated under Section 402 of the Federal Water Pollution Control Act Amendments of 1972.

(n) The term "discharge of fill material" means the addition of fill material into waters of the United States. The term generally includes, without limitation, the following activities: Placement of fill that is necessary to the construction of any structure in a water of the United States; the building of any structure or impoundment requiring rock, sand, dirt, or other material for its construction; site-development fills for recreational, industrial, commercial, residential, and other uses; causeways or road fills; dams and dikes; artificial islands; property protection and/or reclamation devices such as riprap, groins, seawalls, breakwaters, and revetments; beach nourishment; levees; fill for structures such as sewage treatment facilities, intake and outfall pipes associated with power plants and subaqueous utility lines; and artificial reefs. The term does not include plowing, cultivating, seeding and harvesting for the production of food, fiber, and forest products.

(o) The term "individual permit" means a Department of the Army authorization that is issued following a case-by-case evaluation of a specific project involving the proposed discharge(s) in accordance with the procedures of this regulation and 33 CFR 325 and a determination that the proposed discharge is in the public interest pursuant to 33 CFR Part 320.

(p) The term "general permit" means a Department of the Army authorization that is issued for a category or categories of discharges of dredged or fill material that are substantially similar in nature and that cause only minimal individual and cumulative adverse environmental impact. A general permit is issued following an evaluation of the proposed category of discharges in accordance with the procedures of this regulation (§ 323.3(c)), 33 CFR Part 325, and a determination that the proposed discharges will be in the public interest pursuant to 33 CFR Part 320.

(q) The term "nationwide permit" means a Department of the Army authorization that has been issued by this regulation in § 323.4 to permit certain discharges of dredged or fill material into waters of the United States throughout the Nation.

§ 323.3 Discharges requiring permits.

(a) *General.* Department of the Army permits will be required for the discharge of dredged or fill material into waters of the United States. Certain discharges specified in §§ 323.4–1, 323.4–2 and 323.4–3 are permitted by this regulation. If a discharge of dredged or fill material is not permitted by this regulation, an individual or general Section 404 permit will be required for the discharge of dredged or fill material into waters of the United States in accordance with the following phased schedule:

(1) Before July 25, 1975, discharges into navigable waters of the United States.

(2) After July 25, 1975, discharges into navigable waters of the United States and adjacent wetlands.

(3) After September 1, 1976, discharges into navigable waters of the United States and their primary tributaries, including adjacent wetlands, and into natural lakes, greater than 5 acres in surface area. (See also § 323.4–2 for discharges that are permitted by this regulation.)

(4) After July 1, 1977, discharges into all waters of the United States. (See also § 323.4–2 for discharges that are permitted by this regulation.)

(b) *Individual permits.* Unless permitted by this regulation (§§ 323.4–1, 323.4–2 and 323.4–3) or authorized by general permits (§ 323.3(c)), the discharge of dredged or fill material into waters of the United States will require an individual Department of the Army permit issued in accordance with the policies in § 320.4 and procedures in 33 CFR Part 325.

(c) *General permits.* The District Engineer may, after compliance with the other procedures of 33 CFR Part 325, issue general permits for certain clearly described categories of structures or work, including discharges of dredged or fill material, requiring Department of the Army permits. After a general permit has been issued, individual activities falling within those categories will not require individual permit processing by the procedures of 33 CFR Part 325 unless the District Engineer determines, on a case-by-case basis, that the public interest requires individual review.

(1) District Engineers will include only those activities that are substantially similar in nature, that cause only minimal adverse environmental impact when performed separately, and that will have only a minimal adverse cumulative effect on the environment as categories which are candidates for general permits.

(2) The District Engineer shall include appropriate conditions as specified in Appendix C of 33 CFR Part 325 in each general permit and shall prescribe the following additional conditions:

(i) The maximum quantity of material that may be discharged and the maximum area that may be modified by a single or incidental operation (if applicable);

(ii) A description of the category or categories of activities included in the general permit; and

(iii) The type of water(s) into which the activity may occur.

(3) The District Engineer may require reporting procedures.

(4) A general permit may be revoked if it is determined that the effects of the activities authorized by it will have an adverse impact on the public interest provided the procedures of 33 CFR 325.7 are followed. Following revocation, applications for future activities in areas covered by the general permit shall be processed as applications for individual permits.

(d) *Activities of Federal agencies.* (1) Discharges of dredged or fill material into waters of the United States done by or on behalf of any Federal agency, or instrumentality other than the Corps of Engineers, are subject to the authorization procedures of this regulation. Agreement for construction or engineering services performed for other agencies by the Corps of Engineers does not constitute authorization under the regulation. Division and District Engineers will therefore advice Federal agencies and instrumentalities accordingly and cooperate to the fullest extent in the expeditious processing of their applications.

(2) The policy provisions set out in 33 CFR 320.4(j), relating to State or local authorizations, do not apply to discharges of dredged or fill material into

[1] For streams that are dry during long periods of the year, District Engineers, after notifying the Regional Administrator of EPA, may establish the headwater point as that point on the stream where a flow of five cubic feet per second is equaled or exceeded 50 percent of the time. The District Engineer shall notify the Regional Administrator of his determination of these headwater points.

waters of the United States undertaken by Federal agencies, except where compliance with non-Federal authorization is required by Federal law or Executive policy. Federal agencies are required to comply with the appropriate State, interstate and local water-quality standards and effluent limitations as are applicable by law that are adopted in accordance with or effective under the provisions of the Federal Water Pollution Control Act, as amended, in the design, construction, management, operation, and maintenance of their respective facilities. (See Executive Order No. 11752, dated 17 Dec. 73). They are not required, however, to provide certification of compliance with effluent limitations and water-quality standards from State or interstate water pollution control agencies in connection with activities involving discharges into waters of the United States.

(e) *Activities licensed under the Federal Power Act of 1920.* Any part of a structure or work licensed by the Federal Power Commission that involves the discharge of dredged or fill material into waters of the United States shall require a Department of the Army authorization under this regulation.

§ 323.4 Discharges permitted by this regulation.

(a) *General.* Discharges of dredged or fill material specified in §§ 323.4–1, 323.4–2 and 323.4–3, below, are hereby permitted for purposes of Section 404 without further processing under this regulation (individual applications are not needed), except as provided in § 323.4–4 below. Permits may, however, be required under Section 10 of the River and Harbor Act of 1899 (see 33 CFR 322). Sections 323.4–1, 323.4–2, and 323.4–3 do not obviate the requirement to obtain State or local assent required by law for the activities permitted therein.

(b) *Management practices.* In addition to the conditions specified in §§ 323.4–2(b) and 323.4–3(b), the following management practices should be followed, to the maximum extent practicable, in the discharge of dredged or fill material permitted by §§ 323.4–2 and 324.4–3 to minimize the adverse effects of these discharges on the aquatic environment:

(1) Discharges of dredged or fill material into waters of the United States should be avoided or minimized through the use of other practical alternatives;

(2) Discharges in spawning areas during spawning seasons should be avoided;

(3) Discharges should not restrict or impede the movement of aquatic species indigenous to the waters or the passage of normal or expected high flows or cause the relocation of the waters (unless the primary purpose of the fill is to impound waters);

(4) If the discharge creates an impoundment water, adverse impacts on the aquatic system caused by the accelerated passage of water and/or the restriction of its flow, should by minimized;

(5) Discharges in wetlands areas should be avoided;

(6) Heavy equipment working in wetlands should be placed on mats;

(7) Discharges into breeding and nesting areas for migratory waterfowl should be avoided; and

(8) All temporary fills should be removed in their entirety.

§ 323.4–1 Discharges prior to effective dates of phasing.

(a) Discharges of dredged or fill material in waters of the United States that occur before the phase-in dates specified in § 323.3(a)(2)–(4) above are hereby permitted for purposes of Section 404, provided the conditions in paragraph (c) below are met.

(b) Discharges of dredged or fill material of less than 500 cubic yards into waters other than navigable waters of the United States (see 33 CFR 329) that are part of an activity that was commenced before July 25, 1975, that were completed by January 25, 1976, and that involve a single and complete project and not a number of projects associated with a complete development plan are hereby permitted for purposes of Section 404, provided the conditions in paragraph (c) below are met. The term "commenced" as used herein shall be satisfied if there has been, before July 25, 1975, some discharge of dredged or fill material as a part of the above activity or an entering into of a written contractual obligation to have the dredged or fill material discharged at a designated disposal site by a contractor.

(c) For the purposes of Section 404 the following conditions must have been satisfied for the discharges occurring before the dates specified in paragraph (a) and (b) above:

(1) That the discharge was not located in the proximity of a public water intake;

(2) That the discharge did not contain unacceptable levels of pathogenic organisms in areas used for recreation involving physical contact with the water;

(3) That the discharge did not occur in areas of concentrated shellfish production; and

(4) That the discharge did not destroy or endanger the critical habitat or a threatened or endangered species, as identified under the Endangered Species Act.

§ 323.4–2 Discharges into certain waters of the United States.

(a) Discharges of dredged or fill material into the following waters of the United States are hereby permitted for purposes of Section 404, provided the conditions in paragraph (b) below are met:

(1) Non-tidal rivers, streams and their impoundments including adjacent wetlands that are located above the headwaters;

(2) Natural lakes, including their adjacent wetlands, that are less than 10 acres in surface area and that are fed or drained by a river or stream above the headwaters. In the absence of adjacent wetlands, the surface area of a lake shall be determined at the ordinary high water mark;

(3) Natural lakes, including their adjacent wetlands, that are less than 10 acres in surface area and that are isolated and not a part of a surface river or stream. In the absence of adjacent wetlands, the surface area of a lake shall be determined at the ordinary high water mark; and

(4) Other non-tidal waters of the United States other than isolated lakes larger than 10 acres (see (3) above) that are not part of a surface tributary system to interstate waters or navigable waters of the United States (see § 323.2 (a)(5)).

(b) For purposes of Section 404, the following conditions must be satisfied for any discharge of dredged or fill material in waters described in paragraph (a), above:

(1) That the discharge will not destroy a threatened or endangered species as identified under the Endangered Species Act, or endanger the critical habitat of such species;

(2) That the discharge will consist of suitable material free from toxic pollutants in other than trace quantities;

(3) That the fill created by the discharge will be properly maintained to prevent erosion and other non-point sources of pollution; and

(4) That the discharge will not occur in a component of the National Wild and Scenic Rivers System or in a component of a State wild and scenic river system.

§ 323.4–3 Specific categories of discharges.

(a) The following discharges of dredged or fill material into waters of the United States are hereby permitted for purposes of Section 404, provided the conditions specified in this paragraph and paragraph (b) below are met:

(1) Dredged or fill material placed as backfill or bedding for utility line crossings provided there is no change in preconstruction bottom contours (excess material must be removed to an upland disposal area). A "utility line" is defined as any pipe or pipeline for the transportation of any gaseous, liquid, liquifiable, or slurry substance, for any purpose, and any cable, line, or wire for the transmission for any purpose of electrical energy, telephone and telegraph messages, and radio and television communication. (The utility line will require a Section 10 permit if in navigable waters of the United States. See 33 CFR Part 322.);

(2) Material discharged for bank stabilization, provided that the bank stabilization activity is less than 500 feet in length, is necessary for erosion prevention, and is limited to less than an average of one cubic yard per running foot along the bank, provided further that no material for bank stabilization is placed in any wetland area, and provided further that no material is placed in any locality or in any manner so as to impair surface water flow into or out of any wetland area. (This activity will require a Section 10 permit if in navigable waters of the United States. See 33 CFR part 322.);

(3) Minor road crossing fills including all attendant features both temporary and permanent that are part of a single and complete crossing of a nontidal waterbody, provided that the crossing is culverted or bridged to prevent the restriction of expected high flows and provided further that discharges into any wetlands adjacent to the waterbody do not extend beyond 100 feet on either side of the ordinary high water mark of that waterbody. A "minor road crossing fill" is defined as a crossing that involves the discharge of less than 200 cubic yards of fill material below the plane of ordinary high water. The crossing will require a permit from the US Coast Guard if located in navigable waters of the United States (see 33 USC 401);

(4) Fill placed incidental to the construction of bridges across tidal waters including cofferdams, abutments, foundation seals, piers, and temporary construction and access fills. Approach fills and causeways are not included in this permit and will require an individual or general Section 404 permit if located in waters of the United States; these fills as well as the bridge itself will also require a permit from the U.S. Coast Guard; and

(5) The repair, rehabilitation or replacement of any previously authorized, currently serviceable fill, or of any currently serviceable fill discharged prior to the requirement for authorization; provided such repair, rehabilitation or replacement does not result in a deviation from the specifications of the original work, and further provided that the fill to be maintained has not been put to uses differing from uses specified for it in any permit authorizing its original construction.

(b) For the purposes of Section 404, the following conditions must be satisfied prior to any discharge of dredged or fill material associated with the activities described above:

(1) That the discharge will not be located in the proximity of a public water supply intake;

(2) That the discharge will not occur in areas of concentrated shellfish production;

(3) That the discharge will not destroy a threatened or endangered species as identified under the Endangered Species Act, or endanger the critical habitat of such species;

(4) That the discharge will not disrupt the movement of those species of aquatic life indigenous to the waterbody;

(5) That the discharge will consist of suitable material free from toxic pollutants in other than trace quantities;

(6) That the fill created by the discharge will be properly maintained to prevent erosion and other non-point sources of pollution; and

(7) That the discharge will not occur in a component of the National Wild and Scenic River System or in a component of a State wild and scenic river system.

§ 323.4–4 Discretionary authority to require individual or general permits.

Notwithstanding the provisions of §§ 323.4–1, 323.4–2 and 323.4–3, above, the procedures of this regulation and 33 CFR Part 325, including those pertaining to individual and general permits, shall apply to any discharge(s) of dredged or fill material if the District Engineer determines that the concerns of the aquatic environment, as expressed in the guidelines (see 40 CFR Part 230) indicate the need for such action because of individual and/or cumulative adverse impacts to the affected waters. In such cases, he shall take such steps as are necessary to notify persons who would be affected by such action. If the Regional Administrator, EPA, advises the District Engineer that the concerns for the aquatic environment as expressed in the Section 404(b) Guidelines require assertion of jurisdiction under § 323.4–4, and the District Engineer and Division Engineer disagree, the Office of the Chief of Engineers (DAEN CWO–N and DAEN–CCH) shall be notified for further coordination and resolution with the Administrator.

§ 323.5 Special policies and procedures.

The Secretary of the Army has delegated to the Chief of Engineers the authority to issue or deny Section 404 permits. (See Appendix A.) The following additional special procedures shall also be applicable to the evaluation of permit applications under this regulation:

(a) *EPA Guidelines.* Applications for permits for the discharge of dredged or fill material into waters of the United States will be reviewed in accordance with guidelines promulgated by the Administrator, EPA, under authority of Section 404(b) of the Federal Water Pollution Control Act. (See 40 CFR Part 230.) If the EPA guidelines alone prohibit the designation of a proposed disposal site, the economic impact on navigation and anchorage of the failure to authorize the use of the proposed disposal site will also be considered in evaluating whether or not the proposed discharge is in the public interest.

(b) *Coordination with EPA.* Prior to actual issuance of permits for the discharge of dredged or fill material in waters of the United States, Corps of Engineers officials will advise appropriate Regional Administrators, EPA, of the intent to issue permits to which EPA has objected, recommended conditions, or for which significant changes are proposed. If the Regional Administrator advises, within fifteen days of the advice of the intent to issue, that he objects to the issuance of the permits, the case will be forwarded to the Chief of Engineers in accordance with 33 CFR 325.11 for further coordination with the Administrator, EPA, and decision. The report forwarding the case will contain an analysis of the economic impact on navigation and anchorage that would occur by failing to authorize the use of a proposed disposal site, and whether there are other economically feasible methods or sites available other than those to which the Regional Administrator objects.

APPENDIX A.—DELEGATION OF AUTHORITY TO ISSUE OR DENY PERMITS FOR THE DISCHARGE OF DREDGED OR FILL MATERIAL INTO NAVIGABLE WATERS

MARCH 12, 1973.

Pursuant to the authority vested in me by Section 404 of the Federal Water Pollution Control Act Amendments of 1972, 86 Stat. 816, P.L. 92–500, I hereby authorize the Chief of Engineers and his authorized representatives to issue or deny permits, after notice and opportunity for public hearings, for the discharge of dredged or filled material into navigable waters at specified disposal sites. The Chief of Engineers shall, in exercising such authority, evaluate the impact of the proposed discharge on the public interest. All permits issued shall specify a disposal site for the discharge of the dredged or fill material through the application of guidelines developed by the Administrator of the Environmental Protection Agency and myself. In those cases where these guidelines would prohibit the specification of a disposal site, the Chief of Engineers, in his evaluation of whether the proposed discharge is in the public interest, is authorized also to consider the economic impact on navigation and anchorage which would occur by failing to authorize the use of a proposed disposal site. The permits so granted may be made subject to such special conditions as the Chief of Engineers or his authorized representatives may consider necessary in order to effect the purposes of the above Act, other pertinent laws and any applicable memoranda of understanding between the Secretary of the Army and heads of other governmental agencies.

The Chief of Engineers and his authorized representative shall exercise the authority hereby delegated subject to such conditions as I or my authorized representative may from time to time impose.

KENNETH E. BELIEU,
Acting Secretary of the Army.

PART 324—PERMITS FOR OCEAN DUMPING OF DREDGED MATERIAL

Sec.
324.1 General.
324.2 Definitions.
324.3 Activities requiring permits.
324.4 Special procedures.
Appendix A.—Delegation of authority.

AUTHORITY: 33 U.S.C. 1413.

§ 324.1 General.

This regulation prescribes in addition to the general policies of 33 CFR 320.4 and procedures of 33 CFR Part 325, those special policies, practices and procedures to be followed by the Corps of Engineers in connection with the review of applications for Department of the Army permits to authorize the transportation of dredged material by vessel for the purpose of dumping it in ocean waters at dumping sites designated under 40 CFR Part 228 pursuant to Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended (33 USC 1413) (hereinafter referred to as Section 103). See 33 CFR 320.2(h). Activities involving the transportation of dredged material for the purpose of dumping in the ocean waters also require Department of the Army permits under Section

10 of the River and Harbor Act of 1899 (33 USC 403) for the dredging in navigable waters of the United States. Applicants for Department of the Army permits under this Part should also refer to 33 CFR Part 322 to satisfy the requirements of Section 10.

§ 324.2 Definitions.

For the purpose of this regulation, the following terms are defined:

(a) The term "ocean waters" means those waters of the open seas lying seaward of the base line from which the territorial sea is measured, as provided for in the Convention on the Territorial Sea and the Contiguous Zone (15 UST 1606; TIAS 5639).

(b) The term "dredged material" means any material excavated or dredged from navigable waters of the United States or ocean waters.

(c) The term "transport" or "transportation" refers to the carriage and related handling of dredged material by a vessel.

§ 324.3 Activities requiring permits.

(a) *General.* Department of the Army permits are required for the transportation of dredged material for the purpose of dumping it in ocean waters.

(b) *Activities of Federal agencies.* (1) The transportation of dredged material for the purpose of dumping in ocean waters done by or on behalf of any Federal agency other than the activities of the Corps of Engineers are subject to the procedures of this regulation. Agreement for construction or engineering services performed for other agencies by the Corps of Engineers does not constitute authorization under the regulation. Division and District Engineers will therefore advise Federal agencies accordingly and cooperate to the fullest extent in the expeditious processing of their applications. The activities of the Corps of Engineers that involve the transportation of dredged material for dumping in ocean waters are regulated by 33 CFR 209.145.

(2) The policy provisions set out in 33 CFR 320.4(j) relating to State or local authorizations do not apply to work or structures undertaken by Federal agencies, except where compliance with non-Federal authorization is required by Federal law or Executive policy. Federal agencies are required to comply with the substantive State, interstate, and local water-quality standards and effluent limitations as are applicable by law that are adopted in accordance with or effective under the provisions of the Marine Protection, Research and Sanctuaries Act of 1972, as amended, and related laws in the design, construction, management, operation, and maintenance of their respective facilities. (See Executive Order No. 11752, dated 17 Dec 73.) They are not required, however, to obtain and provide certification of compliance with effluent limitations and water-quantity standards from State or interstate water pollution control agencies in connection with activities involving discharges into ocean waters.

§ 324.4 Special procedures.

The Secretary of the Army has delegated to the Chief of Engineers the authority to issue or deny Section 103 permits. (See Appendix A.) The following additional procedures shall also be applicable under this regulation.

(a) *Public notice.* For all applications for Section 103 permits, the District Engineer will issue a public notice which shall contain, in addition to the information specified in 33 CFR 325.3, the following information:

(1) The location of the proposed disposal site and its physical boundaries;

(2) A statement as to whether the site has been designated for use by the Administrator, EPA, pursuant to Section 102(c) of the Act;

(3) If the proposed disposal site has not been designated by the Administrator, EPA a description of the characteristics of the proposed disposal site and an explanation as to why no previously designated disposal site is feasible;

(4) A brief description of known dredged material discharges at the proposed disposal site;

(5) Existence and documented effects of other authorized dumpings that have been made in the dumping area (e.g., heavy metal background reading and organic carbon content);

(6) An estimate of the length of time during which disposal will continue at the proposed site;

(7) Characteristics and composition of the dredged material; and

(8) A statement concerning a preliminary determination of the need for and/or availability of an environmental impact statement.

(b) *Evaluation.* Applications for permits for the transportation of dredged material for the purpose of dumping it in ocean waters will be evaluated to determine whether the proposed dumping will unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems or economic potentialities. In making this evaluation, criteria established by the Administrator, EPA, pursuant to Section 102 of the Marine Protection Research and Sanctuaries Act of 1972, as amended, shall be applied including an evaluation of the need for the ocean dumping and including the availability of alternatives to ocean dumping. Where ocean dumping is determined to be necessary, the District Engineer will, to the extent feasible, specify disposal sites using the recommendations of the Administrator pursuant to Section 102(c) of the Act. See 40 CFR Parts 220 to 229.

(c) *EPA review.* If the Regional Administrator, EPA, advises the District Engineer that the proposed dumping will comply with the criteria the District Engineer shall complete his evaluation of the Section 103 application under this regulation and 33 CFR Parts 320 and 325. If, however, the Regional Administrator advises the District Engineer that the proposed dumping will not comply with the Criteria, the District Engineer will proceed as follows.

(1) The District Engineer shall determine whether there is an economically feasible alternative method or site available other than the proposed ocean disposal site. If there are other feasible alternative methods or sites available, the District Engineer shall evaluate them in accordance with 33 CFR Parts 320, 322, 323, 325 and this regulation, as appropriate.

(2) If the District Engineer makes a determination that there is no economically feasible alternative method or site available, he shall so advise the Regional Administrator of his intent to issue the permit setting forth his reasons for such determination.

(d) *EPA objection.* If the Regional Administrator advises, within 15 days of the notice of the intent to issue, that he still objects to the issuance of the permit, the case will be forwarded to the Chief of Engineers, for further coordination with the Administrator, EPA, and decision. The report forwarding the case will contain, in addition to the analysis required by 33 CFR 325.11, an analysis of whether there are other economically feasible methods or sites available to dispose of the dredged material.

(e) *Chief of Engineers review.* The Chief of Engineers shall evaluate the permit application and make a decision to deny the permit or recommend its issuance. If the decision of the Chief of Engineers is that ocean dumping at the proposed disposal site is required because of the unavailability of economically feasible alternatives, he shall so certify and request that the Secretary of the Army seek a waiver from the Administrator, EPA, of the Criteria or of the critical site designation in accordance with 40 CFR 225.4.

APPENDIX A—DELEGATION OF AUTHORITY TO ISSUE OR DENY PERMITS FOR THE TRANSPORTATION OF DREDGED MATERIAL FOR THE PURPOSE OF DUMPING IT INTO OCEAN WATERS

MARCH 12, 1973.

Pursuant to the authority vested in me by Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972, 86 Stat. 1052, Pub. L. 92-532, I hereby authorize the Chief of Engineers and his authorized representatives to issue or deny permits, after notice and opportunity for public hearings, for the transportation of dredged material for the purpose of dumping it in ocean waters. The Chief of Engineers and his authorized representatives shall, in exercising such authority, evaluate the impact of the proposed dumping on the public interest. No permit shall be issued unless a determination is made that the proposed dumping will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities. In making this determination, those criteria for ocean dumping established by the Administrator of the Environmental Protection Agency pursuant to Section 102 (a) of the above Act which relate to the effects of the proposed dumping shall be applied. In addition, based upon an evaluation of the potential effect which a permit denial will have on navigation, economic and industrial development, and foreign and domestic commerce of the United States, the Chief of Engineers or his authorized representatives, in evaluating the permit appli-

cation, shall make an independent determination as to the need for the dumping, other possible methods of disposal, and appropriate locations for the dumping. In considering appropriate disposal sites, recommended sites designated by the Administrator of the Environmental Protection Agency pursuant to Section 102(c) of the above Act will be utilized to the extent feasible. Prior to issuing any permit, the Chief of Engineers or his authorized representatives shall first notify the Administrator of the Environmental Protection Agency or his authorized representative of his intention to do so. In any case in which the Administrator or his authorized representative disagrees with the determination of the Chief of Engineers or his authorized representative as to compliance with the criteria established pursuant to Section 102(a) of the above Act relating to the effects of the dumping or with the restrictions established pursuant to Section 102(c) of the above Act relating to critical areas, the determination of the Administrator or his authorized representative shall prevail. If, in any such case, the Chief of Engineers or his Director of Civil Works finds that, in the disposition of dredged material, there is no economically feasible method or site available other than a dumping site the utilization of which would result in noncompliance with such criteria or restrictions, he shall so certify and request that I seek a waiver from the Administrator of the Environmental Protection Agency of the specific requirements involved. Unless the Administrator of the Environmental Protection Agency grants a waiver, the Chief of Engineers or his authorized representatives shall not issue a permit which does not comply with such criteria and restrictions. The permits so granted may be made subject to such special conditions as the Chief of Engineers or his authorized representatives may consider necessary in order to effect the purposes of the above Act, other pertinent laws, and any applicable memoranda of understanding between the Secretary of the Army and the heads of other governmental agencies.

The Chief of Engineers and his authorized representative shall exercise the authority hereby delegated subject to such conditions as I or my authorized representative may from time to time impose.

KENNETH E. BELIEU,
Acting Secretary of the Army.

PART 325—PROCESSING OF DEPARTMENT OF THE ARMY PERMITS

Sec.

AUTHORITY: 33 U.S.C. 401 et seq.; 33 U.S.C. 1344; 33 U.S.C. 1413.

§ 325.1 Applications for permits.

(a) *General.* The processing procedures of this regulation (Part 325) apply to any form of Department of the Army permit. Special procedures and additional information are contained in Parts 320 through 324. This Part is arranged in the basic timing sequence used by the Corps of Engineers in processing Department of the Army permits.

(b) *Application form.* Any person proposing to undertake any activity requiring Department of the Army authorization as specified in 33 CFR 321-324 must apply for a permit to the District Engineer in charge of the District where the proposed activity is to be performed. Applications for permits must be prepared in accordance with instructions in Engineer Pamphlet 1145-2-1, "A Guide for Applicants," utilizing the prescribed application form (ENG Form 4345). The form and pamphlet may be obtained from the District Engineer having jurisdiction over the waterway in which the proposed activity will be located. Local variations of the application form for purposes of facilitating coordination with State and local agencies may be used.

(c) *Content of application.* (1) Generally, the application must include a complete description of the proposed activity including necessary drawings, sketches or plans; the location, purpose and intended use of the proposed activity; scheduling of the activity; the names and addresses of adjoining property owners; the location and dimensions of adjacent structures; and the approvals required by other Federal, interstate, State or local agencies for the work, including all approvals received or denials already made.

(2) If the activity involves dredging in waters of the United States, the application must include a description of the type, composition and quantity of the material to be dredged, the method of dredging, and the site and plans for disposal of the dredged material.

(3) If the activity includes the discharge of dredged or fill material in the waters of the United States or the transportation of dredged material for the purpose of dumping it in ocean waters, the application must include the source of the material; a description of the type, composition and quantity of the material; the method of transportation and disposal of the material; and the location of the disposal site. (See Part 324 for additional information requirements on ocean dumping applications.) Certification under Section 401 of the Federal Water Pollution Control Act is required for such discharges into waters of the United States.

(4) If the activity includes the construction of a fill or pile or float-supported platform, the project description must include the use and specific structures to be erected on the fill or platform.

(d) *Additional information.* In addition to the information indicated in subparagraph (c), above, the applicant will be required to furnish such additional information as the District Engineer may deem necessary to assist him in his evaluation of the application. Such additional information may include environmental data and information on alternate methods and sites, as may be necessary for the preparation of the Environmental Assessment or Environmental Impact Statement (see § 325.4).

(e) *Signature of application.* The application must be signed by the person who desires to undertake the proposed activity; however, the application may be signed by a duly authorized agent if accompanied by a statement by that person designating the agent and agreeing to furnish, upon request, supplemental information in support of the application. In either case, the signature of the applicant will be understood to be an affirmation that he possesses the authority to undertake the activity proposed in his application, except where the lands are under the control of the Corps of Engineers, in which cases the District Engineer will coordinate the transfer of the real estate and the permit action. When the application is submitted by an agent, the application may include the activity of more than one owner provided the character of the activity of each owner is similar and in the same general area.

(f) *Fees.* Fees are required for permit applications under Section 404 of the Federal Water Pollution Control Act Amendments of 1972, Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended, and Sections 9 and 10 of the River and Harbor Act of 1899. A fee of $100.00 will be charged when the planned or ultimate purpose of the project is commercial or industrial in nature and is in support of operations that charge for the production, distribution or sale of goods or services. A $10.00 fee will be charged for permit applications when the work is non-commercial in nature and provides personal benefits that have no connection with a commercial enterprise. The final decision as to basis for fee (commercial vs. non-commercial) shall be solely the responsibility of the District Engineer. No fee will be charged if the applicant withdraws his application at any time prior to issuance of the permit and/or if his application is denied. Collection of the fee will be deferred until the applicant is notified by the District Engineer that a public interest review has been completed and that the proposed activity has been determined to be in the public interest. Upon receipt of this notification the applicant will forward a check or money order to the District Engineer, made payable to the Treasurer of the United States. The permit will then be issued upon receipt of the application fee. Multiple fees are not to be charged if more than one law is applicable. Any modification significant enough to require a permit will also require a fee. No fee will be assessed when a permit is transferred from one property owner to another. No fees will be charged for time extensions or general permits. Agencies or instrumentalities of Federal, State or local governments will not be required to pay any fee in connection with the applications for permits. This fee structure will be reviewed from time to time.

§ 325.2 Processing of applications.

(a) *Standard procedures.* (1) When an application for a permit is received, the District Engineer shall immediately assign it a number for identification, acknowledge receipt thereof, and advise the applicant of the number assigned to it. He shall review the application for completeness, and obtain from the applicant any additional information he deems necessary for further processing.

(2) When all required information has been provided, the District Engineer will issue a public notice as described in § 325.3, below, unless specifically exempted by other provisions of this regulation.

(3) The District Engineer shall consider all comments received in response to the public notice (see § 325.3) in his subsequent actions on the permit application. Receipt of the comments will be acknowledged and they will be made a part of the official file on the application. Comments received as form letters or petitions may be acknowledged as a group to the person or organization responsible for the form letter or petition. If comments relate to matters within the special expertise of another Federal agency, the District Engineer may seek the advice of that agency. The applicant must be given the opportunity to furnish the District Engineer his proposed resolution or rebuttal to all objections from Government agencies and other substantive adverse comments before final decision will be made on the application.

(4) The District Engineer shall prepare an Environmental Assessment on all applications. The Environmental Assessment shall be dated, signed, and placed in the record and shall include the expected environmental impacts of the proposal. Where the District Engineer has delegated authority to sign permits for and in his behalf, he may similarly delegate the signing of the Environmental Assessment. In those cases requiring an Environmental Impact Statement (EIS), the draft EIS may serve as the Environmental Assessment. Where an EIS is not prepared, the Environmental Assessment will include a statement that the decision on the application is not a major Federal action significantly affecting the quality of the human environment.

(5) The District Engineer shall also evaluate the proposed application to determine the need for a public hearing pursuant to 33 CFR Part 327.

(6) After all above actions have been completed, the District Engineer will determine in accordance with the record and applicable regulations whether or not the permit should be issued. He shall prepare a Findings of Fact on all applications to support his determination. The Findings of Fact shall include the District Engineer's views on the probable effect of the proposed work on the public interest including conformity with the guidelines published for the discharge of dredged or fill material in waters of the United States (40 CFR Part 230) or with the criteria for dumping of dredged material in ocean waters (40 CFR Parts 220 to 229), if applicable, and the conclusions of the District Engineer. The Findings of Fact shall be dated, signed, and included in the record prior to final action on the application. Where the District Engineer has delegated authority to sign permits for and in his behalf, he may similarly delegate the signing of the Findings of Fact. If a permit is warranted, the District Engineer will determine the conditions and duration which should be incorporated into the permit. In accordance with the authorities specified in § 325.8, the District Engineer will take final action or forward the application with all pertinent comments, records, and studies, including the final Environmental Impact Statement, if prepared, through channels to the official authorized to make the final decision. The report forwarding the application for decision will be in the format prescribed in § 325.11. Notice that the application has been forwarded to higher headquarters will be furnished the applicant and to any Federal agency expressing an interest in the application. Such notice shall not divulge the District Engineer's recommendations. In those cases where the application is forwarded for decision in the format prescribed in § 325.11, the report will serve as the Findings of Fact.

(7) If the final decision is to deny the permit, the applicant will be advised in writing of the reason for denial. If the final decision is to issue the permit, the issuing official will forward two copies of the draft permit to the applicant for signature accepting the conditions of the permit. The applicant will return both signed copies to the issuing official who then signs and dates the permit. The permit is not valid until signed by the issuing official. Final action on the permit application is the signature on the letter notifying the applicant of the denial of his application or signature of the issuing official on the authorizing document.

(8) The District Engineer will publish monthly a list of permits issued or denied during the previous month. The list will identify each action by public notice number, name of applicant, and brief description of activity involved. This list will be distributed to all persons who received any of the public notices listed.

(9) If the applicant fails to respond within 45 days to any request or inquiry of the District Engineer, the District Engineer may advise the applicant by certified letter that his application will be considered as having been withdrawn unless the applicant responds thereto within thirty days of the date of the letter.

(b) *Procedures for particular types of permit situations.* (1) If the District Engineer determines that water quality certification for the proposed activity is necessary under the provisions of the Federal Water Pollution Control Act, he shall so notify the applicant and obtain from him either the appropriate certification or a copy of his application for such certification. The District Engineer may issue the public notice of the application jointly with the certifying agency if arrangements for such joint notices have been approved by the Division Engineer. When the activity may affect the waters of another State, a copy of the certification will be forwarded to the Regional Administrator of EPA who shall determine if the proposed activity may affect the quality of the waters of any State or States other than the State in which the work is to be performed. If he needs supplemental information in order to make this determination, the Regional Administrator may request it from the District Engineer who shall obtain it from the applicant and forward it to the Regional Administrator. The Regional Administrator shall, within thirty days of receipt of the application, certification and supplemental information, notify the affected State, the District Engineer, and the applicant in the event such a second State may be affected. The second State then has sixty days to advise the District Engineer that it objects to the issuance of the permit on the basis of the effect on the quality of its waters and to request a hearing. No authorization will be granted until required certification has been obtained or has been waived. Waiver is deemed to occur if the certifying agency fails or refuses to act on a request for certification within a reasonable period of time after receipt of such request. The request for certification must be made in accordance with the regulations of the certifying agency. In determining whether or not a waiver period has commenced, the District Engineer will verify that the certifying agency has received a valid request for certification. Three months shall generally be considered to be a reasonable period of time. If, however, special circumstances identified by the District Engineer require that action on an application be taken within a more limited period of time, the District Engineer shall determine a reasonable lesser period of time, advise the certifying agency of the need for action by a particular date and that, if certification is not received by that date, it will be considered that the requirement for certification has been waived. Similarly if it appears that circumstances may reasonably require a period of time longer than three months, the District Engineer may afford the certifying agency up to one year to provide the required certification before determining that a waiver has occurred. District Engineers shall check with the certifying agency at the end of the allotted period of time before determining that a waiver has occurred.

(2) If the proposed activity is to be undertaken in a State operating under a coastal zone management program approved by the Secretary of Commerce pursuant to the Coastal Zone Management Act (see 33 CFR 320.3(b)), the District Engineer shall proceed as follows:

(i) If the applicant is a Federal agency, and the application involves a Federal activity in or affecting the coastal zone or a Federal development project in the coastal zone, the District Engineer shall forward a copy of the public notice to

the agency of the State responsible for reviewing the consistency of Federal activities. The Federal agency applicant shall be responsible for complying with the Coastal Zone Management Act's directives for ensuring that Federal agency activities are undertaken in a manner which is consistent, to the maximum extent practicable, with approved coastal zone management programs. (See 15 CFR Part 930.) If the State coastal zone agency objects to the proposed Federal activity on the basis of its inconsistency with the State's approved coastal zone management program, the District Engineer shall not make a final decision on the application until the disagreeing parties have had an opportunity to utilize the procedures specified by the Coastal Zone Management Act for resolving such disagreements.

(ii) If the applicant is not a Federal agency and the application involves an activity affecting the coastal zone, the District Engineer shall obtain from the applicant a certification that his proposed activity complies with and will be conducted in a manner that is consistent with the approved State coastal zone management program. Upon receipt of the certification, the District Engineer will forward a copy of the public notice (which will include the applicant's certification statement) to the State coastal zone agency and request its concurrence or objection. The District Engineer can issue the public notice of the application jointly with the State agency if arrangements for such joint notices have been approved by the Division Engineer. If the State agency objects to the certification or issues a decision indicating that the proposed activity requires further review, the District Engineer shall not issue the permit until the State concurs with the certification statement or the Secretary of Commerce determines that the proposed activity is consistent with the purposes of the Coastal Zone Management Act or is necessary in the interest of national security. If the State agency fails to concur or object to a certification statement within six months of the State agency's receipt of the certification statement, State agency concurrence with the certification statement shall be conclusively presumed.

(3) If the proposed activity involves any property listed or eligible for listing in the National Register of Historic Places (which is published in its entirety in the FEDERAL REGISTER annually in February with addenda published each month), the District Engineer will proceed in accordance with 33 CFR Part 305.

(4) If the proposed activity consists of the dredging of an access channel and/or berthing facility associated with an authorized Federal navigation project, the activity will be included in the planning and coordination of the construction or maintenance of the Federal project to the maximum extent feasible. Separate notice, hearing, and Environmental Impact Statement will not be required for activities so included and coordinated; and the public notice issued by the District Engineer for these Federal and associated non-Federal activities will be the notice of intent to issue permits for those included non-Federal dredging activities. The decision whether to issue or deny such a permit will be consistent with the decision on the Federal project unless special considerations applicable to the proposed activity are identified. (See § 322.5(a).)

(5) Copies of permits will be furnished to other agencies in appropriate cases as follows:

(i) If the activity involves the construction of structures or artificial islands on the outer continental shelf, to the Director, Defense Mapping Agency, Hydrographic Center, Washington, D.C. 20390; Attention, Code N512 and to the Director, National Ocean Survey, NOAA, Department of Commerce, Rockville, Maryland 20852.

(ii) If the activity involves the construction of structures to enhance fish propagation (fish havens) along the coasts of the United States, to Defense Mapping Agency, Hydrographic Center and National Ocean Survey as in (i), above, and to the Director, Office of Marine Recreational Fisheries, National Marine Fisheries Service, Washington, D.C. 20235.

(iii) If the activity involves the erection of an aerial transmission line across a navigable water of the United States, to the Director, National Ocean Survey, NOAA, Department of Commerce, Rockville, Maryland 20852, reference C322.

(iv) If the activity is listed in subparagraphs (i), (ii), or (iii), above, or involves the transportation of dredged material for the purpose of dumping it in ocean waters, to the appropriate District Commander, U.S. Coast Guard.

(c) *Emergency procedures.* An "emergency" is a situation which would result in an unacceptable hazard to life or severe loss of property if corrective action requiring a permit is not undertaken within a time period less than the normal time needed to process the application under required procedures. In such cases the District Engineer will explain the circumstance and recommend special procedures in writing to the Chief of Engineers, ATTN: DAEN-CWO-N. The Chief of Engineers, upon consultation with the Secretary of the Army or his authorized representative, will instruct the District Engineer as to further processing of the application.

(d) *Timing of processing of applications.* In view of the extensive coordination with other agencies and the public and the study of all aspects of proposed activities required by the above procedures, applicants must allow adequate time for the processing of their applications. The District Engineer will be guided by the following time limits for the indicated steps in processing permit applications:

(1) Public notice should be issued within fifteen days of receipt of all required information from the applicant, unless joint notice with State agencies is to be used.

(2) The receipt of comments as a result of the public notice should not extend beyond thirty days from the date of the notice. However, if unusual circumstances warrant, the District Engineer may extend the comment period up to a maximum of seventy-five days.

(3) The District Engineer should either send notice of denial to the applicant or issue the draft permit to the applicant for acceptance and signature, or forward the application to higher headquarters within thirty days of one of the following whichever is latest: Closing of the public notice comment period with no objections received; receipt of notice of withdrawal of objections; completion of coordination following receipt of applicant's rebuttal of objections; closing of the record of a public hearing; or expiration of the waiting period following the filing of the final Environmental Impact Statement with CEQ.

§ 325.3 *Public notice.*

(a) *General.* The Public notice is the primary method of advising all interested parties of the proposed activity for which a permit is sought and of soliciting comments and information necessary to evaluate the probable impact on the public interest. The notice must, therefore, include sufficient information to give a clear understanding of the nature of the activity to generate meaningful comments. The notice should include the following items of information:

(1) Applicable statutory authority or authorities;

(2) The name and address of the applicant;

(3) The location of the proposed activity;

(4) A brief description of the proposed activity, its purpose and intended use, including a description of the type of structures, if any, to be erected on fills, or pile or float-supported platforms, and a description of the type, composition and quantity of materials to be discharged or dumped and means of conveyance. See also 33 CFR 324 for additional information required on ocean dumping public notices;

(5) A plan and elevation drawing showing the general and specific site location and character of all proposed activities, including the size relationship of the proposed structures to the size of the impacted waterway and depth of water in the area;

(6) If the proposed activity would occur in the territorial seas or ocean waters, a description of the activity's relationship to the baseline from which the territorial sea is measured;

(7) A list of other government authorizations obtained or requested, including required certifications relative to water quality, coastal zone management, or marine sanctuaries;

(8) A statement concerning a preliminary determination of the need for and/or availability of an Environmental Impact Statement;

(9) Any other available information which may assist interested parties in evaluating the likely impact of the proposed activity, if any, on factors affecting the public interest, including environmental values; and

(10) A reasonable period of time, normally thirty days but not less than fifteen days from date of mailing, within which interested parties may express their views concerning the permit application.

(b) *Evaluation factors.* A paragraph describing the various factors on which decisions are based during evaluation of a permit application shall be included in every public notice.

(1) Except as provided in paragraph (b)(4) below, the following will be included:

The decision whether to issue a permit will be based on an evaluation of the probable impact of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefit which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered; among those are conservation, economics, aesthetics, general environmental concerns, historic values, fish and wildlife values, flood damage prevention, land use, navigation, recreation, water supply, water quality, energy needs, safety, food production and, in general, the needs and welfare of the people.

(2) If the activity involves the discharge of dredged or fill material into the waters of the United States or the transportation of dredged material for the purpose of dumping it in ocean waters, the public notice shall also indicate that the evaluation of the impact of the activity on the public interest will include application of the guidelines promulgated by the Administrator, EPA, under authority of Section 404(b) of the Federal Water Pollution Control Act (40 CFR Part 230) or of the criteria established under authority of Section 102(a) of the Marine Protection, Research and Sanctuaries Act of 1972, as amended (40 CFR Parts 220 to 228), as appropriate. See also 33 CFR Part 324.

(3) If the activity includes the discharge of dredged or fill material in the waters of the United States or the transportation of dredged material for the purpose of dumping it in ocean waters, the following statement will also be included in the public notice:

Any person may request, in writing, within the comment period specified in this notice, that a public hearing be held to consider this application. Requests for public hearings shall state, with particularity, the reasons for holding a public hearing.

(4) In cases involving construction of fixed structures or artificial islands on Outer Continental Shelf lands which are under mineral lease from the Department of the Interior, the notice will contain the following statement: "The decision as to whether a permit will be issued will be based on an evaluation of the impact of the proposed work on navigation and national security."

(c) *Distribution of public notices.* (1) Public notices will be distributed for posting in post offices or other appropriate public places in the vicinity of the site of the proposed work and will be sent to the applicant, to appropriate city and county officials, to adjoining property owners, to appropriate State agencies, to concerned Federal agencies, to local, regional and national shipping and other concerned business and conservation organizations, to appropriate River Basin Commissions, and to any other interested party. If in the judgment of the District Engineer the proposal may result in substantial public interest, the public notice (without drawings) may be published for five consecutive days in the local newspaper, and the applicant shall reimburse the District Engineer for the costs of publication. Copies of public notices will be sent to all parties who have specifically requested copies of public notices, to the U.S. Senators and Representatives for the area where the work is to be performed, the Field Representatvie of the Secretary of the Interior, the Regional Director of the Fish and Wildlife Service, the Regional Director of the National Park Service, the Regional Administrator of the Environmental Protection Agency (EPA), the Regional Director of the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration (NOAA), the head of the State agency responsible for fish and wildlife resources, and the District Commander, U.S. Coast Guard.

(2) In addition to the general distribution of public notices cited above, notices will be sent to other addresses in appropriate cases as follows:

(i) If the activity involves structures or dredging along the shores of the sea or Great Lakes, to the Coastal Engineering Research Center, Washington, D.C. 20016.

(ii) If the activity involves construction of fixed structures or artificial islands on the Outer Continental Shelf or in the territorial seas, to the Deputy Assistant Secretary of Defense (Installations and Housing), Washington, D.C. 20310; the Director, Defense Mapping Agency, Hydrographic Center, Washington, D.C. 20390, Attention, Code N512; and the Director, National Ocean Survey, NOAA, Department of Commerce, Rockville, Maryland 20852.

(iii) If the activity involves the construction of structures to enhance fish propagation along the Atlantic, Pacific, and Gulf coasts, to the Director, Office of Marine Recreational Fisheries, National Marine Fisheries Service, Washington, D.C. 20235.

(iv) If the activity involves the construction of structures which may affect aircraft operations or for purposes associated with seaplane operations, to the Regional Director of the Federal Aviation Administration.

(v) If the activity is in connection with a foreign-trade zone, to the Executive Secretary, Foreign-Trade Zones Board, Department of Commerce, Washington, D.C. 20230 and to the appropriate District Director of Customs as Resident Representative, Foreign-Trade Zones Board.

(3) It is presumed that all interested parties and agencies will wish to respond to public notices; therefore, a lack of response will be interpreted as meaning that there is no objection to the application. A copy of the public notice with the list of the addressees to whom the notice was sent will be included in the record. If a question develops with respect to an activity for which another agency has responsibility and that other agency has not responded to the public notice, the District Engineer may request their comments. Whenever a response to a public notice has been received from a member of Congress, either in behalf of a constituent or himself, the District Engineer will inform the member of Congress of the final decision.

(d) *General permit notices (RCS: DAEN-CWO-52).* For purposes of performing a nationwide analysis of the effectiveness of the general permit program, Division offices will submit "Public Notices on General Permits" reports (RCS: DAEN-CWO-52) by COB on the 15th day, following the end of each quarter, to HQDA (DAEN-CWO-N) Washington, D.C. 20314. Said reports will be in the form of a letter listing the public notices published during the previous month to announce proposals or to finalize issuances of general permits; copies of the public notices are to be made inclosures to the reports. Negative reports will be submitted if no general permit actions have taken place in the Division during the reporting period.

§ 325.4 Environmental impact statements.

(a) *General.* Section 102(2)(c) of the National Environmental Policy Act of 1969 (NEPA) requires all Federal agencies, with respect to major Federal actions significantly affecting the quality of the human environment, to submit to the President's Council on Environmental Quality a detailed statement on:

(1) The environmental impact of the proposed actions.

(2) Any adverse environmental effects which cannot be avoided should the proposal be implemented.

(3) Alternatives to the proposed action.

(4) The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity.

(5) Any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented. The District Engineer must determine whether such an Environmental Impact Statement (EIS) is required in connection with each permit application.

(b) *EIS procedures.* In addition to the procedures required by 33 CFR 209.410 (ER 1105-2-507), the following special procedures apply to the processing of permits involving the preparation of an EIS.

(1) The District Engineer, at the earliest practicable time prior to the is-

suance of the public notice, shall make a preliminary assessment of impacts of the project should it be approved and make a preliminary determination as to whether the quality of the human environment would be significantly affected. This preliminary assessment will normally be based on experience with similar type activities performed in the past. A statement of the District Engineer's preliminary determination shall be included in the public notice. This preliminary determination will be reconsidered as additional information is developed.

(2) If the District Engineer's final determination after consideration of all additional information developed (including responses to the public notice) is that the proposed work will not significantly affect the quality of the human environment, the District Engineer's determination shall be documented, dated, and placed in the record as his Environmental Assessment (see § 325.2(a)(4))

(3) At such time as the District Engineer believes that a permit may be warranted but that the proposed activity would significantly affect the quality of the human environment, he will require the applicant to furnish any additional information that the District Engineer considers necessary to allow his preparation of an EIS. The applicant should also be advised at this time that there is no assurance that favorable action will ultimately be taken on his application. Additionally, if the District Engineer has previously announced a preliminary determination that no EIS would be required he shall issue a supplemental public notice to advise the public of the changed determination. If the applicant is unable to furnish certain information considered by the District Engineer to be necessary for the EIS, the District Engineer may, after obtaining written approval from the Division Engineer, charge the applicant pursuant to 31 U.S.C. 483(a) for those extraordinary expenses incurred by the Government in developing the information. All money so collected shall be paid into the Treasury of the United States as miscellaneous receipts. Otherwise the costs of the preparation and distribution of the EIS itself shall be borne by the Federal Government. In those cases when the determination has been made that an EIS will be required, the District Engineer shall consider inviting public comments as to specific factors of concern which should be addressed in the draft EIS. Upon preparation of the draft EIS a public notice shall be issued summarizing the facts of the case and announcing the availability of the draft EIS. A copy of that notice shall be furnished to all recipients of the draft EIS including CEQ. If a public hearing is to be held pursuant to § 325.2(a)(5), the hearing may be held anytime after completion of the draft EIS.

(4) If another agency is the lead agency as defined by the CEQ guidelines (40 CFR 1500.7(b)) the District Engineer will coordinate with that agency to insure that the resulting EIS adequately describes the impact of the activity which is subject to Corps permit authority. That previously prepared EIS will be referenced in the public notice announcing the permit application and a statement included that the effects of the proposed activity on the environment as outlined therein will be carefully considered in the evaluation of the permit application.

(c) *Public notice on EIS filing.* The 30-day wait period required by the National Environmental Policy Act for issuing a permit for which an EIS has been prepared begins with notation in the Federal Register that the FEIS has been filed with CEQ or on the date of delivery to U.S. Postal Service facilities for mailing of copies of the FEIS to agencies, groups, and individuals on the project mailing list, whichever date is later. In order to notify the interested public of their opportunity to comment on the FEIS, the District Engineer shall issue a public notice when the filing notation has been published in the Federal Register to all parties receiving the original application notice or draft EIS and to all others who have expressed an interest in the application. The public notice should include:

(1) A brief summary of application (applicant, work, date of public notice, date of draft EIS release, date of public hearing, if held);

(2) Opportunity to comment to the District Engineer on the FEIS until the deadline date projected by the 30-day wait period;

(3) A statement that the comments received on the FEIS will be evaluated and considered in arriving at the final decision on the application; and

(4) Information on how interested parties can obtain or have access to the FEIS.

§ 325.5 Forms of authorization.

(a) *General.* (1) Department of the Army authorizations under this regulation shall be in the form of an individual permit, general permit, or letter of permission, as appropriate. The basic format shall be ENG Form 1721, Department of the Army Permit (Appendix A).

(2) While the general conditions included in ENG Form 1721 are normally applicable to all permits, some may not apply to certain authorizations (e.g., after-the-fact situations where work is completed, or situations in which the permittee is a Federal agency) and may be deleted by the issuing officer. Special conditions applicable to the specific activity will be included in the permit as necessary to protect the public interest.

(b) *Letters of permission.* In those cases subject to Section 10 of the River and Harbor Act of 1899 in which, in the opinion of the District Engineer, the proposed work is minor, will not have significant impact on environmental values, and should encounter no opposition, the District Engineer may omit the publishing of a public notice and authorize the work by a letter of permission. However, he will coordinate the proposal with all concerned fish and wildlife agencies, Federal and State, as required by the Fish and Wildlife Coordination Act. The letter of permission will not be used to authorize the discharge of dredged or fill material into waters of the United States nor the transportation of dredged material for purposes of dumping it in ocean waters. The letter of permission will be in letter form and will identify the permittee, the authorized work and location of the work, the statutory authority (i.e., 33 U.S.C. 403), any limitations on the work, a construction time limit and a requirement for a report of completed work. A copy of the general conditions from ENG Form 1721 will be attached and will be incorporated by reference into the letter of permission.

(c) *General permits.* The District Engineer may, after compliance with the other procedures of this regulation, issue general permits for certain clearly described categories of structures or work, including discharges of dredged or fill material, requiring Department of the Army permits. After a general permit has been issued, individual activities falling within those categories that are authorized by such general permits do not have to be further authorized by the procedures of this regulation unless the District Engineer determines, on a case-by-case basis, that the public interest requires.

(d) *Section 9 permits.* Permits for structures under Section 9 of the River and Harbor Act of 1899 will be drafted during review procedures at Department of the Army level.

(e) *Nationwide permits.* Nationwide permits mean Department of the Army authorizations that have been issued by the regulations for certain specified activities nationwide. If certain conditions are met, the specified activities can take place without the need for an individual or general permit.

§ 325.6 Duration of authorizations.

(a) *General.* Department of the Army authorization may authorize both the work and the resulting use. Authorizations continue in effect until they automatically expire or are modified, suspended, or revoked.

(b) *Structures.* Authorizations for the existence of a structure or other activity of a permanent nature are usually for an indefinite duration with no expiration date cited. However, where a temporary structure is authorized, or where restoration of a waterway is contemplated, the authorization will be of limited duration with a definite expiration date. Except as provided in subparagraph (e), below, permits for the discharge of dredged material in the waters of the United States or for the transportation of dredged material for the purpose of dumping it in ocean waters will be of limited duration with a definite expiration date.

(c) *Works.* Authorizations for construction work or other activity will specify time limits for accomplishing the work or activity. The time limits will specify a date by which the work must be started, normally one year from the date

of issuance, and a date by which the work must be completed. The dates will be established by the issuing official and will provide reasonable times based on the scope and nature of the work involved. An authorization for work or other activity will automatically expire if the permittee fails to request an extension or revalidation.

(d) *Extensions of time.* Extensions of time may be granted by the District Engineer for authorizations of limited duration, or for the time limitations imposed for starting or completing the work or activity. The permittee must request the extension and explain the basis of the request, which will be granted only if the District Engineer determines that an extension is in the general public interest. Requests for extensions will be processed in accordance with the regular procedures of § 325.2, including issuance of a public notice, except that such processing is not required where the District Engineer determines that there have been no significant changes in the attendant circumstances since the authorization was issued and that the work is proceeding essentially in accordance with the approved plans and conditions.

(e) *Periodic maintenance.* If the authorized work includes periodic maintenance dredging, an expiration date for the authorization of that maintenance dredging will be included in the permit. The expiration date, which in no event is to exceed ten years from the date of issuance of the permit, will be established by the issuing official after his evaluation of the proposed method of dredging and disposal of the dredged material in accordance with the requirements of 33 CFR Parts 320 to 325. In such cases, the District Engineer shall require notification of the maintenance dredging prior to actual performance to insure continued compliance with the requirements of the regulation and 33 CFR Parts 320–324. If the permittee desires to continue maintenance dredging beyond the expiration date, he must request a revalidation of that portion of his permit which authorized the maintenance dredging. The request must be made to the District Engineer six months prior to the expiration date, and include full description of the proposed methods of dredging and disposal of dredged materials. The District Engineer will process the request for revalidation in accordance with the standard procedures including the issuance of a public notice describing the authorized work to be maintained and the proposed methods of maintenance.

§ 325.7 Modification, suspension or revocation of authorizations.

(a) *General.* The District Engineer may reevaluate the circumstance and conditions of a permit either on his own motion or as the result of periodic progress inspection, and initiate action to modify, suspend, or revoke a permit as may be made necessary by considerations of the general public interest. Among the factors to be considered are the extent of the permittee's compliance with the terms and conditions of the permit; whether or not circumstances relating to the activity authorized have changed since the permit was issued, extended or revalidated, and the continuing adequacy of the permit conditions; any significant objections to the activity authorized by the permit which were not earlier considered; revisions to applicable statutory and/or regulatory authorities; and the extent to which modification, suspension, or other action would adversely affect plans, investments and actions the permittee has reasonably made or taken in reliance on the permit. Significant increases in scope of a permitted activity will be processed as new applications for permits in accordance with Sec. 325.2, and not as modifications under this paragraph.

(b) *Modification.* The District Engineer, as a result of revaluation of the circumstances and conditions of a permit, may determine that protection of the general public interest requires a modification of the terms or conditions of the permit. In such cases, the District Engineer will hold informal consultations with the permittee to ascertain whether the terms and conditions can be modified by mutual agreement. If a mutual agreement is reached on modification of the terms and conditions of the permit, the District Engineer will give the permittee written notice of the modification, which will then become effective on such date as the District Engineer may establish, which in no event shall be less than ten days from its date of issuance. In the event a mutual agreement cannot be reached by the District Engineer and the permittee, the District Engineer will proceed in accordance with subparagraph (c), below, if immediate suspension is warranted. In cases where immediate suspension is not warranted but the District Engineer determines that the permit should be modified, he will notify the permittee of the proposed modification and reasons therefor, and that he may request a hearing. The modification will become effective on the date set by the District Engineer which shall be at least ten days after receipt of the notice unless a hearing is requested within that period. If the permittee fails or refuses to comply with the modification, the District Engineer will proceed in accordance with 33 CFR Part 326.

(c) *Suspension.* The District Engineer may suspend a permit after preparing a written determination and finding that immediate suspension would be in the general public interest. The District Engineer will notify the permittee in writing by the most expeditious means available that the permit has been suspended with the reasons therefor, and order the permittee to stop all previously authorized activities. The permittee will also be advised that following this suspension a decision will be made to either reinstate, modify, or revoke the permit, and that he may request a hearing within 10 days of receipt of notice of the suspension to present information in this matter. If a hearing is requested the procedures prescribed in 33 CFR 327 will be followed. After the completion of the hearing (or within a reasonable period of time after issuance of the notice to the permittee that the permit has been suspended if no hearing is requested), the District Engineer will take action to reinstate the permit, modify the permit, or recommend revocation of the permit in accordance with subparagraph (d), below.

(d) *Revocation.* Following completion of the suspension procedures in subparagraph (c), above, if revocation of the permit is recommended, the District Engineer will prepare a report of the circumstances and forward it together with the record of the suspension proceedings to DAEN-CWO-N. The Chief of Engineers may, prior to deciding whether or not to revoke the permit, afford the permittee the opportunity to present any additional information not made available to the District Engineer at the time he made the recommendation to revoke the permit including, where appropriate, the means by which he intends to compy with the terms and conditions of the permit. The permittee will be advised in writing of the final decision.

§ 325.8 Authority to issue or deny authorizations.

(a) *General.* Except as otherwise provided in this regulation, the Secretary of the Army subject to such conditions as he or his authorized representative may from time to time impose, has authorized the Chief of Engineers and his authorized representatives to issue or deny authorizations for construction or other work in or affecting navigable waters of the United States pursuant to Sections 10 and 14 of the Act of March 3, 1899, and Section 1 of the Act of June 13, 1902. He also has authorized the Chief of Engineers and his authorized representatives to issue or deny authorizations for the discharge of dredged or fill material in waters of the United States pursuant to Section 404 of the Federal Water Pollution Control Act Amendments of 1972 or for the transportation of dredged material for the purpose of dumping it into ocean waters pursuant to Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended. The authority to issue or deny permits pursuant to Section 9 of the River and Harbor Act of March 3, 1899 has not been delegated to the Chief of Engineers or his authorized representatives.

(b) *District Engineer's authority.* District Engineers are authorized to issue in accordance with this regulation permits and letters of permission which are subject to such special conditions as are necessary to protect the public interest in the waters of the United States or ocean waters pursuant to Sections 10 and 14 of the River and Harbor Act of March 3, 1899; Section 1 of the River and Harbor Act of June 13, 1902; Section 404 of the Federal Water Pollution Control Act Amendments of 1972; and Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended, in all cases in which there are no known substantive objections to the proposed work or activity or in which objections

have been resolved to the satisfaction of the District Engineer. Unless otherwise precluded by this regulation, District Engineers may issue permits over an unresolved objection of another Federal agency if that agency indicates to the District Engineer that it does not desire to refer the application to a higher level of authority for review. It is essential to the legality of a permit that it contain the name of the District Engineer as the issuing officer. However, the permit need not be signed by the District Engineer, in person; but may be signed for and in behalf of him by whoever he designates. District Engineers shall deny permits when required State or local authorization and/or certification has been denied or when a State has objected to a required certification of compliance with its coastal zone management program and the Secretary of Commerce has not reviewed the action and reached a contrary finding. A District Engineer may also deny any permit if he determines that the proposed activity is not in the public interest provided the referral requirements of § 325.8(d) below are not applicable. In such cases the Findings of Fact should be in the general format required for reports under Sec. 325.11 and must conclusively justify a denial decision. All other permit applications including those cases in § 325.7 (c) and (d) below will be referred to Division Engineers. District Engineers are also authorized to add, modify, or delete special conditions in permits, except for those conditions which have been imposed by higher authority, and to suspend permits according to the procedures of § 325.7(c).

(c) *Division Engineer's authority.* Division Engineers will review, attempt to resolve outstanding matters, and evaluate all permit applications referred by District Engineers. Division Engineers may authorize the issuance or denial of permits pursuant to Sections 10 and 14 of the River and Harbor Act of March 3, 1899; Section 1 of the River Harbor Act of June 13, 1902, Section 404 of the Federal Water Pollution Control Act Amendments of 1972; and Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended; and the inclusion of conditions to those permits as may be necessary to protect the public interest in waters of the United States or ocean waters in accordance with the policies cited in this regulation. Except as provided in subparagraph (d), below, if the Division Engineer determines that issuance of a permit with or without conditions is in the public interest, but there is continuing objection to the issuance of the permit by another Federal agency, he shall advise the regional representative of that Federal agency of his intent to issue the permit. The Division Engineer shall not proceed with the issuance of a permit if, within 15 days after the date of this notice of intent to issue a permit, an authorized representative of that Federal agency indicates to the Division Engineer in writing that he wishes to bring his concerns to the Departmental level and has Departmental concurrence to do so. In such cases, the proposed permit will be forwarded to higher authority for resolution. Thereafter, a permit will be issued only pursuant to and in accordance with instructions from such higher authority. Every effort should be made to resolve differences at the Division Engineer level before referring the matttr to higher authority.

(d) *Referral to the Chief of Engineers.* Division Engineers will refer to the Chief of Engineers the following cases:

(1) When it is proposed to issue a permit and there are unresolved objections from another Federal agency which must be handled under special procedures specified in statutes or Memoranda of Understanding which thereby preclude final resolution by the Division Engineer;

(2) When the recommended decision is contrary to the stated position of the Governor of the State in which the work is to be performed;

(3) When there is substantial doubt as to authority, law, regulations, or policies applicable to the proposed activity;

(4) When the Chief of Engineers requests the case be forwarded for decision;

(5) When the proposed activity would affect the baseline used for determination of the limits of the territorial sea; and

(6) When Section 9 of the River and Harbor Act of 1899 authority is involved.

§ 325.9 *Supervision and enforcement.*

(a) *Inspection and monitoring.* District Engineers will assure that authorized activities are conducted and executed in conformance with approved plans and other conditions of the permits. Appropriate inspections should be made on timely occasions during performance of the activity and appropriate notices and instructions given permittees to insure that they do not depart from the approved plans. Revaluation of permits to assure compliance with its purposes and conditions will be carried out as provided in § 325.7. If there are approved material departures from the authorized plans, the District Engineer will require the permittee to furnish corrected plans showing the activity as actually performed.

(b) *Non-compliance.* Where the District Engineer determines that there has been non-compliance with the terms or conditions of a permit, he should first contact the permittee and attempt to resolve the problem. If a mutually agreeable resolution cannot be reached, a written demand for compliance will be made. If the permittee has not agreed to comply within 5 days of receipt of the demand, the District Engineer will issue an immediately effective notice of suspension in accordance with § 325.7(c) and consider initiation of appropriate legal action.

(c) *Surveillance.* For purposes of inspection of permitted activities and for surveillance of the waters of the United States for enforcement of the permit authorities the District Engineer will use all means at his disposal. All Corps of Engineers employees will be instructed to observe and report all activities in waters of the United States which would require permits. The assistance of members of the public and personnel of other interested Federal, State and local agencies to observe and report such activities will be encouraged. To facilitate this surveillance, the District Engineer will, in appropriate cases, require a copy of ENG Form 4336 to be posted conspicuously at the site of authorized activities and will make available to all interested persons information on the scope of authorized activities and the conditions prescribed in the authorizations. Furthermore, significant actions taken under § 325.7 will be brought to the attention of those Federal, State and local agencies and other persons who express particular interest in the affected activity. Surveillance in ocean waters will be accomplished primarily by the Coast Guard pursuant to section 107(c) of the Marine Protection, Research and Sanctuaries Act of 1972, as amended.

(d) *Inspection expenses.* The expenses incurred in connection with the inspection of permitted activity in waters of the United States normally will be paid by the Federal Government in accordance with the provisions of section 6 of the River and Harbor Act of 3 March 1905 (33 U.S.C. 417) unless daily supervision or other unusual expenses are involved. In such unusual cases, and after approval by the Division Engineer, the permittee will be required to bear the expense of inspections in accordance with the conditions of his permit; however, the permittee will not be required or permitted to pay the United States inspector either directly or through the District Engineer. The inspector will be paid on regular payrolls or service vouchers. The District Engineer will collect the cost from the permittee in accordance with the following:

(1) At the end of each month the amount chargeable for the cost of inspection pertaining to the permit will be collected from the permittee and will be taken up on the statement of accountability and deposited in a designated depository to the credit of the Treasurer of the United States, on account of reimbursement of the appropriation from which the expenses of the inspection were paid.

(2) If the District Engineer considers such a procedure necessary to insure the United States against loss through possible failure of the permittee to supply the necessary funds in accordance with subparagraph (1), above, he may require the permittee to keep on deposit with the District Engineer at all times an amount equal to the estimated cost of inspection and supervision for the ensuing month, such deposit preferably being in the form of a certified check, payable to the order of Treasurer of the United States. Certified checks so deposited will be carried in a special deposit account (guaranty for inspection expenses) and upon completion of the work under the permit the funds will be returned to the permittee provided he has paid the actual cost of inspection.

(3) On completion of work under a permit, and the payment of expenses by the permittee without protest, the account will be closed, and outstanding deposits returned to the permittee. If the account is protested by the permittee, it will be referred to the Division Engineer for approval before it is closed and before any deposits are returned to the permittee.

(c) *Bonds.* If the permitted activity includes restoration of the waterway to its original condition, or if the issuing official has reason to consider that the permittee might be prevented from completing work which is necessary to protect the public interest in the waterway, he may require the permittee to post a bond of sufficient amount to indemnify the government against any loss as a result of corrective action it might take.

§ 325.10 Publicity.

The District Engineer will establish and maintain a program to assure that potential applicants for permits are informed of the requirements of this regulation and of the steps required to obtain permits for activities in navigable waters or ocean waters. Whenever the District Engineer becomes aware of plans being developed by either private or public entities who might require permits in order to implement the plans, he will advise the potential applicant in writing of the statutory requirements and the provisions of this regulation. Similarly when the District Engineer is aware of changes in Corps of Engineers regulatory jurisdiction, he will issue appropriate public notices.

§ 325.11 Reports.

The report of a District Engineer on an application for a permit requiring action by the Division Engineer or by the Chief of Engineers will be in a letter form with the application and all pertinent comments, records, photographs, maps, and studies including the final Environmental Impact Statement if prepared, as inclosures. The inclosures for all cases referred to the Chief of Engineers will be in duplicate. If an EIS has been prepared, the report shall not be forwarded until expiration of the 30-day comment period following filing of the final EIS and shall address any comments received on the final EIS. The following items will be included or discussed in the report:

(a) Name of applicant.

(b) Location, character and purpose of proposed activity, including a description of any wetlands involved.

(c) Applicable statutory authorities and administrative determinations conferring Corps of Engineers regulatory jurisdiction.

(d) Other Federal, State, and local authorizations obtained or required and pending.

(e) Date of public notice and public hearings, if held, and summary of objections offered with comments of the District Engineer thereon. The comments should explain the objections and not merely refer to inclosed letters.

(f) Views of State and local authorities.

(g) Views of District Engineer concerning probable effect of the proposed work on:

(1) Navigation, present and prospective.

(2) Harbor lines, if established.

(3) Flood heights, drift and flood damage protection.

(4) Beach erosion or accretion.

(5) Fish and Wildlife.

(6) Water Quality.

(7) Aesthetics.

(8) Historic values.

(9) Recreation.

(10) Economy.

(11) Water supply.

(12) Energy needs.

(13) Land use classification and coastal zone management plans.

(h) Other pertinent remarks, such as:

(1) Extent of public and private need.

(2) Appropriate alternatives.

(3) Extent and permanence of beneficial and/or detrimental effects.

(4) Probable impact in relation to cumulative effects created by other activities.

(i) A copy of the environmental assessment or the Environmental Impact Statement. If an EIS is prepared, a summary of comments received on the final EIS together with the District Engineer's response to those comments.

(j) A discussion of conformity with the guidelines published for the discharge of dredged or fill material in waters of the United States (40 CFR Part 230) or the dumping of dredged material in ocean waters (40 CFR Parts 220 to 229), as applicable.

(k) Conclusions.

(l) Recommendations including any proposed special conditions.

APPENDIX A—PERMIT FORM

Application No. _____
Name of Applicant _____
Effective Date _____
Expiration Date (If applicable) _____

DEPARTMENT OF THE ARMY

Permit

Referring to written request dated _____ for a permit to:

( ) Perform work in or affecting navigable waters of the United States, upon the recommendation of the Chief of Engineers, pursuant to Section 10 of the Rivers and Harbors Act of March 3, 1899 (33 U.S.C. 403);

( ) Discharge dredged or fill material into waters of the United States upon the issuance of a permit from the Secretary of the Army acting through the Chief of Engineers pursuant to Section 404 of the Federal Water Pollution Control Act (86 Stat. 816, Pub. L. 92-500);

( ) Transport dredged material for the purpose of dumping it into ocean waters upon the issuance of a permit from the Secretary of the Army acting through the Chief of Engineers pursuant to Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (86 Stat. 1052; Pub. L. 92-532): _____

_____

(Here insert the full name and address of the permittee.)

is hereby authorized by the Secretary of the Army: to _____

_____

_____

_____

_____

_____

(Here describe the proposed structure or activity, and its intended use. In the case of an application for a fill permit, describe the structures, if any proposed to be erected on the fill. In the case of an application for the discharge of dredged or fill material into waters of the United States or the transportation for discharge in ocean waters of dredged material, describe the type and quantity of material to be discharged.)

in _____

_____

_____

_____

_____

_____

_____

(Here to be named the ocean, river, harbor, or waterway concerned.)

at _____

_____

_____

_____

_____

_____

_____

(Here to be named the nearest well-known locality—preferably a town or city—and the distance in miles and tenths from some definite point in the same, stating whether above or below or giving direction by points of compass.)

in accordance with the plans and drawings attached hereto which are incorporated in and made a part of this permit (on drawings; give file number or other definite identification marks). Subject to the following conditions:

I. General conditions: (a) That all activities identified and authorized herein shall be consistent with the terms and conditions of this permit; and that any activities not specifically identified and authorized herein shall constitute a violation of the terms and conditions of this permit which may result in the modification, suspension or revocation of this permit, in whole or in part, as set forth more specifically in General Conditions j or k hereto, and in the institution of such legal proceedings as the United States Government may consider appropriate, whether or not this permit has been previously modified, suspended or revoked in whole or in part.

(b) That all activities authorized herein shall, if they involve, during their construction or operation, any discharge of pollutants into waters of the United States or ocean waters, be at all times consistent with applicable water quality standards, effluent limitations and standards of performance, prohibitions, pretreatment standards and management practices established pursuant to the Federal Water Pollution Control Act of 1972 (Pub. L. 92-500; 86 Stat. 816), the Marine Protection, Research and Sanctuaries Act of 1972 (Pub. L. 92-532, 86 Stat. 1052), or pursuant to applicable State and local law.

(c) That when the activity authorized herein involves a discharge during its construction or operation, of any pollutant (including dredged or fill material), into waters of the United States, the authorized activity shall, if applicable water quality standards are revised or modified during the term of this permit, be modified, if necessary, to conform with such revised or modified water

quality standards within 6 months of the effective date of any revision or modification of water quality standards, or as directed by an implementation plan contained in such revised or modified standards, or within such longer period of time as the District Engineer, in consultation with the Regional Administrator of the Environmental Protection Agency, may determine to be reasonable under the circumstances.

(d) That the discharge will not destroy a threatened or endangered species as identified under the Endangered Species Act, or endanger the critical habitat of such species.

(e) That the permittee agrees to make every reasonable effort to prosecute the construction or operation of the work authorized herein in a manner so as to minimize any adverse impact on fish, wildlife, and natural environmental values.

(f) That the permittee agrees that it will prosecute the construction or work authorized herein in a manner so as to minimize any degradation of water quality.

(g) That the permittee shall permit the District Engineer or his authorized representative(s) or designee(s) to make periodic inspections at any time deemed necessary in order to assure that the activity being performed under authority of this permit is in accordance with the terms and conditions prescribed herein.

(h) That the permittee shall maintain the structure or work authorized herein in good condition and in accordance with the plans and drawings attached hereto.

(i) That this permit does not convey any property rights, either in real estate or material, or any exclusive privileges; and that it does not authorize any injury to property or invasion of rights or any infringement of Federal, State, or local laws or regulations nor does it obviate the requirement to obtain State or local assent required by law for the activity authorized herein.

(j) That this permit may be summarily suspended, in whole or in part, upon a finding by the District Engineer that immediate suspension of the activity authorized herein would be in the general public interest. Such suspension shall be effective upon receipt by the permittee of a written notice thereof which shall indicate (1) the extent of the suspension, (2) the reasons for this action, and (3) any corrective or preventative measures to be taken by the permittee which are deemed necessary by the District Engineer to abate imminent hazards to the general public interest. The permittee shall take immediate action to comply with the provisions of this notice. Within ten days following receipt of this notice of suspension, the permittee may request a hearing in order to present information relevent to a decision as to whether his permit should be reinstated, modified or revoked. If a hearing is requested, it shall be conducted pursuant to procedures prescribed by the Chief of Engineers. After completion of the hearing, or within a reasonable time after issuance of the suspension notice to the permittee if no hearing is requested, the permit will either be reinstated, modified or revoked.

(k) That this permit may be either modified, suspended or revoked in whole or in part if the Secretary of the Army or his authorized representative determines that there has been a violation of any of the terms or conditions of this permit or that such action would otherwise be in the public interest. Any such modification, suspension, or revocation shall become effective 30 days after receipt by the permittee of written notice of such action which shall specify the facts or conduct warranting same unless (1) within the 30-day period the permittee is able to satisfactorily demonstrate that (a) the alleged violation of the terms and the conditions of this permit did not, in fact, occur or (b) the alleged violation was accidental, and the permittee has been operating in compliance with the terms and conditions of the permit and is able to provide satisfactory assurances that future operations shall be in full compliance with the terms and conditions of this permit; or (2) within the aforesaid 30-day period, the permittee requests that a public hearing be held to present oral and written evidence concerning the proposed modification, suspension or revocation. The conduct of this hearing and the procedures for making a final decision either to modify, suspend or revoke this permit in whole or in part shall be pursuant to procedures prescribed by the Chief of Engineers.

(l) That in issuing this permit, the Government has relied on the information and data which the permittee has provided in connection with his permit application. If, subsequent to the issuance of this permit, such information and data prove to be false, incomplete or inaccurate, this permit may be modified, suspended or revoked, in whole or in part, and/or the Government may, in addition, institute appropriate legal proceedings.

(m) That any modification, suspension, or revocation of this permit shall not be the basis for any claim for damages against the United States.

(n) That the permittee shall notify the District Engineer at what time the activity authorized herein will be commenced, as far in advance of the time of commencement as the District Engineer may specify, and of any suspension of work, if for a period of more than one week, resumption of work and its completion.

(o) That if the activity authorized herein is not started on or before ---------- day of ----------, 19—, (one year from the date of issuance of this permit unless otherwise specified) and is not completed on or before ---------- day of ----------, 19—, (three years form the date of issuance of this permit unless otherwise specified) this permit, if not previously revoked or specifically extended, shall automatically expire.

(p) That this permit does not authorize or approve the construction of particular structures, the authorization or approval of which may require authorization by the Congress or other agencies of the Federal Government.

(q) That if and when the permittee desires to abandon the activity authorized herein, unless such abandonment is part of a transfer procedure by which the permittee is transferring his interests herein to a third party pursuant to General Condition S hereof, he must restore the area to a condition satisfactory to the District Engineer.

(r) That if the recording of this permit is possible under applicable State or local law, the permittee shall take such action as may be necessary to record this permit with the Register of Deeds or other appropriate official charged with the responsibility for maintaining records of title to and interests in real property.

(s) That there shall be no unreasonable interference with navigation by the existence or use of the activity authorized herein.

(t) That this permit may not be transferred to a third party without prior written notice to the District Engineer, either by the transferee's written agreement to comply with all terms and conditions of this permit or by the transferee subscribing to this permit in the space provided below and thereby agreeing to comply with all terms and conditions of this permit. In addition, if the permittee transfers the interests authorized herein by conveyance of realty, the deed shall reference this permit and the terms and conditions specified herein and this permit shall be recorded along with the deed with the Register of Deeds or other appropriate official.

II. Special Conditions: Here list conditions relating specifically to the proposed structure or work authorized by this permit. The following Special Conditions will be applicable when appropriate:

Structures In or Affecting Navigable Waters of the United States

(a) That this permit does not authorize the interference with any existing or proposed Federal project and that the permittee shall not be entitled to compensation for damage or injury to the structures or work authorized herein which may be caused by or result from existing or future operations undertaken by the United States in the public interest.

(b) That no attempt shall be made by the permittee to prevent the full and free use by the public of all navigable waters at or adjacent to the activity authorized by this permit.

(c) That if the display of lights and signals on any structure or work authorized herein is not otherwise provided for by law, such lights and signals as may be prescribed by the United States Coast Guard shall be installed and maintained by and at the expense of the permittee.

(d) That the permittee, upon receipt of a notice of revocation of this permit or upon its expiration before completion of the authorized structure or work, shall, without expense to the United States and in such time and manner as the Secretary of the Army or his authorized representative may direct, restore the waterway to its former conditions. If the permittee fails to comply with the direction of the Secretary of the Army or his authorized representative, the Secretary or his designee may restore the waterway to its former condition, by contract or otherwise, and recover the cost thereof from the permittee.

(e) Structures for Small Boats: That permittee hereby recognizes the possibility that the structure permitted herein may be subject to damage by wave wash from passing vessels. The issuance of this permit does not relieve the permittee from taking all proper steps to insure the integrity of the structure permitted herein and the safety of boats moored thereto from damage by wave wash and the permittee shall not hold the United States liable for any such damage.

Maintenance Dredging

(a) That when the work authorized herein includes periodic maintenance dredging, it may be performed under this permit for —— years from the date of issuance of this permit (ten years unless otherwise indicated);

(b) That the permittee will advise the District Engineer in writing at least two weeks before he intends to undertake any maintenance dredging.

Discharges of Dredged or Fill Material Into Waters of the United States

(a) That the discharge will be carried out in conformity with the goals and objectives of the EPA Guidelines established pursuant to Section 404(b) of the FWPCA and published in 40 CFR 230;

(b) That the discharge will consist of suitable material free from toxic pollutants in other than trace quantities;

(c) That the fill created by the discharge will be properly maintained to prevent erosion and other non-point sources of pollution; and

(d) That the discharge will not occur in a component of the National Wild and Scenic River System or in a component of a State wild and scenic river system.

Dumping of Dredged Material Into Ocean Waters

(a) That the dumping will be carried out in conformity with the goals, objectives, and requirements of the EPA criteria established pursuant to Section 102 of the Marine Protection, Research and Sanctuaries Act of 1972, published in 40 CFR 220–226.

(b) That the permittee shall place a copy of this permit in a conspicuous place in the vessel to be used for the transportation and/or dumping of the dredged material as authorized herein.

This permit shall become effective on the date of the District Engineer's signature.

Permittee hereby accepts and agrees to comply with the terms and conditions of this permit.

(Permittee)

(Date)

By authority of the Secretary of the Army:

(District Engineer)

(Date)

Transferee hereby agrees to comply with the terms and conditions of this permit.

(Transferee)

(Date)

APPENDIX B—MEMORANDUM OF UNDERSTANDING BETWEEN THE SECRETARY OF THE INTERIOR AND THE SECRETARY OF THE ARMY

In recognition of the responsibilities of the Secretary of the Army under sections 10 and 13 of the Act of March 3, 1899 (33 U.S.C. 403 and 407), relating to the control of dredging, filling, and excavation in the navigable waters of the United States, and the control of refuse in such waters, and the interrelationship of those responsibilities with the responsibilities of the Secretary of the Interior under the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.), the Fish and Wildlife Coordination Act, as amended (16 U.S.C. 661–666c), and the Fish and Wildlife Act of 1956, as amended (16 U.S.C. 742a et seq.), relating to the control and prevention of water pollution in such waters and the conservation of the Nation's natural resources and related environment, including fish and wildlife and recreational values therein; in recognition of our joint responsibilities under Executive Order No. 11288 to improve water quality through the prevention, control, and abatement of water pollution from Federal and federally licensed activities; and in recognition of other provisions of law and policy, we, the two Secretaries, adopt the following policies and procedures:

POLICIES

1. It is the policy of the two Secretaries that there shall be full coordination and cooperation between their respective Departments on the above responsibilities at all organizational levels, and it is their view that maximum efforts in the discharge of those responsibilities, including the resolution of differing views, must be undertaken at the earliest practicable time and at the field organizational unit most directly concerned. Accordingly, District Engineers of the U.S. Army Corps of Engineers shall coordinate with the Regional Directors of the Secretary of the Interior on fish and wildlife, recreation, and pollution problems associated with dredging, filling, and excavation operations to be conducted under permits issued under the 1899 Act in the navigable waters of the United States, and they shall avail themselves of the technical advice and assistance which such Directors may provide.

2. The Secretary of the Army will seek the advice and counsel of the Secretary of the Interior on difficult cases. If the Secretary of the Interior advises that proposed operations will unreasonably impair natural resources or the related environment, including the fish and wildlife and recreational values thereof, or will reduce the quality of such waters in violation of applicable water quality standards, the Secretary of the Army in acting on the request for a permit will carefully evaluate the advantages and benefits of the operations in relation to the resultant loss or damage, including all data presented by the Secretary of the Interior, and will either deny the permit or include such conditions in the permit as he determines to be in the public interest, including provisions that will assure compliance with water quality standards established in accordance with law.

PROCEDURES FOR CARRYING OUT THESE POLICIES

1. Upon receipt of an application for a permit for dredging, filling, excavation, or other related work in navigable waters of the United States, the District Engineers shall send notices to all interested parties, including the appropriate Regional Directors of the Federal Water Pollution Control Administration, the United States Fish and Wildlife Service, and the National Park Service of the Department of the Interior, and the appropriate State conservation, resources, and water pollution agencies.

2. Such Regional Directors of the Secretary of the Interior shall immediately make such studies and investigations as they deem necessary or desirable, consult with the appropriate State agencies, and advise the District Engineers whether the work proposed by the permit applicant, including the deposit of any material in or near the navigable waters of the United States, will reduce the quality of such waters in violation of applicable water quality standards or unreasonably impair natural resources or the related environment.

3. The District Engineer will hold public hearings on permit applications whenever response to a public notice indicates that hearings are desirable to afford all interested parties full opportunity to be heard on objections raised.

4. The District Engineer, in deciding whether a permit should be issued, shall weigh all relevant factors in reaching his decision. In any case where Directors of the Secretary of the Interior advise the District Engineers that proposed work will impair the water quality in violation of applicable water quality standards or unreasonably impair the natural resources or the related environment, he shall, within the limits of his responsibility, encourage the applicant to take steps that will resolve the objections to the work. Failing in this respect, the District Engineer shall forward the case for the consideration of the Chief of Engineers and the appropriate Regional Director of the Secretary of the Interior shall submit his views and recommendations to his agency's Washington Headquarters.

5. The Chief of Engineers shall refer to the Under Secretary of the Interior all those cases referred to him containing unresolved substantive differences of views and he shall include his analysis thereof, for the purpose of obtaining the Department of Interior's comments prior to final determination of the issues.

6. In those cases where the Chief of Engineers and the Under Secretary are unable to resolve the remaining issues, the cases will be referred to the Secretary of the Army for decision in consultation with the Secretary of the Interior.

7. If in the course of operations within this understanding, either Secretary finds its terms in need of modification, he may notify the other of the nature of the desired changes. In that event the Secretaries shall within 90 days negotiate such amendment as is considered desirable or may agree upon termination of this understanding at the end of the period.

Dated: July 13, 1967.

STEWART L. UDALL,
Secretary of the Interior.

Dated: July 13, 1967.

STANLEY RESOR,
Secretary of the Army.

PART 326—ENFORCEMENT

Sec.
326.1 Purpose.
326.2 Discovery.
326.3 Investigation.
326.4 Legal Action.
326.5 Processing After-the-fact Applications.

AUTHORITY: 33 U.S.C. 401 et seq.; 33 U.S.C. 1344; 33 U.S.C. 1413.

§ 326.1 Purpose.

This regulation prescribes the policy, practice, and procedures to be followed by the Corps of Engineers in connection with activities requiring Department of the Army permits that are performed without prior authorization.

§ 326.2 Discovery of unauthorized activity in Progress

When the District Engineer becomes aware of any unauthorized activity which is still in progress, he shall immediately issue a cease and desist order to all persons responsible for and/or involved in the performance of the activity. If appropriate, the District Engineer may also order interim protective measures to be taken in order to protect the public interest.

§ 326.3 Investigation.

The District Engineer shall commence an immediate investigation of all unauthorized activities brought to his attention to ascertain the facts surrounding the activity. In making this investigation, the District Engineer shall solicit the views of the Regional Administrator of the Environmental Protection Agency, the Regional Director of the U.S. Fish and Wildlife Service, and the Regional Director of the National Marine Fisheries Service, and other appropriate Federal, State, and local agencies. He shall also request the persons involved in the unauthorized activity to provide appropriate information on the activity to assist him in his evaluation and in recommending the course of action to be taken. The District Engineer shall evaluate the information and views developed during this investigation in conjunction with the appropriate factors and criteria that pertain to the particular unauthorized activity as cited in 33 CFR Parts 320, 321, 322, 323, and 324, and the guidance contained in § 326.4, below. Following this evaluation, the District Engineer shall formulate recommendations as to the appropriate administrative and/or legal action to be taken.

§ 326.4 Legal action.

(a) District Engineers shall be guided by the following policies in determining whether an unauthorized activity requires appropriate legal action:

(1) *Criminal action.* Criminal action is considered appropriate when the facts surrounding an unauthorized activity reveal the necessity for punitive action and/or when deterrence of future unauthorized activities in the area is considered essential to the establishment or maintenance of a viable permit program.

(2) *Civil action.* Civil action is considered appropriate when the preliminary evaluation of the unauthorized activity reveals that (i) restoration is in the public interest and attempts to secure voluntary restoration have failed, or (ii) the unauthorized activity is in the public interest but must be altered or modified by judicial order because attempts to secure voluntary compliance have failed, or (iii) a civil penalty under Section 309 of the FWPCA is warranted.

(b) Preparation of case. If the District Engineer determines that legal action is appropriate, he shall prepare a litigation report which shall contain an analysis of the data and information obtained during his investigation and a recommendation of appropriate civil and criminal action. In those cases where the analysis of the facts developed during his investigation (when made in conjunction with the appropriate factors and criteria specified in 33 CFR Parts 320, 321, 322, 323, and 324) leads to the preliminary conclusion that removal of the unauthorized activity is in the public interest, the District Engineer shall also recommend restoration of the area to its original or comparable condition.

(c) Referral to local U.S. Attorney. Except as provided in subsection (d), District Engineers are authorized to refer the following cases directly to the local U.S. Attorney.

(1) All unauthorized structures or work affecting navigable waters of the United States that fall exclusively within the purview of Section 10 of the River and Harbor Act of 1899 (see 33 CFR Part 322) for which a criminal fine or penalty under Section 12 of that Act (33 USC 406) is considered appropriate.

(2) All civil actions involving small unauthorized structures, such as piers, which the District Engineer determines are (i) not in the public interest and therefore must be removed, or (ii) are in the public interest but must be altered or modified by judicial order, because attempts to secure voluntary compliance have failed.

(3) All violations of Section 301 of the Federal Water Pollution Control Act Amendments of 1972 (33 USC 1311) involving the unauthorized discharge of dredged or fill material into the waters of the United States where the District Engineer determines, with the concurrence of the Regional Administrator, that civil and/or criminal action pursuant to Section 309 of the FWPCA is appropriate.

(4) All cases for which a temporary restraining order and/or preliminary injunction is appropriate following noncompliance with a cease and desist order.

Information copies of all letters of referral shall be forwarded to the Chief of Engineers, ATTN: DAEN-CCK, and the Chief Pollution Control Section, Land and Natural Resources Division, Department of Justice, Washington, D.C. 20530.

(d) Referral to Office, Chief of Engineers. District Engineers shall prepare and forward a litigation report to the Office, Chief of Engineers, ATTN: DAEN-CCK, for all other cases not identified in subsection (c) in which civil and/or criminal action is considered appropriate, including:

(1) All cases involving significant questions of law or fact;

(2) All cases involving discharges of dredged or fill material into waters of the United States that are not interstate waters or navigable waters of the United States, or part of a surface tributary system to these waters;

(3) All cases involving recommendations for substantial or complete restoration;

(4) All cases involving violations of Section 9 of the River and Harbor Act of 1899; and

(5) All cases involving violations of the Marine Protection, Research and Sanctuaries Act of 1972.

(e) If the District Engineer refers a case to the local U.S. Attorney or if criminal and/or civil action is instituted against the responsible person for any unauthorized activity, the District Engineer shall not accept for processing any application for a Department of the Army permit until final disposition of the referral action and/or all judicial proceedings, including the payment of all prescribed penalties and fines and/or completion of all work ordered by the court. Thereafter, the District Engineer may accept an application for a permit; provided, that with respect to any judicial order requiring partial or total restoration of an area, the District Engineer, if so ordered by the court, shall supervise this restoration effort and may allow the responsible persons to apply for a permit for only that portion of the unauthorized activity for which restoration has not been so ordered.

§ 326.5 Processing after-the-fact applications.

In those cases in which the District Engineer determines that the unauthorized activity does not warrant legal action, the following procedures shall be followed.

(a) Processing and evaluation of applications for after-the-fact authorizations for activities undertaken without the required Department of the Army permits will in all other respects follow the standard policies and procedures of 33 CFR Parts 320-325. Thus, authorization may still be denied in accordance with the policies and procedures of those regulations.

(b) Where after-the-fact authorization in accordance with this paragraph is determined to be in the public interest, the standard permit form for the activity will be used, omitting inappropriate conditions, and including whatever special conditions the District Engineer may deem appropriate to mitigate or prevent undesirable effects which may have occurred or might occur.

(c) Where after-the-fact authorization is not determined to be in the public interest, the notification of the denial of the permit will prescribe any corrective actions to be taken in connection with the work already accomplished, including restoration of those areas subject to denial, and establish a reasonable period of time for the applicant to complete such actions. The District Engineer, after denial of the permit, will again consider whether civil and/or criminal action is appropriate in accordance with § 326.4.

(d) If the applicant declines to accept the proposed permit conditions, or fails to take corrective action prescribed in the notification of denial, or if the District Engineer determines, after denying the permit application, that legal action is appropriate, the matter will be referred to the Chief of Engineers, ATTN: DAEN-CCK, with recommendations for appropriate action.

PART 327—PUBLIC HEARINGS

Sec.

AUTHORITY: 33 U.S.C. 1344; 33 U.S.C. 1413.

§ 327.1 Purpose.

This regulation prescribes the policy, practice and procedures to be followed by the U.S. Army Corps of Engineers in the conduct of public hearings conducted in the evaluation of a proposed Department of the Army permit action or Federal project as defined in § 327.3 below including those held pursuant to Section 404 of the Federal Water Pollution Control Act (FWPCA) (33 U.S.C. 1344) and Section 103 of the Marine Protection, Research and Sanctuaries Act (MPRSA), as amended (33 U.S.C. 1413).

§ 327.2 Applicability.

This regulation is applicable to all Divisions and Districts responsible for the conduct of public hearings.

§ 327.3 Definitions.

(a) Public hearing means a public proceeding conducted for the purpose of acquiring information or evidence which will be considered in evaluating a proposed Department of the Army permit action, or Federal project, and which affords to the public the opportunity to present their views, opinions, and information on such permit actions or Federal projects.

(b) Permit action, as used herein, means the review of an application for a permit pursuant to Section 10 of the

River and Harbor Act of 1890 (33 U.S.C. 403), Section 404 of the FWPCA (33 U.S.C. 1344), the Outer Continental Shelf Act (43 U.S.C. 1333(f)), and Section 103 of the MPRSA of 1972, as amended (33 U.S.C. 1413), or the modification or revocation of any Department of the Army permit. (See 33 CFR 325.7.)

(c) Federal project means a Corps of Engineers project (work or activity of any nature for any purpose which is to be performed by the Chief of Engineers pursuant to Congressional authorizations) involving the discharge of dredged or fill material into waters of the United States or the transportation of dredged material for the purpose of dumping it in ocean waters subject to Section 404 of the FWPCA (33 U.S.C. 1344) or Section 103 of the MPRSA, as amended (33 U.S.C. 1413; and 33 CFR 209.145. (This regulation supersedes all references to public meetings in 33 CFR 209.145.)

§ 327.4 General policies.

(a) A public hearing will be held in connection with the consideration of a Department of the Army permit application under Section 404 of the FWPCA or Section 103 of the MPRSA, or a Federal project whenever a public hearing will assist in making a decision on such permit application or Federal project. In addition, a public hearing may be held when it is proposed to modify or revoke a permit. (See 33 CFR 325.7.)

(b) Unless the public notice specifies that a public hearing will be held, any person may request, in writing, within the comment period specified in the public notice on a Department of the Army permit application under Section 404 of the FWPCA or Section 103 of the MPRSA or on a Federal project, that a public hearing be held to consider the material matters in issue in the permit application or Federal project. Upon receipt of any such request, stating with particularity the reasons for holding a public hearing, the District Engineer shall promptly set a time and place for the public hearing, and give due notice thereof, as prescribed in § 327.11 below. Requests for a public hearing under this paragraph shall be granted, unless the District Engineer determines that the issues raised are insubstantial or there is otherwise no valid interest to be served by a hearing. The District Engineer will make such a determination in writing, and communicate his reasons therefor to all requesting parties.

(c) In cases involving the evaluation of a Department of the Army permit application only under Section 10 of the River and Harbor Act of 1899 (33 U.S.C. 403), public hearings will be held upon written request whenever the District Engineer determines that there is sufficient public interest to warrant such action. Among the instances warranting public hearings are general public opposition to a proposed work, Congressional requests or requests from responsible local authorities, or controversial cases involving significant environmental issues.

(d) In case of doubt, a public hearing shall be held. HQDA has the discretionary power to require hearings in any case.

(e) In fixing the time and place for a hearing, due regard shall be had for the convenience and necessity of the interested public.

§ 327.5 Presiding officer.

(a) The District Engineer, in whose District a matter arises, shall normally serve as the Presiding Officer. When the District Engineer is unable to serve, he may designate the Deputy District Engineer as such Presiding Officer. In any case, he may request the Division Engineer to designate another Presiding Officer. In cases of unusual interest, the Chief of Engineers reserves the power to appoint such person as he deems appropriate to serve as the Presiding Officer.

(b) The Presiding Officer in each case shall establish a hearing file. The hearing file shall include a copy of any permit application or permits and supporting data, any public notices issued in the case, the request or requests for the hearing and any data or material submitted in justification thereof, materials submitted in opposition to the proposed action, the hearing transcript, and such other material as may be relevant or pertinent to the subject matter of the hearing. The hearing file shall be available for public inspection with the exception of material exempt from disclosure under the Freedom of Information Act.

§ 327.6 Legal adviser.

In each public hearing, the District Counsel or his designee shall serve as legal adviser to the Presiding Officer in ruling upon legal matters and issues that may arise.

§ 327.7 Representation.

At the public hearing, any person may appear on his own behalf, and may be represented by counsel, or by other representatives.

§327.8 Conduct of hearings.

(a) Hearings shall be conducted by the Presiding Officer in an orderly but expeditious manner. Any person shall be permitted to submit oral or written statements concerning the subject matter of the hearing, to call witnesses who may present oral statements, and to present recommendations as to an appropriate decision. Any person may present written statements for the hearing file prior to the time the hearing file is closed to public submissions, and may present proposed findings and recommendations. The Presiding Officer shall afford participants an opportunity for rebuttal.

(b) The Presiding Officer shall have discretion to establish reasonable limits upon the time allowed for statements of witnesses, for arguments of parties or their counsel or representatives, and upon the number of rebuttals.

(c) Cross-examination of witnesses shall not be permitted.

(d) All public hearings shall be reported verbatim. Copies of the transcripts of proceedings may be purchased by any person from the Corps of Engineers or the reporter of such hearing. A copy will be available for public inspection at the office of the appropriate District Engineer.

(e) All written statements, charts, tabulations, and similar data offered in evidence at the hearing shall, subject to exclusion by the Presiding Officer for reasons of redundancy, be received in evidence and shall constitute a part of the hearing file.

(f) At any hearing, the Presiding Officer shall make an opening statement, outlining the purpose of the hearing and prescribing the general procedures to be followed. The Presiding Officer shall afford participants an opportunity to respond to his opening statement.

(g) The Presiding Officer shall allow a period of 10 days after the close of the public hearing for submission of written comments. After such time has expired, unless such period is extended by the Presiding Officer or the Chief of Engineers for good cause, the hearing file shall be closed to additional public written comments.

(h) In appropriate cases, the District Engineer may participate in joint public hearings with other Federal or State agencies, provided the procedures of those hearings meet the requirements of this regulation. In those cases in which the other Federal or State agency is required to allow cross-examination in its public hearing, the District Engineer may still participate in the joint public hearing but shall not require cross examination as a part of his participation.

(i) The procedures in subparagraphs (d), (f) and (g) of this Section may be waived by the Presiding Officer in appropriate cases.

§ 327.9 Filing of transcript of the public hearing.

Where the Presiding Officer is the initial action authority, the transcript of the public hearing, together with all evidence introduced at the public hearing, shall be made a part of the administrative record of the permit action or Federal project. The initial action authority shall fully consider the matters discussed at the public hearing in arriving at his initial decision or recommendation and shall address, in his decision or recommendation, all substantial and valid issues presented at the hearing. Where a person other than the initial action authority serves as Presiding Officer, such person shall forward the transcript of the public hearing and all evidence received in connection therewith to the initial action authority together with a report summarizing the issues covered at the hearing. The report of the Presiding Officer and the transcript of the public hearing and evidence submitted there shall in such cases be fully considered by the initial action authority in making his decision or recommendation to higher authority as to such permit action or Federal project.

§ 327.10 Powers of the Presiding Officer.

Presiding Officers shall have the following powers:

(a) To regulate the course of hearing including the order of all sessions and the scheduling thereof, after any initial session, and the recessing, reconvening, and adjournment thereof; and

(b) To take any other action necessary or appropriate to the discharge of the duties vested in them, consistent with the statutory or other authority under which the Chief of Engineers functions, and with the policies and directives of the Chief of Engineers and the Secretary of the Army.

§ 327.11 Public notice.

(a) Public notice shall be given of any public hearing to be held pursuant to this regulation. Such notice shall provide for a period of not less than 30 days following the date of public notice during which time interested parties may prepare themselves for the hearing, except that, in cases of public necessity, a shorter time may be allowed. Notice shall also be given to all Federal agencies affected by the proposed action, and to State and local agencies having an interest in the subject matter of the hearing. Notice shall be sent to all persons requesting a hearing and shall be posted in appropriate government buildings and published in newspapers of general circulation.

(b) The notice shall contain time, place, and nature of hearing; the legal authority and jurisdiction under which the hearing is held; and location of and availability of the draft Environmental Impact Statement or Environmental Assessment.

PART 328—HARBOR LINES

Sec.
328.1 Purpose and scope.
328.2 Applicability.
328.3 References.
328.4 Definition.
328.5 The purpose of harbor lines.
328.6 Establishment or modification of harbor lines.

AUTHORITY: 33 U.S.C. 401 et seq.

§ 328.1 Purpose and scope.

This regulation prescribes the policy, practice and procedures concerning harbor lines and any work in navigable waters of the United States shoreward of such lines.

§ 328.2 Applicability.

This regulation is applicable to all Corps of Engineers activities and installations having Civil Works responsibilities.

§ 328.3 References.

(a) Section 11 of the River and Harbor Act of 1899 (33 U.S.C. 404).

(b) Section 10 of the River and Harbor Act of 1899 (33 U.S.C. 403).

(c) Public Law 91-190, the National Environmental Policy Act of 1969.

§ 328.4 Definition.

The term "harbor line(s)" is used here in its generic sense. It includes types of harbor lines frequently referred to by other names, including, for example, pierhead lines and bulkhead lines.

§ 328.5 The purpose of harbor lines.

(a) Under previous policies, practices and procedures, riparian owners could erect open pile structures or undertake solid fill construction shoreward of established harbor lines without obtaining a permit under 33 U.S.C. 403. This was a matter of great concern, particularly in cases involving long established harbor lines, since all factors affecting the public interest may not have been taken into account at the time the lines were established. Accordingly, under previous policies, practices and procedures there was the danger that work shoreward of existing harbor lines could be undertaken without appropriate consideration having been given to the impact which such work may have on the environment and without a judgment having been made as to whether or not the work was, on balance, in the public interest.

(b) In order to assure that the public interest will be considered and protected in all instances, all existing and future harbor lines were declared on 27 May 1970 (33 CFR 209.150) to be guidelines for defining, with respect to the impact on navigation interests alone, the offshore limits of open pile structures (pierhead lines) or fills (bulkhead lines). A permit under 33 USC 403 is required in each case for any work which is commenced shoreward of existing or future harbor lines after 27 May 1970. Applications for permits for work in navigable waters of the United States shoreward of harbor lines shall be filed and processed in accordance with the provisions of 33 CFR Part 325. No permit is required for work completed or commenced prior to 27 May 1970 in conformance with existing harbor line authority.

§ 328.6 Establishment or modification of harbor lines.

Applications for the establishment of new harbor lines or the modification of existing harbor lines will be processed in a manner similar to applications for permits for work in navigable waters of the United States. Public notice concerning any such application will be sent to all parties known or believed to be interested in the application and a copy of the notice will be posted in post offices or other public places in the area. Public notices, apart from providing information relative to any harbor line application, shall make it clear that harbor lines are guidelines for defining, with respect to the impact on navigation interests alone, the offshore limits of open pile structures or fills and that the establishment of a harbor line carries with it no presumption that individual applications for permits to undertake work shoreward of any harbor line will be granted. Public hearings will be held in connection with applications for the establishment or modification of harbor lines whenever there appears to be sufficient public interest to justify the holding of a public hearing or when responsible Federal, State or local authorities, including Members of the Congress, request that a hearing be held and it is likely that information will be presented at the hearing that will be of assistance in determining whether the harbor line should be established or modified. District Engineers will forward all recommendations concerning the establishment or modification of harbor lines through the appropriate Division Engineer to the Office of the Chief of Engineers, DAEN-CWO-N. No new harbor lines will be established and no existing harbor lines will be modified unless specifically authorized by the Chief of Engineers.

PART 329—DEFINITION OF NAVIGABLE WATERS OF THE UNITED STATES

Sec.
329.1 Purpose.
329.2 Applicability.
329.3 General policies.
329.4 General definitions.
329.5 General scope of determinations.
329.6 Interstate or foreign commerce.
329.7 Intrastate or interstate nature of waterway.
329.8 Improved or natural conditions of waterbody.
329.9 Time at which commerce exists or determination is made.
329.10 Existence of obstructions.
329.11 Geographic and jurisdictional limits of rivers and lakes.
329.12 Geographic and jurisdictional limits of oceanic and tidal waters.
329.13 Geographic limits: shifting boundaries.
329.14 Determination of navigability.
329.15 Inquiries regarding determinations.
329.16 Use and maintenance of lists of determinations.

AUTHORITY: 33 U.S.C. 401 et seq.

§ 329.1 Purpose.

This regulation defines the term "navigable waters of the United States" as it is used to define authorities of the Corps of Engineers. It also prescribes the policy, practice and procedure to be used in determining the extent of the jurisdiction of the Corps of Engineers and in answering inquiries concerning "navigable waters."

§ 329.2 Applicability.

This regulation is applicable to all Corps of Engineers Districts and Divisions having Civil Works responsibilities.

§ 329.3 General policies.

Precise definitions of "navigable waters" or "navigability" are ultimately dependent on judicial interpretation, and cannot be made conclusively by administrative agencies. However, the policies and criteria contained in this regulation are in close conformance with the tests used by the Federal Courts and determinations made under this regulation are considered binding in regard to the activities of the Corps of Engineers.

§ 329.4 General definition.

Navigable waters of the United States are those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. A determination of navigability,

once made, applies laterally over the entire surface of the waterbody, and is not extinguished by later actions or events which impede or destroy navigable capacity.

§ 329.5 General scope of determination.

The several factors which must be examined when making a determination whether a waterbody is a navigable water of the United States are discussed in detail below. Generally, the following conditions must be satisfied:

(a) Past, present, or potential presence of interstate or foreign commerce;

(b) Physical capabilities for use by commerce as in subparagraph (a) above; and

(c) Defined geographic limits of the waterbody.

§ 329.6 Interstate or foreign commerce

(a) *Nature of Commerce: type, means, and extent of use.* The types of commercial use of a waterway are extremely varied and will depend on the character of the region, its products, and the difficulties or dangers of navigation. It is the waterbody's capability of use by the public for purposes of transportation of commerce which is the determinative factor, and not the time, extent or manner of that use. As discussed in § 329.9 below, it is sufficient to establish the potential for commercial use at any past, present, or future time. Thus, sufficient commerce may be shown by historical use of canoes, bateaux, or other frontier craft, as long as that type of boat was common or well-suited to the place and period. Similarly, the particular items of commerce may vary widely, depending again on the region and period. The goods involved might be grain, furs, or other commerce of the time. Logs are a common example; transportation of logs has been a substantial and well-recognized commercial use of many navigable waters of the United States. Note, however, that the mere presence of floating logs will not of itself make the river "navigable"; the logs must have been related to a commercial venture. Similarly, the presence of recreational craft may indicate that a waterbody is capable of bearing some forms of commerce, either presently, in the future, or at a past point in time.

(b) *Nature of commerce: interstate and intrastate.* Interstate commerce may of course be existent on an intrastate voyage which occurs only between places within the same state. It is only necessary that goods may be brought from, or eventually be destined to go to, another state. (For purposes of this regulation, the term "interstate commerce" hereinafter includes "foreign commerce" as well.)

§ 329.7 Intrastate or interstate nature of waterway.

A waterbody may be entirely within a state, yet still be capable of carrying interstate commerce. This is especially clear when it physically connects with a generally acknowledged avenue of interstate commerce, such as the ocean or one of the Great Lakes, and is yet wholly within one state. Nor is it necessary that there be a physically navigable connection across a state boundary. Where a waterbody extends through one or more states, but substantial portions, which are capable of bearing interstate commerce, are located in only one of the states, the entirety of the waterway up to the head (upper limit) of navigation is subject to Federal jurisdiction.

§ 329.8 Improved or natural conditions of the waterbody.

Determinations are not limited to the natural or original condition of the waterbody. Navigability may also be found where artificial aids have been or may be used to make the waterbody suitable for use in navigation.

(a) *Existing improvements: artificial waterbodies.* (1) An artificial channel may often constitute a navigable water of the United States, even though it has been privately developed and maintained, or passes through private property. The test is generally as developed above, that is, whether the waterbody is capable of use to transport interstate commerce. Canals which connect two navigable waters of the United States and which are used for commerce clearly fall within the test, and themselves become navigable. A canal open to navigable waters of the United States on only one end is itself navigable where it in fact supports interstate commerce. A canal or other artificial waterbody that is subject to ebb and flow of the tide is also a navigable water of the United States.

(2) The artificial waterbody may be a major portion of a river or harbor area or merely a minor backwash, slip, or turning area. (See § 329.12(b).)

(3) Private ownership of the lands underlying the waterbody, or of the lands through which it runs, does not preclude a finding of navigability. Ownership does become a controlling factor if a privately constructed and operated canal is not used to transport interstate commerce nor used by the public; it is then not considered to be a navigable water of the United States. However, a private waterbody, even though not itself navigable, may so affect the navigable capacity of nearby waters as to nevertheless be subject to certain regulatory authorities.

(b) *Non-existing improvements, past or potential.* A waterbody may also be considered navigable depending on the feasibility of use to transport interstate commerce after the construction of whatever "reasonable" improvements may potentially be made. The improvements need not exist, be planned, nor even authorized; it is enough that potentially they could be made. What is a "reasonable" improvement is always a matter of degree; there must be a balance between cost and need at a time when the improvement would be (or would have been) useful. Thus, if an improvement were "reasonable" at a time of past use, the water was therefore navigable in law from that time forward. The changes in engineering practices or the coming of new industries with varying classes of freight may affect the type of the improvement; those which may be entirely reasonable in a thickly populated, highly developed industrial region may have been entirely too costly for the same region in the days of the pioneers. The determination of reasonable improvement is often similar to the cost analyses presently made in Corps of Engineers studies.

§ 329.9 Time at which commerce exists or determination is made.

(a) *Past use.* A waterbody which was navigable in its natural or improved state, or which was susceptible of reasonable improvement (as discussed in § 329.8(b) above) retains its character as "navigable in law" even though it is not presently used for commerce, or is presently incapable of such use because of changed conditions or the presence of obstructions. Nor does absence of use because of changed economic conditions affect the legal character of the waterbody. Once having attained the character of "navigable in law," the Federal authority remains in existence, and cannot be abandoned by administrative officers or court action. Nor is mere inattention or ambiguous action by Congress an abandonment of Federal control. However, express statutory declarations by Congress that *described portions of* a waterbody are nonnavigable, or have been abandoned, are binding upon the Department of the Army. Each statute must be carefully examined, since Congress often reserves the power to amend the Act, or assigns special duties of supervision and control to the Secretary of the Army or Chief of Engineers.

(b) *Future or potential use.* Navigability may also be found in a waterbody's susceptibility for use in its ordinary condition or by reasonable improvement to transport interstate commerce. This may be either in its natural or improved condition, and may thus be existent although there has been no actual use to date. Non-use in the past therefore does not prevent recognition of the potential for future use.

§ 329.10 Existence of obstructions.

A stream may be navigable despite the existence of falls, rapids, sand bars, bridges, portages, shifting currents, or similar obstructions. Thus, a waterway in its original condition might have had substantial obstructions which were overcome by frontier boats and/or portages, and nevertheless be a "channel" for commerce, even though boats had to be removed from the water in some stretches, or logs be brought around an obstruction by means of artificial chutes. However, the question is ultimately a matter of degree, and it must be recognized that there is some point beyond which navigability could not be established.

§ 329.11 Geographic and jurisdictional limits of rivers and lakes.

(a) *Jurisdiction over entire bed.* Federal regulatory jurisdiction, and powers of improvement for navigation, extend laterally to the entire water surface and bed of a navigable waterbody, which includes all the land and waters below the ordinary high water mark.

(1) The "ordinary high water mark" on non-tidal rivers is the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of soil; destruction of terrestrial vegetation; the presence of litter and debris; or other appropriate means that consider the characteristics of the surrounding areas.

(2) Ownership of a river or lake bed or of the lands between high and low water marks will vary according to state law; however, private ownership of the underlying lands has no bearing on the existence or extent of the dominant Federal jurisdiction over a navigable waterbody.

(b) *Upper limit of navigability.* The character of a river will, at some point along its length, change from navigable to non-navigable. Very often that point will be at a major fall or rapids, or other place where there is a marked decrease in the navigable capacity of the river. The upper limit will therefore often be the same point traditionally recognized as the head of navigation, but may, under some of the tests described above, be at some point yet further upstream.

§ 329.12 Geographic and jurisdictional limits of oceanic and tidal waters.

(a) *Ocean and coastal waters.* The navigable waters of the United States over which Corps of Engineers regulatory jurisdiction extends include all ocean and coastal waters within a zone three geographic (nautical) miles seaward from the coast line. Wider zones are recognized for special regulatory powers, such as those exercised over the Outer Continental Shelf.

(1) *Coast line defined.* Generally, where the shore directly contacts the open sea, the line on the shore reached by the ordinary low tides comprises the coast line from which the distance of three geographic miles is measured. On the Pacific coast the line of mean lower low water is used. The line has significance for both domestic and international law (in which it is termed the "baseline"), and is subject to precise definitions. Special problems arise when offshore rocks, islands, or other bodies exist, and the line may have to be drawn to seaward of such bodies.

(2) *Shoreward limit of jurisdiction.* Regulatory jurisdiction in coastal areas extends to the line on the shore reached by the plane of the mean (average) high water. However, on the Pacific coast, the line reached by the mean of the higher high waters is used. Where precise determination of the actual location of the line becomes necessary, it must be established by survey with reference to the available tidal datum, preferably averaged over a period of 18.6 years. Less precise methods, such as observation of the "apparent shoreline" which is determined by reference to physical markings, lines of vegetation, or changes in type of vegetation, may be used only where an estimate is needed of the line reached by the mean high water.

(b) *Bays and estuaries.* Regulatory jurisdiction extends to the entire surface and bed of all waterbodies subject to tidal action. Jurisdiction thus extends to the edge (as determined by § 329.12(a)(2) above) of all such waterbodies, even though portions of the waterbody may be extremely shallow, or obstructed by shoals, vegetation, or other barriers. Marshlands and similar areas are thus considered "navigable in law," but only so far as the area is subject to inundation by the mean high waters. The relevant test is therefore the presence of the mean high tidal waters, and not the general test described above, which generally applies to inland rivers and lakes.

§ 329.13 Geographic limits: shifting boundaries.

Permanent changes of the shoreline configuration result in similar alterations of the boundaries of the navigable waters of the United States. Thus, gradual changes which are due to natural causes and are perceptible only over some period of time constitute changes in the bed of a waterbody which also change the shoreline boundaries of the navigable waters of the United States. However, an area will remain "navigable in law," even though no longer covered with water, whenever the change has occurred suddenly, or was caused by artificial forces intended to produce that change. For example, shifting sand bars within a river or estuary remain part of the navigable water of the United States, regardless that they may be dry at a particular point in time.

§ 329.14 Determination of navigability.

(a) *Effect on determinations.* Although conclusive determinations of navigability can be made only by Federal Courts, those made by Federal agencies are nevertheless accorded substantial weight by the courts. It is therefore necessary that when jurisdictional questions arise, District personnel carefully investigate those waters which may be subject to Federal regulatory jurisdiction under the guidelines set out above, as the resulting determination may have substantial impact upon a judicial body. Official determinations by an agency made in the past can be revised or reversed as necessary to reflect changed rules or interpretations of the law.

(b) *Procedures of determination.* A determination whether a waterbody is a navigable water of the United States will be made by the Division Engineer, and will be based on a report of findings prepared at the District level in accordance with the criteria set out in this regulation. Each report of findings will be prepared by the District Engineer, accompanied by an opinion of the District Counsel, and forwarded to the Division Engineer for a final determination. Each report of findings will be based substantially on applicable portions of the format in subparagraph (c) below.

(c) Suggested format of report of findings:

(1) Name of waterbody.....
(2) Tributary to.....
(3) Physical characteristics.....
(i) Type: (river, bay slough, estuary, etc.).....
(ii) Length .....
(iii) Approximate discharge volumes:
Maximum .....
Minimum .....
Mean .....
(iv) Fall per mile.....
(v) Extent of tidal influence.....
(vi) Range between ordinary high and ordinary low water.....
(vii) Description of improvements to navigation not listed in subparagraph (5) below .....
(4) Nature and location of significant obstructions to navigation in portions of the waterbody used or potentially capable of use in interstate commerce.....
(5) Authorized projects.....
(i) Nature, condition and location of any improvements made under projects authorized by Congress.....
(ii) Description of projects authorized but not constructed.....
(iii) List of known survey documents or reports describing the waterbody.....
(6) Past or present interstate commerce.....
(i) General types, extent, and period in time .....
(ii) Documentation if necessary.....
(7) Potential use for interstate commerce, if applicable.....
(i) If in natural condition.....
(ii) If improved.....
(8) Nature of jurisdiction known to have been exercised by Federal agencies if any...
(9) State or Federal court decisions relating to navigability of the waterbody, if any...
(10) Remarks .....
(11) Finding of navigability (with date) and recommendation for determination...

§ 329.15 Inquiries regarding determinations.

(a) Findings and determinations should be made whenever a question arises regarding the navigability of a waterbody. Where no determination has been made, a report of findings will be prepared and forwarded to the Division Engineer, as described above. Inquiries may be answered by an interim reply which indicates that a final agency determination must be made by the Division Engineer. If a need develops for an emergency determination, District Engineers may act in reliance on a finding prepared as in § 329.14 above. The report of findings should then be forwarded to the Division Engineer on an expedited basis.

(b) Where determinations have been made by the Division Engineer, inquiries regarding the navigability of specific portions of waterbodies covered by these determinations may be answered as follows:

This Department, in the administration of the laws enacted by Congress for the protection and preservation of the navigable waters of the United States, has determined that ------ (River) (Bay) (Lake, etc.) is a navigable water of the United States from ------ to ------. Actions which modify or otherwise affect those waters are subject to the jurisdiction of this Department.

whether such actions occur within or outside the navigable areas.

(c) Specific inquiries regarding the jurisdiction of the Corps of Engineers can be answered only after a determination whether (1) the waters are navigable waters of the United States or (2) if not navigable, whether the proposed type of activity may nevertheless so affect the navigable waters of the United States that the assertion of regulatory jurisdiction is deemed necessary.

§ 329.16 Use and maintenance of lists of determinations.

(a) Tabulated lists of final determinations of navigability are to be maintained in each District office, and be updated as necessitated by court decisions, jurisdictional inquiries, or other changed conditions.

(b) It should be noted that the lists represent only those waterbodies for which determinations have been made; absence from that list should not be taken as an indication that the waterbody is not navigable.

(c) Deletions from the list are not authorized. If a change in status of a waterbody from navigable to non-navigable is deemed necessary, an updated finding should be forwarded to the Division Engineer; changes are not considered final until a determination has been made by the Division Engineer.

[FR Doc.77-20484 Filed 7-18-77;8:45 am]

[3710-92]

DEPARTMENT OF DEFENSE

Corps of Engineers, Department of the Army

[33 CFR Part 239]

WATER RESOURCES POLICIES AND AUTHORITIES

Implementation of Executive Order 11988 on Floodplain Management

AGENCY: U.S. Army Corps of Engineers.

ACTION: Proposed regulation.

SUMMARY: This proposed regulation prescribes policies to be used by the Corps of Engineers in implementing Executive Order 11988, Floodplain Management as it pertains to the planning, design and construction of civil works projects, and to the activities under the operation and maintenance and the regulatory programs of the Corps.

DATE: Comments must be received by June 24, 1978.

FOR FURTHER INFORMATION CONTACT:

Mr. Maurice B. Jackson, 202-693-6807, or write: Office of the Chief of Engineers, Forrestal Building, Washington, D.C. 20314, Attn: DAEN-CWR-R.

Dated: May 19, 1978.

C. A. SELLECK, Jr.,
Colonel, Corps of Engineers,
Executive Director of Civil Works.

PART 239—WATER RESOURCES POLICIES AND AUTHORITIES: IMPLEMENTATION OF EXECUTIVE ORDER 11988 ON FLOOD PLAIN MANAGEMENT

Sec.
239.1 Purpose.
239.2 Applicability.
239.3 References.
239.4 Definitions.
239.5 Background.
239.6 The objective of the order.
239.7 General policy
239.8 General procedures.
239.9 Assessment of impacts.
239.10 Minimize.
239.11 Restore and preserve.
239.12 Regulatory.
239.13 Reporting requirements and public involvement.
239.14 Application of EO to Civil Works program.

AUTHORITY: E.O. 11988, 43 FR 6030, February 10, 1978.

§ 239.1 Purpose.

The purpose of this regulation is to provide policy and guidance for Corps of Engineers implementation of Executive Order 11988, Floodplain Management, as it pertains to the planning, design and construction of Civil Works projects, and to the activities under the operation and maintenance and the regulatory programs of the Corps.

§ 239.2 Applicability.

This regulation is applicable to all OCE elements and all field operating agencies having Civil Works responsibilities.

§ 239.3 References.

(a) Executive Order 11988, Floodplain Management, May 24, 1977.
(b) Water Resources Council, Floodplain Management Guidelines for Implementing E.O. 11988, February 10, 1978 (43 FR 6030).
(c) Water Resources Council, A Unified National Program for Flood Plain Management, July 1976.
(d) 33 CFR Parts 320 through 329 (42 FR 37121-37164, July 19, 1977).
(e) ER 1105-210.
(f) ER 1105-2-230.
(g) ER 1105-2-240.
(h) ER 1105-2-250.
(i) ER 1105-2-351.
(j) ER 1105-2-502.
(k) ER 1105-2-800.
(l) ER 1105-2-811
(m) ER 1120-2-117
(n) ER 1165-2-500

§ 239.4 Definitions.

(a) "Action" is any Federal activity including (1) acquiring, managing, and disposing of Federal lands and facilities; (2) providing federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

(b) "Base Floodplain" is the one percent chance floodplain.

(c) "Minimize" is to reduce to the smallest possible amount or degree.

(d) "Practicable" is capable of being done within existing constraints. The test of what is practicable depends upon the situation and includes consideration of the pertinent factors, such as environment, cost or technology.

(e) "Preserve" is to prevent modification to the natural floodplain environment or to maintain it as closely as possible to its natural state.

(f) "Restore" is to re-establish a setting or environment in which the natural functions of the floodplain can again operate.

§ 239.5 Background.

Executive Order 11988, Floodplain Management, signed May 24, 1977, revoked and replaced Executive Order 11296 issued August 10, 1966. The new Order is based in part on the National Environmental Policy Act of 1969 (NEPA) and adds new prominence to the environmental aspects of floodplains that were not present in Executive Order 11296. Federal agencies are required, during the decisionmaking process, to recognize significant public values of floodplains and to consider the public benefits that will be derived from the restoration and preservation of floodplains. The new Order requires agencies to amend their existing procedures and regulations within one year in consultation with the Water Resources Council (WRC), Federal Insurance Administration (FIA) and the Council on Environmental Quality (CEQ). In this regard, a task force was formed under the leadership of WRC for the purpose of developing broad guidance on the interpretation of the Order to assist Federal agencies in developing their procedures and regulations. The efforts of the task force resulted in the publication of the Floodplain Management Guidelines for Implementing EO 11988 in the FEDERAL REGISTER on February 10, 1978, (43 FR 6030) (Reference 3b). The guidelines provide an explanation of key terms in the Order, floodplain management concepts, and procedures necessary to comply with the EO. The Order requires that agency procedures incorporate the conceptual framework of floddplain management as set out in the "Unified National Program for Flood Plain Management." (Reference 3c). The Unified Program has as a goal sound floodplain management that embodied the "wise use, conservation, development and utilization of interrelated land and water resources to serve objectives of economic efficiency, environmental quality and social well-being as consonant with responsibilities assigned to respective levels of government by law."

§ 239.6 The objective of the order.

The objective of the Executive Order is to avoid to the extent possible the long and short term adverse impacts associated with occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. The Order requires Federal agencies to provide leadership and take action to:

(a) Avoid the base floodplain unless it is the only practicable alternative;

(b) Reduce the hazard and risk of flood loss;

(c) Minimize the impact of floods on human safety, health and welfare; and

(d) Restore and preserve the natural and beneficial floodplain values. Direct support of floodplain development is an action in the floodplain that encourages, allows, serves or otherwise facilitates additional floodplain development. An example of direct support would be provision of flood protection measures to undeveloped or underrutilized floodplain lands for the purposes of permitting future development and growth.

§ 239.7 General policy.

It shall be Corps policy to formulate projects which, to the extent possible,

avoid the adverse impacts associated with use of floodplains and avoid inducing development in the base floodplain unless there is no practicable alternative to the development. The decision on whether a practicable alternative exists shall be based on the advantages and disadvantages of floodplain sites and non-floodplain sites. Factors to be considered include conservation, economics, aesthetics, natural and beneficial values served by floodplains, impact of floods on human safety, locational advantage, the functional need for locating the development in the floodplain, historic values, fish and wildlife habitat values, endangered and threatened species, Federal and State designations of wild and scenic rivers, refuges, etc., recreation, water supply, water quality, food production, and, in general, the needs and welfare of the people. The test of practicability will apply to both the Corps action and to any induced development caused by the action. When it is determined that no practicable alternative to actions in the floodplain exist, the features or qualities of the floodplain that make it advantageous over alternative non-floodplain sites shall be described and adequately supported. The practicability analysis is not required for lots or small tracts of vacant lands in closely spaced urban areas, unless these vacant areas have retained most of the unique environmental values associated with undisturbed floodplains.

§ 239.8 General procedures.

The basic determinations necessary to implement the Executive Order are:

(a) Determine whether the proposed action is in the base floodplain.

(b) If so, determine whether there is a practicable alternative to locating the action in the base floodplain as outlined in 7 above.

(c) Identify adverse impacts due to the action and the induced development and identify losses of natural and beneficial values of the floodplain.

(d) If the proposed action induces development in the base floodplain, determine if there is a practicable alternative to the development as outlined in § 239.7.

(e) As part of the multiobjective planning approach under the Principles and Standards, determine viable methods to minimize the adverse impacts of the action and the induced development and methods to restore and preserve the natural and beneficial values of the floodplain. Successive iterations of the planning process as called for in ER 1105-2-200 should be used to develop methods for minimization (see paragraphs 10 and 11). This includes reevaluation of the no action alternative.

(f) Advise the general public if the proposed action will be located in the floodplain. The policies and procedures of ER 1105-2-502 shall be utilized to the extent possible to advise the public.

(g) Recommend the most desirable plan responsive to the established planning objectives and consistent with the requirements of the Executive Order stated in § 239.6 above.

§ 239.9 Assessment of impacts.

The determination called for in § 239.8e above, requires an assessment of the impacts of the action. Impact identification and assessment apply to both the Corps action and to the induced development, if any, that would occur in the base floodplain with the proposed action, but not in the absence of the action. Existing procedures and guidance for identifying and assessing impacts are contained in ER 1105-2-240 for multiobjective planning and ER 1105-2-507 for responding to NEPA requirements. These procedures are designed to ensure that all significant adverse and beneficial effects of actions are identified and measured. ER 1105-2-240 requires identifying sources of impacts, tracing impacts, describing the magnitude of impacts and specifying the location, timing, and duration of impacts. ER 1105-2-507 generally requires the identification of impacts and effects of an action on the environment. In this regard, impact identification and assessment procedures required by existing regulations meet the requirements of the EO and shall be followed.

§ 239.10 Minimize.

As previously defined, minimize is to reduce to the smallest possible amount or degree. The goal of minimization is to avoid the adverse impacts associated with induced floodplain use. "Minimize" as defined in the WRC guidelines is broad and open-ended. There is an implicit acceptance of practical limitations which makes it consistent with the Principles and Standards. It is expected that all practicable workable means and measures will be utilized to minimize adverse impacts. Application of "minimization" to Corps activities and programs will require careful consideration and evaluation of the floodplain action and any adverse impacts of induced floodplain development. For example, successive iterations of the planning process should normally result in the deletion of separable segments of a project when such segment protects undeveloped land and induces development in the floodplain for which there would be another practicable non-floodplain alternative.

§ 239.11 Restore and preserve.

Restoration and preservation are methods of enhancing the natural and beneficial values of floodplains. Such values are primarily environmental quality (EQ) objectives. Therefore, restoration and preservation should be considered as EQ components of overall plans or as EQ Plans under the Principles and Standards and the ER 1105-2-200 series. The implementation of actions or measures to restore or preserve floodplain values shall be recommended in reporting documents if they fall under existing Corps authorities. If they are not within existing authorities of the Corps, the report shall describe how the measures can be implemented. Example of actions that could be taken to restore floodplain values are as follows:

(a) Relocate non-conforming structures and facilities out of the floodplain.

(b) Reestablish damaged floodplain ecosystems.

(c) Restore, preserve, and create wetlands, marshes, and etc.

(d) Implement measures that will enhance fish and wildlife values.

(e) Restore and revegetate damaged beaches and dunes.

§ 239.12 Regulatory.

The policy in this regulation is consistent with the general policies for evaluating permit applications under the Corps of Engineers regulatory program as contained in reference 3d. Section 2(c) of the Order pertaining to the issuance of permits or licenses requires agencies to: (a) Consider and evaluate flood hazards for actions in floodplains; (b) provide early public review of plans or proposals in floodplains for which the impact is not significant to require preparation of an EIS; and (c) provide guidance to applicants to enable them to evaluate the effects of their proposal on the floodplain prior to submitting an application. Parts 320.4 and 325.3 of reference 3d contain policies and procedures that comply with the intent of the Order for items 1 and 2 above, respectively, and shall be continued. A forthcoming Corps of Engineers regulation will provide broad general guidance that will assist an applicant in preparing an application for a permit to evaluate early in the planning process the effects the proposal will have on the floodplain.

§ 239.13 Reporting requirements and public involvement.

When a determination has been made that there is no practicable alternative to locating an action in the floodplain, the EO requires the reporting of this finding by various procedures. In addition, the Order requires early public review of plans whenever an action is proposed for the floodplain. The Order requirements generally include and relate to reporting procedures that are presently accomplished under existing Corps regula-

tions, with some minor exceptions. The following additional information shall be included in existing reporting requirements, as appropriate, for general investigation studies, projects in engineering and design stages, studies under the special continuing authorities program, and activities under the operations and maintenance program.

(a) *Section 2(a)(2).* If there is no practicable alternative to locating an action in the floodplain, a public notice shall be prepared and circulated to the general public. The notice shall include the following: (1) A description of why the action must be located in the floodplain; (2) a description of significant facts considered in making the determination to locate in the floodplain, including alternative sites and actions considered and any tradeoffs that were made; and (3) a statement indicating whether the proposal conforms to applicable State or local floodplain protection standards. The public notice issued upon completion of a study action or its equivalent will serve as the means to satisfy this requirement of the Order. Public notices shall provide specific information pertaining to subparagraphs (1), (2) and (3) of this paragraph, and the notices shall be appropriately disseminated to the general public in the affected area.

(b) *Section 2(a)(3)* requires the submission of a notice, not to exceed three pages in length, including a location map, to State and areawide A-95 Clearinghouse for the geographic area affected, when an action is to be located in the floodplain. Continuation of existing procedures and requirements stated in ER 1105-2-811 will comply with the intent of the Order with the exception that future notices to clearinghouses shall also include the additional information requested in paragraph (a) of this section.

(c) *Section 2b.* Requests for new authorizations or new appropriations for construction starts transmitted to the Office of Management and Budget shall provide information on whether a proposed Corps action will be located in the floodplain. If the proposed action is located in the floodplain the transmittal to OMB shall provide information on compliance with the EO. This shall include statements on whether the action affects the natural and beneficial values of the floodplains; steps taken to minimize potential harm to or within the floodplain caused by the action; and steps taken to restore and preserve the natural and beneficial floodplain values of the floodplain area.

(d) *Statement of findings.* Since Corps actions in the floodplain are subject to NEPA, the Statement of Findings that accompanies the EIS (paragraph 6b of ER 1105-2-509), or covered in the feasibility report will include, in addition to existing requirements, the following:

(1) Reasons why the proposed action must be located in the floodplain.

(2) Facts considered in making the determination to locate in the floodplain, including alternative sites and actions considered.

(3) Statement on whether the proposed action conforms to applicable State or local floodplain protection standards.

(4) Statement on whether the action affects the natural and beneficial values of the floodplain.

(5) Description of steps taken to design or modify the proposed action in order to minimize potential harm to or within the floodplain; and

(6) A general listing of other involved agencies, groups, and organizations.

(e) *Public involvement.* To insure that adequate information and opportunities are provided early in the decision-making process to allow the public to participate effectively in floodplain management decisions, a public involvement program shall: (1) Include as broad an audience as possible; (2) provide continuous interaction and involvement opportunities for the public during the decision-making process; (3) provide information which promotes the fullest understanding of the proposed action; and (4) provide timely opportunities for all segments of the public to affect an action or plan before alternative actions have been precluded. The policies and objectives for public involvement contained in ER 1105-2-800 for planning Civil Works projects are generally parallel to the requirements of the Order. However, public participation programs shall include early, specific reference to Executive Order 11988 and its objectives. The public in the affected area shall be advised early, through the public participation process, whenever a proposed plan will result in action in the base floodplain.

§ 239.14 Application of EO to Civil Works program.

The provisions of Executive Order 11988 shall be implemented by each agency not later than May 24, 1978.

(a) *Preauthorization studies.* At the earliest stages of planning, the policy and procedures of this regulation shall be incorporated in the multiobjective planning process (ER 1105-2-200 series of regulations) to a scope and level of detail appropriate for preauthorization studies. For those studies for which reports have been completed and forwarded by the reporting officers, supplemental information concerning the implementation of the Executive Order has been requested by DAEN-CWP under a separate action.

(b) *Advanced engineering and design.* Reporting officers shall insure that projects in the advanced engineering and design stage comply with the intent and objective of the Executive Order as set forth in this regulation.

(c) *Continuing authorities program (ER 1105-2-50).* The policies and procedures of this regulation are applicable to the planning and design of projects under the Continuing Authorities Program. Current studies under the Continuing Authorities Program shall incorporate the policies and procedures of this regulation early in the multi-objective planning process as required by ER 1105-2-50.

(d) *Projects under construction.* The Order does not apply to projects presently under construction, or to projects for which all of the funds have been appropriated through fiscal year 1978, or to projects and programs for which a draft or final enviromental impact statement was filed prior to October 1, 1977, as part of AE&D activities.

(e) *Operation and Maintenance Activities.* The policies and procedures of this regulation are applicable to operation and maintenance activities of the Corps of Engineers. District Engineers shall insure that projects operated and maintained by the Corps comply with the policies and procedures set forth in this regulation and 33 CFR 209.145.

(f) *Emergency Activities.* Emergency and flood-related activities conducted under Pub. L. 84-99 essential to saving lives and protecting property and public health and safety, are exempt from the provisions of the Order (e.g. the requirement to prepare and circulate a notice of a proposed activity in the floodplain). However, rehabilitation activities performed under Pub. L. 84-99 by the Corps shall be carried out in a manner that reflects compliance with the spirit and intent of the Executive Order. This shall include providing leadership and taking actions to:

(1) Avoid harm to the natural and beneficial values of floodplains;

(2) Minimize the impact of floods on human safety, health and welfare;

(3) Restore the natural and beneficial floodplain values that have been impacted by an emergency action.

[FR Doc. 78-14541 Filed 5 23-78; 8:45 am]

Appendix E

TECHNICAL APPENDIX

METHODOLOGY FOR EVALUATION OF LAND USE FROM AERIAL PHOTOS*

1. As a means of identifying the rates and causes of wetland alteration in the Snohomish estuary it was determined that historical trends of land use in the area should be analyzed. This required acquisition of historical maps and aerial photographs which might be useful in delineating the types and extent of land use within the estuary. Table I identifies the dates, scale, and characteristics of the maps and photographs which were acquired.

2. After the material was acquired, it was inspected to determine the most appropriate approach for land use interpretation. The approach included identification of the area to be analyzed and selection of 15 land use categories which could be readily identified. The study area was bounded as follows: To the north and east, the 100 year floodplain (COE, 1975c); to the south, an east-west line through the confluence of the Snohomish River and Ebey Slough; to the west the 100 year floodplain from Ebey Slough to Preston Point and a line from Preston Point to Priest Point. The land use categories are described in Table VII-1, Section VII.

3. The 15 categories were most easily identified on the 1977 photo series, due to both the large scale and color infra-red format of those photographs. In addition, verification of present land use in the estuary was possible. In the older photographs identification of the 15 categories was somewhat more difficult. However, the familiarity with land use in the estuary gained while interpreting the 1977 photographs provided considerable help in interpretation.

4. In order to determine the areal extent of the various land uses, a mosaic of the photographs was made and then overlain with a sheet of transparent mylar. The boundaries of the various use categories were then transferred to the mylar. With the reduction of the mylar to a scale of 1:24000 a set of land use maps for different years, all at the same scale, was generated. These maps could then be planimetered to determine the extent of each land use category for each year.

5. Although this method allows a reasonable degree of accuracy, there are several problems which might cause errors in measurement. These problems are:

- Inconsistent scale of photographs
- Time when photographs were taken
- Lack of complete photographic coverage
- Shoreline changes

---

* Formulated by SAI for this project.

- Difficulties in land use identification
- Inherent planimetry errors
- Inaccuracy of old maps

In addition, old maps are subject to the interpretation errors of those who prepared them. Each of these problems, as well as the mitigating measures used to minimize the effect of the problem, are discussed below.

Inconsistent scale of photographs

6. This relates not to the fact that aerial photographs taken in different years are at different scales, but rather to the fact that the scale of a photograph will vary from center to edges, and also from photograph to photograph within a series. The degree of this variation in a single photograph is a product of the quality of the equipment used, in both original photography and in reproduction. The variation in scale between photographs is a product of changes in the elevation of the airplane taking the photographs.

7. Although the center of a photograph is generally considered to have the most accurate reproduction, it is not possible to limit use to that area without damaging the print through folding or cutting. Therefore, to determine the degree of error within each series of photographs, comparisons were made between the area of each island for a given year and the area as determined on the USGS topographic quadrangle maps of the estuary. From this comparison it was discovered that the range of variation between area on the photographs and area on the map was less than 10%. For example, the area of each island in the 1977 photographs varied with that on the map by anywhere from 0 to -10% with a mean of -4.5%. Therefore, all measurements made from the 1977 photographs were multiplied by a correction factor of 1.05. At that point all measurements for 1977 were within ±5% of the measurements made on the topographic quadrangle. This method was used for photographs from all years.

Time when photographs were taken

8. The area of land exposed in a tidal estuary will vary depending on the height of the tide. The tidal height in turn will vary with both time and location within the estuary (see Tides Profile). Most of the estuary has been diked, thus forming steep shores. Where there are no dikes, natural scarps or vegetation delineate the boundary of wetland areas. With these conditions it was felt that the tidal height would have little effect on the areal extent of land exposed, and in the study area that effect would probably cause considerably less than the error created by other factors.

Lack of complete photographic coverage

9. Both the 1969 and 1947 photograph series did not completely cover the estuary. In the 1969 series, the west shore of Ebey Island and the Lowell area were missing. In the 1947 series the complete eastern boundary, approximately one mile in width, was not included. To complete the 1969 series, a set of photographs taken in 1970 were acquired. It was assumed that few changes in land use occurred during that period in that small area; therefore, the substitution would be appropriate. For the 1947 series comparison of land use in the missing area in 1941 and 1955 showed little change in activities. Therefore, the 1955 data for that area was applied to the 1947 material.

Shoreline changes

10. There have been numerous shoreline changes in the estuary between 1884 and 1977. Some changes have been man-made and some have not. None of these changes has resulted in significant area variations of islands within the estuary, but all have affected interpretation of land use.

Examples of man-made shoreline changes include:

- Between 1947 and 1955 a north-south trending slough dividing Smith Island was closed at both ends, creating a single island out of two islands.

- Between 1955 and 1963 a channel was dredged through Spencer Island connecting Union and Steamboat Sloughs.

Examples of natural changes include:

- Between 1941 and 1947 Otter Island became separated from North Ebey Island due to erosion of a channel between them.

- A small wooded island located at the confluence of Ebey Slough and the Snohomish River has been slowly eroding away since 1941. It is presently only a small marsh and may erode away entirely in a few years.

Difficulties in land use identification

11. Accurate identification and delineation of land use categories from aerial photographs is a task which requires both patience and practice. This is particularly true of small scale photographs. Shrub wetlands and shrub uplands are often difficult

to distinguish. Roads and dikes which are long and narrow but account for considerable acreage are not easily planimetered. Log storage facilities may not have been in use at the time the photographs were taken. As a result of these difficulties there is a variation in the area reported for some classifications even where there has been no increase. For example, dikes on Spencer Island South are reported to comprise 30 acres in 1947, 29 acres in 1955, and 27 acres in 1969. In 1977 the dikes comprised 66 acres. This increase, however, does not represent an error in measurement, rather it represents the enlargement of these dikes through disposal of wood waste.

Inherent planimetry errors

12. Planimetry techniques are known to contain errors. Inaccurate tracing, irregular surface friction and slight misadjustments of the planimeter all contribute to possible errors. Very small or long narrow shapes are particularly susceptible to the possible errors of planimetry. In order to minimize these errors, each measurement was repeated until three values within 5% of each other were achieved. The mean of these three values was then reported as the area of the unit being measured.

13. Upon completion of planimetry, several comparisons were made to determine the accuracy of the measurements. The total of all the land use categories on each island was compared to the total island area. The total island area was compared to the island area measured on the most recent USGS topographic quadrangle map. All of these totals were within ±5% of the area determined from the USGS map. As a further check the total area for each island was compared with the total area obtained in the Habitat Classification Study (Burrell, 1978). These also were within ±5%.

Inaccuracies of the old maps

14. The accuracy of the old maps for land use interpretation is dependent on the accuracy of interpretations made by the original survey teams. There are several items on the 1895 and 1911 topographic maps ("quads") which are of questionable accuracy.

15. First, Ebey Island is designated as undiked marsh while many of the other islands are diked. According to Whitfield (1926) Ebey Island was diked in 1892. There is no evidence that this dike ever fell into disrepair. Second, the 1911 Marysville quad shows all of Otter Island as being diked. Inspection of the site and aerial photographs suggest that only five acres were diked, and not the whole island. Finally, most of the area west of the railroad

on North Ebey Island is designated as undiked upland on the 1911 quad. All evidence suggests this area is and always was a wetland.

16. Thus, it is apparent that old maps can have inconsistencies, and proper interpretation of these maps requires resolution of these inconsistancies. A knowledge of the area and a variety of historical sources are useful aids in resolving these problems.

DATA COMPARISON

17. In order to compare land use data from various years and identify trends, island areas were normalized and the area of each land use category was appropriately adjusted. The areal data obtained from the 1977 photographs was chosen as the standard, and data from all other years was normalized to that standard. An example of this process is shown below:

Before normalization:

		OS	W	D	A	TOTAL
1955	Spencer Is. S.	106	64	29	235	434
1977	Spencer Is. S.	23	30	66	321	440

After normalization:

		OS	W	D	A	TOTAL
1955	Spencer Is. S.	108	65	29	238	440
1977	Spencer Is. S.	23	30	66	321	440

18. In this manner, all islands and the entire estuary could be analyzed for trends in land use and wetlands alteration.

Table I

MAPS AND CHARTS OF THE SNOHOMISH ESTUARY

Date	Type	Scale	Source*	Comments
1884	Navigation Chart	1:254[illegible]8	USC&GS	Identifies all of floodplain within study area as marsh or swamp
1895	30' Quadrangle Snohomish	1:125000	USGS	Includes southern portion of estuary. Delineates marsh and dikes. Joins w/1911.
1911	30' Quadrangle Mt. Vernon	1:125000	USGS	Includes northern portion of estuary. Delineates marsh and dikes. Joins w/1985.
1941	B&W Photographs	1:17000	USDA, SCS	Complete coverage of the estuary.
1947	B&W Photographs	1:12000	USGS	Complete coverage except for eastern 0.5 miles of area.
1955	B&W Photographs	1:12000	USGS	Complete coverage.
1963	B&W Photographs	1:12000	USACofE	Complete coverage.
1965	B&W Photographs	1:12000	Wa DNR	Covers only port and mouth of estuary.
1969	B&W Photographs	1:12000	USGS	Complete except for southwest corner of study area.
1970	B&W Photographs	1:400	PSCOG	
1974	B&W Photographs	1:24000	Wa DOH	Complete coverage
1977	Color Infrared	1:6000	USACofE	Complete coverage.

* USC&GS - U.S. Coast and Geodetic Survey (presently Nat'l Ocean Survey)
USGS - U.S. Geological Survey
USDA,SCS - U.S. Department of Agriculture, Soil Conservation Service
USACofE - U.S. Army, Corps of Engineers
Wa DNR - Washington Department of Natural Resources
PSCOG - Puget Sound Council of Governments
Wa DOH - Washington Department of Highways

BIRD DISTRIBUTION IN THE SNOHOMISH ESTUARY

Table 29 is a tabulation of those bird species likely to be found in the study area. Not included are species for which there is only a slight possibility of their being found, or migratory species that are only briefly present in the area. Those birds for which recorded observations have been documented are indicated. Notes regarding breeding status of the species are also included. Most of the tabulation is a prediction of seasonal use of the various habitats of the study area.

Notes

1. Based on: Salo, 1975; Canning 1977; Engman and Stendal, 1976; Whal and Paulson, 1973; Peterson, 1961.

2. Habitat Codes:

   - SW: salt water and associated shorelines
   - EW: estuarine water and associated shorelines
   - FW: freshwater and associated shorelines
   - WL: wetlands
   - SL: swamp lands
   - BL: brush lands; shrubby thickets; brush swamps
   - CF: coniferous forest
   - BF: broadleaf forest
   - RW: riparian woodland streamside
   - AG: agricultural land, grasslands
   - UR: urban parks, parkways, gardens, lakes, etc.

3. Seasonality (in columns under Habitats):

   - R: resident; present all year, abundance may vary seasonally
   - S: summer visitor, including spring and fall migration periods
   - W: winter visitor, including spring and fall migration periods
   - M: migrant during spring and fall

4. Observations Codes Bibliography:

   1. Salo, 1975
   2. Canning, 1977
   3. Engman and Stendal, 1976
   4. Burrell, 1977

The habitat codes devised for this appendix are based on the avian ecology of habitat use in general, and what is known of avian use habitats in the study area. These avian habitat codes are not directly comparable to the detailed habitat codes devised by the Washington Department of Game for purposes of describing vegetation types and communities and also land use types. Most Department of Game codes are comparable to only one avian habitat, though many are equivalent to two or more avian habitats. A listing of this comparability is shown in Table 2A.

Table 2A

CORRELATION OF AVIAN HABITAT CODES WITH
HABITAT TYPES OF THE SNOHOMISH ESTUARY
ACCORDING TO BURRELL, 1978

Avian Habitat Code	Snohomish Estuary Habitat Types
SW - Salt Water and associated shorelines	Marina, log storage, bays and estuaries, open water, algal communities, eelgrass, nonvegetated aquatic land.
EW - Estuarine Water and associated shorelines	Marina, log storage, rivers/streams, lakes/ponds, bays and estuaries, marine blind channel, open water, intertidal freshwater/brackish swamp, brackish/freshwater intertidal marsh.
FW - Freshwater and associated shorelines	Rivers/streams, lakes/ponds, freshwater blind channel, open water, brackish/freshwater intertidal marsh, freshwater marsh.
WL - Wetlands	Grass, salt marsh, brackish/freshwater intertidal marsh, freshwater marsh.
SL - Swamp Lands	Aquatic land - forested.
BL - Bursh Lands, Shrubby Thickets, Brush Swamps	Dike, inactive agriculture, shrub, riparian shrub, shrub-grass.
CF - Coniferous Forest	Coniferous forest, mixed forest.
BF - Broadleaf Forest	Broadleaf forest, mixed forest.
RW - Riparian Woodland Streamside	Forested riparian
AG - Agricultural Land, Grassland	Crop/pasture, inactive agriculture, farm yards, meadow, beach grassland.
UR - Urban Parks, Parkways, Gardens, Lakes, etc.	Wooded residential, recreational, farm yards.

TABLE 2B

SPECIES	HABITATS											BREEDING	RECORDED OBSERVATIONS
	SW	EW	FW	UL	SL	BL	CF	DF	RW	AG	UR		
GAVIIDAE													
Common Loon	R	M	M	-	-	-	-	-	-	-	-	possible	1
Arctic Loon	W	-	-	-	-	-	-	-	-	-	-	-	-
Red-throated Loon	W	-	-	-	-	-	-	-	-	-	-	-	-
PODICIPEDIDAE													
Red-necked Grebe	W	W	-	-	-	-	-	-	-	-	-	-	1,4
Horned Grebe	W	W	-	-	-	-	-	-	-	-	-	-	1
Eared Grebe	W	W	-	-	-	-	-	-	-	-	-	-	1
Western Grebe	W	W	M	-	-	-	-	-	-	-	-	-	1,2,3,4
Pied-billed Grebe	W	W	R	W	-	-	-	-	-	-	-	-	-
PHALACRGCORACIOAE													
Double-Crested Cormorant	W	W	W	-	-	-	-	-	-	-	-	-	1,3,4
Brandt's Cormorant	W	-	-	-	-	-	-	-	-	-	-	-	-
Pelagic Cormorant	W	-	-	-	-	-	-	-	-	-	-	-	-
ARDEIDAE													
Great Blue Heron	R	R	R	R	-	-	R	R	R	-	-	probable	1,2,3,4
Green Heron	M	M	R	R	R	-	-	-	-	-	-	possible	3,4

TABLE 2B, cont.

SPECIES	HABITATS											BREEDING	RECORDED OBSERVATIONS
	SW	EW	FW	WL	SL	BL	CF	BF	RW	AG	UR		
American Bittern	-	-	S	S	-	-	-	-	-	-	-	possible	2
ANATIDAE													
Canada Goose	W	W	W	-	-	-	-	-	-	R	R	-	3
Black Brant	W	-	-	-	-	-	-	-	-	-	-	-	-
White fronted Goose	M	M	-	-	-	-	-	-	-	-	-	-	1
Snow Goose	W	-	-	-	-	-	-	-	-	-	-	-	4
Mallard	R	R	R	R	-	-	-	-	R	R	R	known	1,2,3,4
Gadwall	W	W	W	R	-	-	-	-	-	-	-	-	-
Pintail	W	W	W	R	-	-	-	-	-	-	-	-	1,3,4
Green-winged Teal	W	W	W	W	-	-	-	-	W	W	-	-	2,3,4
Blue-winged Teal	M	M	S	S	-	-	-	-	-	-	-	probable	3,4
Cinnamon Teal	M	M	S	S	-	-	-	-	-	-	-	probable	3
American Wigeon	W	W	W	W	-	-	-	-	-	-	W	-	2,3,4
Shoveler	W	W	W	W	-	-	-	-	-	-	-	-	2,3
Wood Duck	-	-	R	R	R	-	-	-	-	-	-	probable	-
Ring-necked Duck	-	-	W	W	-	-	-	-	-	-	-	-	-
Canvasback	W	W	W	-	-	-	-	-	-	-	-	-	1

TABLE 2B, cont.

SPECIES	HABITATS											BREEDING	RECORDED OBSERVATIONS
	SW	EW	FW	WL	SL	BL	CF	BF	RW	AG	UR		
Greater Scaup	W	W	-	-	-	-	-	-	-	-	-	-	-
Lesser Scaup	-	W	W	-	-	-	-	-	-	-	-	-	3
Common Goldeneye	W	W	W	-	-	-	-	-	-	-	-	-	1
Barrow's Goldeneye	W	W	W	-	-	-	-	-	-	-	-	-	-
Bufflehead	W	W	W	-	-	-	-	-	-	-	-	-	3
Common Scoter	M	M	-	-	-	-	-	-	-	-	-	-	4
White-winged Scoter	W	W	M	-	-	-	-	-	-	-	-	-	2
Surf Scoter	W	W	M	-	-	-	-	-	-	-	-	-	2,1
Ruddy Duck	W	W	W	-	-	-	-	-	-	-	-	-	3
Hooded Merganser	W	W	R	-	-	-	-	-	-	-	-	-	-
Common Merganser	W	W	R	-	-	-	-	-	-	-	-	-	2,3,1,4
Red-Breasted Merganser	W	W	M	-	-	-	-	-	-	-	-	-	2
ACCIPITRIDAE													
Sharp-shinned Hawk	-	-	-	-	R	R	R	R	R	-	-	probable	4
Cooper's Hawk	-	-	-	-	R	R	R	R	R	-	-	probable	3,4
Red-tailed Hawk	-	-	-	R	R	-	R	R	R	R	-	probable	2,3,4
Rough-legged Hawk	-	-	-	W	-	-	-	-	-	W	-	-	3
Bald Eagle	R	R	R	-	R	-	R	-	R	-	-	probable	1,3
Marsh Hawk	-	-	R	R	R	-	-	-	-	R	-	probable	2,3,4

TABLE 2B, cont.

SPECIES	HABITATS											BREEDING	RECORDED OBSERVATIONS
	SW	EW	FW	WL	SL	BL	CF	BF	RW	AG	UR		
FALCONIDAE													
Gyrfalcon	-	-	-	W	-	-	-	-	-	W	-	-	3
Peregrine Falcon	-	-	-	-	R	-	R	-	-	-	-	probable	-
Sparrow Hawk	-	-	-	-	R	-	R	R	R	R	-	probable	3
TETRAONIDAE													
Ruffed Grouse	-	-	-	-	R	R	R	R	R	-	-	probable	3
PHASIANIDAE													
California Quail	-	-	-	-	-	R	R	-	-	-	-	probable	3
Ring-necked Pheasant	-	-	-	-	-	R	-	R	-	-	-	probable	3,2
RALLIDAE													
Virginia Rail	-	-	R	-	-	-	-	-	-	-	-	probable	3,4
American Coot	R	R	R	R	-	-	-	-	-	-	R	probable	1,2,3,4
CHARADRIIDAE													
Semi-palmated Plover	-	M	M	-	-	-	-	-	-	-	-	-	-
Killdeer	W	R	R	-	-	-	-	-	-	R	-	probable	2,3,4,
Black Turnstone	W	W	-	-	-	-	-	-	-	-	-	-	-
Common Snipe	-	-	R	R	-	-	-	-	-	-	-	probable	3
Whimbrel	M	M	M	-	-	-	-	-	-	-	-	-	4

TABLE 2B, cont.

SPECIES	HABITATS											BREEDING	RECORDED OBSERVATIONS
	SW	EW	FW	WL	SL	BL	CF	BF	RW	AG	UR		
Spotted Sandpiper	M	M	S	-	-	-	-	-	-	-	-	-	3,4
Yellowlegs	-	M	M	-	-	-	-	-	-	-	-	-	4
Knot	M	M	M	-	-	-	-	-	-	-	-	-	4
Least Sandpiper	M	M	M	-	-	-	-	-	-	-	-	-	2,4
Dunlin	W	W	W	-	-	-	-	-	-	-	-	-	2
Dowitcher	M	M	M	-	-	-	-	-	-	-	-	-	4
Western Sandpiper	M	M	M	-	-	-	-	-	-	-	-	-	2,3,4
Sanderling	M	M	M	-	-	-	-	-	-	-	-	-	-
PHALAROPODIDAE													
Wilson's Phalarope	M	M	M	-	-	-	-	-	-	-	-	-	1
Northern Phalarope	M	M	M	-	-	-	-	-	-	-	-	-	-
LARIDAE													
Glaucous-winged Gull	R	R	R	-	-	-	-	-	-	-	-	-	2,3,4
Western Gull	R	R	R	-	-	-	-	-	-	-	-	-	3
Herring Gull	W	W	W	-	-	-	-	-	-	-	-	-	3
California Gull	M	M	M	-	-	-	-	-	-	-	-	-	1
Ring-billed Gull	W	W	W	-	-	-	-	-	-	-	-	-	1,4
Mew Gull	W	W	W	-	-	-	-	-	-	-	-	-	1,4
Bonaparte's Gull	M	M	M	-	-	-	-	-	-	-	-	-	1,4

TABLE 2B, cont.

SPECIES	HABITATS											BREEDING	RECORDED OBSERVATIONS
	SW	EW	FW	WL	SL	BL	CF	BF	RW	AG	UR		
ALCIDAE													
Common Murre	R	-	-	-	-	-	-	-	-	-	-	-	-
Pigeon Guillemot	R	-	-	-	-	-	-	-	-	-	-	-	1
Cassin's Auklet	S	-	-	-	-	-	-	-	-	-	-	-	-
Marbled Murrelet	R	-	-	-	-	-	-	-	-	-	-	-	-
Rhinoceros Auklet	R	-	-	-	-	-	-	-	-	-	-	-	-
COLUMBIDAE													
Band-tailed Pigeon	-	-	-	-	-	-	R	R	R	R	R	probable	3,4
Rock Dove	-	-	-	-	-	-	-	-	-	R	R	probable	3,4
Mourning Dove	-	-	-	S	S	-	S	S	-	S	-	probable	3
TYTONIDAE													
Barn Owl	-	-	-	-	-	-	-	-	R	R	R	probable	3
STRIGIDAE													
Screech Owl	-	-	-	-	-	-	-	R	R	-	R	probable	-
Great Horned Owl	-	-	-	-	-	-	R	R	R	R	R	probable	-
Snowy Owl	-	-	-	W	-	-	-	-	-	W	-	-	-
Pygmy Owl	-	-	-	-	-	-	R	-	-	-	-	probable	-
Long-eared Owl	-	-	-	-	-	-	-	-	W	-	-	-	-
Short-eared Owl	-	-	-	R	-	R	-	-	-	R	-	probable	4

TABLE 2B, cont.

SPECIES	HABITATS											BREEDING	RECORDED OBSERVATIONS
	SW	EW	FW	WL	SL	BL	CF	BF	RW	AG	UR		
CAPRIMULGIDAE													
Common Nighthawk	-	-	-	-	-	-	S	-	-	S	S	possible	-
TROCHILIDAE													
Rufous Hummingbird	-	-	-	-	-	-	S	S	S	-	-	possible	3
ALCEDINIDAE													
Belted Kingfisher	-	R	R	-	-	-	-	-	R	-	-	probable	1,2,3,4
PICIDAE													
Common Flicker	-	-	-	-	-	R	R	R	R	-	R	probable	2,3,4
Piliated Woodpecker	-	-	-	-	-	-	R	R	R	-	-	probable	2,3
Downy Woodpecker	-	-	-	-	-	R	-	R	R	-	-	probable	-
Hairy Woodpecker	-	-	-	-	-	-	R	-	-	-	-	probable	3,4
TYRANNIDAE													
Olive-sided Flycatcher	-	-	-	-	-	-	S	-	-	-	-	possible	3
HIRUNDINIDAE													
Violet-green Swallow	-	-	-	-	-	-	S	S	S	S	S	possible	3
Tree Swallow	-	-	S	-	-	-	S	S	S	S	S	possible	3
Bank Swallow	-	-	M	M	-	-	-	-	-	-	-	-	-
Barn Swallow	-	S	S	S	-	S	-	S	S	S	S	possible	3,2
Cliff Swallow	-	-	-	-	-	-	-	-	S	S	S	possible	3,2

TABLE 2B, cont.

SPECIES	HABITATS											BREEDING	RECORDED OBSERVATIONS
	SW	EW	FW	WL	SL	BL	CF	BF	RW	AG	UR		
CORVIDAE													
Gray Jay	-	-	-	-	-	-	R	-	-	-	-	probable	3
Steller's Jay	-	-	-	-	R	-	R	R	R	-	R	probable	3,2
Crow	R	R	R	-	R	-	R	R	R	R	R	probable	2,3,4
PARIDAE													
Black-capped Chickadee	-	-	-	-	R	R	R	R	R	-	R	probable	2,3,4
Chestnut-backed Chickadee	-	-	-	-	-	-	R	R	-	-	R	probable	-
Bushtit	-	-	-	-	-	R	-	R	R	-	R	probable	-
SITTIDAE													
White-breasted Nuthatch	-	-	-	-	-	-	R	R	R	-	R	probable	-
Red-breasted Nuthatch	-	-	-	-	R	-	R	R	R	-	R	probable	-
CERTHIIDAE													
Brown Creeper	-	-	-	-	R	-	R	-	-	-	-	probable	3
TROGLODYTIDAE													
House Wren	-	-	-	-	-	S	S	S	S	-	S	possible	-
Winter Wren	-	-	-	-	W	W	W	W	-	-	-	-	2,3
Bewick's Wren	-	-	-	-	-	R	-	R	R	-	-	probable	-
Long-billed Marsh Wren	-	-	R	R	-	-	-	-	-	-	-	-	2,3,4

TABLE 2B, cont.

SPECIES	HABITATS											BREEDING	RECORDED OBSERVATIONS
	SW	EW	FW	WL	SL	BL	CF	BF	RW	AG	UR		
TURDIDAE													
Robin	-	-	-	-	R	-	R	R	R	-	R	probable	2,3,4
BOMBYCILLIDAE													
Cedar Waxwing	-	-	-	-	S	-	S	S	S	-	S	possible	3,4
STURNIDAE													
Starling	-	R	-	R	R	R	R	R	R	R	R	probable	2,3,4
PARULIDAE													
Yellow Warbler	-	-	-	-	-	-	S	S	S	-	S	possible	3
Yellowthroat	-	-	S	-	S	-	-	-	S	-	-	possible	3
Yellow-rumped Warbler	-	-	-	-	-	W	-	-	-	-	-	-	4
PLOCEIDAE													
House Sparrow	-	-	-	-	-	-	-	-	-	R	R	probable	3,4
ICTERIDAE													
Western Meadowlark	-	-	-	R	-	R	-	-	-	R	-	probable	3,4
Red-winged Blackbird	-	-	-	R	-	-	-	-	-	R	R	probable	2,3,4
Brown-headed Cowbird	-	-	-	-	S	S	S	S	S	-	S	possible	3?
Bullock's Oriole	-	-	-	-	-	-	-	S	S	-	S	possible	3
Brewer's Blackbird	-	-	-	R	-	-	-	-	-	R	R	probable	3,4

TABLE 2B, cont.

SPECIES	HABITATS											BREEDING	RECORDED OBSERVATIONS
	SW	EW	FW	WL	SL	BL	CF	BF	RW	AG	UR		
FRINGILLIDAE													
Evening Grosbeak	-	-	-	-	R	-	R	R	-	-	R	probable	3
House Finch	-	-	-	-	-	-	-	-	R	-	R	probable	3
American Gold Finch	-	-	-	R	-	R	-	R	R	R	R	probable	2,3,4
Rufous-sided Towhee	-	-	-	-	R	R	R	R	R	-	R	probable	3
Savannah Sparrow	-	-	-	-	-	R	-	-	-	R	-	probable	2,4
Dark-eyed Junco	-	-	-	-	R	R	R	R	R	-	R	probable	2,3,4
White-crowned Sparrow	-	-	-	-	R	R	R	R	R	-	R	probable	4
Golden-crowned Sparrow	-	-	-	-	W	W	W	W	W	-	W	-	-
Fox Sparrow	-	-	-	-	R	R	-	R	R	-	-	probable	4
Song Sparrow	-	-	-	R	R	R	R	R	R	-	R	probable	2,4

Table 3A

RESOURCE SPECIES
(Miller & Borton, 1974)

SPECIES	AREA	SEASONALITY	FREQUENCY OF COLLECTION	COMMENTS
spiny dogfish *(Squalus acanthias)*	Gedney Island S. Port Gardner Possession Sd.	year-round	abundant " "	pelagic
big skate *(Raja binoculata)*	S. Port Gardner	year-round	common	juv. in eelgrass beds.
longnose skate *(Raja rhina)*	Gedney Island S. Port Gardner	year-round	occasional occasional reported	juv. in eelgrass & mud-flats. Spawn on mud-flats.
ratfish *(Hydrolagus colliei)*	Gedney Island S. Port Gardner Possession Sd.	year-round	abundant " "	
American shad *(Alosa sapidissima)*	flats estuary river sloughs	spring & summer (spawning runs)	occasional " " "	spawn in sloughs & lower mainstem in spring & summer. Juv. in eelgrass beds in summer & fall.
Pacific herring *(Clupea harengus pallasi)*	Port Gardner delta estuary	winter & early spring(spawning)	abundant " "	spawn in eelgrass.
pink salmon *(Oncorhynchus gorbuscha)*	project area	adults: early fall (spawning) juv.: winter & spring,esp. April	abundant	adults spawn in lower mainstem; juv. rear in near-shore areas.
chum salmon *(Oncorhynchus keta)*	project area	adults: late fall, early winter (spawning) juv.: March through May	abundant	adults spawn in lower mainstem; juv. rear in near-shore areas.
coho salmon *(Oncorhynchus kisutch)*	project area	adults: August thru early December (spawning) yearlings: April - June	abundant	adults spawn in headwaters; yearlings rear in near-shore areas, especially eelgrass.

Table 3A

RESOURCE SPECIES

(cont.)

SPECIES	AREA	SEASONALITY	FREQUENCY OF COLLECTION	COMMENTS
chinook salmon *(Oncorhynchus tshawytscha)*	project area	adults: late May thru October juv.& yearlings: April - June	abundant	adults spawn in mid & upper mainstem; juv. rear in eelgrass.
cutthroat trout *(Salmo clarki)*	project area Mission Beach Tulalip Bay	adults: July thru January adolescents: March thru July	common abundant "	young move to salt water when 3-5 yrs. old; generally occur over gravel bottom.
rainbow trout (steelhead) *(Salmo gairdneri)*	river estuary flats Gedney Island	adults: year-round yearlings: March - June	common " " occasional	adults spawn upstream; yearlings rear briefly in eelgrass beds & over gravel substrate.
longfin smelt *(Spirinchus thaleichthys)*	Gedney Island S. Port Gardner	adults: October - December juv.: April - August	common abundant	spawn in lower mainstem & sloughs.
eulachon *(Thaleichthus pacificus)*	S. Port Gardner	adults: March - May larvae: May - July	reported	adults spawn in fresh water.
Pacific cod *(Gadus macrocephalus)*	S. Port Gardner Possession Sd. Gedney Island	year-round	abundant common abundant	adults pelagic; juv. also in eelgrass.
Pacific tomcod *(Microgadus proximus)*	Gedney Island S. Port Gardner Possession Sd. flats	year-round, especially summer	abundant " common reported	wide variety of habitats.
walleye pollock *(Theragra chalcogramma)*	Gedney Island Possession Sd. S. Port Gardner flats	year-round	abundant common abundant reported	sedimentary substrate & eelgrass.

Table 3A

RESOURCE SPECIES

(cont.)

SPECIES	AREA	SEASONALITY	FREQUENCY OF COLLECTION	COMMENTS
three-spine stickleback *(Gasterosteus aculeatus)*	Gedney Island flats S. Port Gardner	year-round	abundant reported occasional	spawns in fresh water in summer, especially in upper sloughs.
shiner perch *(Cymatogaster aggregata)*	Gedney Island Possession Sd. flats S. Port Gardner	year-round, especially late spring through late fall.	reported occasional reported abundant	variety of habitats, especially eelgrass; tolerates brackish water.
striped seaperch *(Embiotoca lateralis)*	Mission Beach Possession Sd. flats S. Port Gardner	late spring through early winter.	occasional common occasional common	frequents man-made structures (pilings, floats, etc.); juv. frequent eelgrass.
pile perch *(Rhacochilus vacca)*	Possession Sd. S. Port Gardner	year-round	common abundant	frequent man-made structures.
Pacific sand lance *(Ammodytes hexapterus)*	Possession Sd. flats S. Port Gardner	larvae: April - June juv.: May - September adults: year-round	common " "	extremely varied life style; frequent eelgrass in summer; larvae in eelgrass in April; important food fish.
rough eye rockfish *(Sebastes aleutianus)*	Possession Sd.	unknown	reported	
copper rockfish *(Sebastes caurinus)*	Gedney Island Possession Sd. S. Port Gardner	year-round (inactive in winter)	common " abundant	prefer shallow, rocky areas or man-made structures.
greenstriped rockfish *(Sebastes elongatus)*	Gedney Island	unknown	reported	

Table 3A

RESOURCE SPECIES
(cont.)

SPECIES	AREA	SEASONALITY	FREQUENCY OF COLLECTION	COMMENTS
quillback rockfish *(Sebastes maliger)*	Gedney Island Possession Sd. S. Port Gardner flats	unknown	common " " reported	prefer rocky substrate
black rockfish *(Sebastes melanops)*	S. Port Gardner	unknown	occasional	
bocaccio *(Sebastes paucispinis)*	S. Port Gardner	unknown	reported	
sablefish *(Anoplopoma fimbria)*	Mission Beach Gedney Island flats Port Gardner Possession Sd.	adolescents: year-round	common abundant common abundant "	occur over sand and mixed fine substrates.
white spotted greenling *(Hexagrammos stelleri)*	S. Port Gardner	unknown	reported	
lingcod *(Ophiodon elongatus)*	Gedney Island Possession Sd. S. Port Gardner	juv.: May, June adults: year-round	occasional " "	adults prefer deep water areas; especially near rocky bottom.
buffalo sculpin *(Enophrys bison)*	flats S. Port Gardner	year-round	reported common	frequent eelgrass beds.
Pacific staghorn sculpin *(Leptocottus armatus)*	Gedney Island flats Possession Sd. S. Port Gardner	year-round	common reported abundant "	frequent eelgrass & sedimentary substrates; especially in shallow waters.
petrale sole *(Eopsetta jordani)*	S. Port Gardner	unknown	occasional	
rex sole *(Glyptocephalus zachirus)*	Gedney Island Possession Sd. S. Port Gardner	unknown	occasional common abundant	normally a deep water species.

Table 3A

RESOURCE SPECIES
(cont.)

SPECIES	AREA	SEASONALITY	FREQUENCY OF COLLECTION	COMMENTS
flathead sole *(Hippoglossoides elassodon)*	Possession Sd. S. Port Gardner	unknown	occasional common	adults are normally in deep water. Juv. occur in shallower waters.
butter sole *(Isopsetta isolepis)*	Gedney Island Possession Sd. S. Port Gardner	especially summer	occasional abundant "	juv. may rear in eelgrass.
rock sole *(Lepidopsetta bilineata)*	Mission Beach flats Gedney Island Possession Sd. S. Port Gardner	year-round	occasional " common abundant "	eelgrass in late summer & fall, especially juv. Adults occur on solid or cobble substrate.
slender sole *(Lyopsetta exilis)*	Gedney Island Possession Sd. Port Gardner	unknown	abundant " "	mixed sediment habitat.
Dover sole *(Microstomus pacificus)*	Gedney Island Possession Sd. flats S. Port Gardner	especially May, June & July	abundant " occasional abundant	prefer mud or fine sand substrate.
English sole *(Parophrys vetulus)*	Gedney Island flats Possession Sd. Port Gardner	unknown	abundant occasional abundant "	
starry flounder *(Platichthys stellatus)*	project area	year-round, spawning: February through April.	abundant	juv. common in estuary, sloughs & eelgrass.
c-o sole *(Pleuronichthys coenosus)*	S. Port Gardner	unknown	occasional	
sand sole *(Psettichthys melanostictus)*	Gedney Island Possession Sd. Port Gardner	year-round; spawning January through March.	abundant " "	juv. common in sand/eelgrass habitat; prefer fine grained substrate.

Table 3A

RESOURCE SPECIES
(Cont.)

SPECIES	AREA	SEASONALITY	FREQUENCY OF COLLECTION	COMMENTS
yelloweye rockfish (*Sebastes ruberrimus*)	S. Port Gardner	spring through fall	occasional	over reefs in deep water.
canary rockfish (*Sebastes pinniger*)	S. Possession Sd		common	over deep water
Pacific hake (*Merluccius productus*)	Gedney Island Possession Sd flats	winter	abundant " reported	important commercial fishery
Pacific sanddab (*Citharichthys sordidus*)	Possession Sd S. Port Gardner		occasional abundant	shallow water over sand, gravel and mud bottoms
speckled sanddab (*Citharichthys stigmaeus*)	Gedney Island Possession Sd S. Port Gardner		common " abundant	
arrowtooth flounder (*Atheresthes stomias*)	Gedney Island Possession Sd S. Port Gardner		occasional " abundant	

Table 38

NON RESOURCE SPECIES

SPECIES	AREA OF OCCURRENCE	FREQUENCY OF COLLECTION
Pacific lamprey *(Entosphenus tridentatus)*	S. Port Gardner	occasional
river lamprey *(Lampetra ayresi)*	S. Port Gardner	reported
sixgill shark *(Hexanchus griseus)*	Gedney Island	reported
brown cat shark *(Apristurus brunneus)*	Gedney Island S. Port Gardner	common occasional
Pacific electric ray *(Torpedo californica)*	Possession Sound	reported
dolly varden *(Salvelinus malma)*	Gedney Island flats	occasional occasional
red brotula *(Brosmophycis marginata)*	Gedney Island Possession Sound S. Port Gardner	common occasional common
pallid eelpout *(Lycodapus mandibularis)*	Gedney Island S. Port Gardner	reported reported
shortfin eelpout *(Lycodes brevipes)*	Gedney Island S. Port Gardner	occasional reported
black eelpout *(Lycodes diapterus)*	Gedney Island S. Port Gardner	reported common
blackbelly eelpout *(Lycodopsis pacifica)*	Gedney Island Possession Sound S. Port Gardner	Occasional common abundant

Table 3B

NON RESOURCE SPECIES

SPECIES	AREA OF OCCURRENCE	FREQUENCY OF COLLECTION
tubesnout *(Aulorhynchus flavidus)*	Possession Sound	occasional
	S. Port Gardner	occasional
bay pipefish *(Syngnathus griseolineatus)*	Possession Sound flats	occasional
		occasional
	S. Port Gardner	occasional
northern ronquil *(Ronquilus jordani)*	Possession Sound flats	reported
		reported
	S. Port Gardner	common
decorated warbonnet *(Chirolophis polyactocephalus)*	Gedney Island	reported
	S. Port Gardner	reported
snake prickleback *(Lumpenus sagitta)*	Possession Sound	common
	S. Port Gardner	abundant
bluebarred prickleback *(Plectobranchus evides)*	Possession Sound flats	reported
		reported
whitebarred prickleback *(Porocinus rothrocki)*	S. Port Gardner	reported
arrow goby *(Clevelandia ios)*	flats	reported
bay goby *(Lepidogobius lepidus)*	S. Port Gardner	abundant
chub mackerel *(Scomber japonicus*	Possession Sound	reported
redstripe rockfish *(Sebastes proriger)*	Gedney Island	reported
painted greenling *(Oxylebius pictus)*	S. Port Gardner	reported
padded sculpin *(Artedius fenestralis)*	S. Port Gardner	occasional
smoothhead sculpin *(Artedius lateralis)*	S. Port Gardner	reported

Table 3B

NON RESOURCE SPECIES

SPECIES	AREA OF OCCURRENCE	FREQUENCY OF COLLECTION
roughback sculpin *(Chitonotus pugetensis)*	Gedney Island Possession Sound S. Port Gardner	occasional occasional common
spinyhead sculpin *(Dasycottus setiger)*	Gedney Island S. Port Gardner	reported occasional
soft sculpin *(Gilbertidia sigalutes)*	Gedney Island S. Port Gardner	reported reported
threadfin sculpin *(Icelinus filamentosus)*	Possession Sound	reported
spotfin sculpin *(Icelinus tenuis)*	Gedney Island Possession Sound S. Port Gardner	reported reported reported
sailfin sculpin *(Nautichthys oculofasciatus)*	S. Port Gardner	reported
tadpole sculpin *(Psychrolutes paradoxus)*	S. Port Gardner	reported
slim sculpin *(Radulinus asprellus)*	S. Port Gardner	occasional
grunt sculpin *(Rhamphocottus richardsoni)*	S. Port Gardner	reported
roughspine sculpin *(Triglops macellus)*	Gedney Island Possession Sound	reported reported
northern spearnose poacher *(Agonopsis emmelane)*	S. Port Gardner	reported
sturgeon poacher *(Agonus acipenserinus)*	Possession Sound S. Port Gardner	reported occasional

Table 3B

NON RESOURCE SPECIES

SPECIES	AREA OF OCCURRENCE	FREQUENCY OF COLLECTION
spinycheek starsnout *(Asterotheca infraspinata)*	S. Port Gardner	reported
blackfin poacher *(Bathyagonus nigripinnis*	Gedney Island	common
	Possession Sound	common
	S. Port Gardner	abundant
pygmy poacher *(Odontopyxis trispinosa)*	S. Port Gardner	occasional
blacktip poacher *(Xeneretmus latifrons)*	Gedney Island	occasional
	Possession Sound	abundant
	S. Port Gardner	abundant
bluespotted poacher *(Xeneretmus triacanthus)*	Gedney Island	reported
	flats	reported
	S. Port Gardner	reported
slipskin snailfish *(Liparis fucensis)*	Gedney Island	reported
showy snailfish *(Liparis pulchellus)*	Gedney Island	reported
	Possession Sound	reported
	S. Port Gardner	occasional
crescent gunnel (*Pholis laeta*)	S. Port Gardner	reported
saddleback gunnel (*Pholis ornata*)	S. Port Gardner	occasional
plainfin midshipman (*Porichthys notatus*)	S. Port Gardner	common
	flats	reported

Appendix F

BIBLIOGRAPHY AND REFERENCES

Anderson, A. C., et al, 1947. See U.S. Department of Agriculture, A. C. Anderson, et al.

Auclair, A.M.D., A. Bouchard and J. Pajaczkowski, 1976. Plant standing crop and productivity relations in a Scirpus-Equisetum wetland. Ecology 57 (5) 941-952.

Barnes, C. A., and C. C. Ebbesmeyer, 1977. "Some Aspects of Puget Sound's Circulation and Water Properties," presented at the 7th Baurch Research Symposium on Transport Processes in Estuarine Environments, Georgetown, S.C., 19-22 May 1975 (in press).

Battelle Pacific Northwest Laboratories, 1974. A Technique for Environmental Decision Making Using Quantified Social and Aesthetic Values. Richland, Washington.

Beck, Eckardt C., 1976. Quality Criteria for Water (EPA-440/9-76-023). U.S. Environmental Protection Agency. Washington, D.C.

Beeman, Ogden, and A. Benkendorf, 1976. "Productive Land Use of Dredged Material Areas." Coastal Zone '78 Proceedings, Volume II. New York: American Society of Civil Engineers.

Bellrose, Frank C., 1976. Ducks, Geese & Swans of North America. Harrisburg: Stackpole Books.

Bish, Robert, Robert Warren, Louis Weschler, James Crutchfield and Peter Harrison, 1975. Coastal Resource Use-Decisions on Puget Sound. Seattle: University Press.

Bledsoe, L. J., et al, 1975. See University of Washington, Center for Quantitative Science.

Bonneville Power Administration, 1967. Pacific Northwest Major Industrial Plant Sites. U.S. Department of the Interior, Vol. 1, Puget Sound Area.

Borland, Stewart, and M. Oliver. Port Expansion in the Puget Sound Region 1970-2000. Division of Marine Resources (SEA Grant), University of Washington, Seattle.

Bottino, P., 1976. Personal communication. Department of Botany, University of Maryland. College Park, Maryland.

Boulé, M., and G. B. Shea, 1978. Delineation of Wetland Boundaries in the Snohomish Estuary. U.S. Army Corps of Engineers, Seattle District.

Brewer, L. W., 1977. The Ruffed Grouse in Western Washington. Washington State Department of Game, Mt. Vernon, Washington.

Brookhaven National Laboratory, Biology Department, 1969. Diversity & Stability in Ecological Systems, Report of Symposium held May 26-28, 1969.

Brown, J. N. Letter from U.S. Fish & Wildlife Service, Division of River Basin Studies, Olympia, Washington, to District Engineer, U.S. Army Corps of Engineers, Seattle, Washington. Attachment: Principal Plants, Mammals, Birds and Invertebrates in the Lower Snohomish River System & Everett Harbor Area.

Burg, M. E., E. S. Rosenberg, and D. R. Tripp, 1976. Vegetation Associations and Primary Productivity of the Nisqually Salt Marsh, pp. 109-144. In S. G. Herman and A. M. Wiedemann, eds, Contributions to the Natural History of the Southern Puget Sound Region, Washington. Evergreen State College, Olympia, Washington.

Burrell, Galen, 1977. Habitat Classification System for the Snohomish River Estuary, Unpublished field notes. Washington State Department of Game and U.S. Army Corps of Engineers. Seattle, Washington.

Cahoon, D. R., 1975. Net Productivity of Emergent Vegetation at Horn Point Salt Marsh. M.S. Thesis. University of Maryland, College Park.

Canning, Douglas J., 1977. Unpublished field journal. Northwest Environmental Consultants, Inc., Seattle, Washington.

Cardwell, Rick D., Charles E. Woelke, Mark I. Carr and Eugene W. Sanborn, 1976. Toxicity of Marine Waters near Everett and Port Angeles, Washington, to Larval Pacific Oysters, 1972 through 1975. (Section IV, Ecological Baseline and Monitoring Study for Port Gardner and Adjacent Waters.) Department of Ecology, Olympia, Washington.

Carstea, D., A. Binder, R. Strieter, 1975. Guidelines for the Environmental Impact Assessment of Small Structures and Related Activities in Coastal Bodies of Water. MITRE Technical Report-6916, McLean, Virginia.

Carstea, D., J. Golden, R. Holberger, 1975. Environmental Assessment of Small Structures and Related Activities in Coastal Bodies of Water. MITRE Technical Report-7062, McLean, Virginia.

Carstea, D., J. Golden, L. Thomas, 1975. Guidelines for the Analysis of Cumulative Environmental Effects of Small Projects in Navigable Waters. MITRE Technical Report-6939 Revision 1, McLean, Virginia.

Chadbreck, Robert H., ed., 1972. Proceedings of the Coastal Marsh & Estuary Management Symposium held at Louisiana State University, July 17-18, 1972. Baton Rouge, Louisiana.

Clark, John, 1974. Coastal Ecosystems: Ecological Considerations for Management of the Coastal Zone. The Conservation Foundation, Washington, D.C.

Conley, Ralph L., 1977. Distribution, Relative Abundance, and Feeding Habits of Marine and Juvenile Anadromous Fish of Everett Bay. M.S. Thesis. University of Washington, Seattle.

Cornett, Deborah, 1974. A Waterfowl Survey of the Snohomish River Delta. Unpublished M.S.S. The Evergreen State College, Olympia, Washington.

Cowardin, Lewis M., V. Carter, F. Gulet and E. LaRoe, 1977. See U.S. Department of Interior, Fish & Wildlife Service, Lewis M. Cowardin, etc.

Crosson, R. S., 1975a. Compilation of Earthquake Hypocenters in Western Washington, July 1970 - December 1972. Division of Geology and Earth Resources Information Circular 53. Washington State Department of Natural Resources, Olympia.

Crosson, R. S., 1975b. Compilation of Earthquake Hypocenters in Western Washington, 1973. Division of Geology and Earth Resources Information Circular 55. Washington State Department of Natural Resources, Olympia.

Crosson, R. S., and R. C. Millard, 1975c. Compilation of Earthquake Hypocenters in Western Washington, 1974. Division of Geology and Earth Resources Information Circular 56. Washington State Department of Natural Resources, Olympia.

Crow, Michael E., R. Rajagopal and Gerard F. Schneuder. The Effects of Modification of Stream Environment on the Aquatic Resources. SVEN and RANN.

Curry, N., and D. Stocker, 1976. Quilceda Creek Area, Bio-Survey, Prepared for the Tulalip Tribes. Washington.

Darnell, Reznedt M., et al, 1976. See U.S. Environmental Protection Agency, Reznedt M. Darnell.

DeLacy, Allen C., B. S. Miller and S. F. Borton, 1972. Checklist of Puget Sound Fishes. Division of Marine Resources (SEA Grant), University of Washington, Seattle.

Disraeli, Donald Jay, 1977. Gradient Analysis of the Vegetation in a Brackish Marsh, Bellingham Bay, Washington. Western Washington State College, Bellingham.

DOE - See Washington State Department of Ecology.

Donovan, N. C., 1974. Earthquake Hazards for Buildings, Earthquakes-Effects on Structures, Engineering Bulletin 46, Dames and Moore, Los Angeles, California.

Drost, B. W., 1977. See U.S. Department of the Interior, U.S. Geology Survey, B. W. Drost.

Dugdale, R. C., 1967. Nutrient Limitation in the Sea: Dynamics, Identification and Significance. Limnology and Oceanography 12: 685-695.

Dugmore, A. Radclyffe, 1902. Bird Homes. New York: Doubleday Page and Company.

Dunnel, Robert C., and John W. Fuller, 1975. See U.S. Department of Interior, National Park Service, Robert C. Dunnel, etc.

Eaton, R. L., et al, 1975. See Washington State Department of Ecology, Washington State Department of Game, R. L. Eaton, et al.

Ebbesmeyer, Curtis C., and Jonathan M. Helseth, 1977. An Analysis of Primary Production Observed During 1966-1975 in Central Puget Sound, Washington. Municipality of Metropolitan Seattle (METRO). Seattle, Washington.

Eckert, James W., 1978. "Design of Retention Structures for Marsh Habitats." Coastal Zone '78 Proceedings, Volume II. New York: American Society of Civil Engineers.

Edmondson, W. T., 1970. Phosphorus, nitrogen and algae in Lake Washington after diversion of sewage. Science 169: 3946.

Eilers, H. P., 1975. Plants, Communities, Net Production and Tide Levels: The Ecological Biogeography of Nehalem Salt Marshes, Tillamook County, Oregon. Unpublished Ph.D. dissertation. Oregon State University, Corvallis.

English, T. Saunders, 1976. Water Quality and Oceanographic Observations in Port Gardner, Washington, 1973, 1974, and 1975 (Section V, Ecological Baseline and Monitoring Study of Port Gardner and Adjacent Waters). Department of Ecology, Olympia, Washington.

Engman, R. Gary, and A. G. Stendahl, 1976. Washington State Department of Game, U.S. Agriculture Department. An Assessment of Fish and Wilflife of the Marshland Watershed, Bulletin No. 9

Everett, City of. A Biological Inventory of Several Specific Sites Located in Everett, Washington.

Everett, City of, David Dilgard and Margaret Riddle, 1976. A Survey of Everett's Historical Properties. Everett, Washington.

Everett, City of, Halprin, Lawrence & Associates, 1972. Everett Community Plan. Everett, Washington.

Everett, City of, Lee Johnson & Associates, and Jongejan/Gerrard/Associates, 1973. City of Everett - Open Space, Park and Recreation Plan. Everett, Washington.

Everett Planning Commission and City Council, 1976. Shoreline Master Program for City of Everett. Everett, Washington.

Everett, Port of, 1977. Consensus Guidelines: Fugure Development of the Port of Everett. Citizens' Planning/Mediation Committee.

Fairbridge, R. W., 1968. "Estuary" in Encyclopedia of Geomorphology. New York: Reinhold.

Frenkel, Robert E., and H. Peter Eilers, 1976. Department of Geography, OSU (Conducted for U.S. EPA). Final Report Tidal Datums and Characteristics of the Upper Limits of Coastal Marshes in Selected Oregon Estuaries.

Geldreich, E. E., 1966. Sanitary Significance of Fecal Coliforms in the Environment. Federal Water Pollution Control Administration, Cincinnati, Ohio, (DJC).

Golley, F. B., 1960. Energy dynamics of a food chain of an old field community. Ecol. Monogr. 30: 187-206.

Goodwin, Richard H., and William A. Niering, 1975. Inland Wetlands of the United States. National Park Service Natural History Theme Studies Number Two. U.S. Government Printing Office, Washington, D.C.

Grays Harbor Regional Planning Commission, Montagne-Bierly & Assoc., Wilsey & Ham, 1978. Grays Harbor Estuary Management Plan, Preliminary Draft.

Gunnison, Douglas, 1978. Mineral Cycling in Salt Marsh - Estuarine Ecosystem, U.S. Army Corps of Engineers, WES Tachnical Report D-78-3.

Haeberlin, Hermann, and Erna Gunther, 1930. The Indians of Puget Sound. University of Washington, Seattle.

Hansen, George, G. Carter, W. Towne, G. O'Neal, 1971. Log Storage and Rafting in Public Waters. Pacific Northwest Pollution Control Council.

Harding, L. W., J. H. Butler and R. E. Heft, 1970. The standing stock and production of eelgrass in Humbolt Bay, California. Lawrence-Livermore Laboratory, University of California, Berkeley.

Harmer, H. A., 1951. See U.S. Department of Commerce, Coast and Geodetic Survey, H. A. Harmer.

Harris, W. F., P. Sollins, N. T. Edwards, B. E. Dinger and N. H. Shugart, 1975. "Analysis of carbon flow and productivity in a temperate deciduous forest ecosystem." Productivity in World Ecosystems. National Academy of Science, Washington, D.C.

Hart, J. L., 1973. Pacific Fishes of Canada. Fisheries Research Board of Canada Bulletin 180. Ottowa, Canada.

Hill, Ingman, Chase & Company, 1971. Lake Stevens Sewer District Comprehensive Sewer Study. Seattle, Washington.

Hitchcock, Henry, 1977. See U.S. Army Engineer Institute of Water Resources, Henry Hitchcock, 1977.

Hoffman, John F., 1978. New Methods for Dredging Pier Slips, Coastal Zone '78 Proceedings, Volume II, 1083.

Hoffnagle, J., ed., 1976. A Comparative Study of Salt Marshes in the Coos Bay Estuary. National Science Foundation. Washington, D.C.

Holmes & Nichols, 1976-77. Checklist of birds observed on the Tulalip Reservation. Pilchuck Audubon Society.

Huntting, M. T., 1956. Inventory of Washington Minerals, Part II - Metallic Minerals: Washington Division of Mines and Geology Bull. 37, pt. 2, 495 p.

Industrial Testing, Inc., 1972. Biological and Chemical Analysis of Bottom Sediments and Water in the Site of the Norton Avenue Terminal Development. Everett, Washington.

Ingles, L. G., 1976. Mammals of the Pacific States. Stanford: Stanford University Press.

Jefferson, C., 1975. Plant Communities and Succession in Oregon Coastal Salt Marshes. Oregon State University, Corvallis.

Jefferson County Planning Department and Northwest Environmental Consultants, 1975. The Tidal Marshes of Jefferson County, Washington. Port Townsend, Washington.

Jermann, Jerry, 1975. Archaeological Resource Potential in Tulalip Bay, Snohomish County, Washington. Report to the Tulalip Tribes, University of Washington, Seattle.

Jervis, R.A., 1964. Primary Production in a Freshwater Marsh Ecosystem. Ph.D. Thesis. Rutgers University, New Brunswick, New Jersey.

Keefe, C.W., 1972. Marsh Production, A Summary of the Literature. Contrib. Marine Science 16: 163-181.

Ketchum, Bostwich H., ed., 1972. The Water's Edge: Critical Problems of the Coastal Zone (Coastal Zone Workshop May 22-June 3, 1972). London: MIT Press.

King County Planning Department, 1964. The Comprehensive Plan for King County, Washington. Seattle, Washington.

Kitsap County Planning Department, 1973. Basic Data and Related Sources to Shorelines, Guide to Natural and Man Influenced Characteristics. Kitsap County, Washington.

Komwisher, J. W., 1966. "Photosynthesis and Respiration in Some Seaweeds." Some Contemporary Studies in Marine Science, Edited by H. Barnes. London: Allen and Unwin.

Kozloff, Eugene N., 1973. Seashore Life of Puget Sound, the Strait of Georgia and the San Juan Archipelago. Seattle: University of Washington Press.

Laird, Leslie B., 1970. See Pacific Northwest River Basins Commission.

Laramie, Dick, 1974. Letter from Washington State Department of Fisheries to Fred H. Weber, Corps of Engineers.

Latourell Associates, The, 1972. Comprehensive Plan: Tulalip Reservation. Seattle, Washington.

Latourell Associates and Calvin Jordon and Associates, 1974. Tulalip Reservation: Comprehensive Park Plan. Seattle, Washington.

Lincoln, J.H., 1917. Derivation of Freshwater Inflow into Puget Sound. Spec. Rpt. No. 72, Ref. M77-28, University of Washington, Department of Oceanography.

Linduska, Joseph P., editor, 1964. Waterfowl Tomorrow. U.S. Government Printing Office, Washington, D.C.

Livingston, Vaugn E., Jr., 1971. See Washington State Department of Natural Resources, Division of Mines and Geology, Vaugn E. Livingston, Jr.

Lower Willamette River Study Team and SRG Partnership, 1973. Lower Willamette River Management Plan, Second Draft, Portland, Oregon.

McAtee, W.L., 1939. Wildfowl Food Plants (Their Value, Propogation, and Management). Ames, Iowa: Colegiate Press.

McCarthy, Jane, and Alice Shorett, 1976. Mediation to Resolve Environmental Conflict: The Snohomish Experiment, Journal of Soil and Water Conservation 31 (5): 212-213. September-October 1976.

McIntosh, Carl, and Joseph Pizzo, ed., 1976. Compendium of Current Environmental Studies in Puget Sound and N.W. Estuarine Waters. Oceanographic Institute of Washington, Seattle.

McKee, Jack Edward, and Harold W. Wolf, 1963. Water Quality Criteria. The Resources Agency of California, State Water Resources Control Board, Sacramento.

Macomber, Richard, 1978. Unpublished manuscript for Board of Engineers, Rivers and Harbors Training Course.

Mann, K.H., 1972. Ecological Energetics of the Seaweed zone in a Marine Bay on the Atlantic Coast of Canada. I. Zonation and biomass of Seaweeds. Marine Biology 12: 1-18.

Marysville, City of, Planning Department, 1975. Shoreline Management Master Program for the City of Marysville, Washington. Marysville, Washington.

Mattson, John L., 1974. Archaeological Tests of Hebolb of the Snohomish. Everett, Washington.

METRO, West Point Environmental Planning Study, 1973. Interim Report, Seattle, Washington.

Miller, Bruce S., and Steven F. Borton, 1974. Geographical Distribution of Puget Sound Fishes: Maps and Data Source Sheets. Report to the Washington State Department of Ecology. Contract #74-142.

Miller, Bruce S., Charles A. Simenstad and Lawrence R. Moulton, 1976. Puget Sound Baseline Program: Near Shore Fish Survey, Washington State Department of Ecology, Olympia.

MITRE Corporation. See Carstea, D., et al.

Moore, A., 1976. Ecological Baseline and Monitoring Study: Juvenile Salmon, Indigenous Fishes and Livebox Studies, Port Gardner and

Adjacent Waters. State of Washington, Department of Ecology. Olympia, Washington.

Nassau-Suffolk Regional Planning Board, 1976. Integration of Regional Land Use Planning and Coastal Zone Science: A Guidebook for Planners.

National Academy of Sciences, 1971. The Great Alaska Earthquake of 1964: Geology, Part A. National Academy of Sciences, Washington, D.C.

NEC, 1975. The Tidal Marshes of Jefferson County, Washington. Jefferson County Planning Department, Port Townsend, Washington.

Nelson, E. W., 1916. The Larger North American Mammals. National Geographic Magazine, 30:5, November 1916.

Nelson, E. W., 1918. Smaller Mammals of North America. National Geographic Society 33:5, May 1918.

Nelson, Leonard M., 1971. See U.S. Department of Interior, Water Resource Division, Washington State Department of Ecology, Leonard M. Nelson.

Newcomb, R. C., 1952. Groundwater Resources of Snohomish County, Washington. U.S. Geological Survey Water Supply Paper 1135.

1990 Comprehensive Park Plan of Snohomish County, Washington, 1976. Snohomish County, Washington.

Nixon, Scott, Candance Oviatt and Sharon Northby, 1973. Ecology of Small Boat Marinas. Graduate School of Oceanography, Marine Technical Report No. 5, University of Rhode Island, Kingston.

Odum, E. P., 1960. Fundamentals of Ecology, Third Edition. New York: W. B. Saunders Company.

Odum, W. E., 1978. The Importance of Tidal Freshwater Wetlands in Coastal Zone Management." Coastal Zone '78 Proceedings, Volume II. New York: American Society of Civil Engineers.

Odum, W. E., J. C. Zieman and E. J. Heald, 1972. Importance of Vascular Plant Detritus to Estuaries in Coastal Marsh and Estuary Management. Ed. R. Chabreck, Louisiana State University, Baton Rouge.

Oglesby, Ray T., Clarence A. Carlson; James A. McCann, ed., 1972. River Ecology and Man. New York: Academic Press.

Olsen, Arden A., and David Jamison, 1973. See Washington State Department of Natural Resources, Division of Surveys and Marine Land Management, Arden Olsen, etc.

Olsen, Arden A., David W. Jamison, and Sharon E. Marchese, 1974. Washington Marine Atlas, Volume 1, North Inland Waters. Washington Department of Natural Resources, Olympia, Washington.

Oregon State Department of Economic Development and Montagne-Bierly Associates, Inc., 1977. Waterway Development Handbook, A Guide to the Permit Process in Oregon's Waterways.

Oregon State University, 1971. Proceedings: Technical Conference on Estuaries of the Pacific Northwest, Circular 42. Engineering Experiment Station, Corvallis, Oregon.

Oregon State University, 1977. Dredging in Estuaries, Guides Manual and Technical. See Schroeder, W. L., principal investigator.

Orlob, Gerald T., M. D. Anserson and D. L. Hansen, 1949. An Investigation of Pollution in Port Gardner Bay and the Lower Snohomish River. Washington State Pollution Control Commission, Technical Report 3.

Orlob, Gerald T., D. R. Peterson and K. R. Jones, 1951. A Reinvestigation of Pollution in Port Gardner Bay and the Lower Shohomish River. Washington State Pollution Control Commission. Technical Bulletin No. 11.

Ovington, J. D., 1956. The Form, Weights and Productivity of Tree Species Grown in Close Stands. New Phytol, 55: 289-304.

Pacific Northwest River Basins Commission, 1970. "Comprehensive Study of Water and Related Land Resources: Puget Sound and Adjacent Waters", Appendix XI, Fish and Wildlife. Fish and Wildlife Technical Committee, Puget Sound Task Force, PNWRBC. Vancouver, Washington.

Parks, Thayne C. A Preliminary Study of Silt Loading in Eight Creeks Between Everett and Mukilteo, Washington. Everett: Everett Community College Department of Biology.

Parks, Thayne C., and Gretchen Lord, 1973. A Biological Inventory of Several Specific Sites Located in Everett, Washington. Everett, Washington.

Pearson, T. Gilbert, ed., 1936. Birds of America. New York: Garden City Books.

Percy, Katherine L., Chet Sutterlin, David A. Bella, and Peter C. Klingeman, 1974. Descriptions and Information Sources for Oregon Estuaries. Sea Grant College, Oregon State University, Corvallis.

Peters, C. F., K. O. Richter, D. A. Manumal and S. G. Herman, 1978. Colonial Nesting Sea and Wading Bird Use of the Estuarine Islands in the Pacific Northwest (Draft). John Graham & Company, Seattle, Washington.

Peterson, Roger Tory, 1961. A Field Guide to Western Birds. Boston: Houghton Mifflin.

Phillips, R. C., 1972. Ecological Life History of Zostera marina L. (eelgrass) in Puget Sound. Ph.D. Thesis. University of Washington.

Pickral, J C., and W. E. Odum, 1977. "Benthic Detritus in a Salt Marsh Tidal Creek." Maintenance Dredging in the Environment of Grays Harbor, Washington. U.S. Army Corps of Engineers, Seattle, Washington, Appendix J.

Pomerov, L. R., et al, 1977. Flux of Organic Matter through a Salt Marsh. Maintenance Dredging in the Enviornment of Grays Harbor, Washington. U.S. Army Corps of Engineers, Seattle, Washington, Appendix J.

Pritchard, D. W., 1955. Estuarine Circulation Patterns. Project of the American Society of Civil Engineers, 81:1-11.

Puget Sound Council of Governments (PSCOG), 1977. Goals and Policies for Regional Development. Seattle, Washington.

Puget Sound Council of Governments, Puget Sound Regional Planning Council, Merwin Parker, 1964. Project Open Space, Report No. 11-Swamp, Marsh and Bog Areas in the Central Puget Sound Region. Seattle, Washington.

Puget Sound Regional Planning Council, Puget Sound Governmental Conference, F. M. Lockfelt, 1964. Marine Shorelines in the Puget Sound Region, Project Open Space Report No. 8, Vol. 11. Seattle, Washington.

Puget Sound Task Force, 1970. Puget Sound and Adjacent Waters, Comprehensive Water and Related Land Resources Study (Preliminary Study Findings).

Puget Sound Task Force, Pacific N.W. River Basins Commission, 1970a, Comprehensive Study of Water and Related Land Resources - Puget Sound and Adjacent Waters - State of Washington, Appendix II, Political and Legislative Environment.

Puget Sound Task Force, Pacific N.W. River Basins Commission, 1970b, Comprehensive Study of Water and Related Land Resources - Puget Sound and Adjacent Waters - State of Washington, Appendix III, Hydrology and Natural Environment.

Puget Sound Task Force, Pacific N.W. River Basins Commission, 1970c, Comprehensive Study of Water and Related Land Resources - Puget Sound and Adjacent Waters - State of Washington, Appendix V, Water-Related Land Resources.

Puget Sound Task Force, Pacific N.W. River Basins Commission, 1970d, Comprehensive Study of Water and Related Land Resources - Puget Sound and Adjacent Waters - State of Washington, Appendix XI, Fish & Wildlife.

Puget Sound Task Force, Pacific N.W. River Basins Commission, 1970e, Comprehensive Study of Water and Related Land Resources - Puget Sound and Adjacent Waters - State of Washington, Appendix XII, Flood Control.

Puget Sound Task Force, Pacific N.W. River Basins Commission, 1971. Comprehensive Study of Water and Related Land Resources - Puget Sound and Adjacent Waters. State of Washington Summary Report.

Reimold, Robert J., 1978. "Coastal Alternative Dredged Material Rehabilitation. Coastal Zone '78 Proceedings, Volume II. New York: American Society of Civil Engineers.

Richard, C. T. Li, Inc., 1972a. Snomet/King County 208 Areawide Waste Management Plan Subtask 5.1, Analysis of Sediment Samples from Existing and Potential Dredging Sites. Seattle, Washington.

Richard, C. T. Li, Inc., 1977b. Snomet/King County 208 Areawide Waste Management Plan Subtask 5.2, Procedures for Upland Dredge Spoil Disposal. Seattle, Washington.

Richard, C. T. Li, Inc., 1977. Snomet/King County 208 Areawide Waste Management Plan Subtask 5.4, Analysis of Department of Natural Resources Disposal Site Operation and Examination of Transfer Site Concept Feasibility. Seattle, Washington.

Ricklefs, Robert E., 1973. Ecology. Newton, Massachusetts: Chiron Press.

Rigg, George B., 1958. See Washington State Department of Natural Resources, Division of Mines and Geology, George B. Rigg.

Riley, G. A., and S. A. Conover, 1956. Oceanography of Long Island Sound 1952-1954. III. Chemical Oceanography. Bull. Bingham Oceanogr. Coll. 15:47.

Rue, Leonard Lee, III, 1968. Sportsman's Guide to Game Animals. New York: Harper & Row.

Salo, Leo J., 1975 See Washington State Department of Game, Leo J. Salo.

Scheffer, Theo. H., and Neil Hotchkiss, 1945. Plant Food Resources for Waterfowl in the Pacific Northwest. Biological Bulletin No. 7. Washington State Department of Game, Olympia.

Schroeder, W. L., 1977. Dredging in Estuaries, A Guide for Review of Environmental Impact Statements (1) Guides Manual, pp. 89; (2) Technical Manual, pp. 312. Washington, D.C., National Science Foundation/Research applied to National Needs.

Scott and Crossman, 1973. Freshwater Fishes of Canada. Canada Fisheries Research Board. Ottowa, Canada.

Shanks, L. R., 1978. "Small Coastal Structures - A Review." Coastal Zone '78 Proceedings, Volume II. New York: American Society of Civil Engineers.

Shapiro & Associates, Inc., 1977. Manual for Management of the Coastal Aquatic Area. Washington Department of Ecology. Olympia, Washington.

Shea, G. Bradford, 1977a. Environmental Setting and Sensitive Environmental Areas of the Tulalip Indian Reservation. Triad Associates, Bellevue, Washington.

Shea, G. Bradford, 1977b. Wetland Survey of the Snohomish/King County 208 Planning Area. Enplan Corporation, Kirkland, Washington.

Shea, G. Bradford, and D. Cornett, 1977. Management Plan for the Rain River Nature Preserve. Western Eco-Systems Technology, Inc., and the Nature Conservancy. Portland, Oregon.

Smith, Hank K., 1978. "Habitat Development: An Alternative Method of Dredged Material Disposal". Coastal Zone '78 Proceedings, Volume II. New York: American Society of Civil Engineers.

Smith, Jack, 1976. See U.S. Army Corps of Engineers and J. Smith, 1976.

Smith, James E., 1977. Washington Cooperative Fishery Research, University of Washington, A Baseline Study of Invertebrates and of the Environmental Impact of Intertidal Log Rafting on the Snohomish River Delta. Seattle, Washington.

Smith, James E., R. Conley, C. Detrich and R. Whitney, 1975. A Report on the Benthic Infauna and Fish Populations of Jetty Island and Mission Beach (Everett, Washington). Washington Cooperative Fisheries Unit, University of Washington, Seattle.

Smith, Mackey, 1976. See Washington State Department of Natural Resources, Division of Geology and Earth Resources, Mackey Smith.

Snohomish Basin Coordinating Committee, 1975. Recommendations for the Snohomish River Basin. Everett, Washington.

Snohomish Conservation District Long Range Resource Program, 1975. Lake Stevens, Washington.

Snohomish County Health District, Division of Environmental Health, 1974. Regulations Governing Solid Waste Handling. Everett, Washington.

Snohomish County Planning Department. A Proposal for a Basin Management Plan for Snohomish and Stillaguamish River Basins (submitted to EPA). Everett, Washington.

Snohomish County Planning Department. River Basin Management Planning in the Snohomish and Stillaguamish River Basins. Everett, Washington.

Snohomish County Planning Department, 1963. General Land Use Plan, Snohomish County, Washington. Everett, Washington.

Snohomish County Planning Department, 1965. Comprehensive Plan Text: Skykomish Valley, Everett, Washington.

Snohomish County Planning Department, 1966. Comprehensive Plan Text: Snohomish, Lake Stevens Planning Area. Everett, Washington.

Snohomish County Planning Department, 1969. Topographic Atlas of Snohomish County Including Camano Island.

Snohomish County Planning Department, 1970a. Formulation of Goals and Objectives, A Technical Supplement to Snohomish County's Land Use Plan Technical Report 8. Everett, Washington.

Snohomish County Planning Department, 1970b. Marysville Area Plan, A Portion of the Snohomish County Comprehensive Plan. North County Section. Everett, Washington.

Snohomish County Planning Department, 1970c. Overall Economic Development Plan. Everett, Washington.

Snohomish County Planning Department, 1970d. The Physical Environment, A Technical Supplement to Snohomish Land Use Plan, Technical Report No. 1. Everett, Washington.

Snohomish County Planning Department, 1971. Interim Population Forecast, A Technical Supplement to Snohomish County's General Land Use Plan, Report No. 10. Everett, Washington.

Snohomish County Planning Department, 1973a. Final Environmental Impact Statement, Marine Industrial Development. Everett, Washington.

Snohomish County Planning Department, 1973b. Final Environmental Impact Statement, Sanitary Landfill. Everett, Washington.

Snohomish County Planning Department, 1973c. The Shorelines of Snohomish County Inventory Summary. Everett, Washington.

Snohomish County Planning Department, 1973d. Washington Urban Systems Engineering Demonstration Project, Final Report, Volume II, Methodology. Everett, Washington.

Snohomish County Planning Department, 1974a. Snohomish County Shoreline Management Master Program. Everett, Washington.

Snohomish County Planning Department, 1974b. Water Quality Management Plan for Snohomish River Basin, Vol. I. Everett, Washington.

Snohomish County Planning Department, 1974c. Water Quality Management Plan for Snohomish River Basin, Vol. V, Environmental Impact Statement. Everett, Washington.

Snohomish County Planning Department, 1974c. Water Quality Management Plan for Snohomish River and Stillaguamish River Basin, Volumes I through V. Everett, Washington.

Snohomish County Planning Department, 1977a. Final Environmental Impact Statement for a Dry Land Marina Storage Facility. Everett, Washington.

Snohomish County Planning Department, 1977b. Snomet/King County Areawide Waste Treatment Management Plan (Draft). Everett, Washington.

Snohomish County Planning Department, 1977c. Zoning Code, Title 18. Snohomish County, Washington.

Snohomish County Planning Department, 1978. Snomet/King County Areawide Waste Treatment Management Plan. Everett, Washington.

Snohomish County Planning Department and George S. Nolte & Associates, 1973. Snohomish County, Washington, Rural Water & Sewage Facilities Study. Everett, Washington.

Snohomish County Planning Department and Washington State Department of Ecology, 1975. 303(e) Water Quality Management Plan, Water Resource Inventory Areas 05 and 07, The Stillaguamish and Snohomish River Basins.

Snohomish County Public Utility District #1, 1952. Washington State Department of Conservation and Development, and R. C. Newcomb. Ground Water Resources of Snohomish County, Washington. U.S. Geological Survey Water Supply Bulletin 1135. Washington, D.C.: U.S. Government Printing.

Snohomish County Public Utility District #1, 1972. Map of distribution system.

Snyder, D. E., 1971. Interpretation of soils for land use planning (A supplement to the soil survey of Snohomish County, Washington). U.S.D.A. Soil Conservation Service. Portland, Oregon.

Snyder, D. E., 1972. Interpretation of soils for land use planning (A supplement to the soil survey of Kitsap County, Washington). U.S.D.A. Soil Conservation Service. Portland, Oregon.

Snyder, D. E., P. S. Gale, and R. F. Pringle, 1973. Soil Survey of King County Area, Washington. U.S. Government Printing Office, Washington, D.C.

Soil Conservation Service, 1951. Soil Survey Manual (U.S.D.A. Handbook No. 18). U.S. Government Printing Office, Washington, D.C.

Sorenson, J. C., 1971. A Framework for Identification and Control of Resource Degradation and Conflict in the Multiple Use of the Coastal Zone. Berkeley: University of California.

State Comprehensive Outdoor Recreation and Open Space Plan (SCORP), Vols. I and II, 1973. Interagency Committee for Outdoor Recreation. Olympia, Washington.

Steele, J. H., 1959. The Quantitative Ecology of Marine Phytoplankton. Biol. Rev. 34: 129-158.

Stevens, Thompson and Runyan, Inc., 1976. Environmental Management for the Metropolitan Area, Water Quality, Part III, Appendix D, Small Lakes Handbook.

Stevenson, J. C., D. R. Heinle, D. A. Elemer, R. J. Small, R. A. Rowland and F. J. Ustach, 1976. Nutrient Exchanges Between Brackish Water Marshes and the Estuary. American Institute of Biological Sciences Conference. New Orleans, 1976.

Stone, Witmer, and William Everett Cram, 1903. American Animals. New York: Doubleday, Page and Company.

Sverdrup, H. U., M. W. Johnson, and R. M. Fleming, 1942. The Oceans, New Jersey: Prentice-Hall.

Tamm, C. O., 1975. "Plant Nutrients as limiting factors in ecosystem dynamics." Productivity of World Ecosystems. National Academy of Sciences. Washington, D.C.

Texas Department of Natural Resources and University of Texas, 1972. The Management of Bay and Estuarine Systems - Phase I, Coastal Resources Management Program. Austin, Texas.

The Coast, 1907. Volume 14, No. 4. The Coast Publishing Company, Seattle, Washington.

The Lower Snohomish Basin 201 Facilities Plan, 1977. Technical Appendix A, Infiltration Information Analysis - Snohomish County Planning Department, Snohomish County, Washington.

The Use, Study and Management of Puget Sound (Symposium March 23-25, 1977). University of Washington, Seattle.

Tippetts, Abbett, McCarthy and Stratton, 1966. Snohomish River Basin Study. Snohomish County Economic Development Council. Everett, Washington.

Tippetts, Abbett, McCarthy and Stratton, 1968. Snohomish River Basin Planning Study. Snohomish County Economic Development Council. Everett, Washington.

Tobin, Caroline C., 1976. A Case Study in Shoreline Management - San Juan County, (Paper).

Tyler, Richard W., 1963. Distribution and Migration of Young Salmon in Everett Harbor, 1962. Fisheries Research Institute, University of Washington, Seattle.

Tyler, Richard W., 1965. Distribution and Migration of Young Salmon in Everett Harbor Relative to Water Quality, 1963-64. Fisheries Research Institute, University of Washington, Seattle, Washington.

U.S. Army Corps of Engineers, 1967. Floodplain Information Study, Snohomish River Basin, Washington, Technical Report. Seattle District, Seattle, Washington.

U.S. Army Corps of Engineers, 1969a. Snoqualmie River, Washington, Report on Flood Control and Other Improvements, Vol. I - Main Report. Seattle, Washington.

U.S. Army Corps of Engineers, 1969b. Snoqualmie River, Washington, Report on Flood Control and Other Improvements, Vol. II, Appendices A to G. Seattle, Washington.

U.S. Army Corps of Engineers, 1969c. Snoqualmie River, Washington, Report on Flood Control and Other Improvements, Vol. III, Appendices H to K. Seattle, Washington.

U.S. Army Corps of Engineers, 1971. Water Resources Development. North Pacific Division. Portland, Oregon.

U.S. Army Corps of Engineers, 1973a. Project and Index Maps, River and Harbor and Flood Control. Seattle, Washington.

U.S. Army Corps of Engineers, 1973b. Water Resources Development in Washington, North Pacific Division. Portland, Oregon.

U.S. Army Corps of Engineers, 1975a. Environmental Assessment, Proposed Projects on Spa and Back Creeks. Annapolis, Maryland.

U.S. Army Corps of Engineers, 1975b. Final Environmental Statement, Everett Harbor and Snohomish River Navigation Project, Everett, Washington. Seattle, Washington.

U.S. Army Corps of Engineers, 1975c. Special Study, Suggested Hydraulic Floodways Snohomish River, Vicinity of Snohomish to Everett. Snohomish County, Washington.

U.S. Army Corps of Engineers, 1975d. Washington Environmental Atlas.

U.S. Army Corps of Engineers, 1976a. Reconnaissance Report on Mediated Plan - Snohomish River Basin, Washington. Seattle, Washington.

U.S. Army Corps of Engineers, 1976b. Siletz Wetlands Review. Portland, Oregon.

U.S. Army Corps of Engineers, 1977. Nehalem Wetlands Review, A Comprehensive Assessment of the Nehalem Bay and River. Portland, Oregon.

U.S. Army Corps of Engineers, John H. Barwis, 1976. Annotated Bibliography on the Geologic, Hydraulic and Engineering Aspects of Tidal Inlets. Springfield, Virginia.

U.S. Army Corps of Engineers, Dredge Material Research Program, C. Lee Hoeppel, Hunt and Carlson, 1976a. Feasibility of the Functional Use of Vegetation to Filter, Dewater, and Remove Contaminants from Dredged Material. Vicksburg, Mississippi.

U.S. Army Corps of Engineers, Dredge Material Research Program, C. Lee, T. Sturgis, and M. Landin, 1976b. A Hydroponic Study of Heavy Metal Uptake by Selected Marsh Plant Species. Vicksburg, Mississippi.

U.S. Army Corps of Engineers, Dredge Material Research Program, Coastal Zone Resource Corporation, 1977. A Comprehensive Study of Successional Patterns of Plants and Animals at Upland Disposal Areas. Wilmington, North Carolina.

U.S. Army Corps of Engineers and Batelle Pacific Northwest, 1974. Columbia Rivers and Tributaries Environmental Assessment Manual. Portland, Oregon.

U.S. Army Corps of Engineers, Mark Boule' and G. Bradford Shae, 1978. Delineation of Tidal Wetlands Boundaries in the Snohomish Estuary. Seattle, Washington.

U.S. Army Corps of Engineers and Galen Burrell, 1978. Snohomish River Estuary Study - Classification and Mapping. Seattle, Washington.

U.S. Army Corps of Engineers and J. Smith, 1976. "Dredging and Some Ecological Relationships in Grays Harbor". Maintenance Dredging in the Environment of Grays Harbor, Washington. Appendix J.

U.S. Army Corps of Engineers and Washington State Department of Ecology, 1973. Middle Fork, Snoqualmie River, Joint Study. Seattle, Washington.

U.S. Army Corps of Engineers and John Welch, 1975. Public Brochure, Alternatives and their Pros and Cons, Snohomish River Basin, Washington. Seattle.

U.S. Army Engineer Institute for Water Resources, Henry Hitchcock, 1977. Analytical Review of Research Report on Social Impacts of Water Resources Development Property. Fort Belvior, Virginia.

U.S. Army Engineer Institute for Water Resources, L. Messman, R. Reppert and E. Stakhiv, 1977. Wetland Values - Interim Assessment and Evaluation Methodology.

U.S. Department of Agriculture, A. C. Anderson, et al, 1947. Soil Survey of Snohomish County, Washington, No. 19.

U.S. Department of Agriculture, Soils Conservation Service, 1976. Land Use and Monitoring Memo, WA-1.

U.S. Department of Agriculture, Soils Conservation Service, 1975. Snohomish Conservation District Long Range Resource Program. Lake Stevens, Washington.

U.S. Department of Agriculture, Soils Conservation Service, Dale E. Snyder, 1971. Interpretations of Soils for Land Use Planning, A Supplement to the Soil Survey of Snohomish County, Washington, with Soil Interpretations for Planning and Development. Seattle, Washington.

U.S. Department of Commerce, Coast and Geodetic Survey, H. A. Harmer, 1951. Tidal Datum Planes No. 135. Washington, D.C.: U.S. Printing Office.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, 1976. Living Coastal Resources. Office of Coastal Zone Management, Washington, D.C.

U.S. Department of Commerce, National Oceanic & Atmospheric Administration, Robert L. Swanson, 1974. Variability of Tidal Datums and Accuracy in Determining Datums from Short Series of Observation. Rockville, Maryland.

U.S. Department of Interior, Federal Water Pollution Control Administration, 1967. Conference on the Matter of Pollution of the Navigable Waters of Puget Sound, the Strait of Juan de Fuca and Their Tributaries and Estuaries, Washington. Seattle, Washington, September 6-7, 1967.

U.S. Department of Interior, Federal Water Quality Administration (Kenneth D. Feigner and Howard S. Harris), 1970. Documentation Report FWQA, Dynamic Estuary Model.

U.S. Department of Interior, Fish and Wildlife Service, 1954. Inventory of Wetlands for the State of Washington. Portland, Oregon.

U.S. Department of Interior, Fish and Wildlife Service, 1970. Fish and Wildlife in Relation to the Ecological and Biological Aspects of Willapa Bay-Estuary, Washington. Portland, Oregon.

U.S. Department of Interior, Fish and Wildlife Service, 1970. National Estuary Study, Vol. IV, Appendix C - Additional Support Data, Appendix D - Estuarine Landscape Survey and Analysis. Washington, D.C.

U.S. Department of Interior, Fish and Wildlife Service, 1970. National Estuary Study, Vol. V, Appendix E - Economic Factors Affecting the Estuary Zone/Market Outlooks for Selected Products; Appendix F - Technological Impacts on Estuary Resource Use; Appendix G - Conflicts and Problems in Specific Estuary. Washington, D.C.

U.S. Department of Interior, Fish and Wildlife Service, 1976. Habitat Evaluation Procedures. Washington, D.C.

U.S. Department of Interior, Fish and Wildlife Service, Lewis M. Cowardin, V. Carter, F. Gulet and E. LaRoe, 1977. Classification of Wetlands and Aquatic Habitats of the U.S., Draft. Washington, D.C.

U.S. Department of Interior, Fish and Wildlife Service, Martel Laboratories, Inc., 1976. Existing State and Local Wetlands Surveys (1965-1975) Vol. II, Narrative.

U.S. Department of Interior, Fish and Wildlife Service, Virginia Institute of Marine Science, 1975. An Assessment of Estuarine and Nearshore Marine Environments, National Water Resources Assessment.

U.S. Department of Interior, Geological Survey, 1970. A Preliminary Study of the Effects of Water Circulation in the San Francisco Bay Estuary - No. 637-A,B. Washington, D.C.

U.S. Department of Interior, Geological Survey, T. J. Conomos, D. M. Peterson, P. R. Carlson, and D. S. McCulloch. Movement of Seabed Drifters in the San Francisco Bay Estuary and Adjacent Pacific Ocean.

U.S. Department of Interior, Geological Survey, B. W. Drost, 1977. Preliminary Assessment of the Water Resources of the Tulalip Indian Reservation, Washington. Tacoma, Washington.

U.S. Department of Interior, Geological Survey, D. D. Harris and R. C. Williams, 1971. Streamflow, Sediment-Transport, and Water-Temperature, Characteristics of Three Small Watersheds in the Alsea River Basin, Oregon, #642. Washington, D.C.

U.S. Department of Interior, Geological Survey, D. S. McCulloch, D. M. Peterson, P. R. Carlson, and T. J. Conomos. Some Effects of Fresh-Water Inflow on the Flushing of South San Francisco Bay.

U.S. Department of Interior, Geological Survey, A. S. Van Denburgh and J. I. Santos, 1965. Ground Water in Washington, its Physical and Chemical Quality. Olympia, Washington.

U.S. Department of Interior, National Parks Service, 1973. Preparation of Environmental Statements: Guidelines for Discussion of Cultural (Historic, Archaeological, Architectural) Resources.

U.S. Department of Interior, National Park Service, Robert C. Dunnell and John W. Fuller, 1975. An Archaeological Survey of Everett Harbor and the Lower Snohomish Estuary-Delta.

U.S. Department of Interior, Washington State Department of Ecology, and M. R. Collings, 1973. Data on Selected Lakes in Washington, Part I. Tacoma, Washington.

U.S. Department of Interior, Water Resource Division, Washington State Department of Ecology, Leonard M. Nelson, 1971. Sediment Transport by Streams in the Snohomish River Basin, Washington, October 1967-June 1969. Tacoma, Washington.

U.S. Environmental Protection Agency, 1976. Ecosystem Impacts of Urbanization Assessment Methodology. Corvallis, Oregon.

U.S. Environmental Protection Agency, Reznedt M. Darnell, et al, 1976. Impacts of Construction Activities in Wetlands of the U.S. Corvallis, Oregon.

U.S. House of Representatives, 81st Congress, 2nd Session, 1950. Document No. 569, Everett Harbor and Srohomsih River, Washington; Letter from Secretary of Army.

University of Washington, Center for Quantitative Science, L. J. Bledsoe, et al, 1975. Shoreline Management Program, Impact Measurement and Policy Projection. Seattle, Washington.

Valentine, G. M., 1960. Inventory of Washington Minerals, Part I - Nonmetallic Minerals, 2nd ed., revised by M. T. Huntting. Washington Division of Mines and Geology Bull.

Wahl, Terance R., and Dennis R. Paulson, 1973. A Guide to Bird Finding in Washington. Whatcom Museum Press, Bellingham.

Washington State Department of Conservation, Washington Pollution Control Commission, and the U.S. Geological Survey, 1961. Quality of Surface Waters, 1959-60. Olympia, Washington.

Washington State Department of Conservation, 1962. Monthly and Yearly Summaries of Hydrographic Data in the State of Washington. October 1953 to September 1960. Water Supply Bulletin #15. Olympia, Washington.

Washington State Department of Conservation, Division of Mines and Geology, Park D. Snavely, Jr., and Holly C. Wagner, 1962. Tertiary Geologic History of Western Oregon and Washington, No. 22. Olympia, Washington.

Washington State Department of Conservation, Division of Water Resources, 1962. Water-Supply Bulletin #15, Monthly and Yearly Summaries of Hydrographic Data, October 1953 to September 1960.

Washington State Department of Conservation, Division of Water Resources, Bruce Liesch, Charles Price and Kenneth Walters, 1963. Geology and Ground Water Resources of N.W. King County, Washington, Water Supply Bulletin No. 20.

Washington State Department of Conservation and Development, Division of Geology, W. A. Broughton, 1942. Inventory of Mineral Properties in Snohomish County, Washington, Report No. 6.

Washington State Department of Conservation and Development, Division of Water Resources, 1955. Monthly and Yearly Summaries of Hydrographic Data in the State of Washington to September 1953, Water Supply Bulletin No. 6. Olympia, Washington.

Washington State Department of Ecology, 1971. Ground Water Contamination Along Interstate 405, Southern Snohomish County, Washington. Olympia, Washington.

Washington State Department of Ecology, 1973. Guidelines for the Development of Water Pollution Control and Abatement Plans for Sewage Drainage Basins. Olympia, Washington.

Washington State Department of Ecology, 1974. The Marine and Estuarine Habitats of Washington, DOE Baseline Studies Program. Olympia, Washington.

Washington State Department of Ecology, 1975. Water Quality Assessment Report, Vols. I and II. Olympia, Washington.

Washington State Department of Ecology, 1976a. Ecological Baseline and Monitoring Study for Port Gardner and Adjacent Water, A Summary Report for the years 1972 through 1975. Olympia, Washington.

Washington State Department of Ecology, 1976b. Washington Baseline Study, Critical Area Study, Vol. VI, Maps, Final Draft Report. Olympia, Washington.

Washington State Department of Ecology, 1976c. Washington State Coastal Zone Management Program. Olympia, Washington.

Washington State Department of Ecology, Attorney General, 1972. The Harbor Line Commission, 1972 Harbor Area Study - A Report to the 43rd Legislature of the State of Washington. Olympia, Washington.

Washington State Department of Ecology, Beak Consultants, Inc., 1975. Washington Baseline Study: Biological Oil Impact Literature Review, Vol. I, Text Final. Olympia, Washington.

Washington State Department of Ecology, Robert A. Bishop, and Ron Deuitt, 1970. A Report on the Port Angeles Harbor Intertidal Clam and Biological Survey. Olympia, Washington.

Washington State Department of Ecology, John S. Isakson and T.M.A. Reichard, 1976. Washington Baseline Study, Critical Area Study, Vol. I (Introduction). Final Draft Report. Olympia, Washington.

Washington State Department of Ecology, Mathematical Sciences N.W., Inc., 1977. Washington Coastal Areas of Major Biological Significance. Olympia, Washington.

Washington State Department of Ecology, Karin E. Mesmer and L. J. Bledsoe, 1976. A Projection of Land Use Change in the Coastal Zone. Seattle, Washington: University of Washington, Center for Quantitative Science.

Washington State Department of Ecology, Northwest Environmental Consultants, 1976. Proposed Definition and Classification System for Washington's Coastal Zone Wetlands (Draft).

Washington State Department of Ecology, Northwest Environmental Consultants, 1977. Aquatic Lands Definition Study. Olympia, Washington.

Washington State Department of Ecology, U.S. Department of Interior, G. C. Bortelson, et al, 1976. Reconnaissance Data of Lakes in Washington, King and Snohomish Counties, Water Supply Bulletin 43, Vol. 2. Olympia, Washington.

Washington State Department of Ecology, U.S. Department of Interior Geological Survey, J. B. McConnell, G. C. Bortelson and J. K. Innes, 1976. Data on Selected Lakes in Washington, Water Supply Bulletin 42, Part 4.

Washington State Department of Ecology, University of Washington Institute for Marine Studies, 1975. Washington Baseline Study: Marine Economic Component, Final Report. Olympia, Washington.

Washington State Department of Ecology, Washington State Department of Game, R. L. Eaton, J. D. Brittell, J. M. Brown and C. A. Starika, 1975. Marine Shoreline Fauna of Washington. Olympia, Washington.

Washington State Department of Ecology, Washington State Water Program, 1973. Lakes of Washington, Vol. 1, Western Washington, 3rd Edition. Olympia, Washington.

Washington State Department of Fisheries, 1971. Criteria Governing the Design of Bulkheads, Landfills, and Marinas in Puget Sound, Hood Canal, and the Strait of Juan de Fuca for Protection of Fish and Shellfish Resources. Olympia, Washington.

Washington State Department of Fisheries, 1974. Bulkhead Criteria for Surf Smelt (Hypomesus pretiosus). Spawning Beaches in Puget Sound, Hood Canal, Strait of Juan de Fuca, San Juan Islands, and the Strait of Georgia. Olympia, Washington. (Supplement to reference immediately below.)

Washington State Department of Fisheries, Robert J. Gerke and V. W. Kaczynski, 1972. Food of Juvenile Pink and Chum Salmon in Puget Sound, Washington, Technical Report 10. Olympia, Washington.

Washington State Department of Fisheries, R. W. Williams, R. M. Laramie and J. J. Ames, 1975. A Catalog of Washington Streams and Salmon Utilization: Vol. I, Puget Sound. Olympia, Washington.

Washington State Department of Game, 1975. Marine Shoreline Fauna of Washington, A Status Survey.

Washington State Department of Game, Leo J. Salo, 1975. A Baseline Survey of Significant Marine Birds in Washington State (Coastal Zone Environmental Studies Report No. 1). Olympia, Washington.

Washington State Department of Game, U.S. Agriculture Department, R. Gary Engman, and A. G. Stendal, 1976. See Engman and Stendahl, 1976.

Washington State Department of Natural Resources, 1977. Washington Marine Atlas. Olympia, Washington.

Washington State Department of Natural Resources, Division of Geology and Earth Resources, J. B. Hall and K. L. Othberg, 1974. Thickness of Unconsolidated Sediments, Puget Lowland, Washington (Map). Olympia, Washington.

Washington State Department of Natural Resources, Division of Geology and Earth Resources, Mackey Smith, 1976. Preliminary Surficial Geologic Map of the Mukilteo and Everett Quadrangles, Geologic Map GM-20, Snohomish County, Washington.

Washington State Department of Natural Resources, Division of Mines and Geology, Vaughn E. Livingston, Jr., 1971. Geology and Mineral Resources of King County, Washington, Bulletin No. 63. Olympia, Washington.

Washington State Department of Natural Resources, Division of Mines and Geology, George B. Rigg, 1958. Peat Resources of Washington, Bulletin No. 44. Olympia, Washington.

Washington State Department of Natural Resources, Division of Surveys and Marine Land Management, 1973. The Land Use Allocation Plan. Olympia, Washington.

Washington State Department of Natural Resources, Division of Surveys and Marine Land Management, Arden Olsen, and David Jamison, 1973. Marine Land Management in Washington. Olympia, Washington.

Weinmann, F. C., and J. Malek, 1978. Planning for Maintenance Dredging in Grays Harbor Estuary, Coastal Zone '78 Proceedings, Volume II, 1346.

Wellman, Thora L., 1932. Early Means of Transportation in Snohomish County. Unpublished M.A. Thesis. University of Washington, Seattle.

Whigham, D. F., and R. L. Simpson, 1978. "Nitrogen and Phosphorus Movement in a Freshwater Tidal Wetland Receiving Sewage Effluent." Coastal Zone 1978, Volume III. New York: American Society of Civil Engineers.

Whitfield, William, 1926. History of Snohomish County, Washington. Chicago: Pioneer Historical Publishing.

Whitman, Ira L., Norbert Dee, et al, 1971. Design of an Environmental Evaluation System. Battelle Memorial Institute, Columbus, Ohio.

Whitney, R. R., J. E. Smith, R. Conley and C. Detrick, 1975. A Report on the Benthic Infauna and Fish Populations of Jetty Island and Mission Beach. Everett, Washington.

Williams, R. W., R. M. Laramie and J. J. Ames, 1975. See Washington State Department of Fisheries, R. W. Williams, R. M. Laramie and J. J. Ames.

Wilsey & Ham, Inc., 1972. Kayak Point, Snohomish County, Washington: Master Plan for Development, Environmental Impact Statement. Seattle, Washington.

Wooldridge, D., George Mack and Jeanette Veasey, 1975. Urban Storm Runoff, Washington. University of Washington, Seattle.

Wooley, Grant A., Chairman, Fish and Wildlife Technical Committee, 1970. "Fish and Wildlife", Appendix XI. Comprehensive Study of Water and Related Land Resources, Puget Sound and Adjacent Waters. Pacific Northwest River Basins Commission

Yearsley, John R., 1977. A Survey of Water Quality in the Snohomish River Estuary, August 16, 17, 1977. U.S. Environmental Protection Agency. Seattle, Washington.

Yocum, Charles F., 1951. Waterfowl and Their Food Plants in Washington. Seattle: University of Washington Press.

Zieman, J., 1977. "Sea Grass Beds." Coastal Ecosystems Management. Edited by John Clark. New York: John Wiley and Sons.

Legal Criterions

Revised Code of Washington (RCW) listings:
- RCW 43.20, Public Health, Department of Social and Health Services
- RCW 43.21c, State Environmental Policy Act
- RCW 43.30, Department of Natural Resources
- RCW 43.51, Parks and Recreation Commission
- RCW 56 and 57, Sewer and Water Districts
- RCW 75, Department of Fisheries
- RCW 76, Department of Natural Resources
- RCW 77, Department of Game
- RCW 79, Department of Natural Resources
- RCW 85.05 and .06, Diking and Drainage Districts
- RCW 89.08, Conservation Districts
- RCW 90.48.260, Department of Ecology
- RCW 90.58, Shorelines Management Act
- RCW 352.32, Parks and Recreation Commission

Code of Federal Regulations (CFR) listings:
- 15 CFR 920,923, NOAA/NMFS Grant Regulations
- 33 CFR 209.320-329, U.S. Army Corps of Engineers Regulation
- 36 CFR 800, Historic Preservation Review
- 40 CFR 115.220-229,230, Environmental Protection Agency Regulations

Washington Administrative Code (WAC) listings:
- WAC 173-220, National Pollutant Discharge Elimination System (NPDES) Permits
- WAC 197-210, State Environmental Policy Act (SEPA) Guidelines
- WAC 232, Game Regulations
- WAC 332, Department of Natural Resources

United States Code (USC) listings:
- 16 USC 1531-1543, Endangered Species Act of 1973
- 225 USC 468, Indian Reorganization Act of 1934

Federal Register (FR) listings;
- FR 40, 231, December 1, 1975, U.S. Fish and Wildlife Service

Public Law (PL) 92-500, Federal Water Pollution Control Act and Amendments

Substitute House Bill 70, Chapter 195, Office of Archaeology and Historic Preservation, Washington State, 1977

Personal Communications, November 1977 - February 1978

Audubon Society
Department of Game
Department of Natural Resources
Edmonds School District
Everett School District
Marysville School District
D. McLaughlin, U.S. Army Corps of Engineers
Alice Shorett, Institute for Environmental Studies, University of Washington
Smith Island Water District
Snohomish County Public Utility District #1
Snohomish School District
Sally Van Niel, Everett Community College