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Restoration Potential of Diked Estuarine Wetlands in Washington and Oregon

Phase I: Inventory of Candidate Sites

Final Report

DIKED WETLANDS RESTORATION POTENTIAL

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Chapter 1

INTRODUCTION

Background

Section 404 of the Clean Water Act and Executive Order 11990 have established policies and measures to protect wetland habitats. Implementation and enforcement of these legal requirements and policies has been given to the Environmental Protection Agency (EPA). The Wetlands Protection Section in the Water Division is responsible for implementing the wetland protection policies in EPA Region 10.

EPA Region 10 has developed interest in the possibility of enhancing wetland habitat in the Pacific Northwest by identifying sites where it may be possible to restore tidal influence to diked agricultural lands within the estuaries of Oregon and Washington.

There are thousands of acres of agricultural lands within the region which have been created by diking of estuaries; some of the diking activity is nearly a century old. Many of these areas are currently prime agricultural lands and the economic values associated with them are substantial. Some of the diked lands, although historically used for pasture or agricultural uses, are now fallow and not actively used. Tide gates may be nonfunctional or dikes breached, and the land is reverting to wetland in response to more saturated conditions. It is these lands which this study has attempted to focus on as potential restoration sites as they may contribute more biological and economic resource values if restored to the estuary than they currently provide as diked agricultural land.

The return of these lands to the estuary would contribute to achieving a national goal of reclaiming lost wetlands as well as providing a potential source of mitigation sites to offset wetland loss resulting from the development of justifiable water-dependent facilities.

Objective

This study was undertaken at the request of EPA Region 10 as the first step in identifying candidate wetland restoration sites in Washington and Oregon. The objective of this first step is to identify areas in Washington and Oregon which 1) once were estuarine wetlands but are not now functioning as such due to dike construction; 2) are greater than 5 acres in size; and 3) may be suitable for restoration.

General Approach

Information Sources

The primary approach of this phase of the work was to create a preliminary inventory using existing information. Actions taken to identify sources of information and compile the preliminary inventory include the following:

- meet with state and local government and resources agency staff to obtain sources of data, personal knowledge, and references;
- review U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps for the presence of wetlands mapped as farmed, drained, or diked which are adjacent to or associated with an estuary;
- analyze available U.S. Army Corps of Engineers (COE) aerial photographs of the estuary sites for potential sites which are not mapped as wetland on the NWI maps (for Oregon, 1986 aerial photomosaics were utilized, for Washington, 1987 aerial flight lines were used, except where noted within the text); and
- review available literature for historical records, potential sites, and previously identified mitigation sites.

Analytical Method

Using the most up-to-date National Wetlands Inventory (NWI) maps, existing diked wetlands were identified within each estuary. The NWI mapped both fresh and saltwater wetlands and classified them according to the USFWS wetland habitat classification system developed by Cowardin et al. (1979). Within the USFWS wetland classification system, special modifiers can be added onto the vegetative descriptors to more accurately describe the wetland. The specific modifiers of interest to this inventory were:

d: partially drained/ditched
f: farmed
h: diked/impounded

These modifiers appear after a general habitat classification code, e.g., PEM1Wh, which translates into a palustrine, emergent, intermittently flooded (temporary), diked wetland. This further translates into a freshwater wetland which is diked and is characterized by herbaceous vegetation (not trees

or shrubs) which contains, at least periodically, standing water.

The special modifiers help to identify those systems which have been directly impacted by human activity. The modifiers are included on the NWI maps only when the modification, such as diking, is visible in the aerial photograph used for the data source or if it is mapped on the USGS quad used for the NWI base map. Wetland areas behind dikes which have been in place for decades often lose their visual distinction, and it is difficult to detect their presence on aerial photos. In the cases of very old diking, it is often necessary to rely on historic data or personal knowledge to detect the presence of dikes as even the USGS quads may not map them.

The NWI maps were the source primarily used to identify wetlands which had been diked. Aerial photographs were used to attempt to determine current land use within these diked areas and to find areas which were diked but no longer classified as wetland. Aerial photographs often reveal former wetland conditions by the presence of old slough channels and meander lines. Many of the former wetlands are currently used for agricultural purposes and therefore would not be identified as wetlands on the NWI maps. The aerial photographs are a valuable source to reveal traces of former conditions which persist in spite of current land use patterns.

Where they were available, historical records were also used to identify the extent of estuarine wetlands. These records were an aid to identifying areas of diking, but they were not useful in distinguishing the type of wetland habitat present at the time of mapping. Much of the historic mapping did not differentiate between fresh and salt water wetlands, therefore, professional judgment was utilized to assess the former extent of tidal influence within the estuary.

Restoration Site Criteria

A preliminary effort was made in this study phase to identify potential sites for the restoration of tidal influence on lands which have been diked. The preliminary effort reported here focuses solely on existing information and does not yet include either field work or necessary feasibility studies. The primary source of information in this aspect of the study was a visual assessment of the aerial photographs available for each of the potential restoration sites.

Sites were identified as potential sites for this inventory if they met the following criteria:

1) They were located within potential tidal range of the estuary and a human intervention such as tide gates or dikes had removed them from tidal influence. This was determined by the presence of adjacent wetland, or channels mapped as estuarine by the NWI, or the clear presence of levees, dikes, or tide gates which impacted tidal influence.

And

2a) Current land use as determined from aerial photograph review was agricultural. Agricultural use was defined as active cultivation, pasture for grazing, or hay-field use. Such areas may have been mapped by the NWI as palustrine, estuarine, or upland systems.

Or

2b) Current land use as determined from aerial photographs was passive and the area appeared to have the potential to be restored to estuarine influence, i.e., the area was not discernable as being cultivated or actively developed. Such areas may have been mapped by the NWI as palustrine, estuarine, or upland systems.

Once a potential site had been identified from either the NWI mapping or the historical data, then the aerial was reviewed to assess current land use and the physical relationship of the site to the rest of the estuary or tidal channels.

In some of the major river deltas, a substantial portion of the estuary has been diked and converted to agricultural use. It is not practical to map these estuaries in their entirety as potential candidates for restoration to estuarine influence because the potential for designation as mitigation sites is low for much of the diked acreage. In these estuaries, focus was placed on identifying sites which were not currently in active cultivation or agricultural use, i.e., fallow fields or areas where the dikes may have been breached through natural causes or neglect, or where the existing fields indicated the continuing presence of saturated conditions. Thus, in some of the major river deltas, the inventory focuses on potential restoration sites, and is not necessarily an inventory of all diked lands.

Non-agricultural sites were identified as potential restoration sites when the area was in passive use such as old holding ponds or where there may have been old fill or dredge disposal sites. Very few of the identified sites are old fill or disposal sites.

Some of the proposed sites are freshwater wetlands which have formed behind dikes or have been purposefully diked off

from the tidal system. Further analysis is necessary to determine whether these could be converted to estuarine wetlands with restoration of tidal influence.

Existing estuarine wetland sites were not included within the inventory unless the site was noted as impounded or farmed, or if the site was under a modified tidal influence such as a non-functioning tide gate or broken levees. In general, estuarine sites bayward of any impoundments were not included within this inventory.

The potential or historical extent of tidal influence is unknown in many estuaries. For this inventory, "tidal influence" is defined as the limit of saltwater intrusion of sufficient concentration to allow the development of halophytic (salt-tolerant) vegetation or to establish non-vegetated estuarine conditions such as mud flats. "Tidal effect" is defined as the limit of hydrologic effects associated with tides. The limit of tidal influence was estimated based on the presence of mapped estuarine systems, a review of the aerial photographs to discern visual indicators of past conditions such as old slough channels and dikes, a review of historical wetland mapping, or literature references to historical conditions.

Report Structure

The report is divided into separate inventories for Oregon and Washington. The Oregon sites are listed north to south as the sites occur down the coast. The Washington sites are listed alphabetically by county, first by the sites on the inland waters and Straits of Juan de Fuca and then Grays Harbor and Willapa Bay. Within Appendix A, the Washington sites are also listed alphabetically by quad, inland waters first and then Grays Harbor and Willapa Bay. The Columbia River estuary is undergoing a work effort similar to this inventory by the Columbia River Estuary Study Team. Their report is currently in draft form, so rather than duplicate efforts within this inventory, the Columbia River estuary is not included herein.

Each estuary which contains potential restoration sites is mapped and a brief discussion is provided based on review of the aerial photographs or other documentation where noted. Where they were available, the maps are based on the 7.5' USGS quads used in the NWI. The text associated with each map discusses specified areas identified by a letter code on the maps.

Study Limitations

The scope of this study is very broad, but limitations on resources and time has placed constraints on the level of detail in this preliminary inventory. Interpretation of the

information contained in this preliminary work must take into account these constraints. Below are outlined some of the constraints, concerns, and limitations associated with this inventory.

Extent of Tidal Influence

Within the scope of this current inventory it is not possible to predict with accuracy the anticipated extent of tidal influence within the estuaries if dikes or tide gates are removed. It cannot be assumed that the historic range of tidal influence will be reestablished just by the simple removal or breaching of dikes. Many factors such as subsidence, ditching and channeling, remaining dikes and obstructions, and changes in river flows and channels all factor into potential tidal action. Detailed analysis, including field work, will be required to identify the feasibility of restoring tidal influence within the identified potential restoration sites.

In addition, when an estuary is diked, the land subsides and soil undergoes physical compaction. Agricultural activities such as haying, cultivation, ditching, or draining also impact the soil structure. These physical changes in elevation and soil structure will affect the hydraulic regime (water depths, flushing, and mixing actions) when tidal influence is restored. What may have historically been high marsh may return as low marsh because of the response of vegetation to changes in water depths and salinity. These factors further complicate the accuracy of trying to identify potential restoration sites.

Land Use Implication

For this preliminary inventory, no attempt was made to discern whether sites were in public, private, or tribal domain. It is known that sites within this inventory are located within each of these categories.

The inclusion of sites within this inventory does not imply any future land use decision. The function of this report is to record the first phase of data collection for the future identification of potential restoration and mitigation sites.

The inclusion of any site does not imply that it would provide a feasible or functional restoration or mitigation site. Many factors, such as existing site conditions, ownership, economics, availability, and existing habitat value and function, will have to be considered in detail prior to any specific restoration or mitigation sites becoming established.

Any proposal to use a specific site as a restoration project or mitigation site would be accompanied by detailed technical analysis as well as a voluntary cooperative effort of the landowner.

Site Verification

None of the sites included within this inventory have been field checked during the process of this study. Some of the sites have been field checked in the course of other studies and therefore their viability is stronger; however, all of these sites will require field verification to establish the feasibility of their restoration potential.

Mapping

Following is the legend for the individual estuary maps. Note that there is a graphic distinction between sites which visually appear to have greater potential for mitigation success vs. diked agricultural lands. In addition, both the Oregon Estuary Plan (OREP) and the Grays Harbor Estuary Management Plan (GHEMP) contain previously identified mitigation sites which are included within this report.

LEGEND:

= Potential Restoration and Mitigation Sites

= Diked Agricultural Land

••••• = Dike

= Preidentified Mitigation Sites per OREP or GHEMP as appropriate

M-1 = MIT-1 per OREP or Reference Number per GHEMP

a = Text Reference Letter

Chapter 2

OREGON SITES

An extensive review of Oregon's estuaries has been undertaken by the Oregon Department of Land Conservation and Development (DLCD); it is contained within the publication, "The Oregon Estuary Plan Book", (OREP), completed in 1987. This publication was a significant source of data for the restoration sites contained within this inventory as it contained a detailed mapping of the diked lands within each estuary.

The Oregon Estuary Plan was developed as a comprehensive long range planning tool for Oregon's estuaries. It contains the 17 largest estuaries in the state and provides detailed habitat and zoning maps for each.

The habitat maps are based on the 1979 Oregon Department of Fish and Wildlife (ODFW) classification of the habitats of the major estuaries of the state. These maps provide not only detailed habitat classification, but they also note which areas have been diked.

The ODFW habitat maps also include potential mitigation sites within many of the estuaries. These mitigation sites were identified by a process that involved the ODFW working with Federal agencies such as USFWS, EPA, and other relevant State agencies to develop a list of potential mitigation sites for each estuary.

Through the community planning process, potential mitigation sites were designated from the agency-generated lists. The potential sites identified within the OREP are biologically sound, as well as politically feasible, and should be considered as the prime potential mitigation sites for each estuary. The amount of detailed analysis which went into identifying those areas in the comprehensive long range planning process far exceeds the scope of this study.

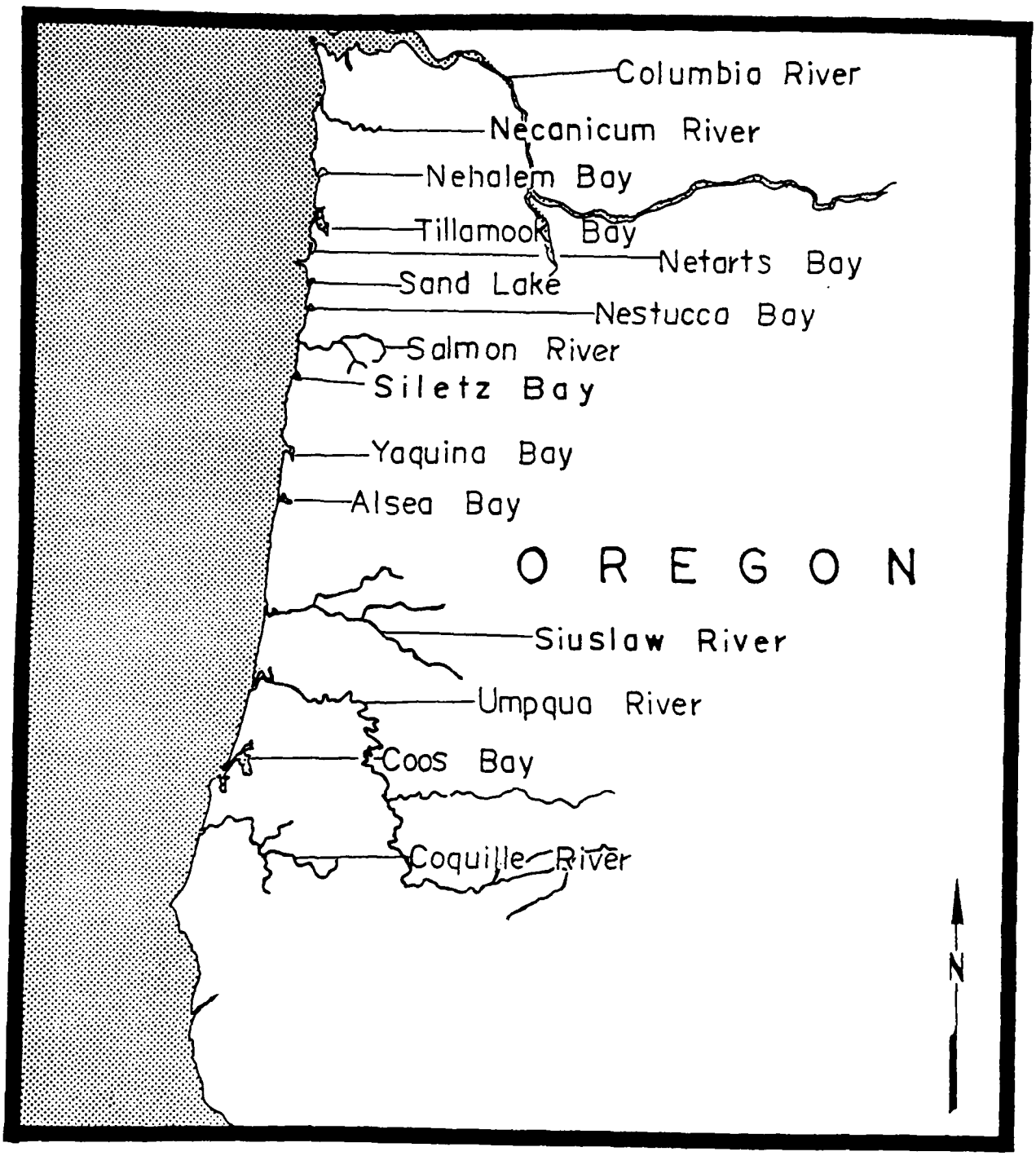
This report includes sites beyond those identified by the OREP process based on an evaluation of the NWI maps, the OREP maps, and aerial photographs. No future use of these additional sites is implied by their inclusion in this inventory.

Within the Oregon Estuary Plan (OREP), the identified mitigation sites are labeled, e.g., MIT1 (4); within the mapping for this report the site is labeled M-4. The number in parenthesis is the reference number for the mitigation site. The text associated with the list of OREP mitigation sites for each estuary is directly quoted from the OREP, therefore the notation "not mapped" means that the area was

not mapped in the source document, the OREP. The photomosaic reference refers to the color photomosaics on file at the Portland office of the Corps of Engineers.

Following are the sites as mapped with their accompanying descriptions. The letter notations on the maps refer to the areas specified in the text.

Site	Quad:
1) Necanicum River	Gearhart, Cannon Beach
2) Nehalem Bay	Newhalem
3) Tillamook River	Newhalem, Tillamook
4) Netarts River	Tillamook
5) Sand Lake	Tillamook
6) Nestucca Bay	Hebo
7) Salmon River	Hebo
8) Siletz Bay	Cape Foulweather, Euchre Mt.
9) Yaquina Bay	Yaquina, Toledo
10) Alsea Bay	Waldport
11) Suislaw River	Siltcoos Lake, Heceta Head
12) Umpqua River	Reedsport, Winchester Bay
13) Coos Bay	Charleston, Empire, Coos Bay, North Bend
14) Coquille River	Bandon, Bullard, Riverton



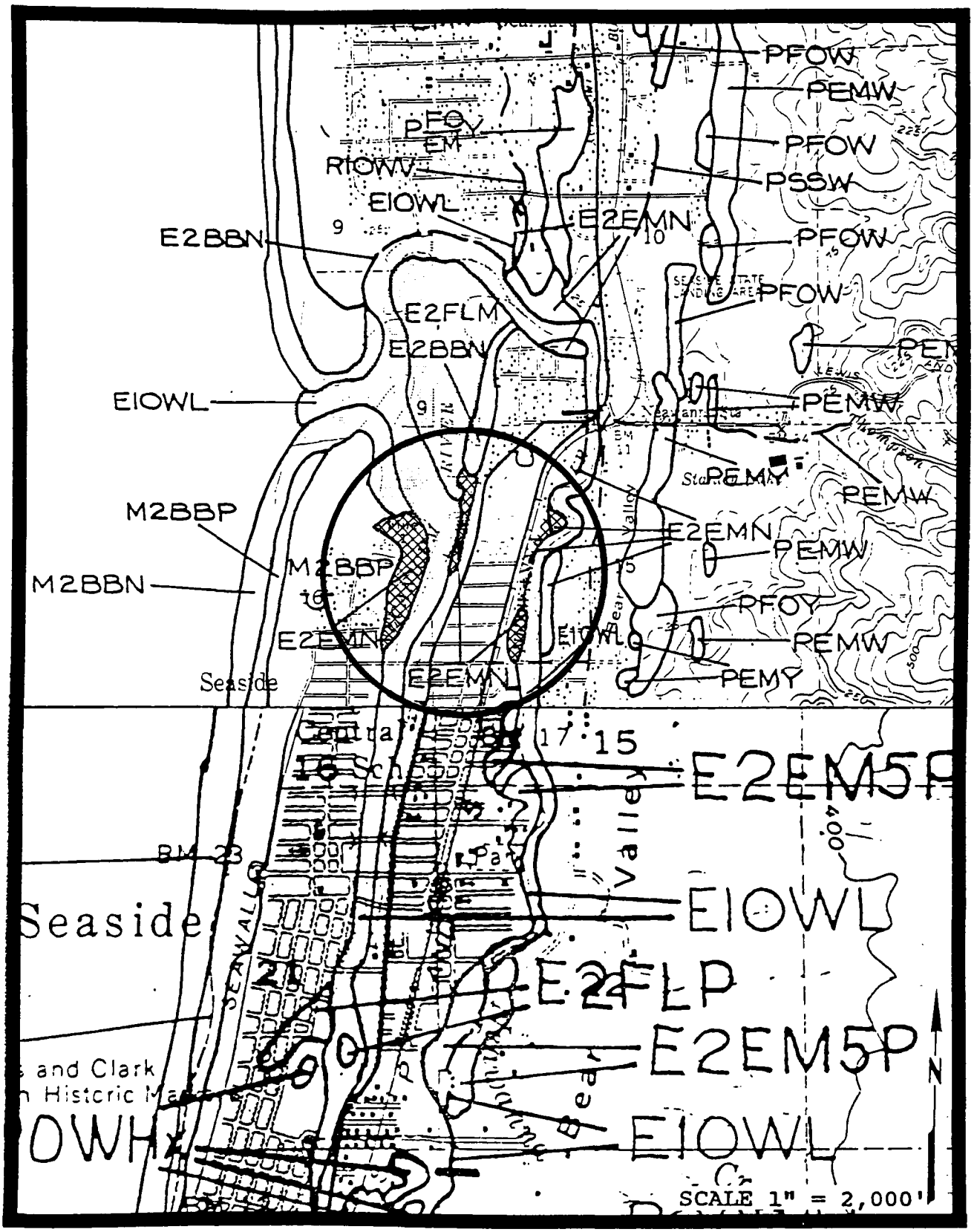
OREGON LOCATION MAP

1) NECANICUM RIVER

USGS Quads: CANNON BEACH, 15'
GEARHART, 7.5'
COE Photomosaic: 1"=1,000'

No potential restoration sites were identified in the OREP. Only two small diked areas are mapped, neither of them are utilized for agricultural purposes. Predominant impacts within the estuary are from residential development. Potential mitigation sites occur along the eastern shoreline of the distributary channel, or potentially at the north end, west side and east side of main channel. It is difficult to discern from the aerials if any of these areas are either pasture or diked. Restoration could be limited to increasing vegetation species diversity or reducing or eliminating human and domestic animal intrusion impacts.

Tidal reach is approximately 3.0 miles from the mouth of the river (Percy, 1974).



1) NECANICUM RIVER, OREGON

2) NEHALEM BAY

USGS Quad: NEHALEM, 15'
COE Photomosaic: 1"=2,000'

The USGS quad does not indicate any diking; neither does the NWI mapping; and the COE photo is not clear enough to show the presence of dikes. The OREP indicates 5 different mitigation sites, most of which refer to breaching dikes which are not mapped on the available data.

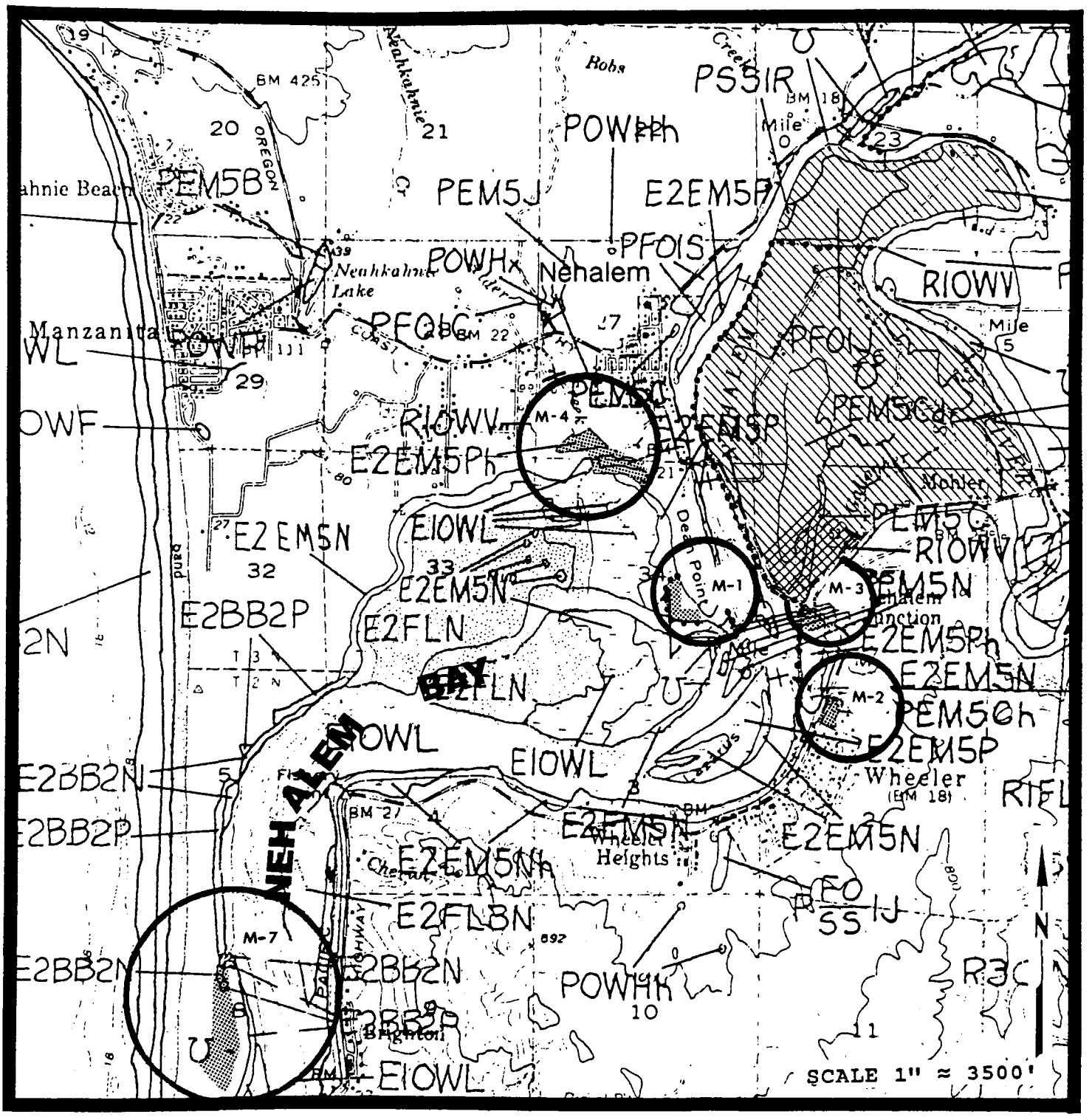
The area interior to the major south bend of the river is currently under cultivation. The only potential restoration sites occur at the southern end of this agricultural lobe where the former tidal channels still enter. Pastures along the former sloughs appear saturated and show a diversity of vegetation not present in the more well drained portions of these fields.

Tidal effects extend approximately to mile 8.6 of the Nehalem River and to mile 4.7 of the North Fork Nehalem River (Percy, 1974).

To the west of the OREP MIT1(4) site, another small slough exists; the potential exists to return it to tidal influence.

<u>Oregon Estuary Plan Mitigation Sites</u>

MIT 1	Dean Point: breach dike, create high marsh; 10.0 acres.
MIT 2	Wheeler: breach dike, create high marsh; 4.2 and 8.0 acres.
MIT 3	MCCoy's Marsh: breach dike, create high marsh; 5.8 acres.
MIT 4	Alder Creek: remove tidegate, regrade pasture; create intertidal marsh; 38.3 acres.
MIT 7	Nehalem Spit: grade and remove logs at mouth of inlet to increase tidal flows; 22 acres.



2) NEHALEM BAY, OREGON

3) TILLAMOOK RIVER USGS Quads: NEHALEM, 15'
TILLAMOOK, 15'
COE Photomosaic: 1"=2,000'

a) Biggs Cove: The southeast end of the cove, west of the spit is mapped as a freshwater lacustrine system by the NWI. It is completely diked from tidal influence. The dikes could be removed or breached to allow tidal influence to be restored. The OREP identifies MIT (7) adjacent to the north on Bayocean Spit with the notation to grade a portion of the spit to create an intertidal flat. Site is over 30 acres in size.

b) Larson Cove: The aerial indicates only one narrow channel. The channel opening could be broadened to increase tidal influence. There is no agricultural use present. Site is less than 15 acres in size.

c) Miami Cove: area is mapped as OREP MIT(1) with a note to breach the dike to restore tidal influence. The aerial photo indicates the area is agricultural, it appears to be pasture. Site is less than 30 acres in size.

d) Area in southeast section of the Bay: It is mapped by OREP as a freshwater forested wetland, however the aerial does not indicate this clearly. The area behind the dike appears to be a mosaic of emergent and scrub/shrub wetland containing old channel remnants. It appears to provide restoration potential, but it is unknown if it is within saltwater influence. Area is greater than 30 acres in size.

e) Area in southeast section of the Bay, south of (d), above: The northern half of this lobe contains several old slough channels. The vegetation diversity indicates potential saturated conditions within what appears to be a freshwater pasture. It is unknown to what extent the site would come under tidal influence if tide gates or dikes were removed. Area is greater than 50 acres in size.

f) Area in southeast section of the Bay, north of (d), above. This area is not mapped as diked, nor do the aerials indicate levees. It is currently pastured or hayed. It is unknown to what extent it would come under tidal influence if the dikes were removed.

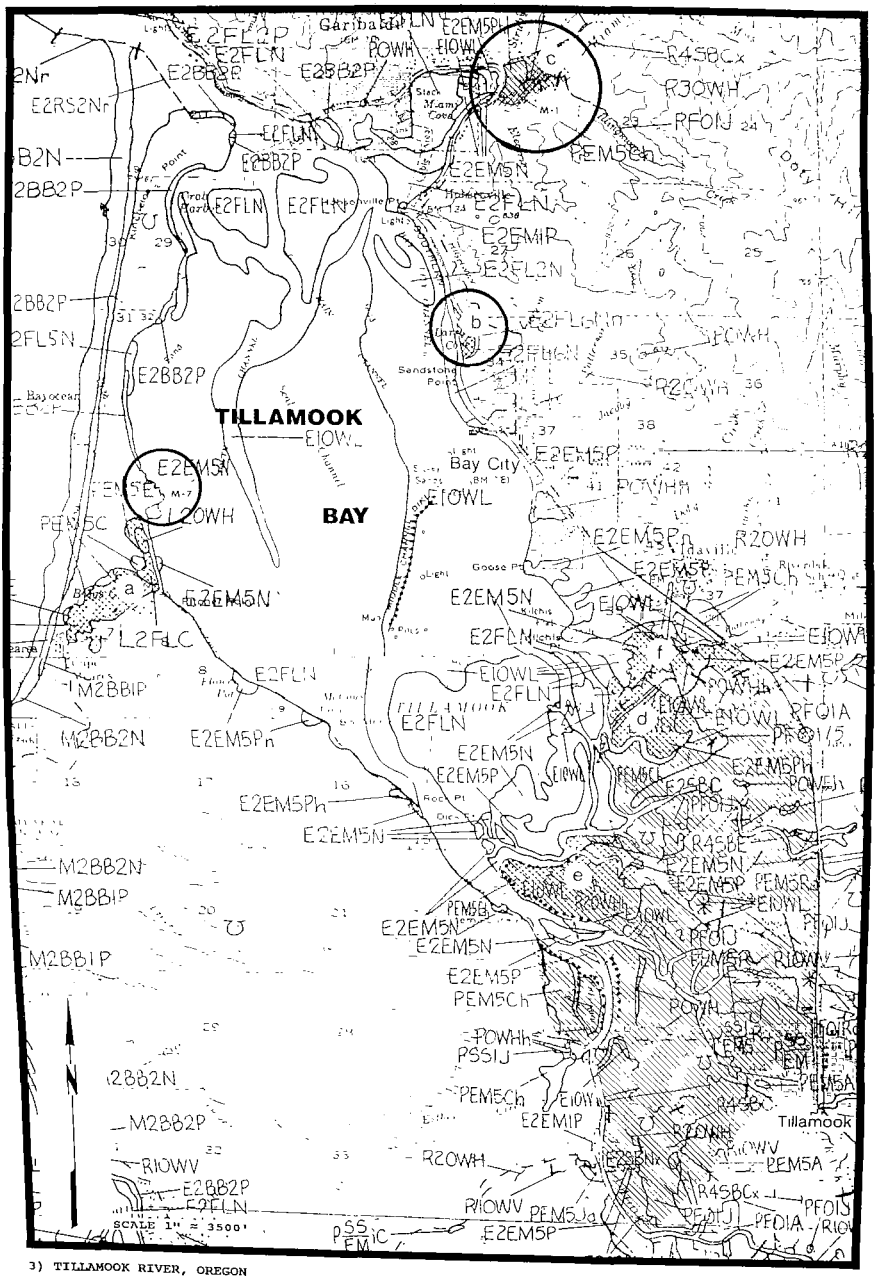
Within the southeast sections of the bay, in the vicinity of areas (d) and (e), above, wetlands are mapped (Hamilton, 1973). All of these areas are now diked and in agricultural use. The 1973 map lacks enough detail to provide even approximate acreage figures.

Tidal effects extend approximately to mile 1.3 of the Kilchis River, mile 0.4 of the Miami River, mile 7.0 of the Tillamook River, mile 4.2 of the Trask River, and mile 2.4 of the Wilson River (Percy, 1974).

<u>Oregon Estuary Plan Mitigation Sites</u>

MIT 1 Miami Cove: breach dike, create high intertidal marsh; 17 acres.

MIT 7 Bayocean Spit: grade to create intertidal flat; 25 acres.



3) TILLAMOOK RIVER, OREGON

4) NETARTS BAY

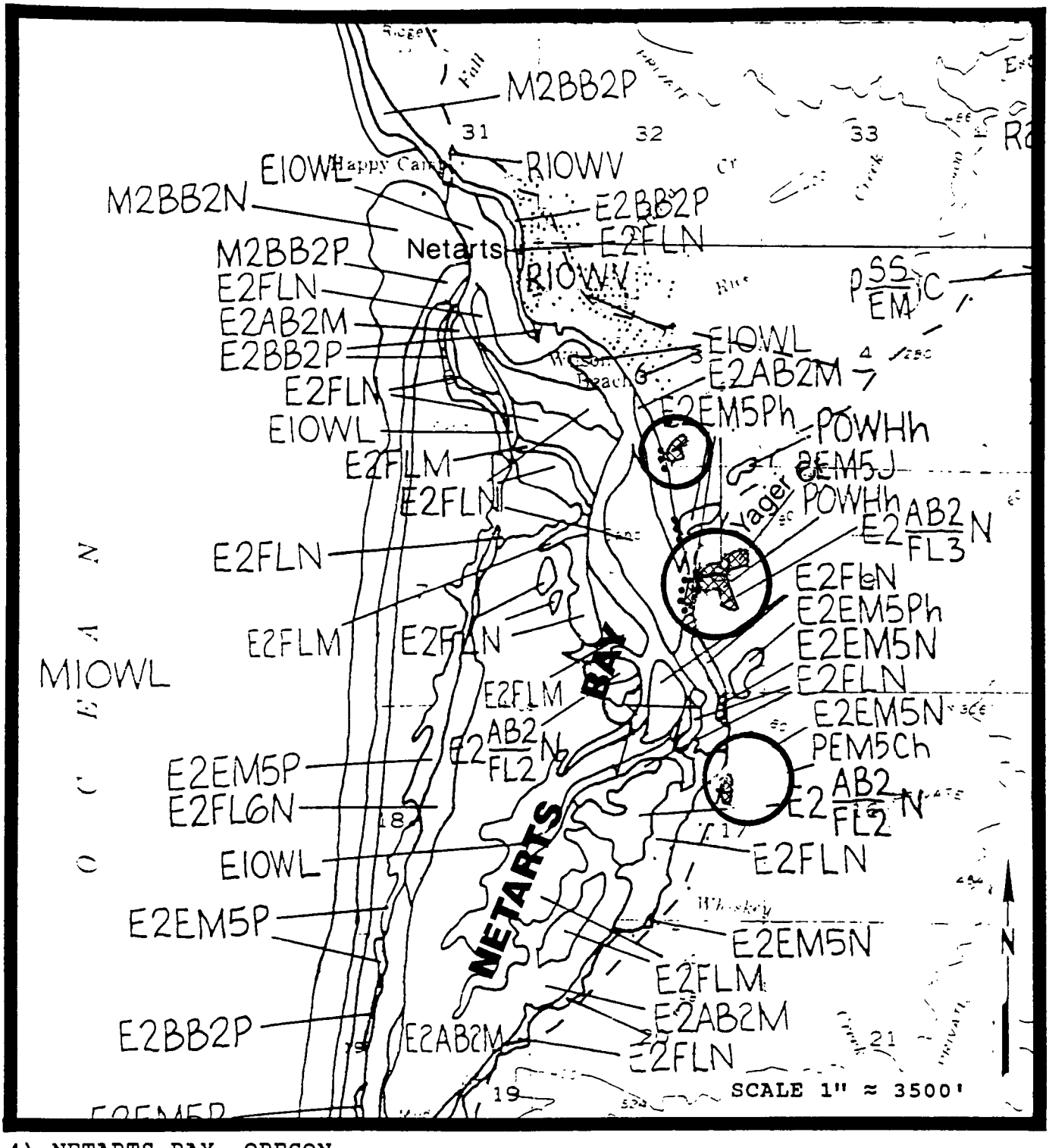
USGS Quad: TILLAMOOK, 15'
COE Photomosaic: 1"=1,000'
(note: photo is 1978)

The OREP indicates several diked areas in the northern half of the bay, along the east shore. The most northern of them is mapped by the NWI as estuarine, and the aerial indicates a vegetation community which does not appear to be diked. Perhaps the dikes are in disrepair or tide gates are not functioning. Field work would be required to verify whether this is a potential restoration site. Site may be less than 5 acres in size.

The area immediately surrounding Yager Creek may provide potential restoration sites. NWI maps the area as both estuarine and palustrine, while the OREP maps it as estuarine only. Tidal influence could be restored or expanded in this area. The aerial indicates a diversity of emergent vegetation within the area. The area is also dissected by several roadways which may influence hydrology. This area is approximately 10 acres in size.

The most southern mapped area is identified as palustrine in the NWI and estuarine in the OREP. The aerial indicates old channels are present, which would aid in restoring or expanding tidal influence. Site may be less than 5 acres in size.

The OREP does not indicate any mitigation sites within this estuary. No upstream limit of tidal effects was listed.



4) NETARTS BAY, OREGON

5) SAND LAKE

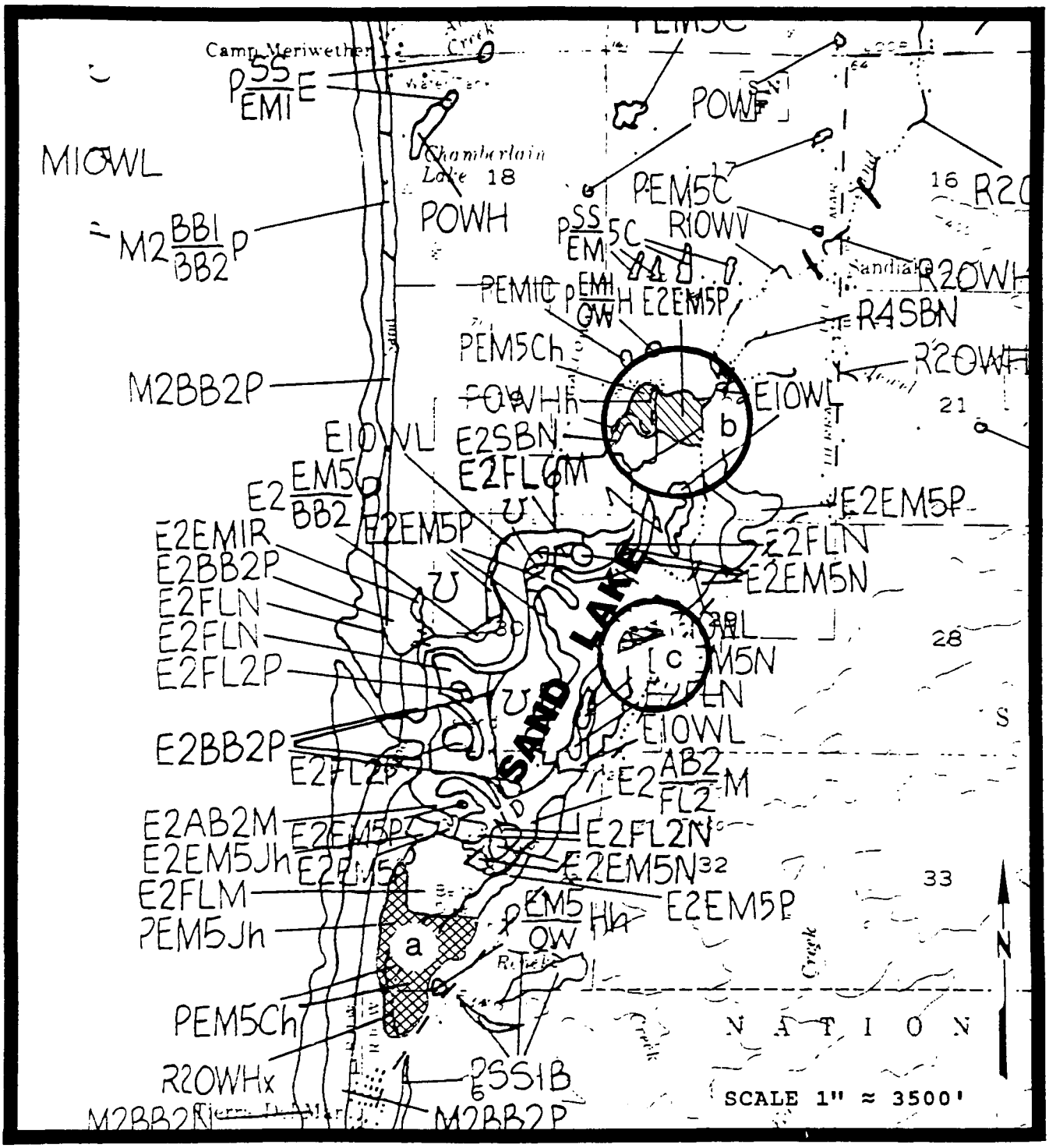
USGS Quad: TILLAMOOK, 15'
COE Photomosaic: 1"=1,000'
(note: 1978 photo)

a) Sand Lake South: The entire area at the south end of Sand Lake is diked and is now a freshwater wetland. Removing the dikes would restore the area to tidal influence. It is noted in the OREP as a special habitat feature as Beltz Farm freshwater wetland.

b) North end of Sand Lake: These areas are mapped as diked per the OREP; however, review of the 1978 aerial photomosaic does not indicate the presence of dikes. The areas may currently be used for pasture in the northern reaches; however, the vegetation within the southern end has the same patterns as that within the area mapped as low salt marsh to the south. Field review would be required to verify the existing vegetation on this site and its potential as a restoration site.

c) East shore, directly east of the mouth of the bay. The 1978 aerial indicates active pasture use out into the estuary; however, no dikes are discernable. If the agricultural use was curtailed, the estuary would likely restore itself.

No OREP mitigation sites were listed for this estuary.



5) SAND LAKE, OREGON

6) NESTUCCA BAY USGS Quad: HEBO, 15'
COE Photomosaic: 1"=2,000'

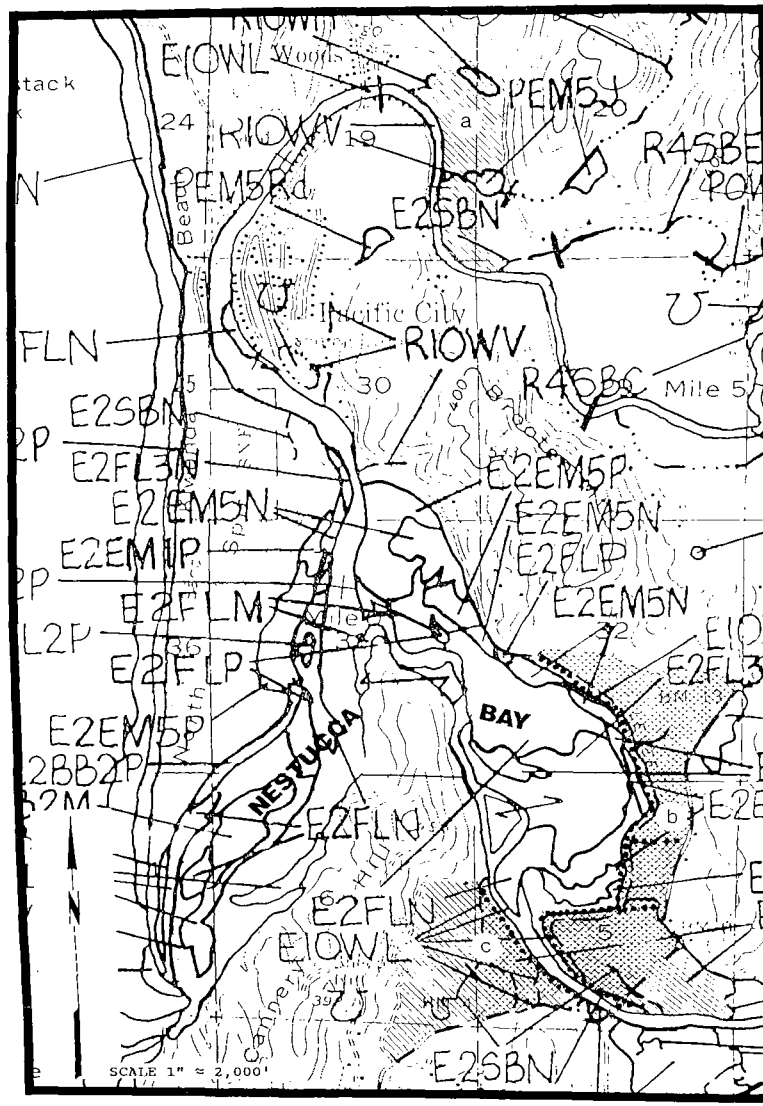
a) Nestucca River I: The area is mapped as an unspecified type of tidal marsh in the OREP; however, it may be beyond tidal influence for the re-establishment of estuarine vegetation. The area south of the river is not appropriate for restoration as there are residences present.

From review of the aerial photographs it is clear that the north shore of the river is currently used for agricultural purposes. No dikes or tide gates are mapped, but the presence of the agricultural use implies the dikes are present. Area is greater than 50 acres in size.

b) Nestucca River II: This is a large area which has been diked. The 1986 aerial photomosaics indicate that the area is currently used for hay production or actively pastured. Old sloughs and channels are present. A diversity of emergent vegetation occurs along the channel margins. Removal of the levees would return the area to tidal influence. Area is greater than 150 acres in size.

c) South end of the bay, west of the Little Nestucca River: The 1986 photomosaics indicate vegetation which appears to reflect saturated conditions. The area appears to be utilized as pasture. Removal of the levees would return at least a portion of the area to tidal influence. Area is greater than 100 acres in size.

Tidal effects extend approximately to mile 7.0 of the Nestucca River and to mile 3.1 of the Little Nestucca River (Percy, 1974). No OREP mitigation sites were listed for this estuary.



6) NESTUCCA BAY, OREGON

7) SALMON RIVER USGS Quad: HEBO, 15'
COE Photomosaic: 1"=1,000'

a) The far east end of the bay, northwest of Highway 101: It is currently diked and utilized for either pasture or hay. There are old channels present. The 1973 mapping (Hamilton, 1973) indicates that the area was wetland. Removal of the dikes would restore tidal influence. Site is greater than 50 acres in size.

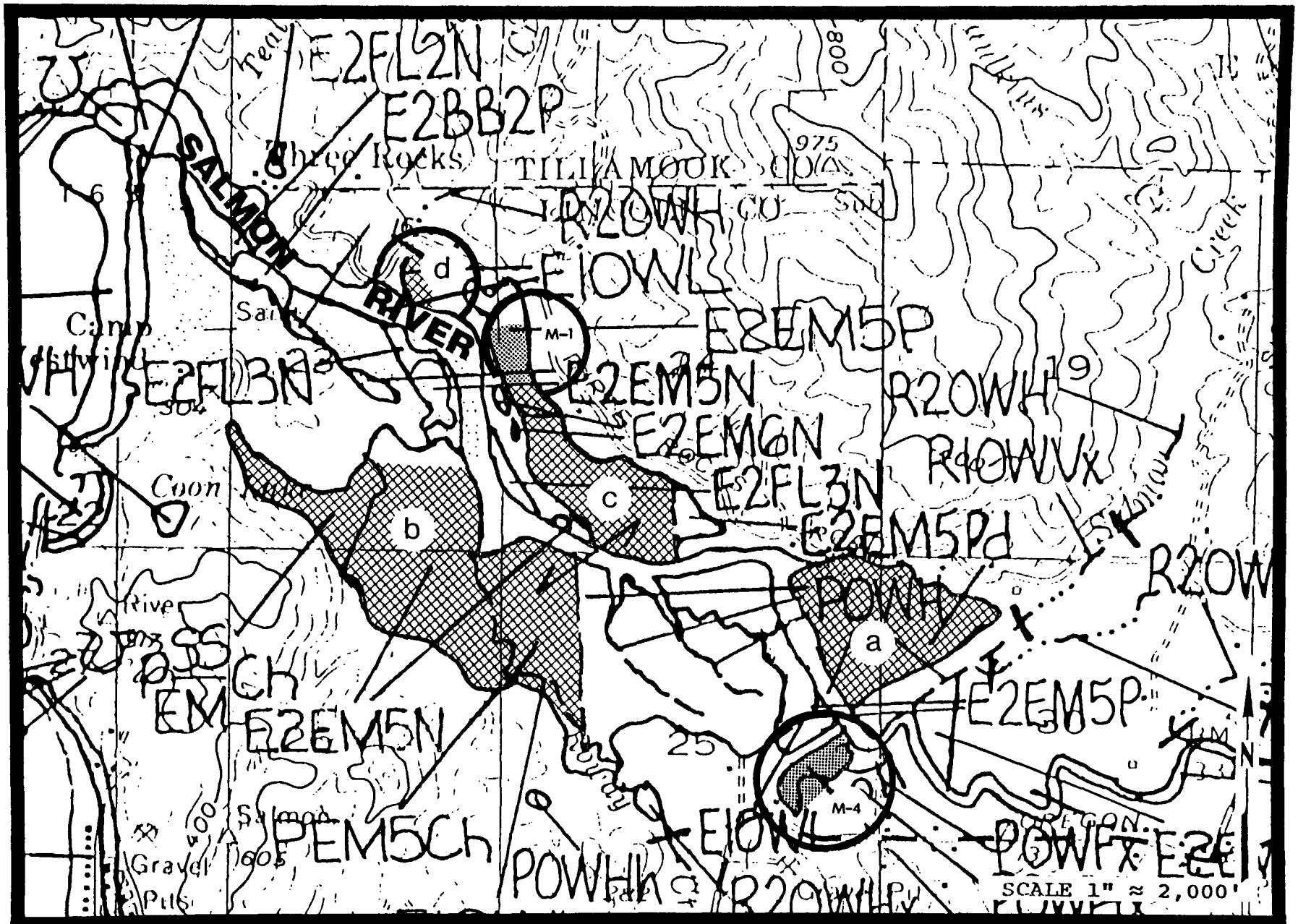
b) The southwest side of the river: This area is adjacent to a slough which is diked and possibly has tide gates as well. Removal of the levees and the tide gates would restore tidal influence and allow the expansion of the estuarine vegetation. This area may currently be used for agricultural purposes. Site is potentially greater than 100 acres in size.

c) East of the river, along the north shoreline: Review of the 1986 photomosaic indicates that the levees are in disrepair which has allowed a diversity of vegetation to establish. Removal of the levees would restore tidal influence. Site is approximately 50 acres in size.

d) Northwest of (c) above: The OREP indicates that the area is diked. The aerial photomosaic is unclear as to existing use. Field review would be required to establish whether this would provide a potential restoration site. Site would be less than 20 acres in size.

<u>Oregon Estuarine Plan Mitigation Sites</u>

MIT 1	Boat Ramp: remove dike; 9.5 acres.
MIT 4	U. S. 101: remove dike; 30 acres.



7) SALMON RIVER, OREGON

8) SILETZ BAY

USGS Quad: CAPE FOULWEATHER 15'
EUCHRE MOUNTAIN, 15'
COE Photomosaic: 1"=2,000'

a) East of Culter City: An extensive slough remains on the east of the highway which crosses the mouth of the slough. The aerials of the pastures indicate continuing saturation and no active cultivation. Current use may be for hay production or grazing pastures. The southern end appears to be scrub/shrub. Removal of the dikes would further restore tidal influence. Site is greater than 100 acres in size.

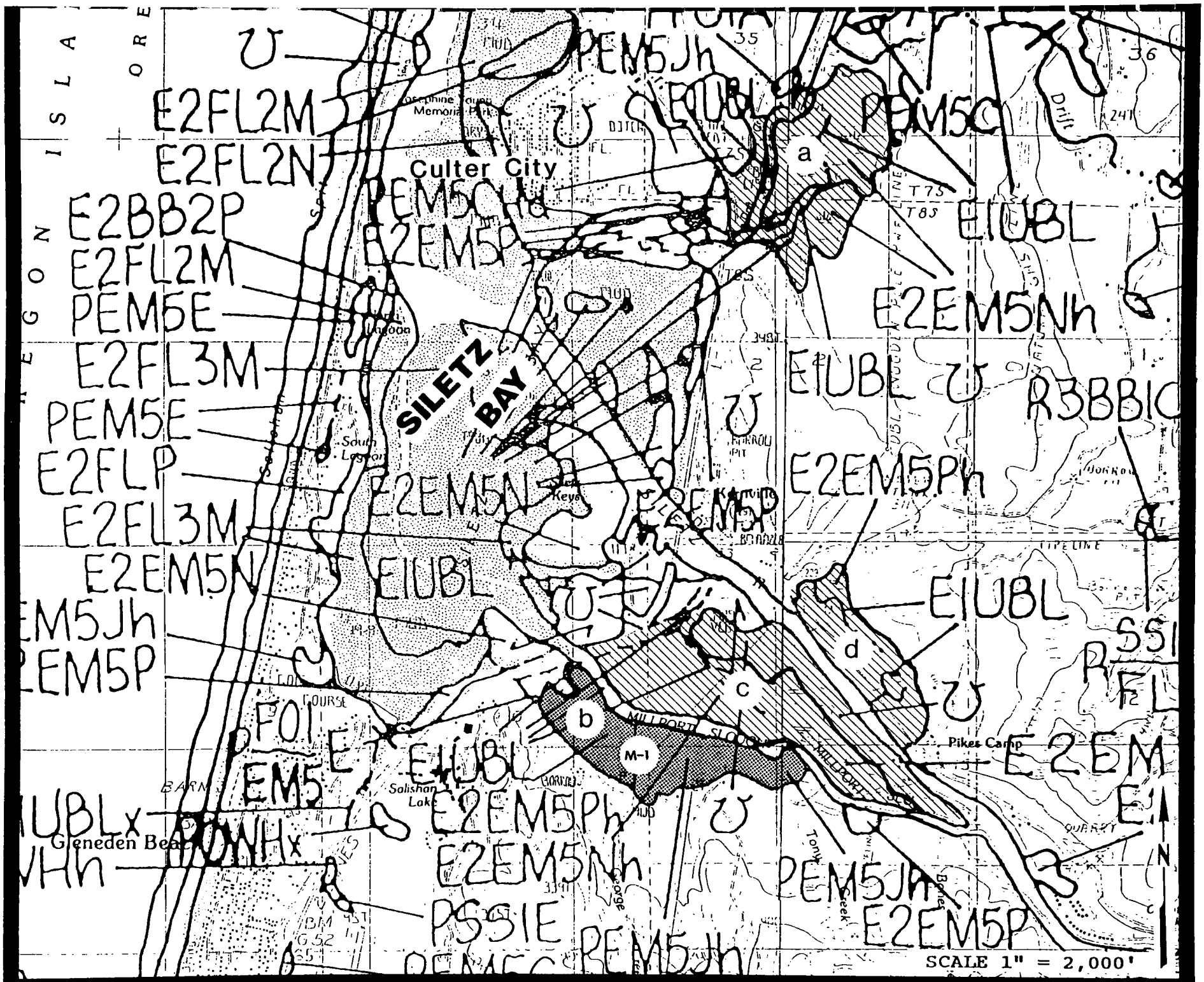
b) Diked area southwest of Millport Slough: The western quarter of it is currently not in use for pasture, the eastern three-quarters of it is active pasture or hay fields. The OREP maps this area as a marsh habitat and as MIT(1). The mitigation notes call to remove the tide gate at the west end and the dikes at the east end. It is unknown how far upstream on Millport Slough the tidal influence would extend. Area is 115 acres in size.

c) Between Millport Slough and the main river channel: It is diked and is currently in active use for pasture. There remains old slough channels within the area; tidal influence would be restored if the dikes and tide gates were removed. Area is more than 150 acres in size.

d) Area northeast of the main river channel, east of a secondary roadway: A substantial area is mapped as diked in the OREP; however, only the northern half of it is noted as marsh habitat. The aerial photomosaics are unclear, but the area appears to be currently used for pasture. If tidal influence was restored under the roadway, the area would be within tidal influence of the bay. Area is potentially almost 100 acres in size.

<u>Oregon Estuary Plan Mitigation Sites</u>

MIT 1 Millport Slough/ Habitat 22: remove tide gate at west end and remove or breach dikes at the east end; 115 acres.



) SILETZ BAY, OREGON

9) YAQUINA BAY

USGS Quads: YAQUINA, 15'
TOLEDO, 15'
COE Photomosaic: 1"=2,000'

a) Boone and Nute Sloughs. Both of these sloughs have tide gates and the lands within are diked. Land use within the diked area is predominantly agricultural, much of it active cultivation. Removal of the tide gates and the dikes would restore the area to tidal influence. Per the OREP the potential area for restoration is 600 acres.

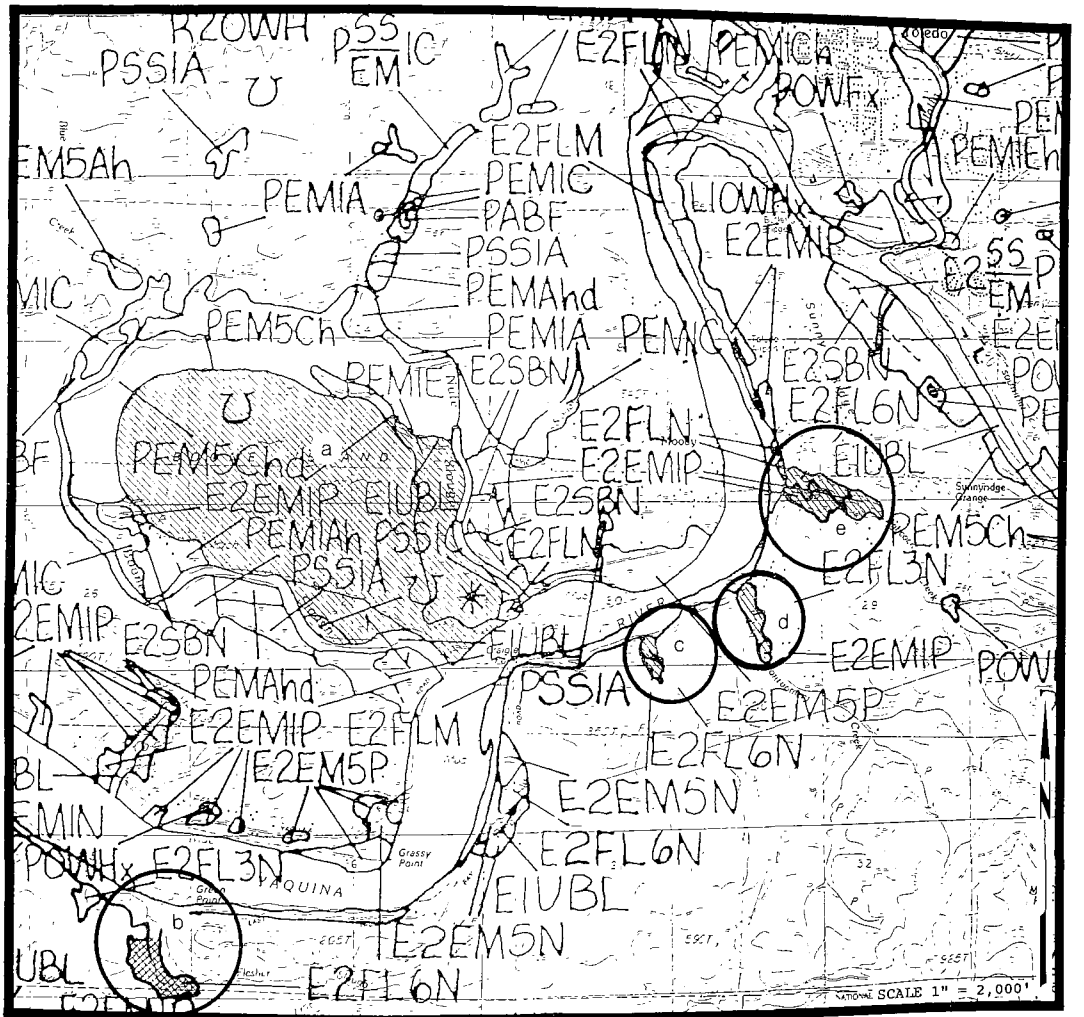
b-e) Small diked sloughs along the south side of the river: Flesher Slough, (b), appears to be in pasture use. The other areas are vegetated with variable vegetation communities; some appear to be scrub/shrub systems. The two areas furthest east, (d) and (e), have adjacent residences, so field verification would be required to assess their restoration potential. Removal of tide gates or dikes on each of these small sloughs would likely restore them to tidal influence.

The Oregon Estuarine Plan book does not map any of the mitigation sites for Yaquina Bay; however, they do provide the following notes in the appendix:

<u>Oregon Estuary Plan Mitigation Sites</u>

MIT 13	Publishers Slough: create additional breaches or remove dike.
MIT 15	Flesher Slough: bridge or increase culvert size; 15 acres.
MIT 2	Huss Property: remove tidegate; 3 acres.
MIT 3	Blackberry Hill: enlarge culvert; 3 acres.
MIT 4	Reinoehl Trout Hatchery: enlarge culvert or install bridge; 2.5 acres.
MIT 5	Sherman Property: enlarge culvert; 2 acres.
MIT 6/7	Lower Boone's and Nute's Sloughs: remove dikes; 600 acres.

Tidal effect extends to approximately mile 26 of the Yaquina River (Percy, 1974).



9) YAQUINA BAY, OREGON

10) ALSEA BAY

USGS Quad: WALPORT
(note: no NWI map in file)
COE Photomosaic: 1"=2,000'

a) Lint Slough: This is an impounded freshwater lake created from diking of the former slough. The OREP notes the northern 11 acre section as a mitigation site with the note to remove the dam and tidegate. To the south of the 11 acres there is another much larger impounded lake (25+ acres) created out of the former slough. Removal of the dikes could restore the entire area to tidal influence.

b) Eckman Slough: This is another impounded coastal lake. The area impounded behind the road is approximately 70 acres. If dams were removed or culverts under the road installed, this area could be restored to tidal influence.

c) Two diked pastures: These two areas are located in the eastern reach of the bay and are noted as diked high salt marsh in the OREP. The aerial indicates that the areas may currently be utilized for pasture. Removal of the dikes and termination of the agricultural use would allow the re-establishment of estuarine vegetation.

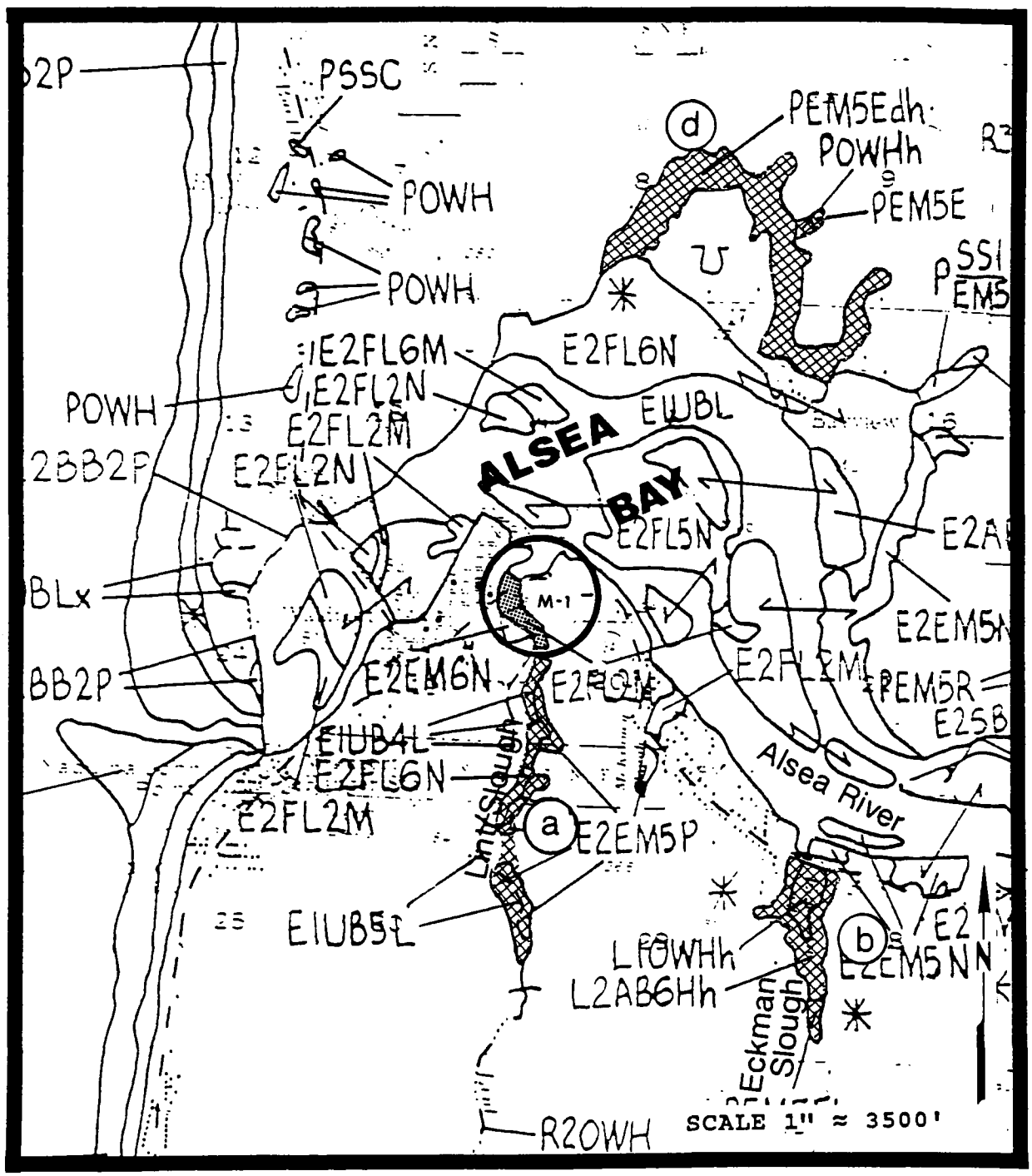
d) North end of bay: Review of the aerial photomosaic indicates an old meander channel in this area which appears to be partially emergent wetland and partially within active agricultural use. It is not possible to determine without field verification whether this area actually is wetland and whether it could be restored to tidal influence. It may be that the former channel mouths are now at an elevation which puts them above tidal influence. Site is potentially over 50 acres in size.

Tidal effects extend approximately to mile 16 of the Alsea River and mile 5.5 of Drift Creek (Percy, 1974).

<u>Oregon Estuary Plan Mitigation Sites</u>

MIT 1 Lint Slough - remove dam and tidegate; 11.4 acres.

MIT 5 Barclay Meadows - remove or breach dikes; 70 acres (not mapped by OREP).



10) ALSEA BAY, OREGON

11) SIUSLAW RIVER

USGS Quads: SILTCOOS LAKE, 15'
HECETA HEAD, 15'
COE Photomosaic: 1"=2,000'

a) North Fork Slough: The North Fork is noted as tidal to river mile 6.9 (Percy, 1974). It is diked on both banks for several miles from Siuslaw Bay. These mapped areas are under active agricultural use as pasture; however, they are not cultivated. Removal of the dikes would restore the area to tidal influence. Potential area of nearly 100 acres.

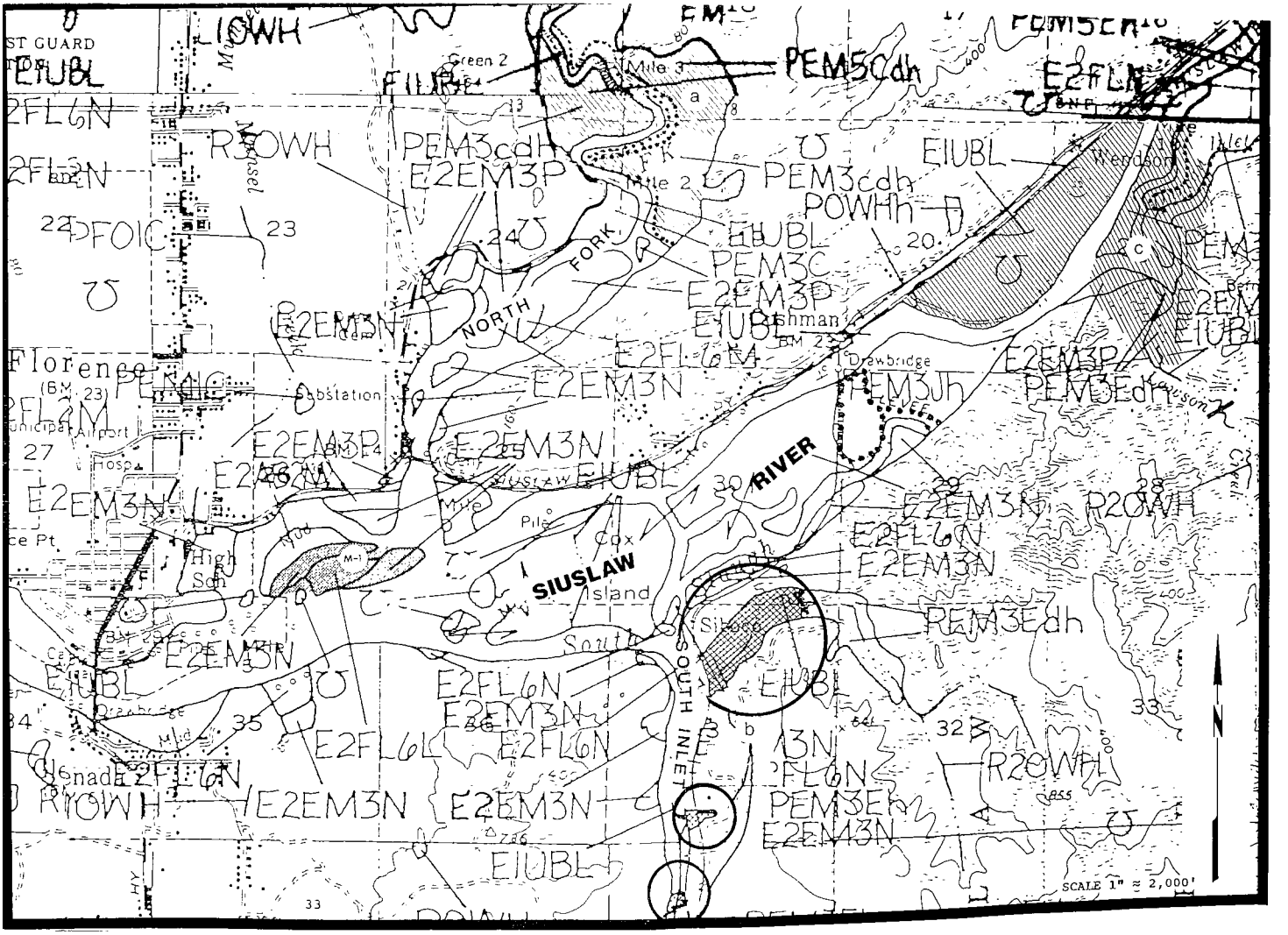
b) South Inlet: The inlet contains several small sloughs which have been diked. It is not possible to determine from the aerial photomosaic if the areas are pasture; however, they would be under tidal influence if the dikes were removed. Each is less than 10 acres.

c) Upriver area: This area contains several areas mapped in the OREP as diked and which appear in the aerials to be pasture lands. The area with the most significant potential is located on the south side of the river in Section 22. It contains a complex system of old channels and sloughs which if the tidal influence was restored, potentially could support a diverse estuarine system. It is unknown to what extent tidal influence would be restored if the dikes were removed from these agricultural lands along the river. Potential area of over 100 acres.

Tidal effects extend approximately to mile 25 of the Siuslaw River and to mile 6.9 of the North Fork Siuslaw River (Percy, 1974).

<u>Oregon Estuary Plan Mitigation Sites</u>

MIT 1 North Fork Islands - remove sand to create intertidal or subtidal environments; 58.0 acres.


SIUSLAW
RIVER
NORTH FORK
SOUTH INLET
Siuslaw Island
Florence
Wendson
Drewbridge
Fishman
Cox Island
Mile 2
Mile 3
Green 2
Substation
Municipal Airport
Hospital
High Sch
Jesse
Mud
Pile
Dunes
Sand
Dreadful
Jenada
Cape
Ice Pt
SCALE 1" ≈ 2,000'
N
PEM5Cdh
PEM3cdh
E2EM3P
POWHh
E1UBL
PEM3C
E2EM3N
E2FL6M
PEM3Jh
PEM3Edh
R2OWH
E2FL6N
E2FL6L
PEM3Eh
R1OWH
PFO1C
E2EM3P
E2EM3N
E1UBL

12) UMPQUA RIVER

USGS Quads: REEDSPORT, 7.5'
WINCHESTER BAY, 7.5'
COE Photomosaic: 1"=3,000'
(infra-red)

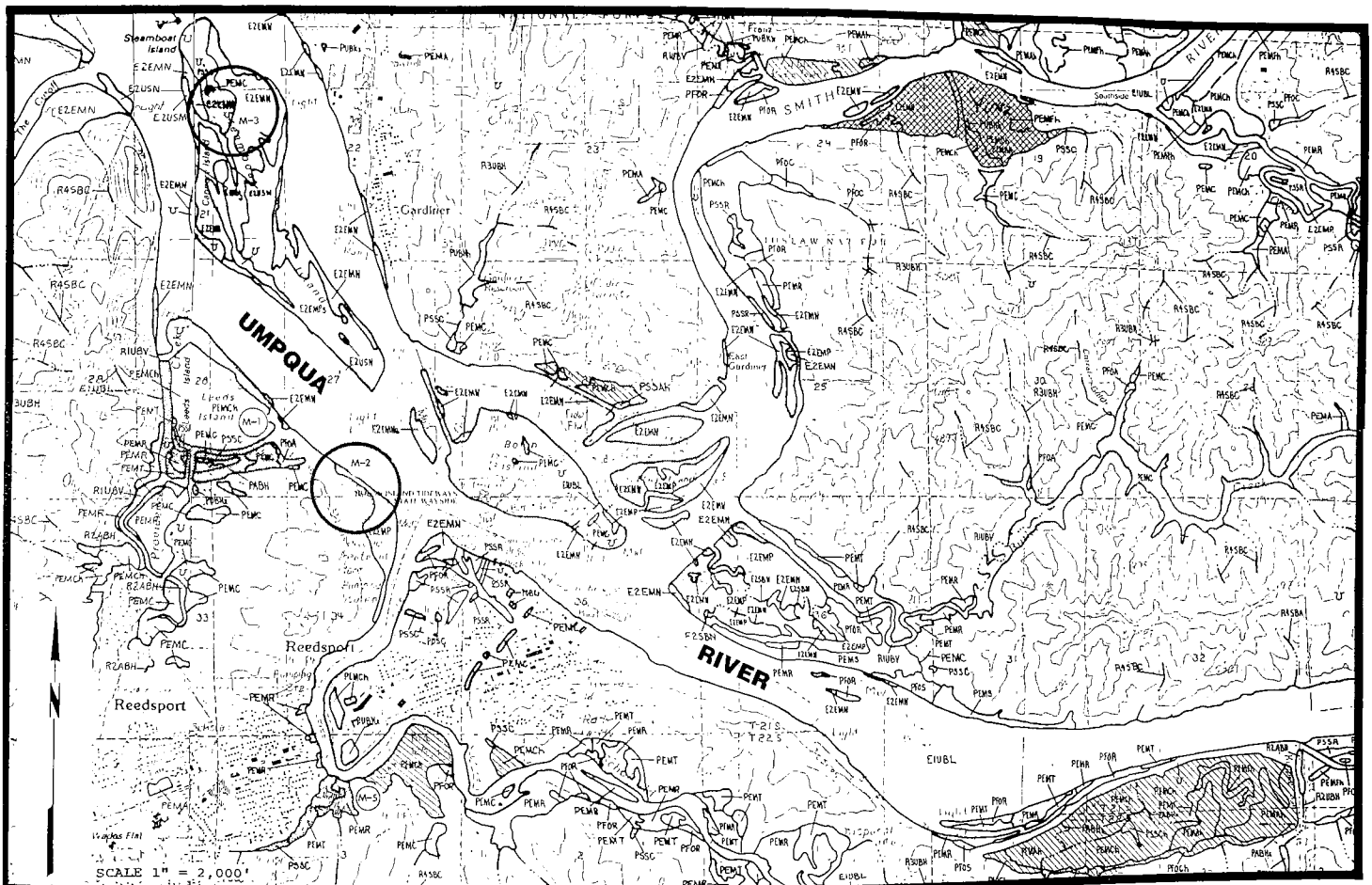
The lower reaches of the river appear to have primarily industrial, log storage and some residential impacts, not those associated with agriculture or other passive uses.

On the south shore of Smith River, west of Otter Slough, there is a wetland system mapped in the OREP as the Franz Creek wetland, Habitat B. The site is also noted as diked, therefore an assumption has been made that this is currently a palustrine system. A review of the aerial indicates an area of equal size and immediately adjacent to Habitat 13 which looks exactly like the vegetation composition within Habitat 13. This entire area would potentially be restored to tidal influence if the dikes were removed.

Tidal effects extend to approximately mile 28 of the Umpqua River (Percy, 1974).

Oregon Estuary Plan Mitigation Sites

MIT 1	Providence Creek - remove tidegates; 55 acres.
MIT 2	West Mouth Scholfield - lower elevation and create tidal channels; 6.3 acres.
MIT 3	Purdy Island - lower elevation and create tidal channels; 3.1 acres.
MIT 4	Scott's Swamp - Install larger culverts or replace dike with causeway; 14.2 acres.
MIT 5	Steamboat Island - move dredge spoils to upland site; 14.5 acres.



12) UMPQUA RIVER, OREGON

13) COOS BAY

USGS Quads: CHARLESTON, 7.5'
COOS BAY, 7.5'
EMPIRE, 7.5'
NORTH BEND, 7.5'
COE Photomosaic: 1"=2,000'

Mitigation sites within the Coos Bay system were identified utilizing the OREP and The Salt Marshes of Coos Bay (Hoffnagle, 1974). A review of the aerial photomosaic and the NWI maps did not reveal any additional potential restoration areas. The OREP and the USGS quads for the Coos Bay region do not indicate the presence of extensive diking within the system, but Hoffnagle (1974) identifies many areas of diked agricultural lands. These areas are indicated in this report as potential restoration sites although much further detailed study would be required to correctly identify feasible restoration sites.

Within the OREP there are 13 mitigation sites referenced in the text. These sites are listed below. However, the maps for Coos Bay identify many more mitigation sites than are listed in the text. The status, composition, and size of these other mitigation sites are unknown. They have been included within this mapping to reflect the detailed analysis that produced the OREP. Further information regarding these sites will have to be generated on a site specific basis by field reconnaisance and/or contact with the appropriate agency staff within the Coos Bay planning district.

Note that due to the size of the Coos Bay system, it has been divided into seven maps as identified on the Coos Bay Location map.

Oregon Estuary Plan Mitigation Sites

MIT L1 Oxford Way Road: Breach or remove dike; 6.0 acres.

MIT L4 Across from Charleston Basin: Remove sand to create marsh beside channel; 5.5 acres.

MIT L5 Lower South Slough: Remove dike; 5.4 acres.

MIT M5 Spoils Islands: Lower elevation to promote tidal flushing; 22.3 acres.

MIT U12 Lilienthal Boom Site: Breach dike and remove tidegates; 36.0 acres.

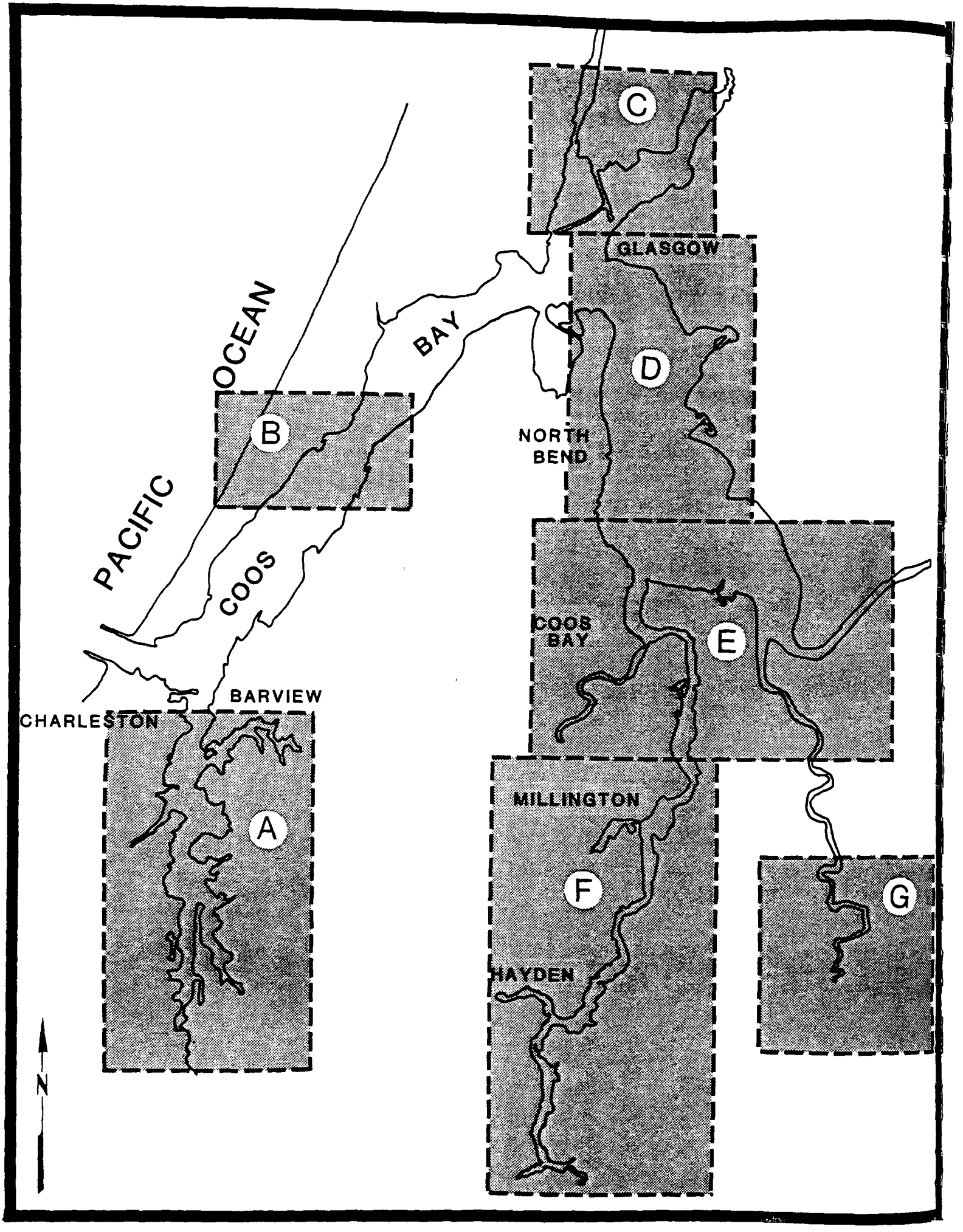
MIT U16A North of Christianson's Ranch: Remove tidegate and breach berm; 3.7 acres.

MIT U30B Sumner Road: Breach dike; 4.8 acres.

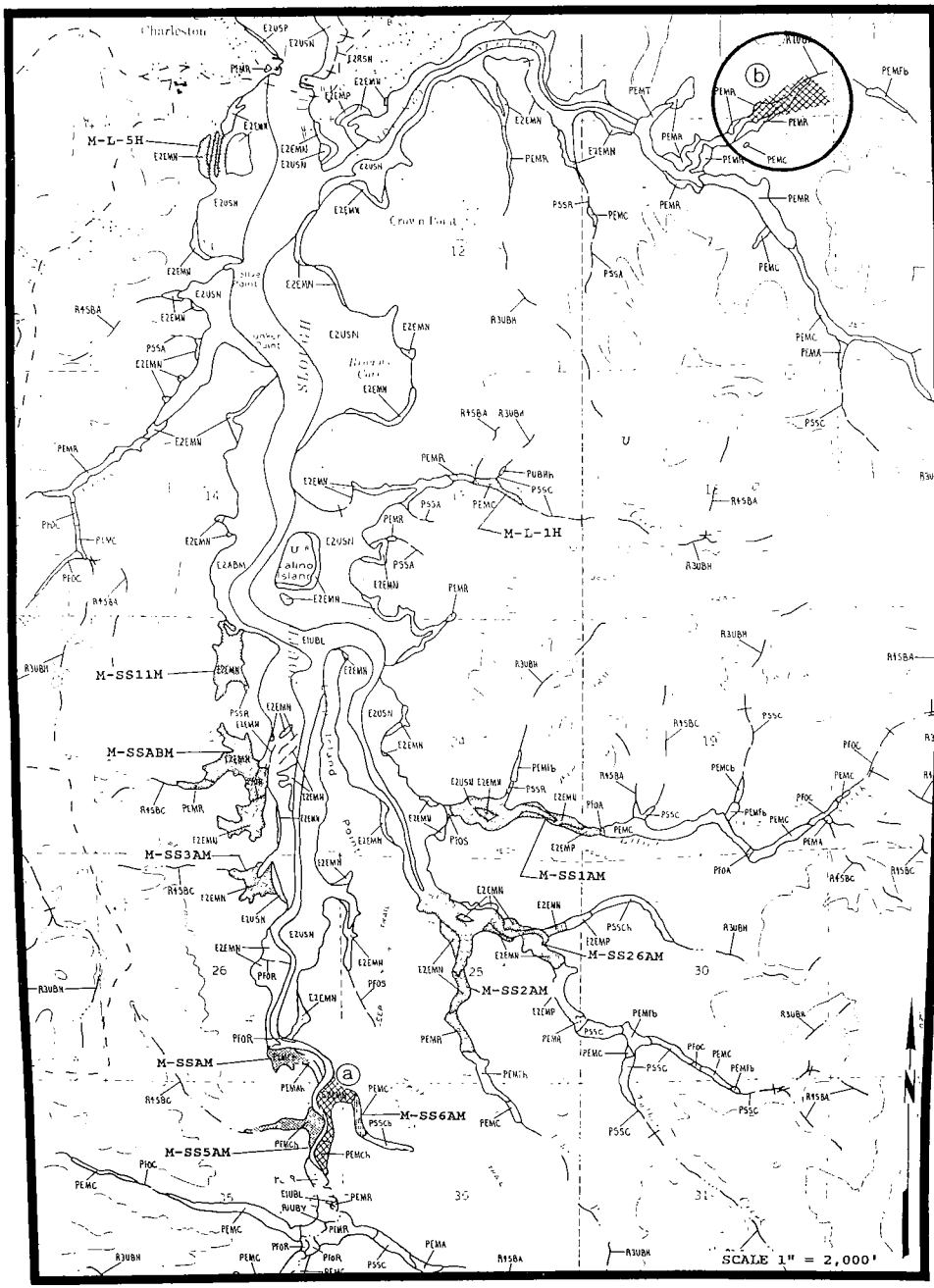
13) COOS BAY (cont'd)

Oregon Estuary Plan Mitigation Sites

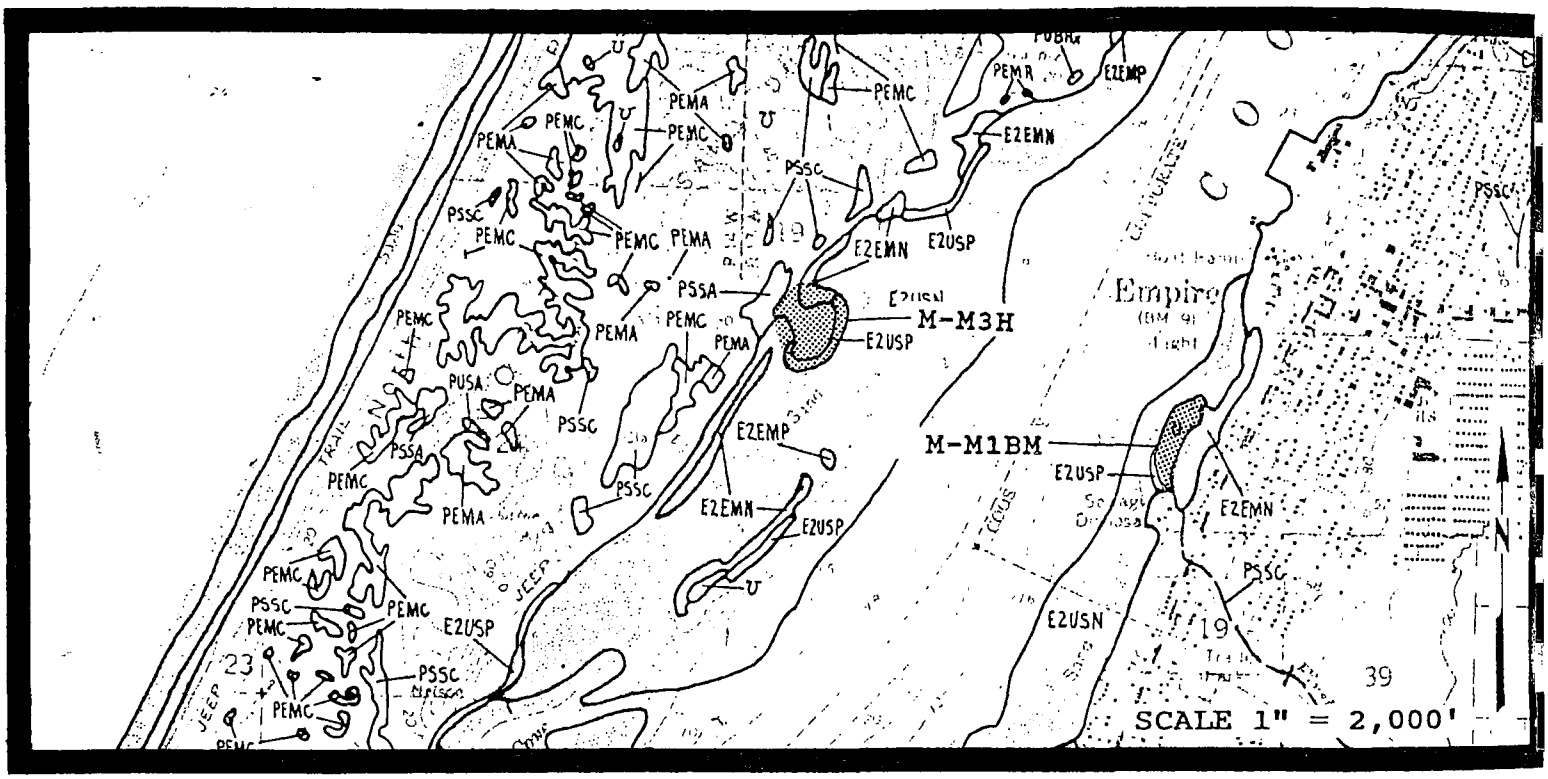
MIT U31	Catching Slough: Enlarge breaches; 2.7 acres.
MIT U44	Isthmus Slough: Remove tidegate and breach berm; 20.0 acres.
MIT U51A	Davis Slough: Breach or remove dikes and/or tidegates; 24.0 acres.
MIT U51B	Davis Slough: Remove tidegates; 16.0 acres.
MIT U59A	Coalbank Slough: Replace or add culvert; 25.0 acres.
MIT U59B	Coalbank Slough: Breach berm; 35.0 acres.



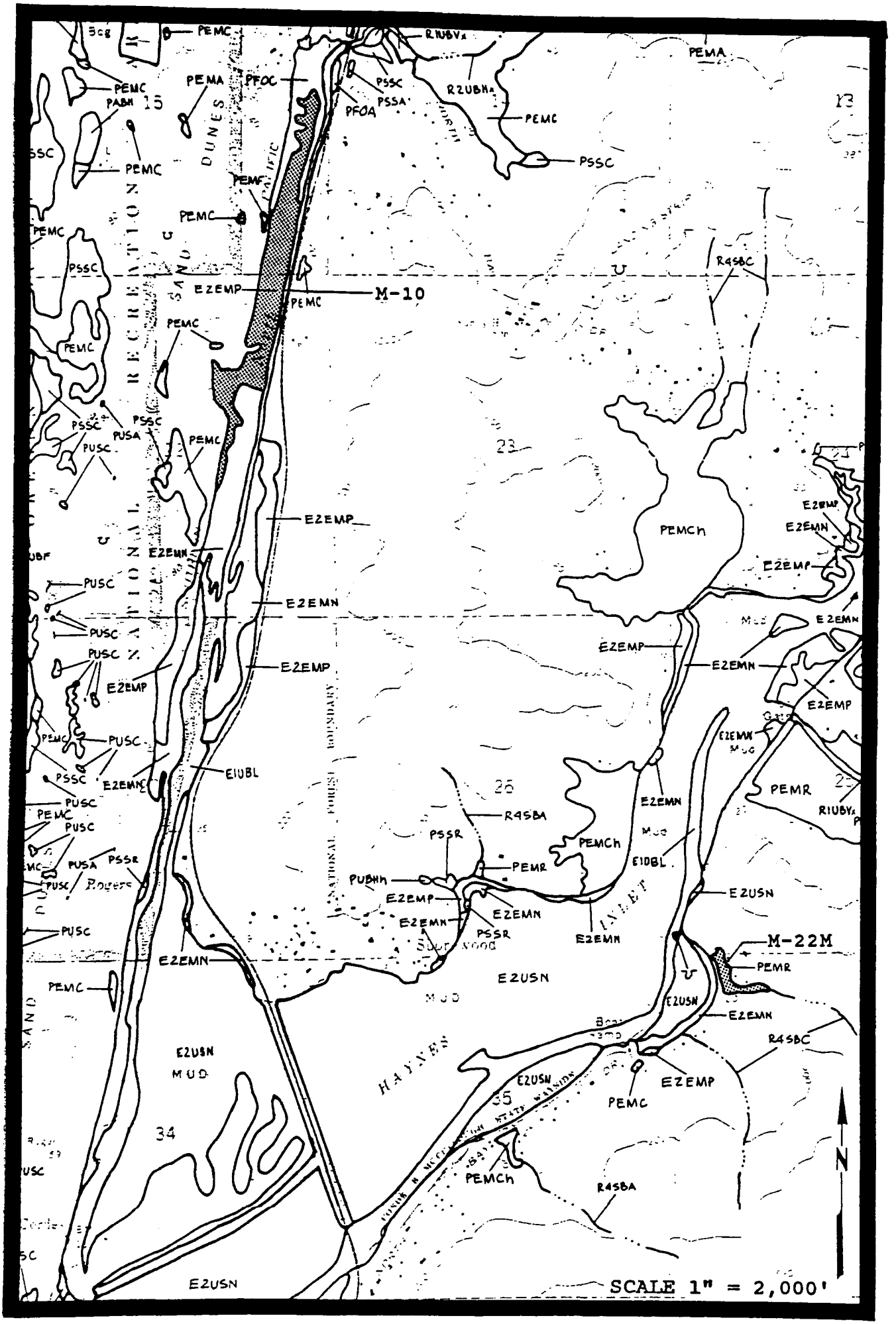
COOS BAY LOCATION MAP



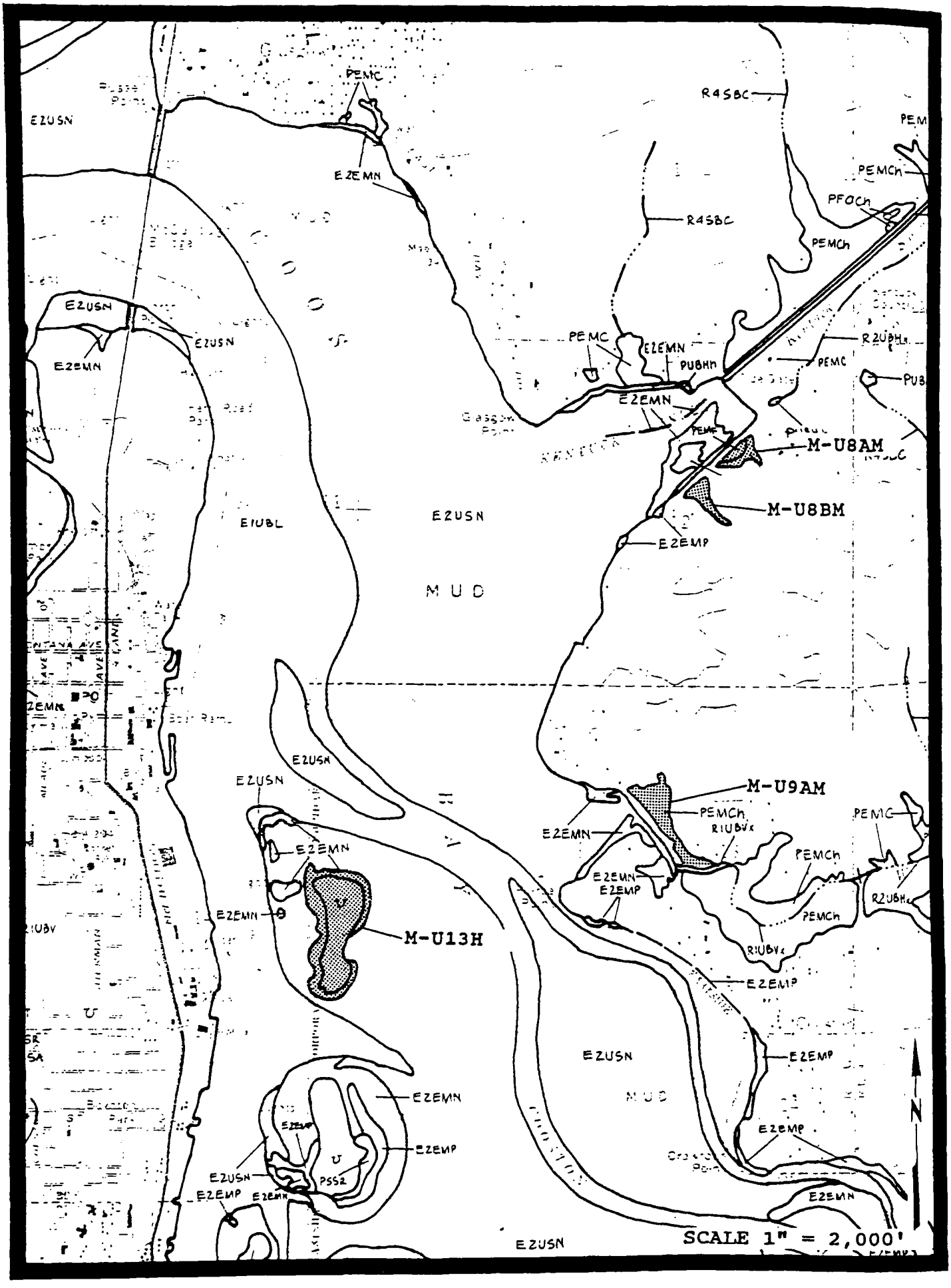
13) COOS BAY, OREGON (A)



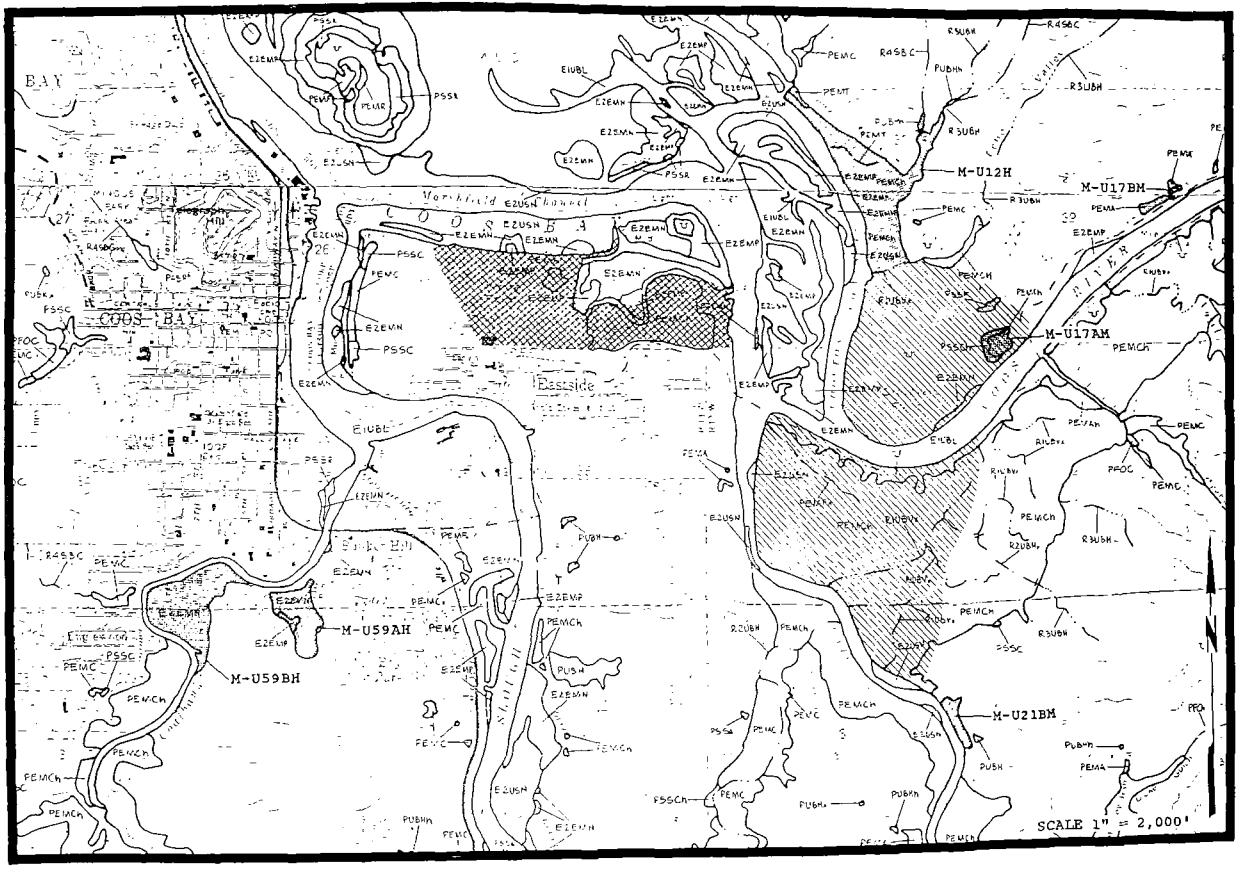
13) COOS BAY, OREGON (B)



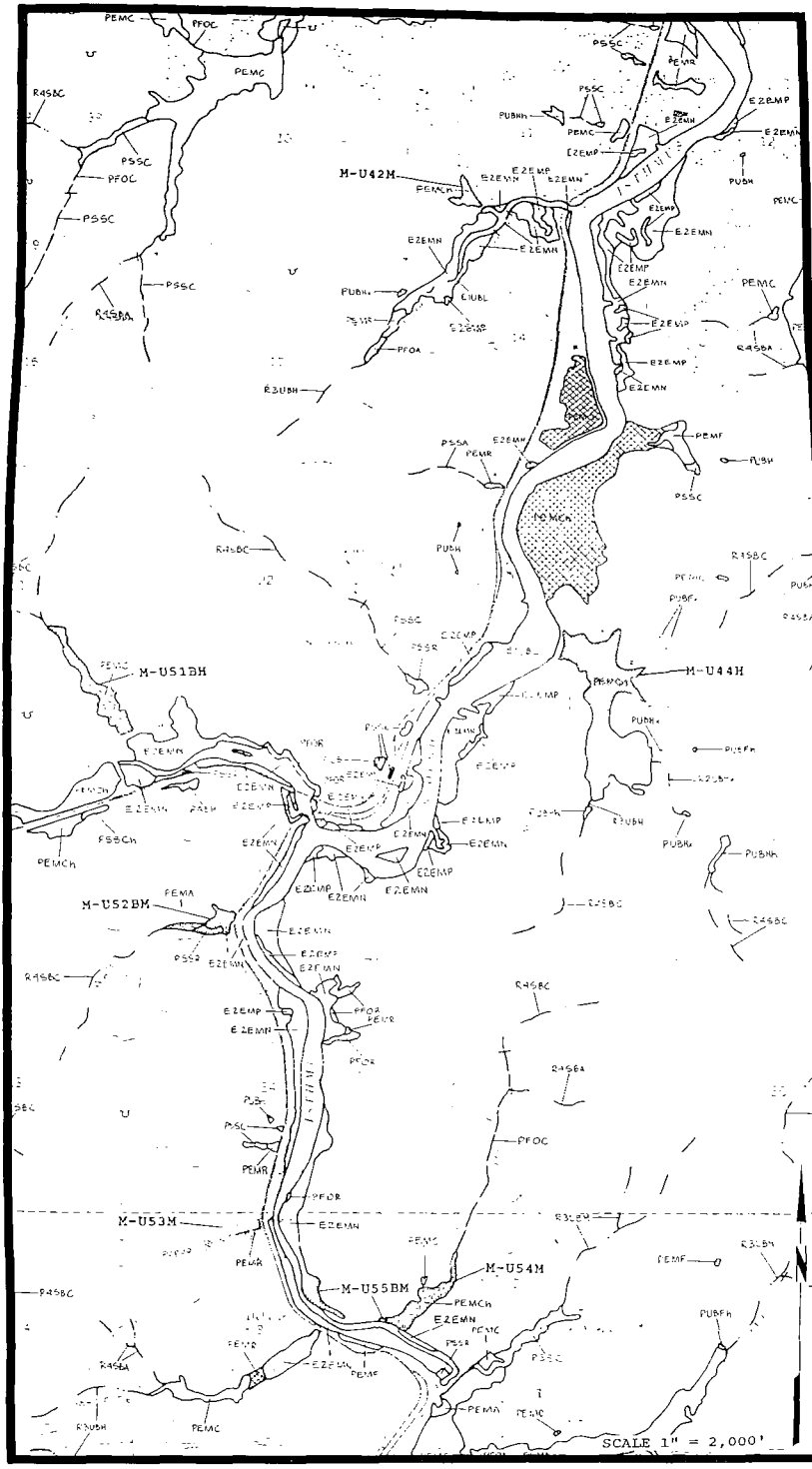
13) COOS BAY, OREGON (C)



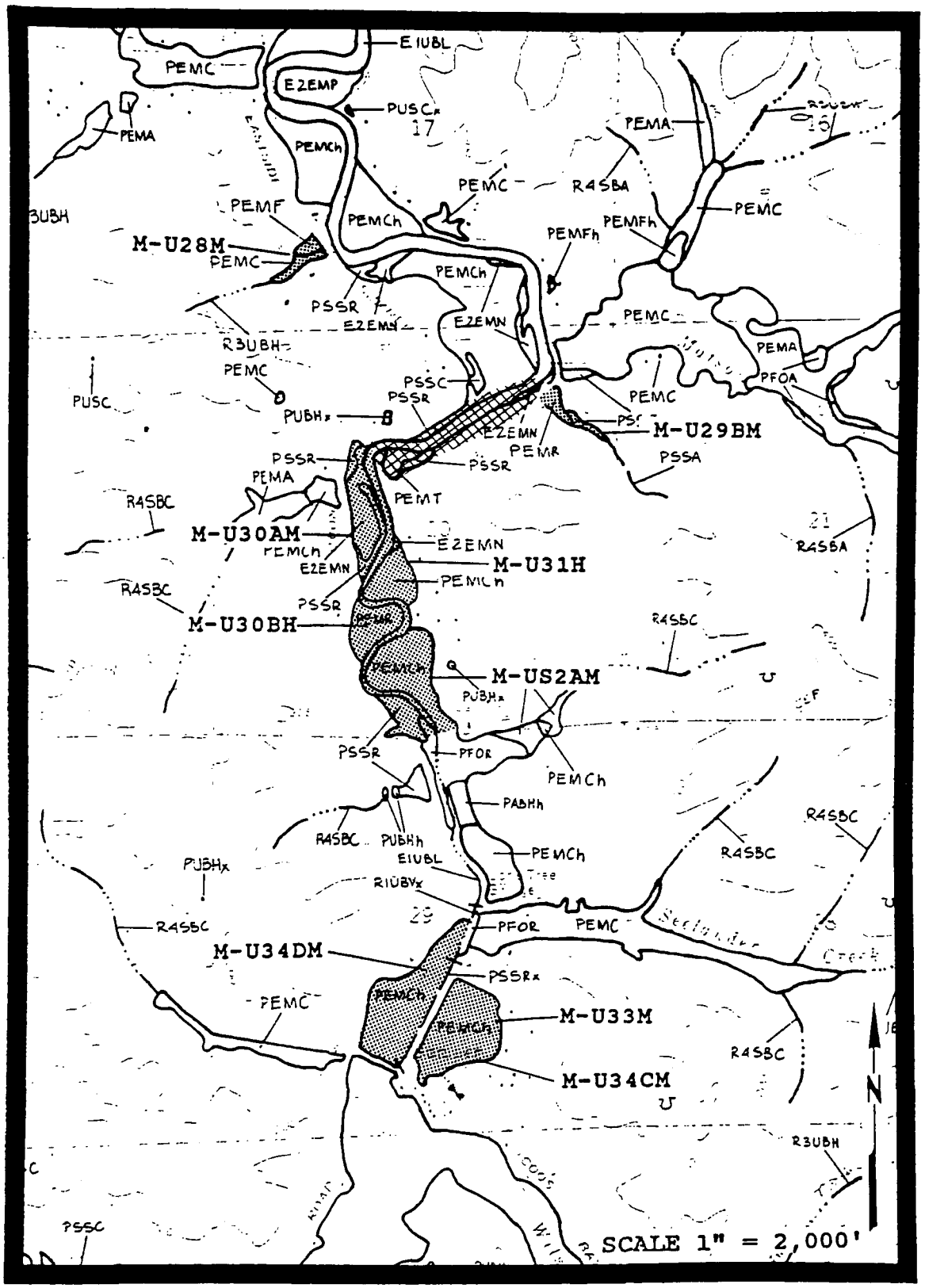
13) COOS BAY, OREGON (D)



13) COOS BAY, OREGON (E)



13) COOS BAY, OREGON (F)



13) COOS BAY, OREGON (G)

14) COQUILLE RIVER

USGS Quads: BANDON, 7.5'
BULLARD, 7.5'
RIVERTON, 7.5'
COE Photomosaic: 1"=1,000'

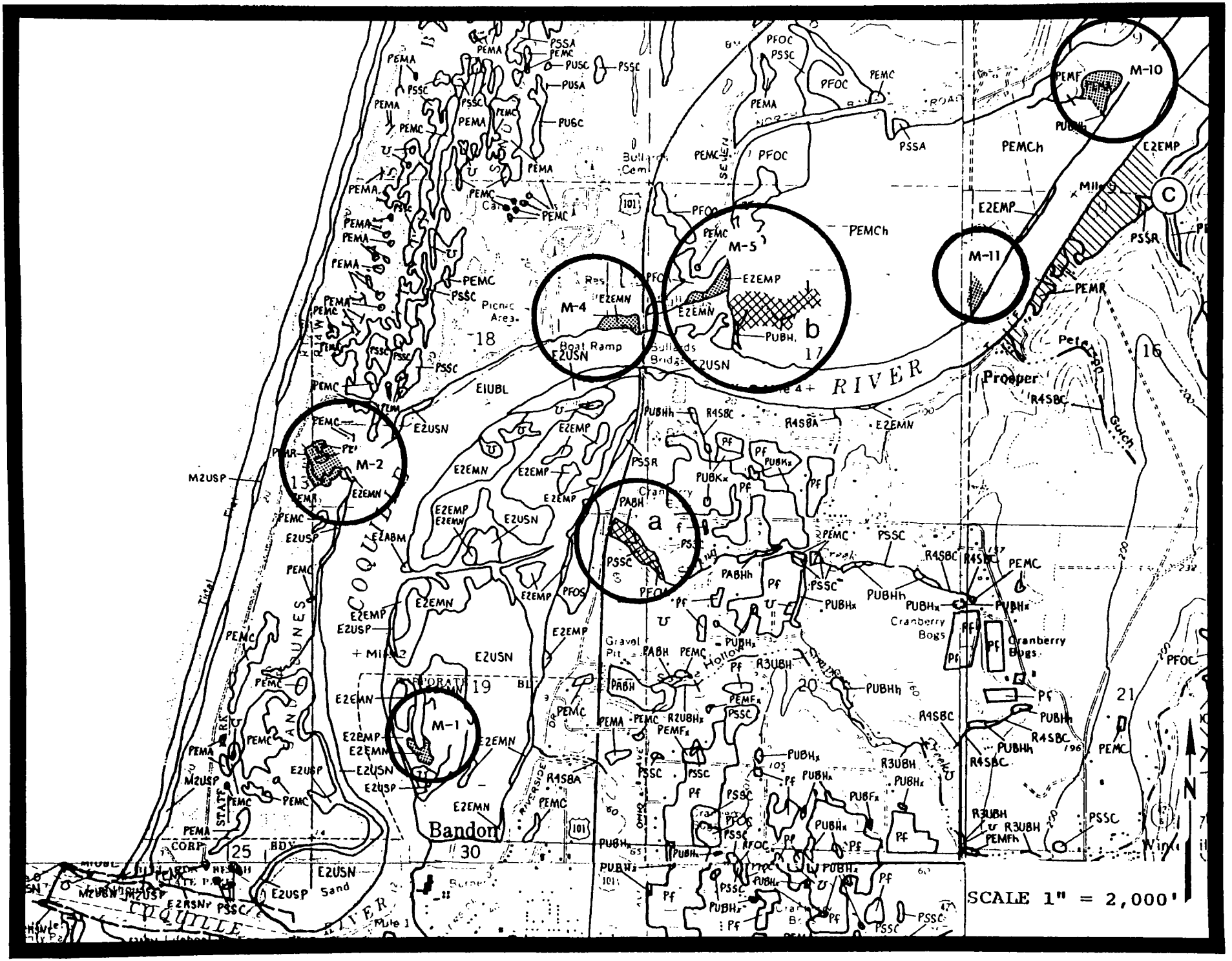
a) Impounded lake: This area appears to be an impounded freshwater lake from the aerial photograph. It is located southeast of the major eastward bend of the river, west of Prosper. The site is located east of the roadway, therefore restoration may require the installation of culverts under the roadway if none exist. Area is just over 5 acres in size.

b) Old Slough: This area is located north of the river, just east of the major eastward bend of the river. The OREP maps the area as diked, and the aerial indicates that it is used for agricultural purposes. Removal of the dike would restore the area to tidal influence. Site is approximately 10 acres in size.

c) Agricultural lands: Upstream from river mile 22 there is extensive agricultural use along both banks of the river. The OREP identifies the area just north of Prosper on the east bank as diked, the remaining agricultural lands are not identified within the OREP or the NWI. It is noted that tidal effects extend to approximately between river mile 36 and 40 of the river (Percy, 1974). It is unknown to what extent estuarine restoration could take place if the dikes were removed. Potential area is greater than 25 acres.

<u>Oregon Estuary Plan Mitigation Sites</u>

MIT 1	Dredge Spoil Island - grade to create high salt marsh; 3 acres.
MIT 10	Unnamed site - remove dike and grade to create salt marsh; 12 acres.
MIT 11	Prosper - create channel and salt marsh; 4 acres.
MIT 2	North Spit; 13.5 acres.
MIT 3	Dredge Spoil Islands - scalp to create salt marsh; 12 acres.
MIT 4	U. S. 101 West; 1.2 acres.
MIT 5	U. S. 101 East; 2.0 acres.
MIT 8	Unnamed site - remove bank to create high marsh; not mapped; 1.5 acres.
MIT 9	Randolph Slough - construct tidal channel; not mapped; 6.0 acres.



14) COQUILLE RIVER, OREGON

Chapter 3

WASHINGTON SITES

Of 13 major estuaries within Washington state, seven of them have lost over 50 percent of their original subaerial wetlands (those wetlands above the intertidal mudflats and submerged algal beds) within approximately the last century. The Lummi, Samish, Duwamish, and Puyallup river systems have lost over 90 percent of their original estuary lands (Simenstad, 1982). Many of these estuaries were historically diked for agricultural uses, and most are still used for that purpose.

The Duwamish and Puyallup systems have been converted from agricultural uses to industrial and commercial uses which have a more significant impact on the potential for restoration. These systems are not contained within this study because of the lack of agricultural or passive uses within the estuaries.

Unlike the detailed work for long range comprehensive planning which has been done in the state of Oregon, Washington does not at this time have detailed comprehensive plans for most of its estuaries. This preliminary study may be the first step to identify potential restoration and mitigation sites throughout the state.

The source for data within Washington state came from the NWI mapping, the COE aerial photos, historical mapping, personal communication from various agency staff, and various specific reports and documents as noted within the text and bibliography.

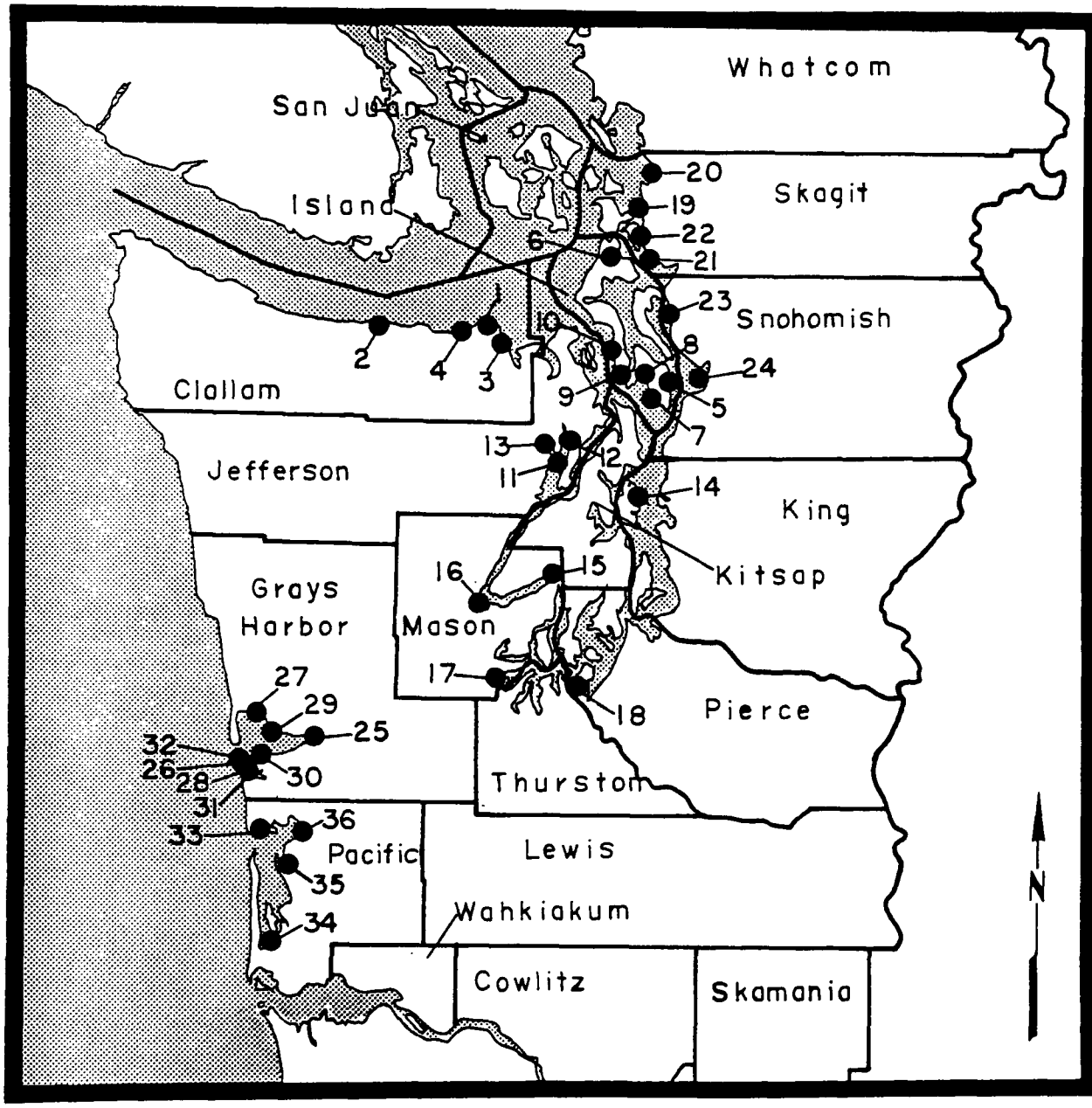
Historical Changes of Shoreline and Wetland at Eleven Major Deltas in the Puget Sound Region, Washington, (Bortleson, 1980), was utilized to determine the former extent of wetland presence in some of the estuaries. The historical data on which the Bortleson (1980) report is based did not differentiate between freshwater and saltwater wetlands within the estuary, therefore the former exact extent of saltwater wetland systems must be estimated.

The sites are listed alphabetically by county; the inland waters and the Straits of Juan de Fuca first, then by county within Grays Harbor and Willapa Bay. "Inland waters" includes the identified potential sites on the Straits of Juan de Fuca, Hood Canal, and within Puget Sound and the San Juan Islands. All of the sites are listed alphabetically by USGS quad in Appendix A.

The COE Photo Number refers to the number of the 1987 color aerial photographs on file at the Seattle office of the U. S. Army Corps of Engineers. A few of the photographs are from the 1986 series, as 1987's were not available for some sites at the time of this inventory.

"Inland Waters" includes the identified potential sites on the Straits of Juan de Fuca, Hood Canal, and within Puget Sound and the San Juan Islands. Following is a list of all sites, including those on inland waters (1-24) and on the Pacific Coast (25-36).

Site	Quad
1) Meadowbrook Creek	Dungeness
2) Crescent Bay	Joyce
3) Batelles Lagoon	Sequim
4) Grays Marsh	Sequim
5) Clinton	Mukilteo
6) Dugalla Bay	Cresent Harbor
7) Picnic Point	Mukilteo
8) Useless Bay	Hansville & Maxwelton
9) Cultus Bay	Maxwelton
10) Maxwelton	Maxwelton
11) Dabob Bay	Brinnon
12) Squamish Harbor	Lofall
13) Quilcene Bay	Quilcene
14) Quartermaster Harbor	Vashon
15) Lynch Cove	Belfair
16) Annas Bay	Potlatch
17) Little Skookum Inlet	Shelton
18) Nisqually	Nisqually
19) Padilla Bay	Anacortes, South, Bow, LaConner
20) Samish River	Bow
21) Skagit River	Conway and Ustalady
22) Swinomish Channel	LaConner
23) Stillaguamish River	Juniper Beach, Utalady, Stanwood
24) Snohomish Delta	Marysville
25) Chehalis River	Aberdeen
26) Copalis River	Copalis Beach
27) Grass Creek	Copalis Crossing
28) South Bay	Grayland
29) Bowerman Basin	Hoquiam
30) Johns River	Hoquiam
31) North River	Western
32) Westport	Westport
33) Kindred Slough	Bay Center
34) Bear River	Chinook, Long Island
35) Palix River	Nemah
36) Willapa River	South Bend

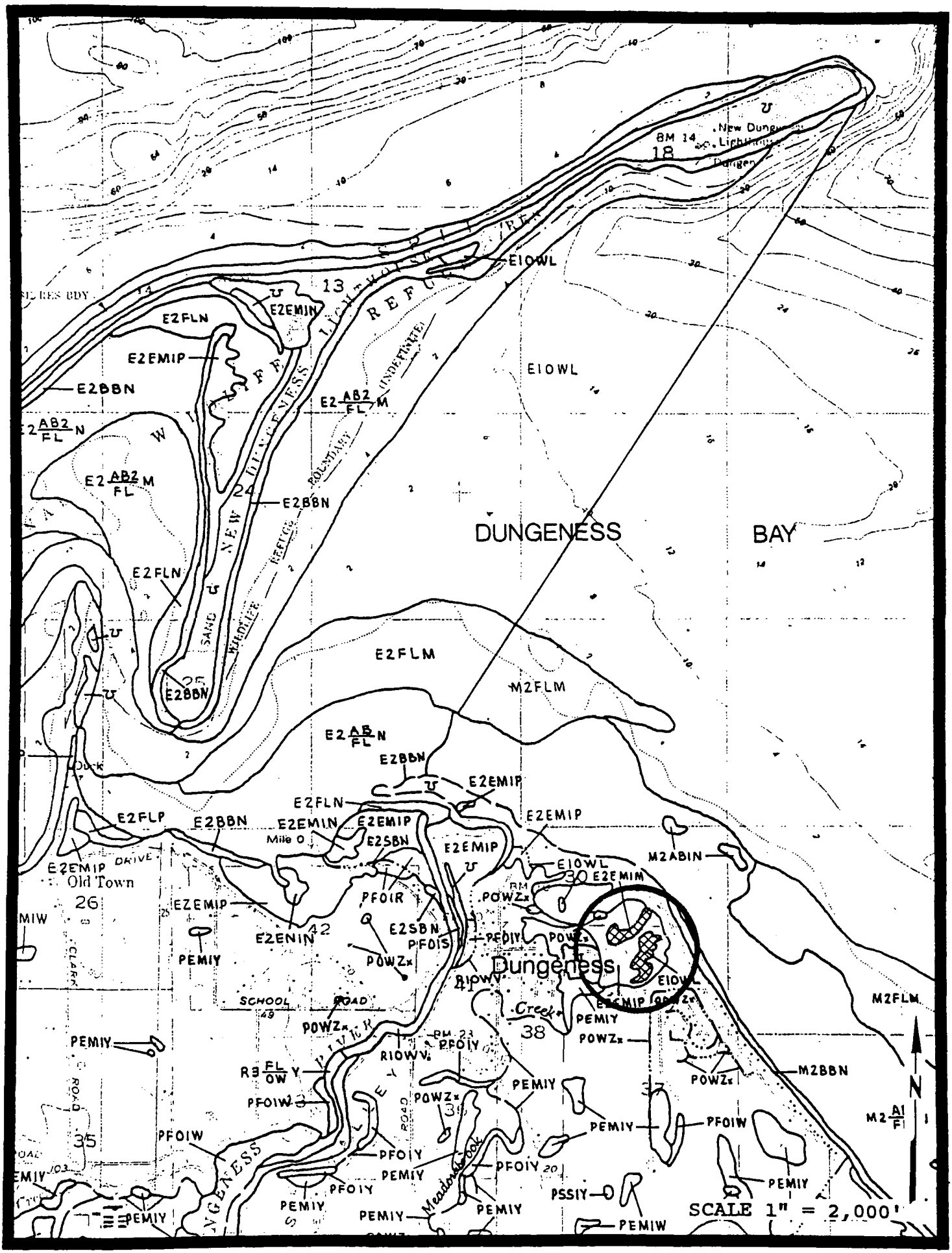


WASHINGTON LOCATION MAP

CLALLAM COUNTY

1) MEADOWBROOK CREEK USGS Quad: DUNGENESS, 7.5'
COE Photo #: S87-009-07-9

The area is located southeast of Dungeness Spit, on the mainland, at the mouth of Meadowbrook Creek. The two areas are mapped as estuarine in the NWI: one is emergent, the other is open water. Review of the aerial photograph does not indicate where the tidal input occurs in these two systems; it may be a culvert under the roadway. The systems appear simple in the aerials; restoration could increase the tidal range and flow into the areas. Field verification of the existing situation is necessary. Both sites are less than 10 acres in size.



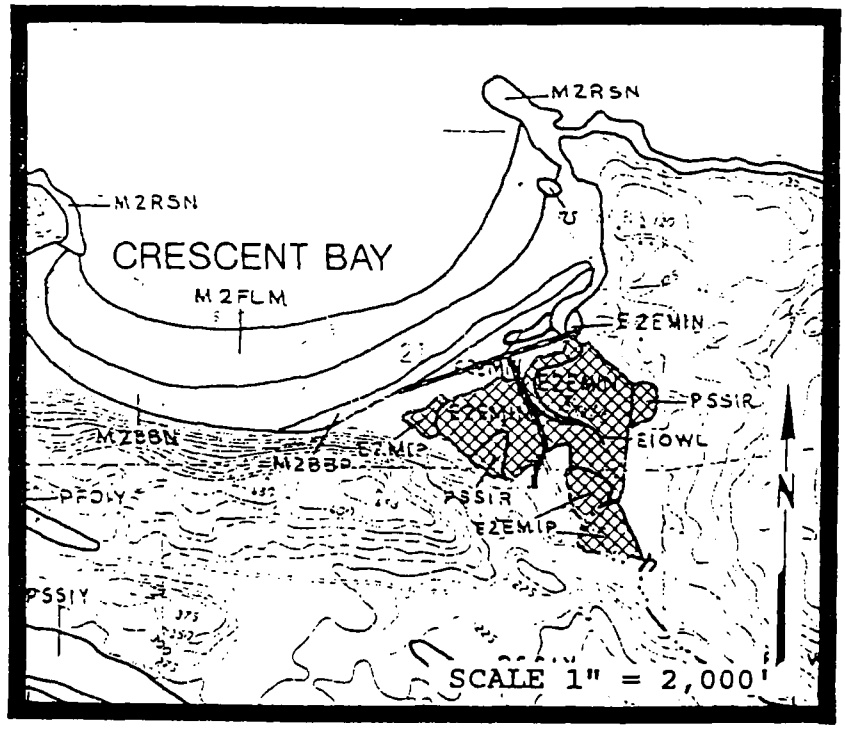
1) MEADOWBROOK CREEK, WASHINGTON

2) CRESCENT BAY

USGS Quad: JOYCE, 7.5'
COE Photo #: S87-009-4-11

In the southeast corner of Crescent Bay, the roadway around the bay has created a dike across Salt Creek. The NWI maps the upstream area as estuarine, however DNR agency staff (L.Kunze, pers. comm.) have noted that the road acts as a dike.

Culverting under the road would restore tidal influence to the area. It is unknown, however, what size of an area would be affected. Field verification is necessary to determine restoration potential. Potential area could be greater than 20 acres.

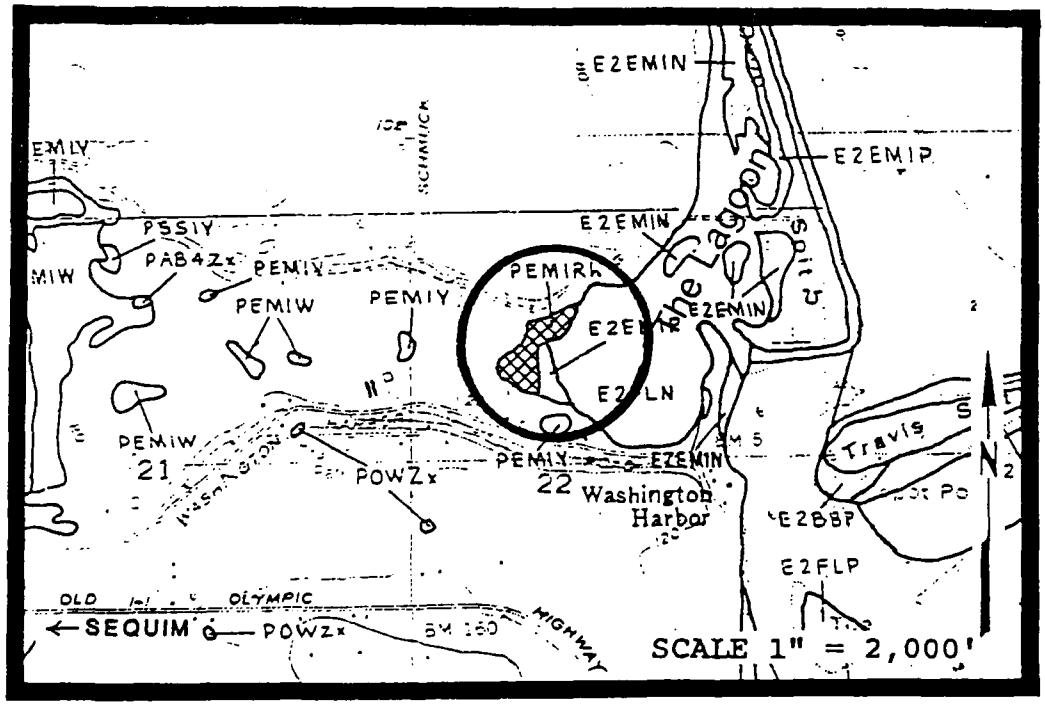


2) CRESCENT BAY, WASHINGTON

3) BATELLES LAGOON

USGS Quad: SEQUIM, 7.5'
COE Photo #: S87-009-7-5

The site is diked wet pasture to the west of the lagoon. Breaching of the dike would restore this area to tidal influence and expand the area of the existing estuary. The site is between 5 and 10 acres in size.

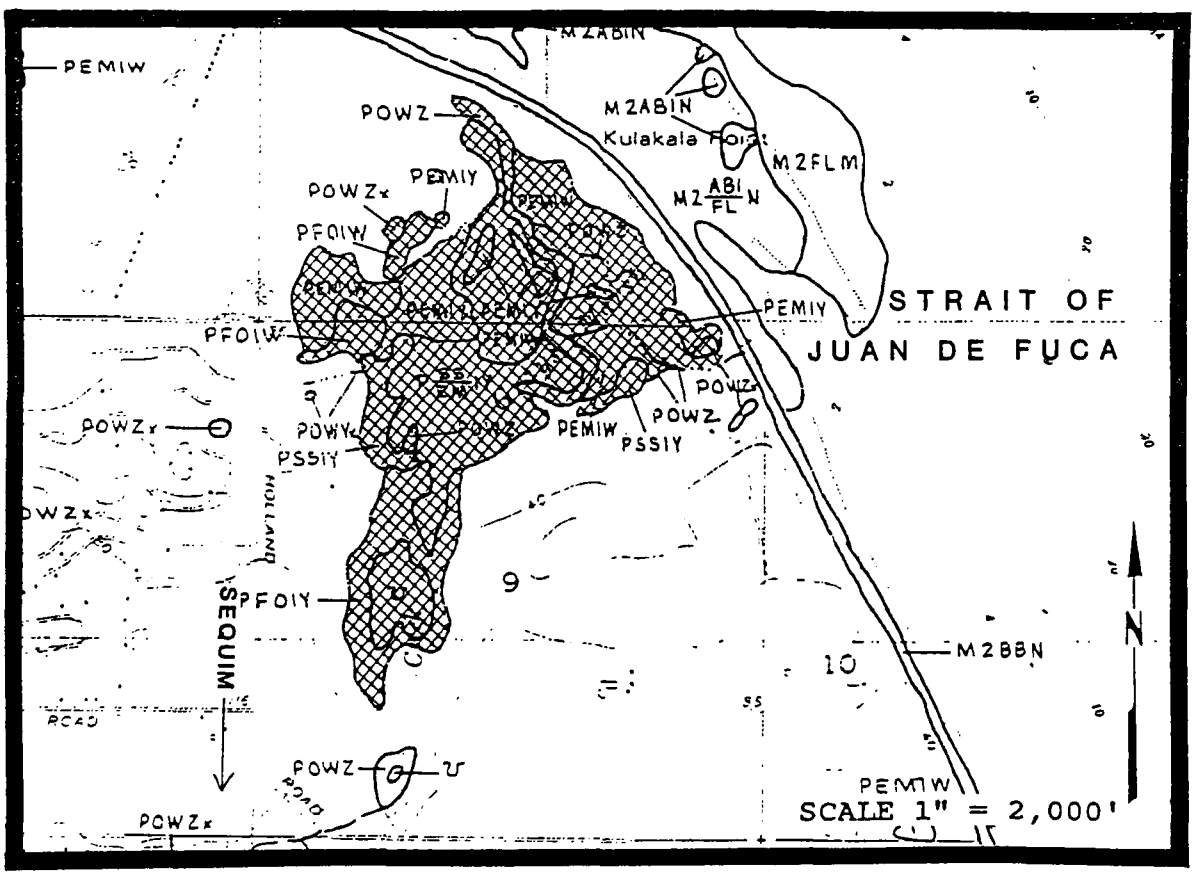


3) BATELLES LAGOON, WASHINGTON

4) GRAYS MARSH

USGS Quad: SEQUIM, 7.5'
COE Photo #: S87-009-7-7

This large extensive wetland is in private ownership and is currently actively managed for waterfowl habitat. The system is currently freshwater wetland as the sloughs and channels have tidegates. Removal of the tidegates would restore the area to tidal influence. The site is over 140 acres.



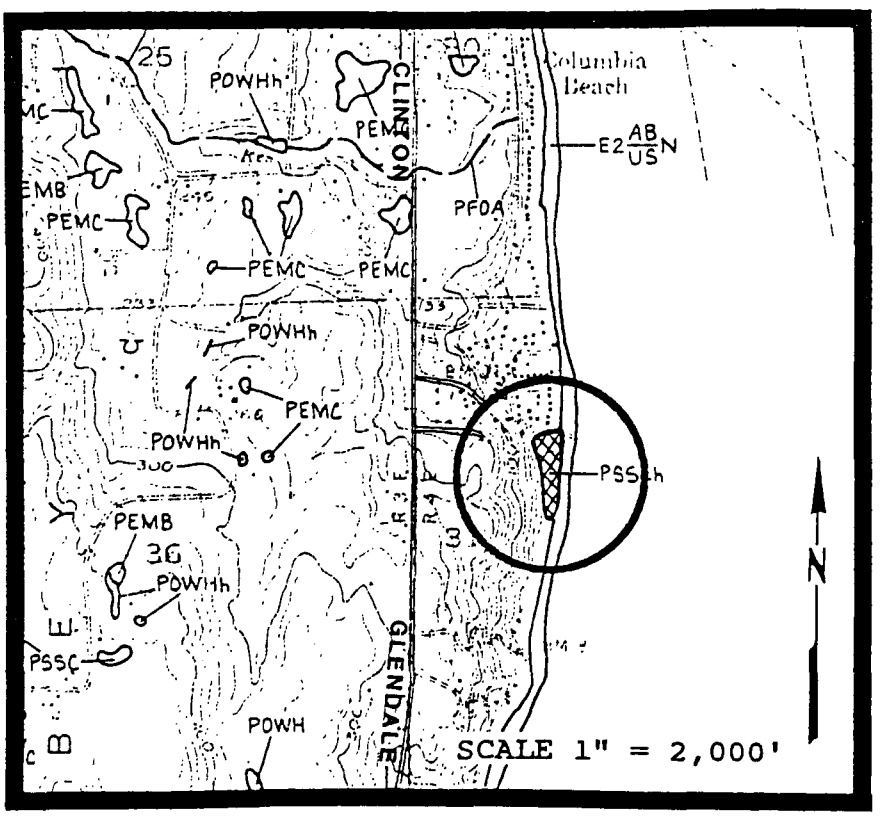
4) GRAYS MARSH, WASHINGTON

ISLAND COUNTY

5) CLINTON

USGS Quad: MUKILTEO, 7.5'
COE Photo #: S87-009-70A-31

The site is located south of the town of Clinton, approximately halfway to Glendale. The site is mapped as a small impounded freshwater scrub/shrub wetland. Field review would establish if it was feasible to restore tidal influence with a culvert. The site is just under 5 acres.



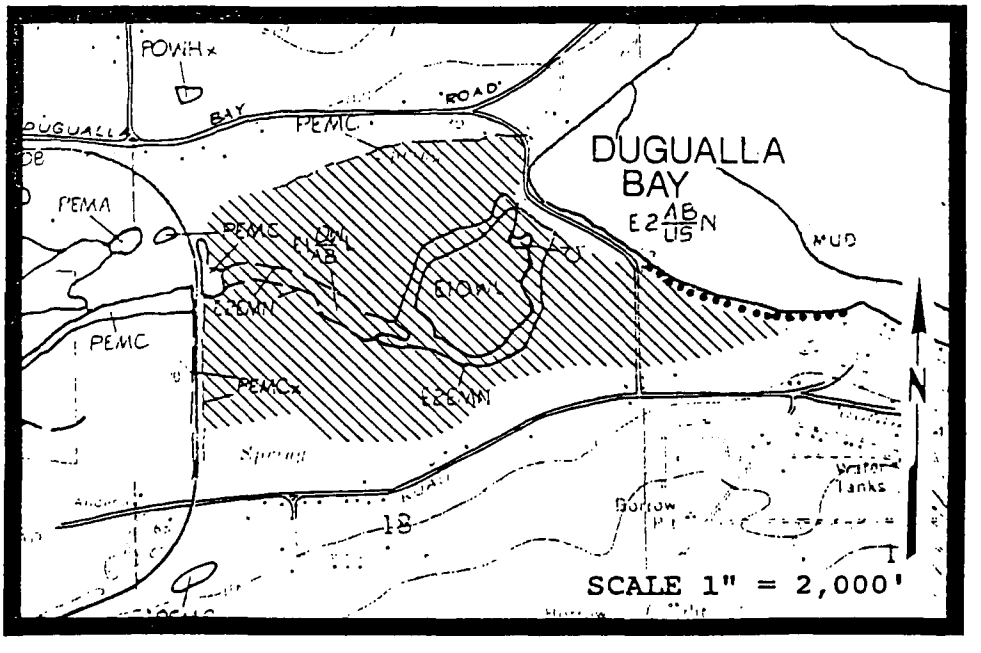
5) CLINTON, WASHINGTON

6) DUGALLA BAY

USGS Quad: CRESENT HARBOR 7.5'
COE Photo #: S87-009-71-19

This area is at the head of Dugalla Bay. It is currently impacted by the presence of tide gates and dikes. The roadway across the head of the bay contains a tide gate. NWI maps the openwater area and old slough to the west as estuarine. The area immediately surrounding the old slough is currently active agricultural use. Removal of the tide gate would possibly expose the area to greater tidal influence; removal of the dikes also would expose a greater area to tidal influence.

The area currently mapped as estuarine is approximately 50+ acres in size; the area of agricultural use is over 100 acres.



6) DUGALLA BAY, WASHINGTON

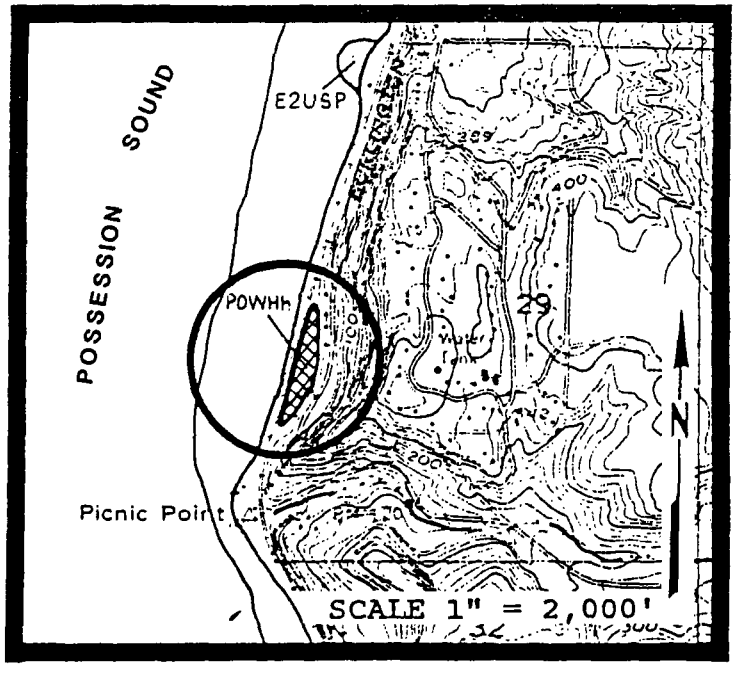
7) PICNIC POINT

USGS Quad: MUKILTEO, 7.5'
COE Photo #: S87-009-54-7

From the aerial photograph this area appears strictly as an open water pond with no margin of emergent vegetation. It is impounded behind the railroad tracks, and it is assumed that there is no culvert connection.

The potential for restoration would be more accurately assessed with a field verification. It may be possible to introduce tidal influence into this system by placing a culvert under the tracks if none exists.

The site is just less than 5 acres.

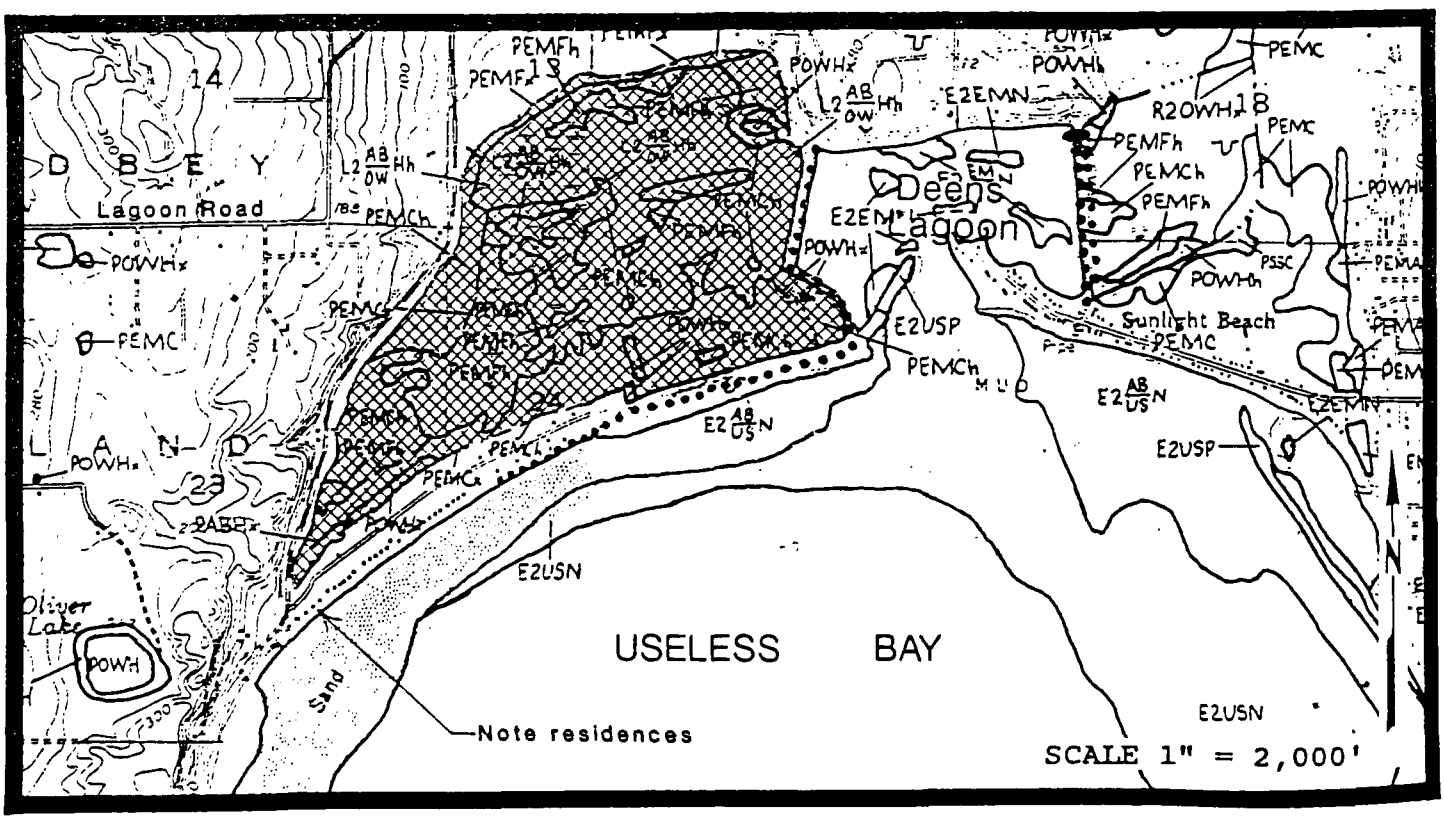


7) PICNIC POINT, WASHINGTON

8) USELESS BAY

USGS Quad: HANSVILLE, 7.5'
MAXWELTON, 7.5'
COE Photo #: S87-009-72-17

Useless Bay is a former estuarine system which is now diked. A diverse freshwater system has developed within the Bay according to the NWI. The area as a whole does not provide feasible restoration because of the presence of houses all along the natural berm. Restoring tidal influence to the Bay would run the risk of not only flooding the existing structures, but also impacting the septic systems and thereby further impacting the already poor water quality within the Bay. Field review may identify areas within the Bay which could be restored to tidal influence without adversely impacting the hydrologic regime of the remainder of the Bay, and therefore not adversely impacting the existing structures.

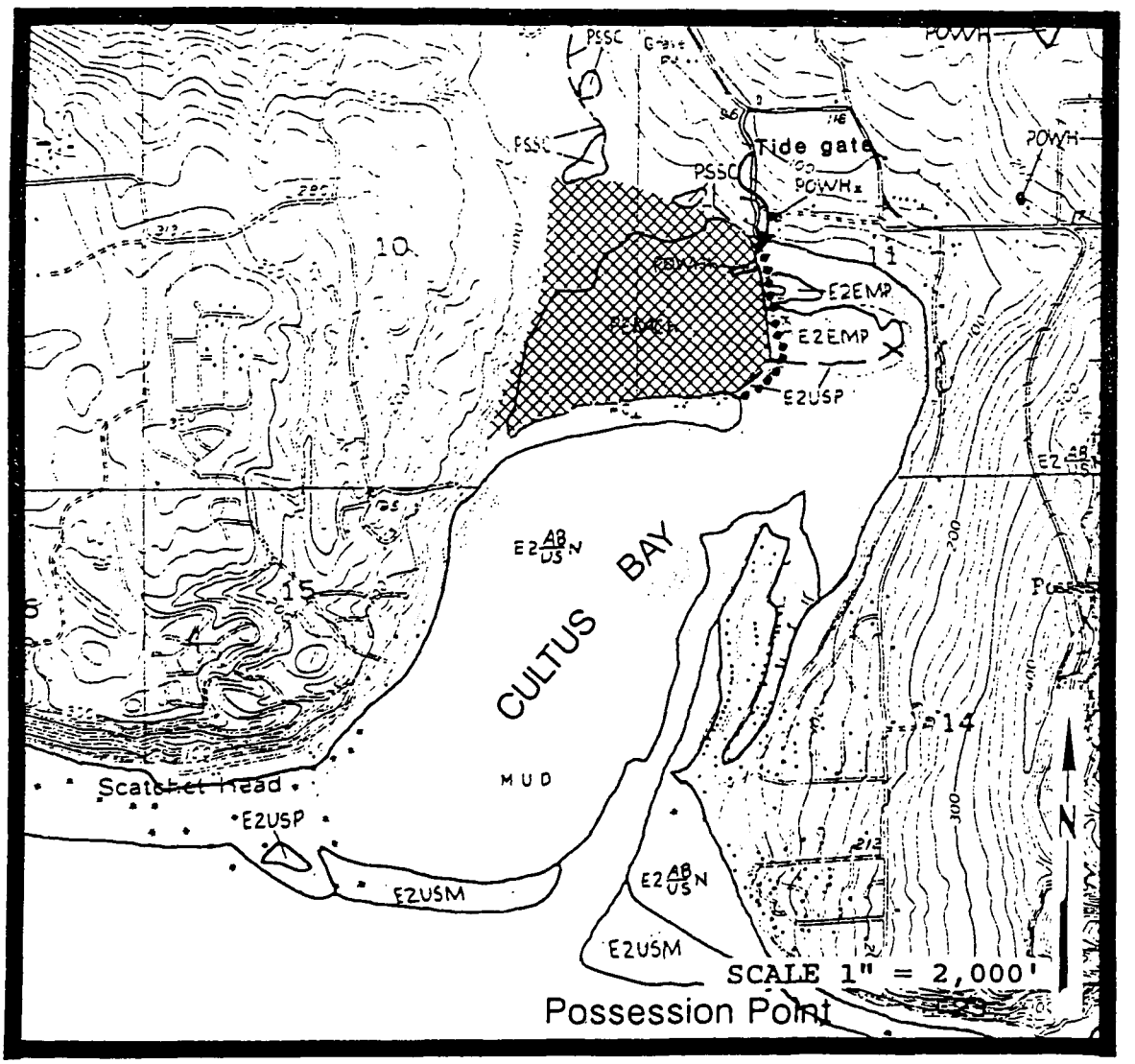


8) USELESS BAY, WASHINGTON

9) CULTUS BAY

USGS Quads: MAXWELTON, 7.5'
COE Photo #: S87-009-72-17

The natural berm at the head of Cultus Bay has been extended with a dike and two tide gates, which effectively closes off the former estuary from tidal influence. The areas currently exist as pasture. Removal of the tidegates and breaching of the dikes would restore the area to tidal influence. The area is approximately 100 acres.

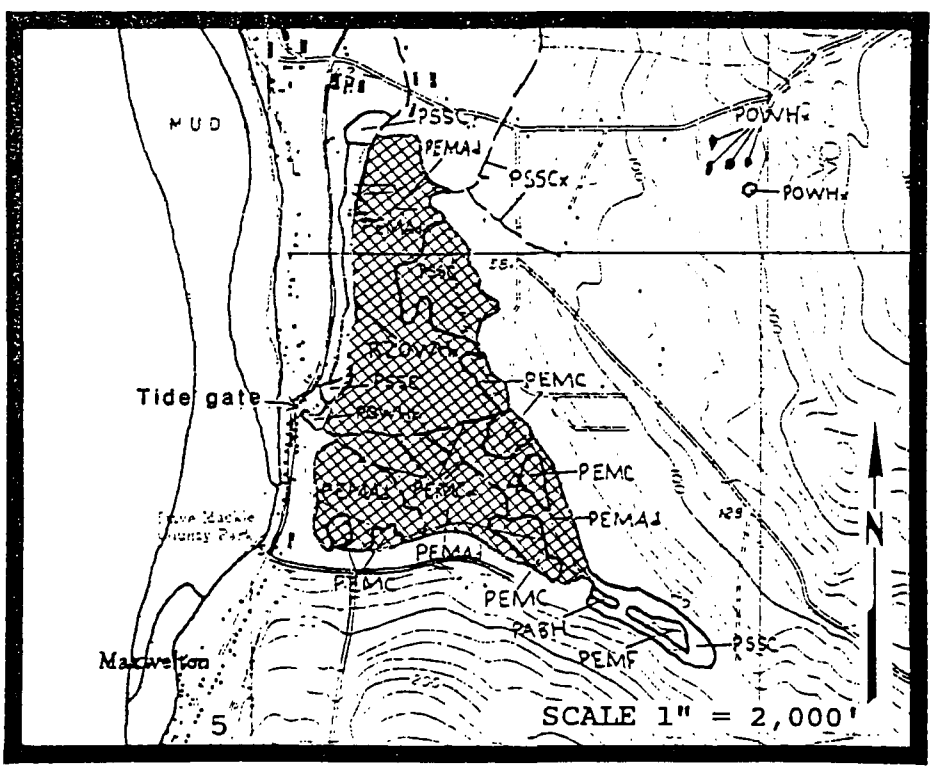


9) CULTUS BAY, WASHINGTON

10) MAXWELTON

USGS Quads: MAXWELTON, 7.5'
COE Photo #: S87-009-72-17

This area is located just north of the town of Maxwelton, on Whidbey Island. According to the NWI, the area is currently a freshwater system located across the road and behind a tide gate from Puget Sound. The freshwater system contains good diversity of vegetation. Removing the tide gates or dikes would restore the area to tidal influence. Old channels are still present within the system. The area is over 100 acres.



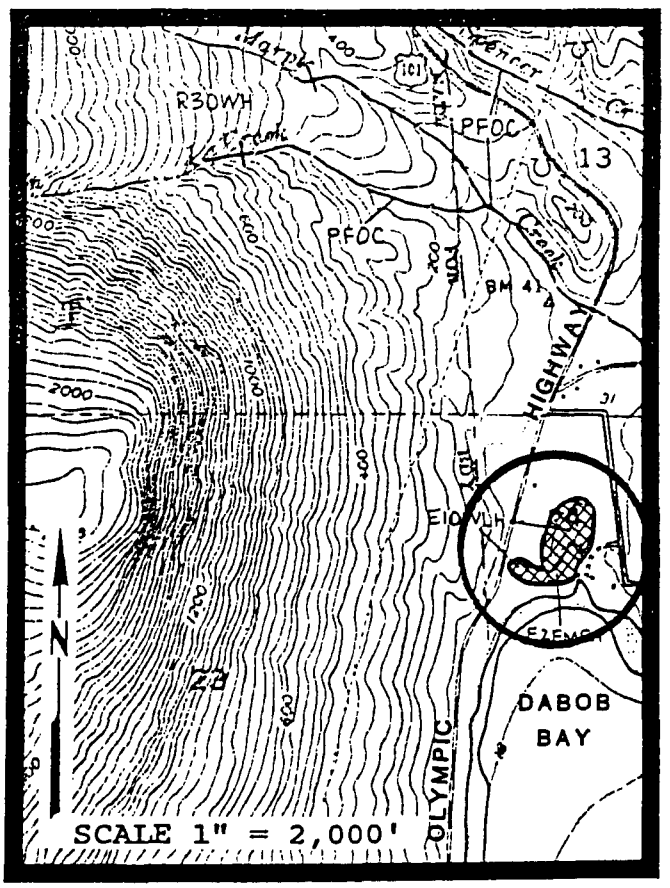
10) MAXWELTON, WASHINGTON

JEFFERSON COUNTY

11) DABOB BAY

USGS Quad: BRINNON 7.5'
COE Photo #: S87-009

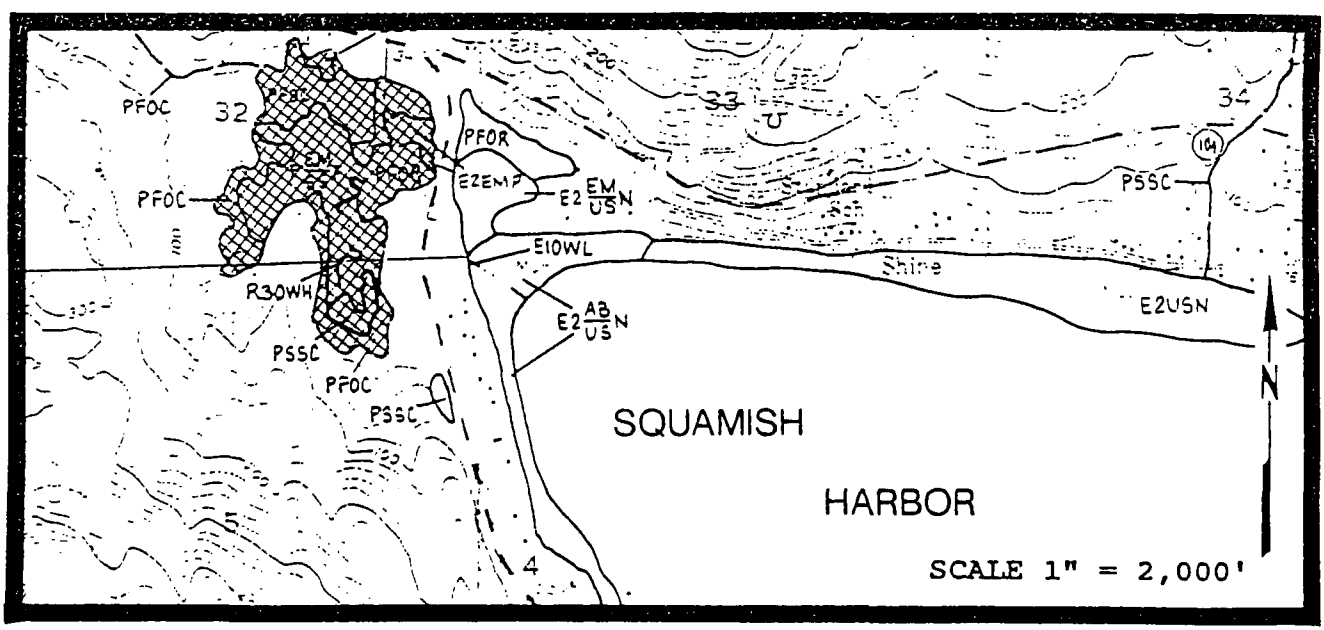
The NWI indicates a small estuarine system at the north end of Dabob Bay as diked. No agricultural use is indicated. A field check would be required to confirm whether the site provides any potential for restoration. The area is just over 10 acres in size.



11) DABOB BAY, WASHINGTON

12) SQUAMISH HARBOR USGS Quad: LOFALL, 7.5'
COE Photo #: S87-009-16-1

This site is identified in the NWI as a freshwater system. It appears to be cut off from tidal influence only by the presence of the road. Field review would confirm whether the site has potential to be restored to tidal influence by placing a culvert under the road or removing a tide gate which may be present. Potential area is over 30 acres in size.

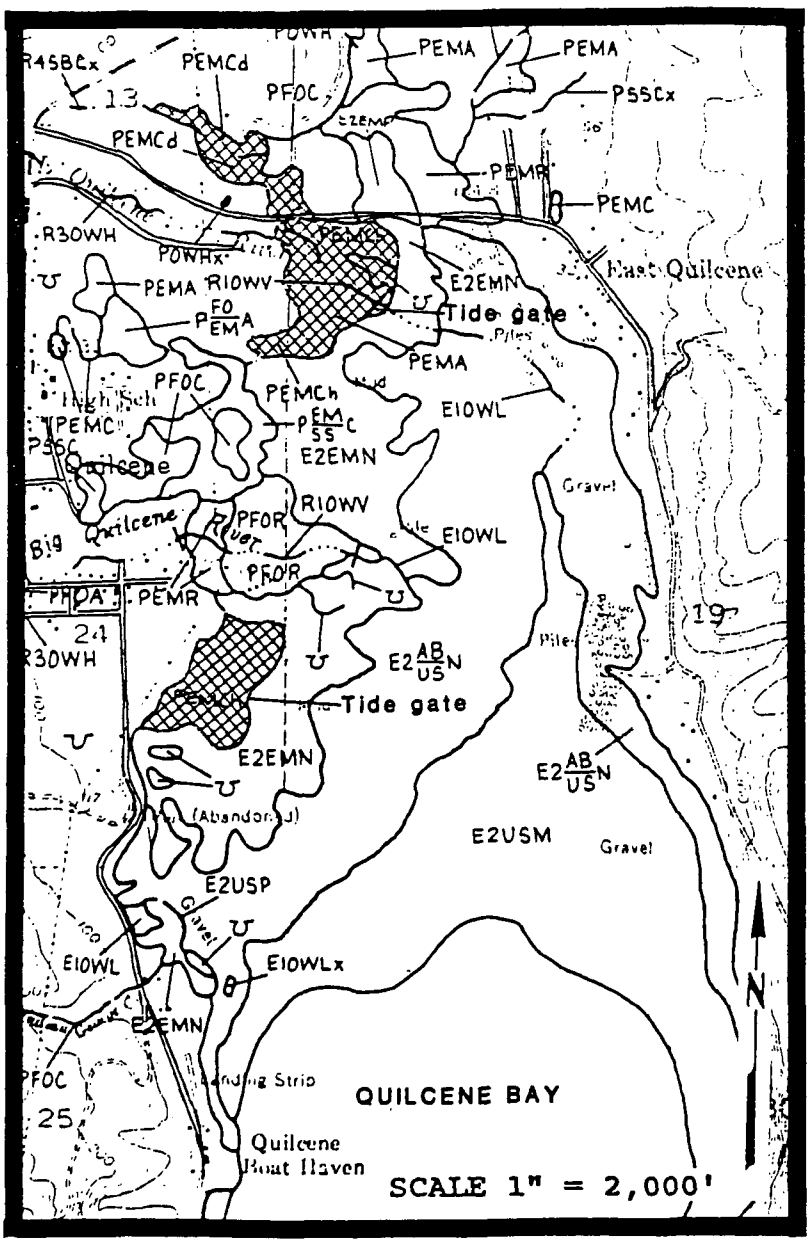


12) SQUAMISH HARBOR, WASHINGTON

13) QUILCENE BAY USGS Quad: QUILCENE, 7.5'
COE Photo #: S87-009-20-3

The areas noted in Quilcene Bay are mapped in the NWI as diked freshwater wetlands. Tide gates are present on the two systems south of the road. No tide gate is mapped on the area just north of the road; it may be impounded behind the road fill with no culvert connection. Removal of the tide gates would restore tidal influence to the two sites with gates. The third site requires field inspection to determine the potential of restoring it to tidal influence. The two sites south of the road are approximately 20 acres each; the one north of the road is approximately 15 acres.

To the northwest of the two sites south of the road, there is potential area which would possibly come into tidal influence as well if the levees were removed. Elevations and existing site conditions would have to be verified as to the feasibility of restoration (area is not mapped).

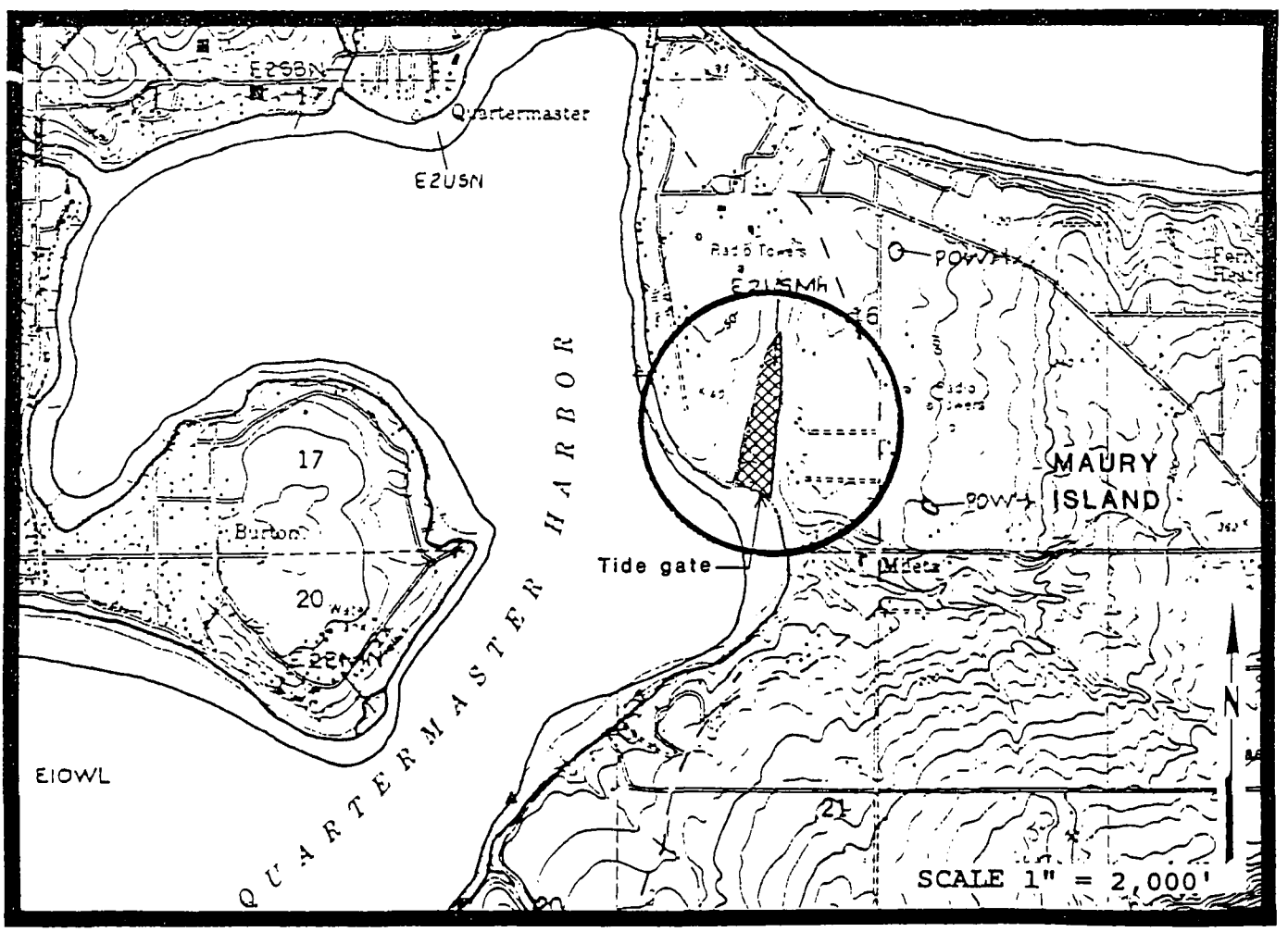


13) QUILCENE BAY, WASHINGTON

KING COUNTY

14) QUARTERMASTER HARBOR USGS Quad: VASHON, 7.5'
COE Photo #: S87-009

The site is located in the northeast section of Quartermaster Harbor. It is an estuary which currently has a tide gate at the mouth. Removal of the tide gate would open the estuary to a different tidal regime. This would restore an element of mud flats which is now lacking because of the permanent impoundment created by the tide gate. The site is approximately 15 acres.



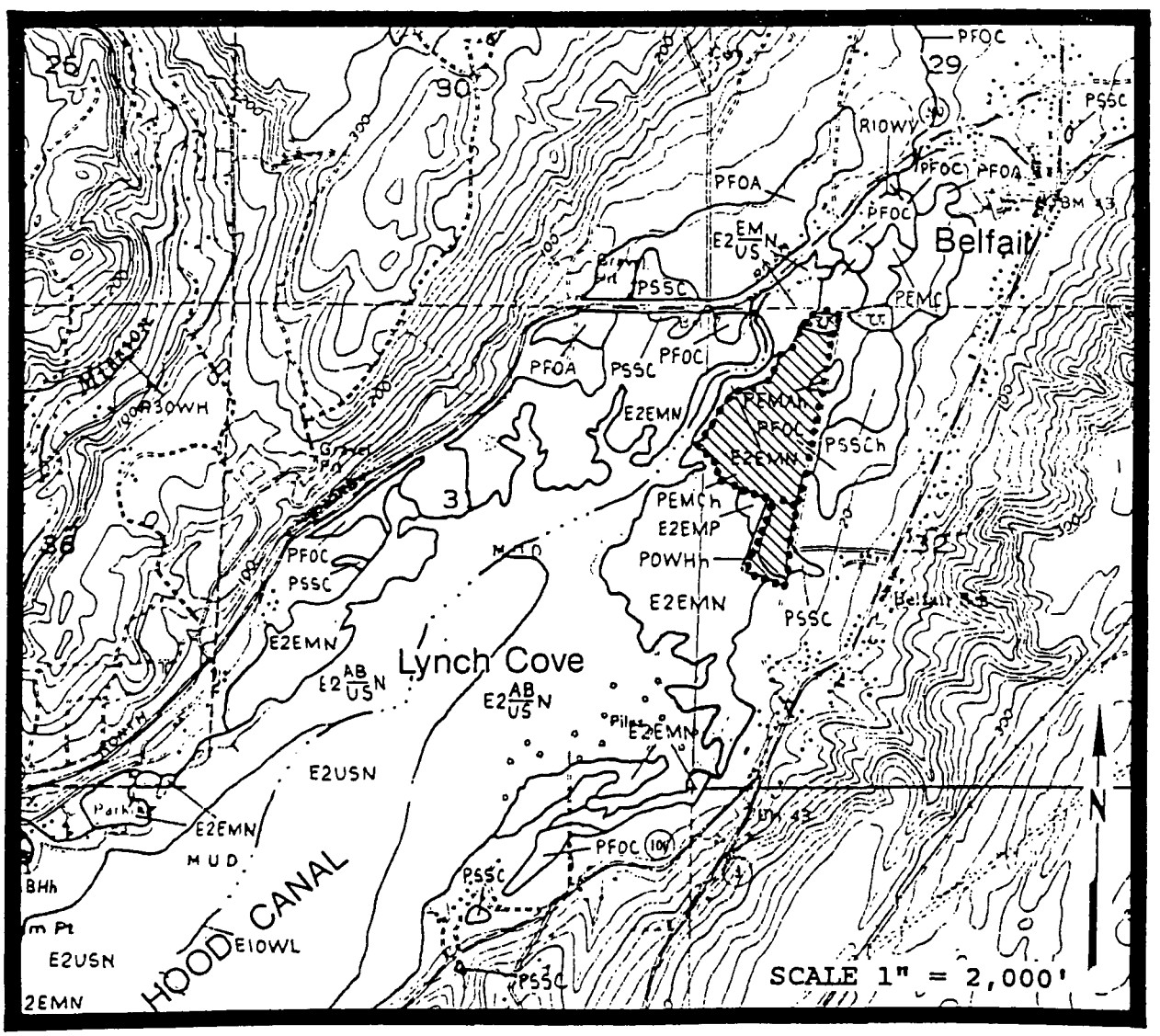
14) QUARTERMASTER HARBOR, WASHINGTON

MASON COUNTY

15) LYNCH COVE

USGS Quad: BELFAIR, 7.5'
COE Photo #: S87-009-24-9

Lynch Cove is at the head of Hood Canal. This area has been diked and is currently either freshwater wetland or in pasture use. Removal of the dikes or tide gates would restore the area to tidal influence. The area is apparently within a private land trust established by the adjacent property owners (L. Kunze, pers. comm.). It may provide a politically feasible restoration site based on the participation of the land trust. The site is approximately 40+ acres.



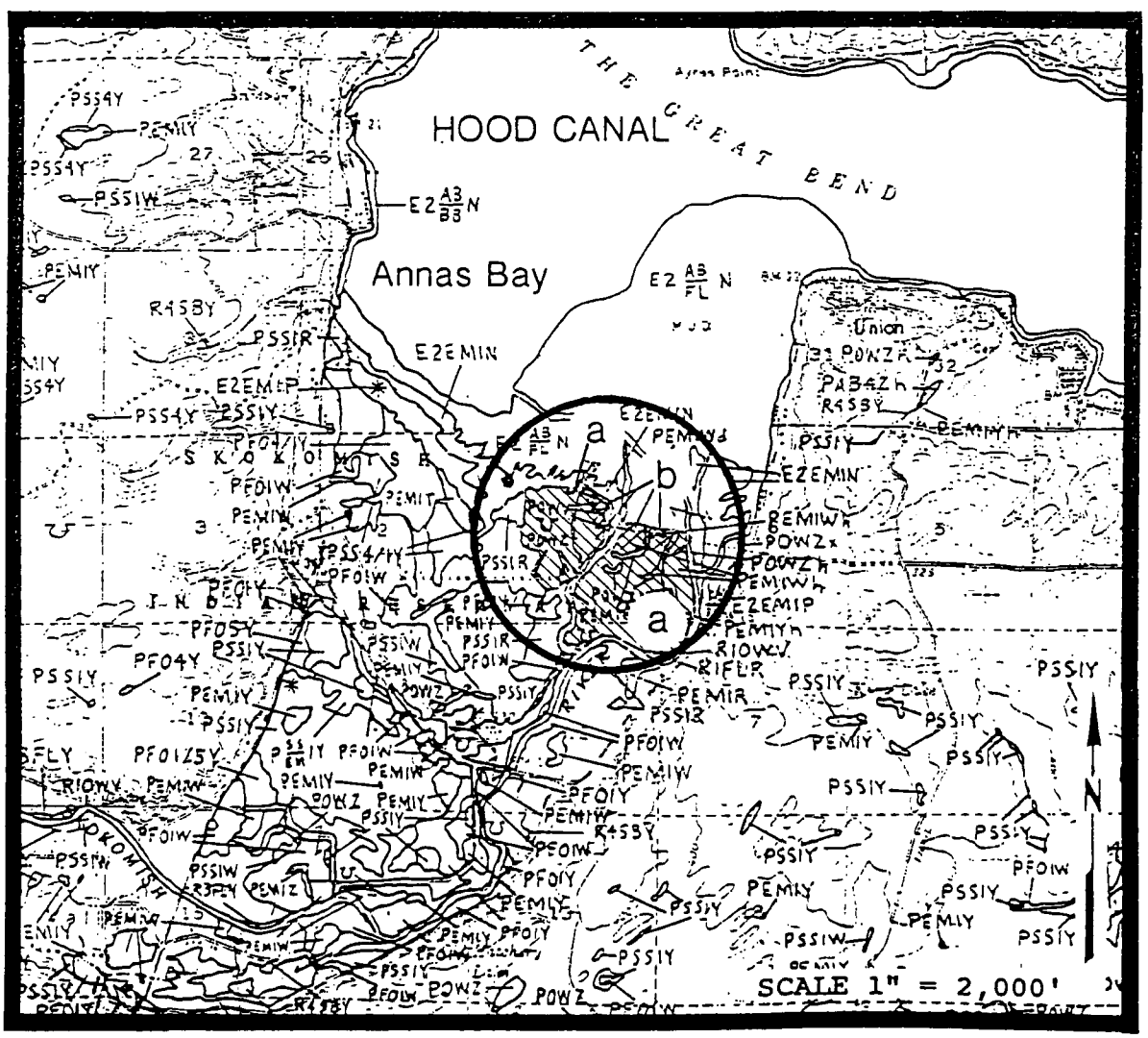
15) LYNCH COVE, WASHINGTON

16) ANNAS BAY

USGS Quad: POTLATCH, 15'
COE Photo #: S87-009-22-15
S87-009-23-1,3

a) Skokomish River Mouth: On both sides of the river at its mouth there are diked lands which are currently under active cultivation. The extent of tidal influence if the dikes were removed is unknown, however the northern-most limits of the diked areas indicate continued saturation. Given the proximity of these sites to the existing estuary, it is assumed that tidal influence would be readily restored if the dikes were removed.

The site north of the river mouth is approximately 20 acres in size, the one to the south is approximately 30 acres.

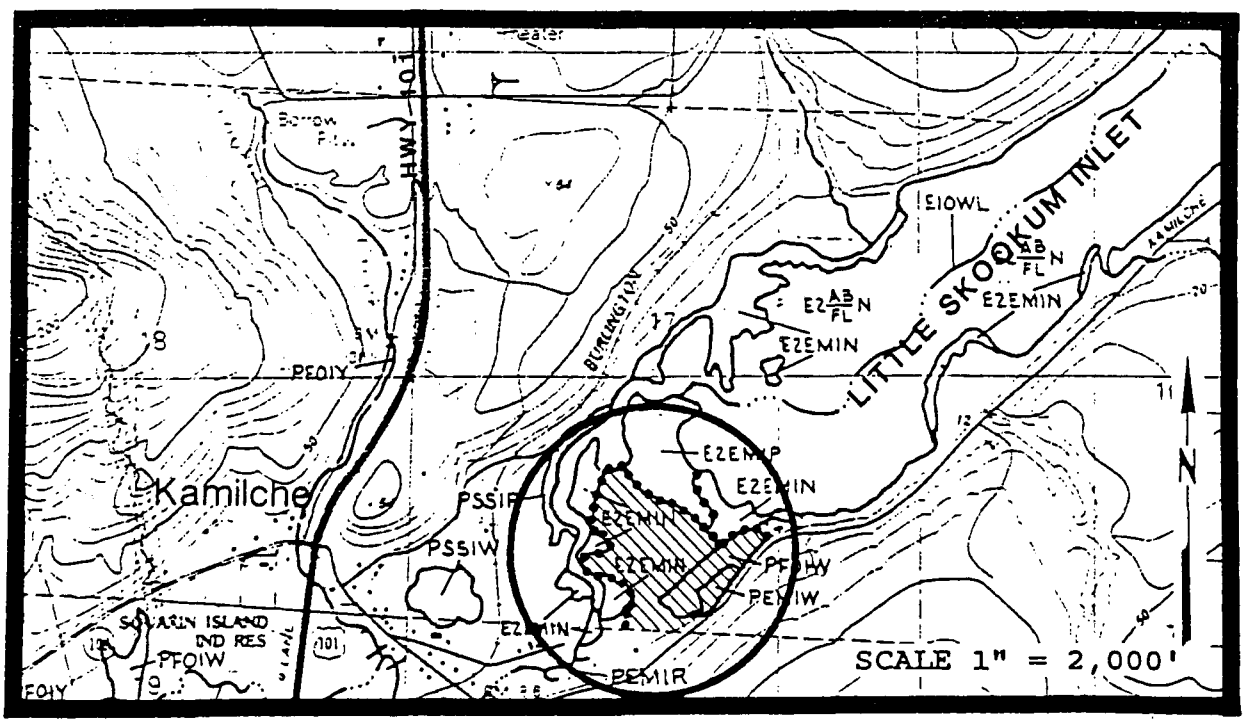


16) ANNAS BAY, WASHINGTON

17) LITTLE SKOOKUM INLET

USGS Quad: SHELTON, 7.5'
COE Photo #: S86-020-41-5
(note: photo is 1986)

The area is not identified as wetland or as diked in the NWI or on the USGS quad map; however, the aerial photo shows clearly that the area is diked and currently used for pasture. Removal of the dike would restore the area to tidal influence. A field check would verify the assumption of the presence of the dike. The area is just under 20 acres.



17) LITTLE SKOOKUM INLET, WASHINGTON

PIERCE COUNTY

18) NISQUALLY

USGS Quad: NISQUALLY, 7.5'
COE Photo #: S87-009-33-1
S87-009-34-19,21

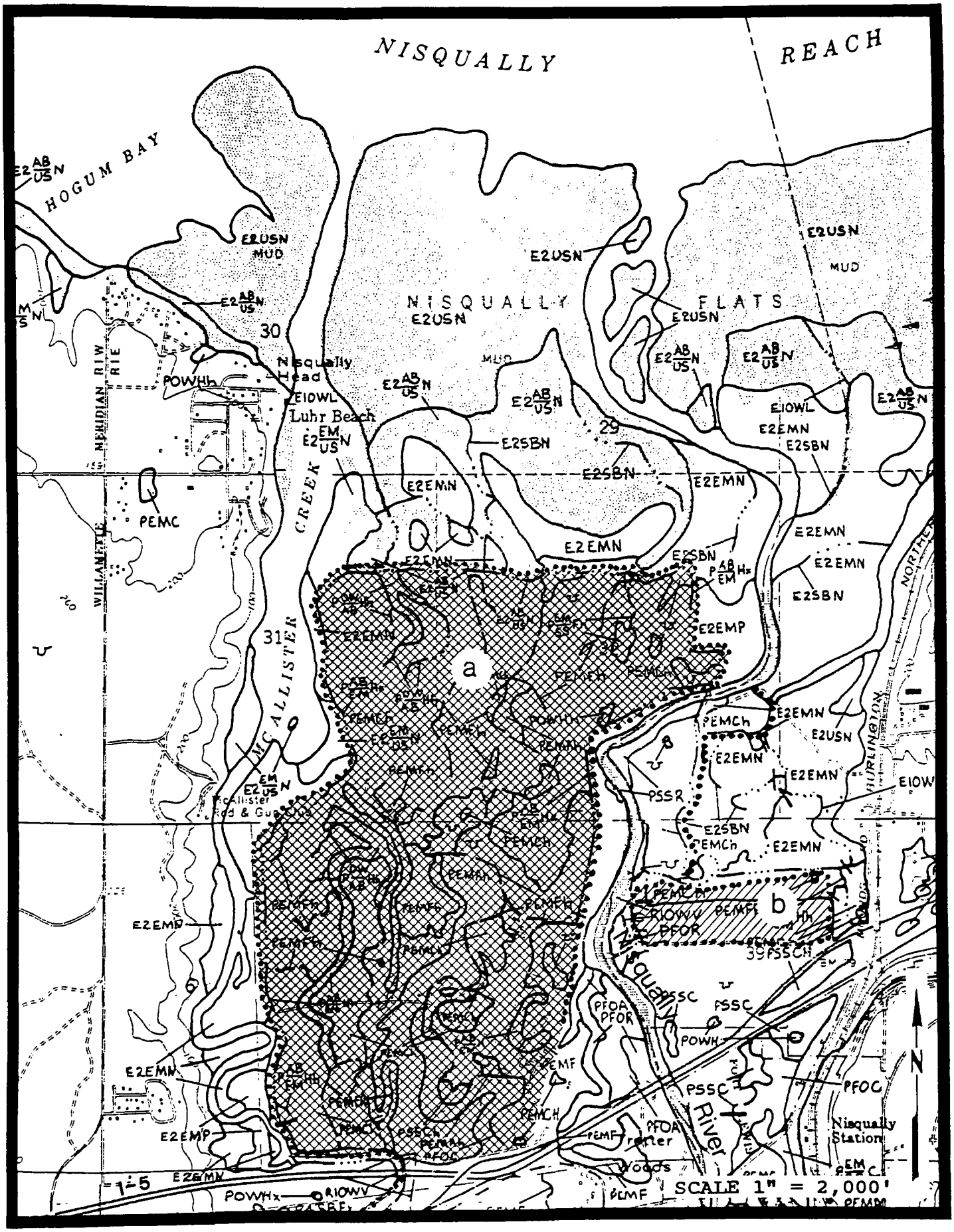
a) Nisqually Refuge: The first area to be impounded within the estuary was diked in 1904. The estuary continued to be further diked and converted to agricultural uses until the 1960s (Bortleson, 1980). According to Burg (1984), there has been a 55 percent reduction in estuarine system habitats within the delta since 1878. She states that estuarine emergent habitat has been reduced by 56 percent as a result primarily of diking. When active agricultural use ceased, the area within the dikes converted to freshwater marsh and old pasture complex. From December 1975 to June 1977 the dike was breached, and salt marsh vegetation began to reestablish. Repair of the dike in 1977 curtailed any further saltmarsh re-establishment in the area (Bortleson, 1980; Burg, 1984).

Currently within the diked sections of the Refuge the area is actively managed to attempt to maintain the freshwater wetland. From the historical record and more detailed recent studies (Burg, 1984), it is clear that the estuary would simply restore itself if the dikes surrounding this area were removed.

The entire area occupied by the Refuge would likely not revert to an estuarine system, as portions of the area were historically surge-plain wetlands and upland. Therefore size approximations and mapping are on a gross scale. There is a potential for several hundred acres of restoration within the refuge.

The issue of restoring the refuge to its former estuarine status is a controversial one; therefore, use of the Refuge as a restoration site is more a question of the political feasibility rather than its biological viability.

b) East of the main river channel: This area is mapped in the Bortleson (1980) report as wetland historically, but the aerial photograph indicates the area has been diked and is currently in agricultural use. From the historical mapping it would appear that primarily the northeast corner of this area was formerly saltwater wetland (Burg, 1984). It is an area of approximately 35 acres.



18) NISQUALLY, WASHINGTON

SKAGIT COUNTY

19) PADILLA BAY

USGS Quad: ANACORTES, SOUTH, 7.5
BOW, 7.5'
LaCONNER, 7.5'
COE Photo #: S87-009-69-21,23
S87-009-92-3,5,7

The entire shoreline of the east shore of Padilla Bay is diked, and behind the dikes are extensive areas of agricultural use. This area is not covered within the Bortleson report (1980), so it is difficult to assess the former extent of tidal influence except where the topography clearly dictates tidal limits.

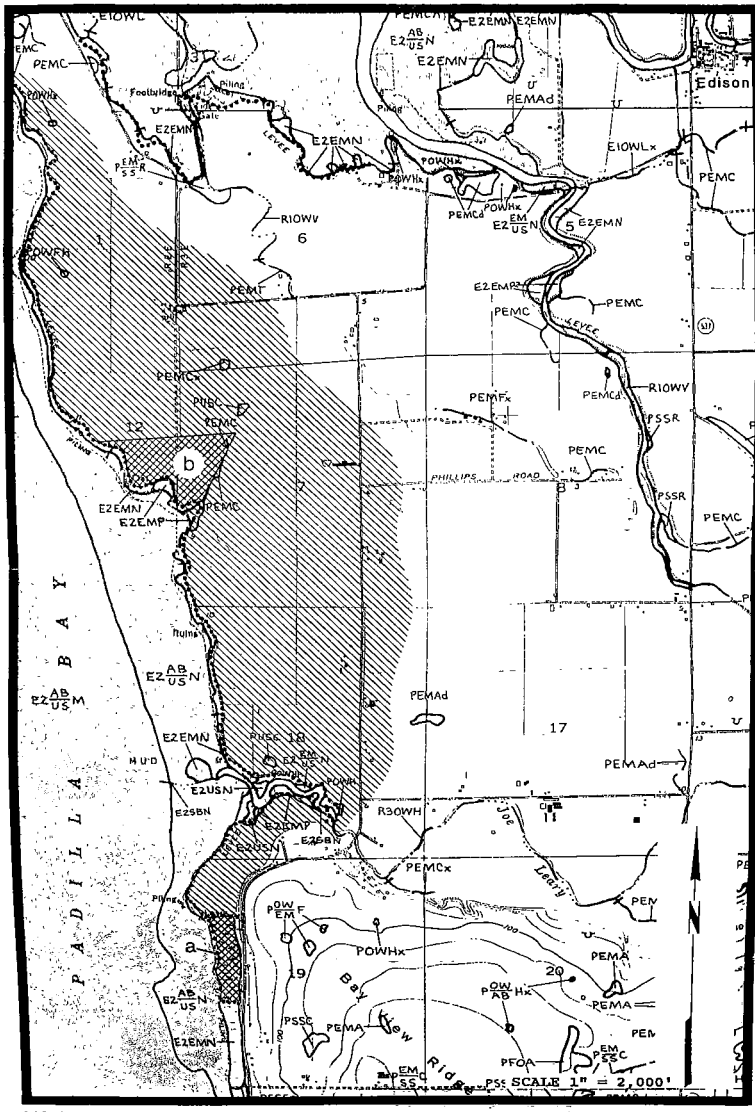
Tidal influence along the shoreline may be limited. It is assumed, however, that some tidal range could be restored to some of the former sloughs and channels.

Only two potential restoration sites were identified within the Bay as the vast majority of the area is within active agricultural use or has been filled and is outside the scope of this inventory.

The southern limits of the Bay at the mouth of the Swinomish Channel is mapped and discussed below (Swinomish Channel, #22). It will be noted here that this area as well, is extensively diked and used for agricultural purposes. Tidal influence along the shoreline would possibly be limited; however, the range would be more extensive up the channels and sloughs.

a) South of Joe Leary Slough: This area is approximately 20+ acres of formerly diked lands where the dikes have not been maintained and estuarine vegetation is already re-establishing itself. Removal of the remaining dikes would allow further tidal influence within the area.

b) North of Joe Leary Slough: Although this area is mapped as diked upland, the aerial photo indicates that the area is saturated and severely channelized. Removal of the dikes would restore approximately 35+ acres to tidal influence.



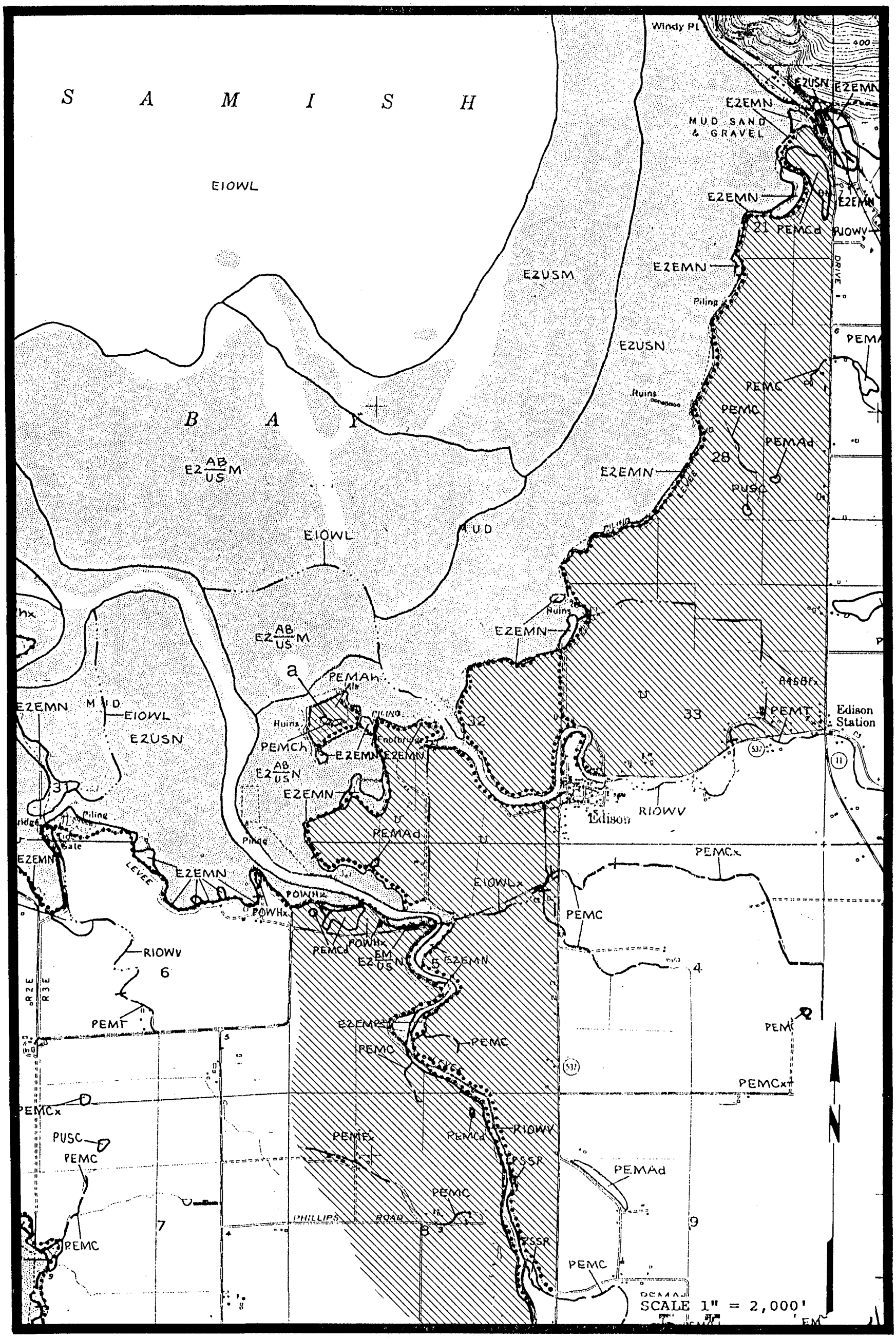
19) PADILLA BAY, WASHINGTON

20) SAMISH RIVER

USGS Quad: BOW, 7.5'
COE Photo #: S87-009-92-5
S87-009-92-7

The Samish River and Samish Bay have all been diked, and the lands behind the dikes are primarily used for agricultural purposes. The only specific potential restoration site identified is a small palustrine emergent marsh on a small island which has been completely diked. No active use was identifiable from a review of the aerial photograph. It is unknown whether the palustrine site or that portion of the diked island which used to be within tidal influence would be able to be restored to tidal influence. The small pond area labeled as "a" on the map is less than 5 acres.

The former or anticipated range of tidal influence is unknown, therefore the mapping of agricultural lands extends eastward to known obstructions such as roads. This mapping is clearly an approximation and is not based on available historical mapping. Size approximations are not provided because of the degree of uncertainty of restoration potential.



20) SAMISH RIVER, WASHINGTON

21) SKAGIT RIVER

USGS Quad: CONWAY, 7.5'
USTALADY, 7.5
COE Photo: S87-009-63-9,11,13
S87-009-65-3

Like the majority of the major river deltas on Puget Sound, the Skagit estuary has been extensively diked and converted to agricultural uses since 1889, (Bortleson, 1980). Most of the delta continues to be used for active cultivation. These extensive, actively cultivated fields have not been included within this inventory as potential restoration sites.

The southern half of the delta, south of Freshwater Slough and the southern half of Milltown Island, have been diked since the 1889 mapping. Both of these areas are indicated as non-impounded wetland in the historical mapping.

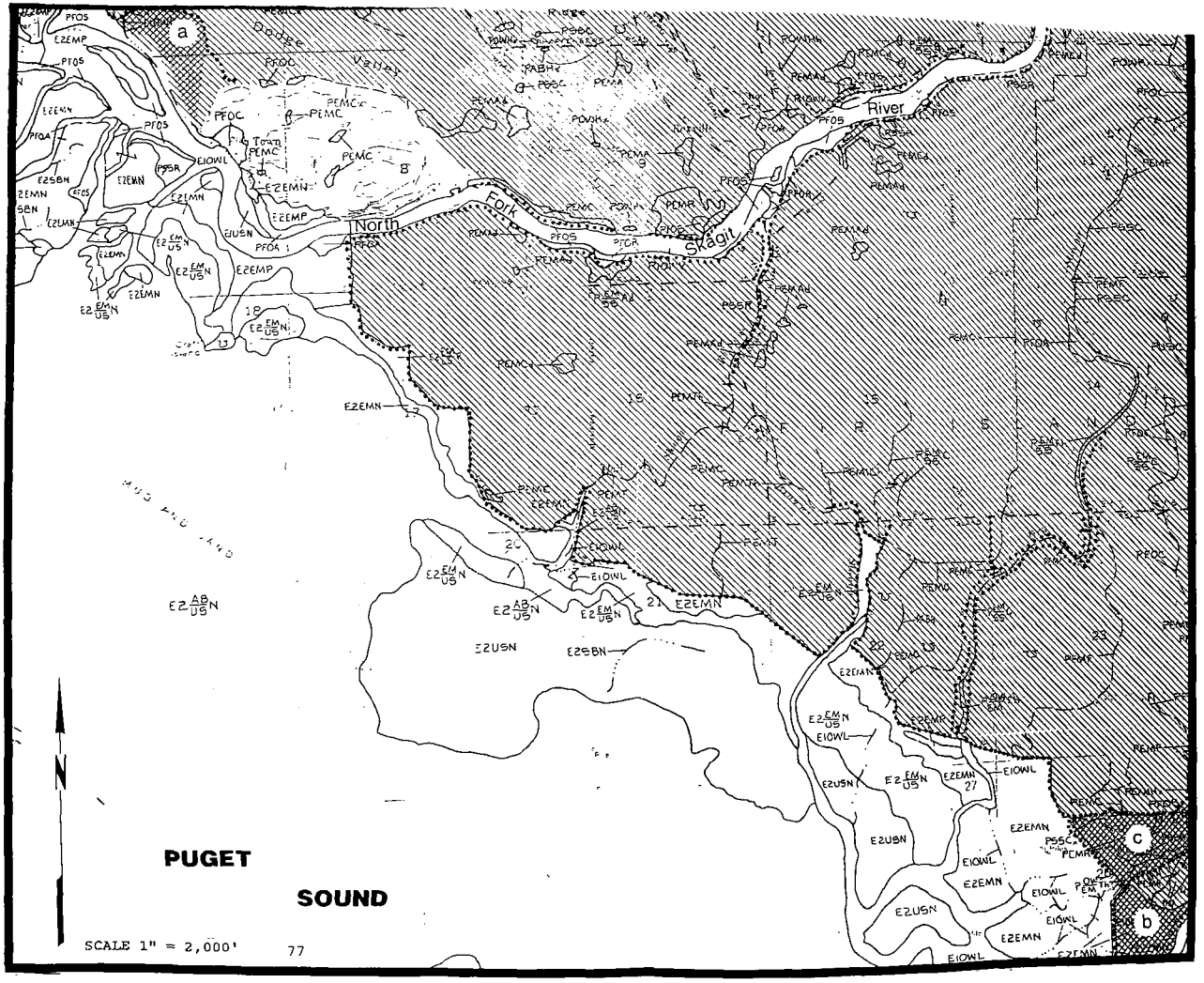
It is assumed that the wetlands within the braided channel systems of the delta were primarily estuarine prior to any diking. As noted previously, the action of diking and years of agricultural uses alters the soil complexity to a degree that may be irreversible in a mitigation time frame.

The previous extent of estuarine systems was not assessed within the scope of this preliminary study; thus, no acreage estimates have been given for potential restoration area. There may be small areas of potential restoration adjacent to some of the slough channels and bayward of the dikes. These areas could only be identified with field work, as they were not discernable from the scale of mapping and aerial photography available.

a) Dodge Valley: This site is located north of the mouth of the North Fork, at the west end of Dodge Valley. It is mapped as estuarine in the NWI; however, review of the aerial photograph reveals that the area has recently been converted to agricultural use. Removal of the dikes would restore the area to tidal influence. The site is over 40 acres.

b) Lower North Freshwater Slough: This area is located north of Freshwater Slough, and it is mapped by the NWI as estuarine. The aerial photo indicates that tidal action is still restricted by the presence of the old dikes. Restoration could be accomplished by further breaching or removal of the dikes to increase tidal influence. Field review is required to determine restoration potential. Area is over 40 acres in size.

c) Upper North Freshwater Slough: This area is north of (b), above. It is mapped by the NWI as a mosaic of palustrine wetlands, old channels, and agricultural lands. Review of the aerials indicates a complex mosaic of vegetation and water patterns. Removal of the dikes would restore the area to tidal influence. The site is greater than 60 acres.



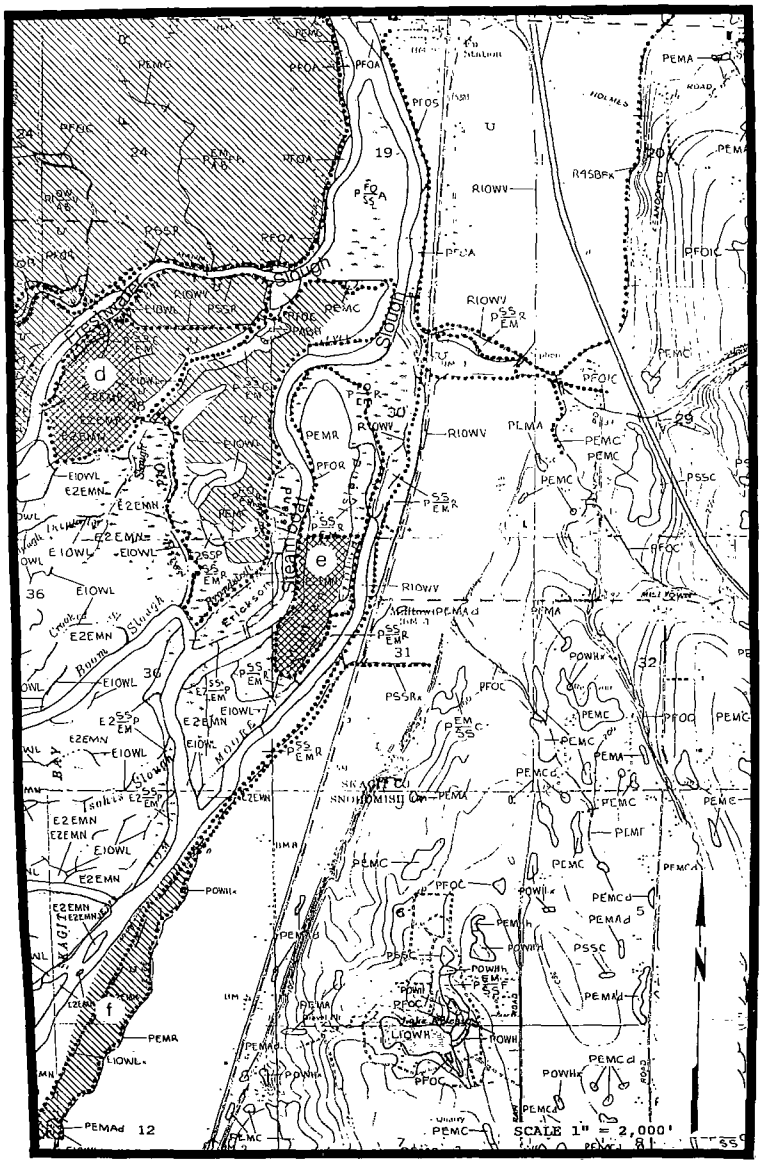
21) SKAGIT RIVER, WASHINGTON

21) SKAGIT RIVER (cont'd)

d) South of Freshwater Slough, north of Deepwater Slough: This is an area which was not diked in the 1889 mapping; it is indicated as being diked presently. From the aerial photos, it appears that the dikes are in disrepair and/or the tide gates are malfunctioning. The vegetation is diverse and the area appears to be saturated. Field checking would verify the current condition and assess the restoration potential. The area is approximately 60+ acres.

e) The middle third of Milltown Island: This area has been diked and apparently used as a settling pond for the adjacent pulpmill. The pond is no longer in use by the mill, and it has been mapped as a freshwater system by the NWI. Removal of the dikes around the impoundment would restore tidal influence; however, the water and substrate quality within the old settling pond could pose a potentially significant problem. Detailed study and field work would be required to assess the restoration potential of the area. It is approximately 30+ acres in size.

f) South of Moore Slough: This area is in the southernmost slough of the delta. It is mapped as wetland in the 1889 mapping (Bortleson 1980), but it is currently in agricultural use. Removal of the dikes would restore tidal influence. Area is greater than 30 acres in size.

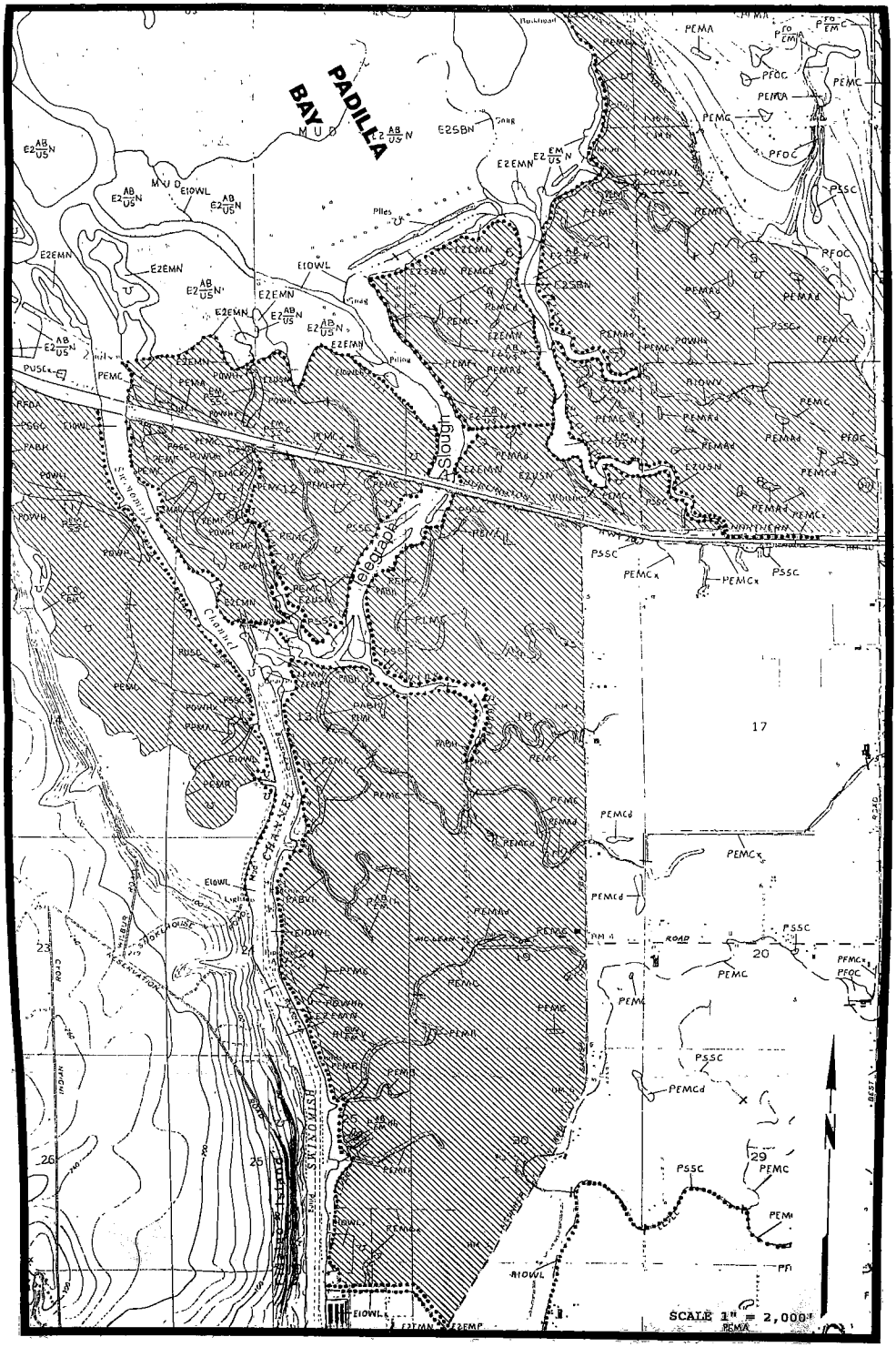


21) SKAGIT RIVER, WASHINGTON (CONTINUED)

22) SWINOMISH CHANNEL

USGS Quad: LaCONNER, 7.5'
COE Photo #: S87-009-69-21,23
S87-009-92-3,5,7

The area surrounding the Swinomish Channel, including Telegraph Slough, Indian Slough, and the southern reach of Padilla Bay, has been thoroughly diked and converted to agricultural use. Review of the aerial photos does not indicate any clear potential restoration sites. The entire area is actively cultivated or in agricultural use such as pasture or hayfield. None of the fields or pastures indicate unmaintained dikes or non-functioning tide-gates, therefore no likely potential restoration sites were discernable. It is unknown to what extent tidal influence would be restored if the dikes were removed. No estimate of potential acreage was calculated.


PADILLA
BAY
MUD
Slough
Channel
CHANNEL
SCALE 1" = 2,000'

SNOHOMISH COUNTY

23) STILLAGUAMISH RIVER

USGS Quad: JUNIPER BEACH, 7.5'
UTASLADY, 7.5'
STANWOOD, 7.5'
COE Photo #: S87-009-63-5,7
S87-009-69-33

Much of the delta has been diked and converted to agricultural uses since the early 1870's (Bortleson 1980). Agricultural use is still the primary land use within the delta; much of the former estuary is within active cultivation and pasture lands. Restoration potential for much of the area is unknown because of the extent of the diking and subsidence which has occurred.

a) Lona Beach: This area is completely diked according to the quad map. The NWI indicates the northern portion of the area as estuarine. The Bortleson report (1980) indicates that the entire area in the historic mapping was wetland. The potential of restoring the area is diminished because of the presence of residences and their associated septic systems on what used to be the old natural berm. Field review would provide specific information on the potential of restoring greater tidal influence into the area which still maintains the estuarine characteristics. The area is over 75 acres.

b)-d) These areas were mapped as wetland in 1886, but they are now in agricultural use. It is unknown to what extent tidal influence would be restored if the dikes were removed. Sites range from over 30 to over 50 acres in size.

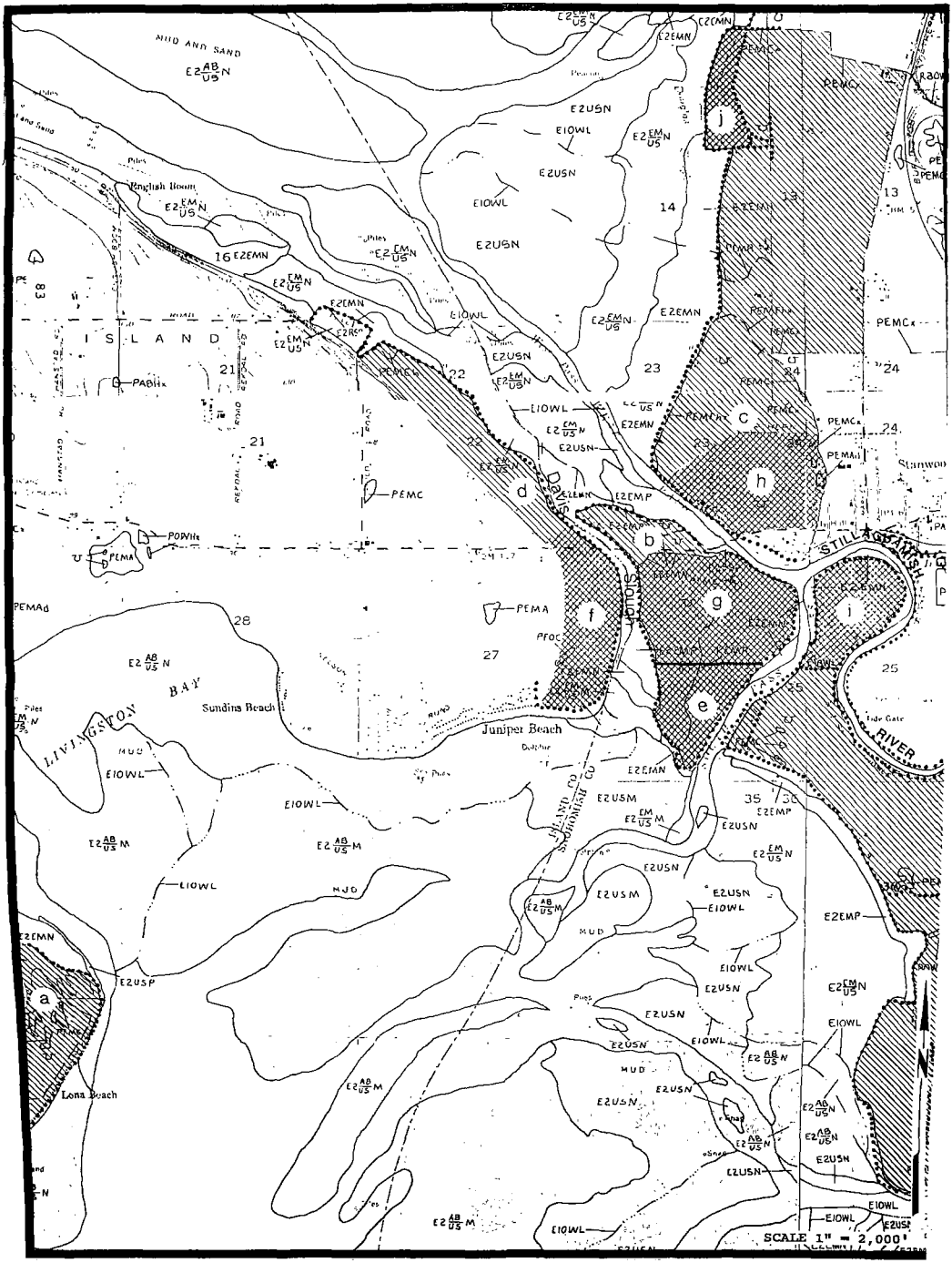
e) North of the mouth of South Slough: This area is diked; however, the aerial photos indicate that the dikes may be in disrepair. The vegetation indicates some diversity. Field review would confirm existing conditions and the potential of restoring tidal influence by removal of the dikes. The site is approximately 60 acres in size.

f)-h) these lands were diked prior to the 1886 mapping. It is assumed that they were previously wetland and the potential exists to remove the dikes and restore tidal influence. Each area is over 100 acres in size.

i) East of the confluence of West and South Sloughs: From the aerial photographs, this area appears to be old fallow pasture. Field review is necessary to determine the potential of restoration and the feasible extent of tidal influence. The area is approximately 60 acres.

j) Douglas Slough. This site is northeast of the mouth of the West Pass of the Stilliguamish, east of Douglas Slough. The area is mapped as estuarine in the NWI; however, the aerials indicate that the area is currently being used for agricultural use. Removal of the dikes would restore tidal influence in the area. The site is approximately 25 acres in size.

The vast majority of the delta is in active agricultural use and as such has not been mapped as potential restoration for the purposes of this inventory.



23) STILLAGUAMISH RIVER, WASHINGTON

24) SNOHOMISH DELTA

USGS Quad: MARYSVILLE, 7.5'
COE Photo #: S87-009-56-3
S87-009-57-5,7

In 1884-85 virtually the entire Snohomish River delta, south to the confluence of the main channel and Ebey Slough, was mapped as wetland (Bortleson, 1980). Because there is no distinction in the historic mapping between freshwater and estuarine wetlands, it is difficult to determine the former extent of saltwater influence. The entire delta is mapped as hydric soils within the SCS Soil Survey (1983).

Currently the entire delta, with the exception of the mouth of the junction of Steamboat and Ebey Sloughs, has been diked and converted to non-wetland status, primarily agricultural uses. The mouths of Steamboat and Ebey Sloughs remain as natural estuarine systems, the last undiked segments of what used to be an extensive wetland delta system of approximately 15 square miles (Bortleson, 1980).

For the purposes of this inventory, the extensive area which has been converted to agricultural uses has not been mapped in its entirety, because much of it is in active cultivation. The southern reaches of the estuary are unlikely to provide potential restoration sites; however, detailed field work and further research beyond the scope of this study would be required to confirm this assumption.

Portions of the delta adjacent to the harbor and the river mouth are currently used for industrial purposes. Log storage areas, settling ponds, active dredge disposal sites, and similar sites were not reviewed or identified for their restoration potential.

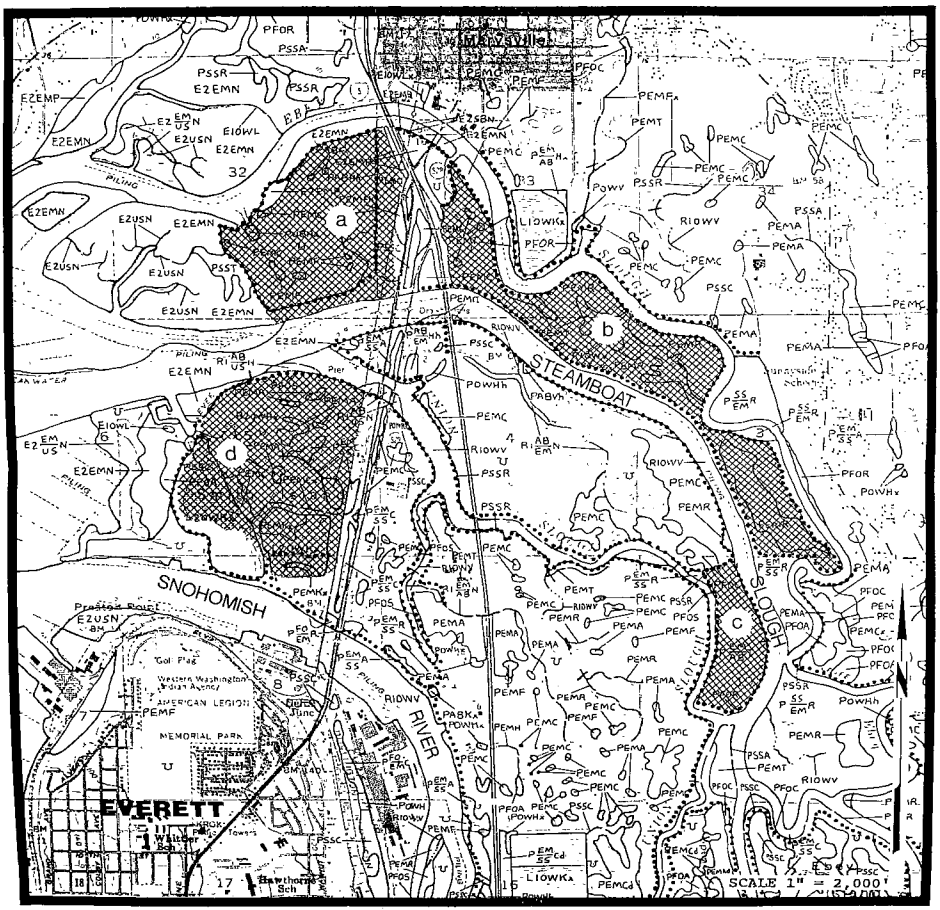
Based on a review of the aerial photographs, the following potential sites have been identified near the mouth of the delta in the vicinity of Interstate 5 (I-5).

a) West end of Spencer Island, just east of the remaining natural estuary: From the aerials the site appears to be cleared. It may be a dredge disposal site, although it is not identified as one in the FEIS for the Everett Harbor and Snohomish River Navigation Project (USCOE, 1975). Field review is required to determine existing conditions and whether the site provides any restoration potential. The site is over 120 acres.

b) North of Steamboat Slough, east of I-5, south of Ebey Slough: This area is mapped as palustrine scrub/shrub and emergent in the NWI. The aerials indicate that the sites have good vegetation diversity. Removal of the dikes would restore tidal influence, which would significantly alter the vegetation community structure.

c) South end of Spencer Island: This area was recorded as diked land in the 1884 historical mapping (Bortleson 1980). It does not appear to be currently in use for agriculture from review of the aerial photographs. Removal of the dikes would restore the area to tidal influence. The area is less than 50 acres.

d) Smith Island: The area of Smith Island, to the west of I-5, contains a variety of land uses. Freshwater ponds diked off from the estuary are present, as is what may be an old disposal site. Without further data as to the historic or current function of the ponds and the use of the cleared areas this site can only be labelled as a potential restoration site pending further data. The area is over 100 acres.



24) SNOHOMISH DELTA, WASHINGTON

GRAYS HARBOR COUNTY

25) CHEHALIS RIVER

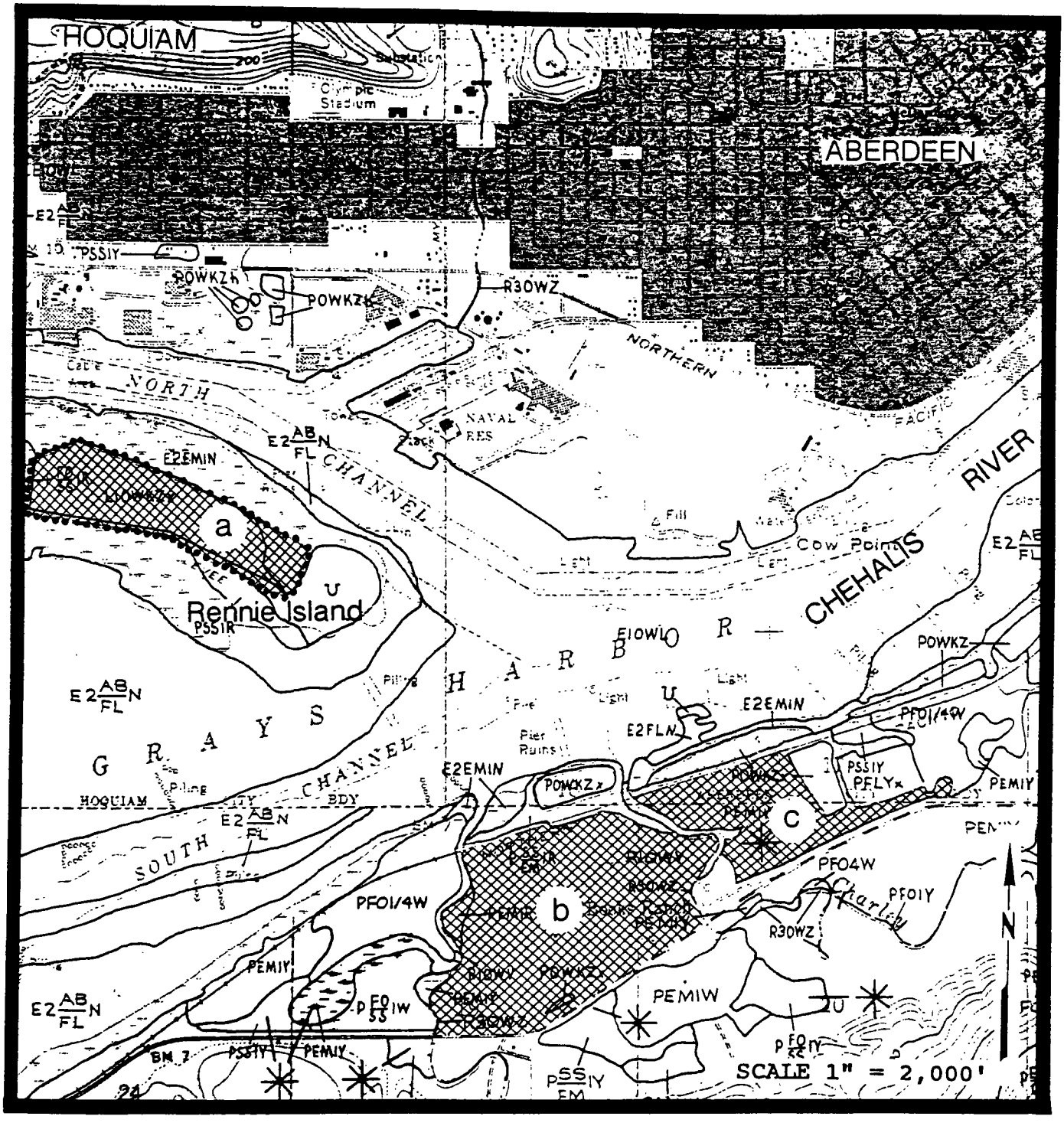
USGS Quad: ABERDEEN, 7.5'
COE Photo #: 87-009-96-3

a) Rennie Island: There is an old holding pond on the island which has been diked. The edges of the island, outside of the dikes, are mapped as estuarine in the NWI. It is therefore assumed that at least a portion of the diked area would also fall within tidal influence. There is potential concern regarding residual toxic sediments within the settling pond, so more detailed analysis of the site's restoration potential would be required. This site is identified as mitigation site N10 in the Grays Harbor Estuarine Management Plan (GHEMP) (1982). Area is approximately 40 acres in size.

b) Books Ranch: This area is not shown on the USGS quad map as diked, nor does the NWI indicate it as wetland. The aerial photographs, however, indicate the presence of what appears to be dikes. Field verification is required to determine the actual restoration potential.

c) South of the railroad: The railroad appears to be functioning as a levee, as the land to the north is mapped as estuarine and to the south as palustrine or upland. To the south of the railroad and east of Books Ranch is an area of approximately 40 acres which is mapped by the NWI as palustrine. There is the potential of placing culverts under the railroad grade or removing tide gates, if they exist, to restore this area to tidal influence. Field verification would be required.

North and east of (c) above, there are several freshwater open water ponds mapped by the NWI. These are located both north and south of the railroad line. Their current and historical use is unknown; the potential may exist to restore these areas to tidal influence.

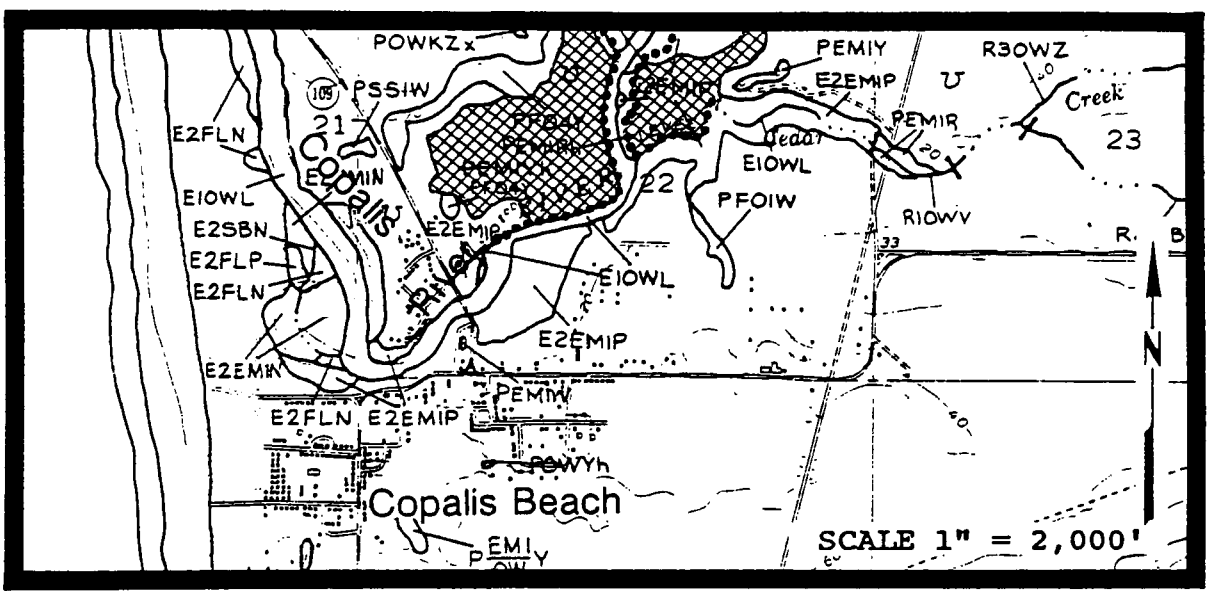


25) CHEHALIS RIVER, WASHINGTON

26) COPALIS RIVER

USGS Quad: COPALIS BEACH, 7.5'
COE Photo #: S87-009-100-11

There are two areas north of the river which appear to be within tidal range if the dikes around them were breached. The larger of the two is approximately 40 acres and is mapped in the NWI as palustrine emergent. The smaller system to the northeast of the river is not mapped in the NWI as wetland, and field verification is necessary to determine if restoration is possible. The larger area to the west of the river is approximately 40 acres in size, the smaller area to the east is less than 25 acres in size.



26) COPALIS RIVER, WASHINGTON

27) GRASS CREEK

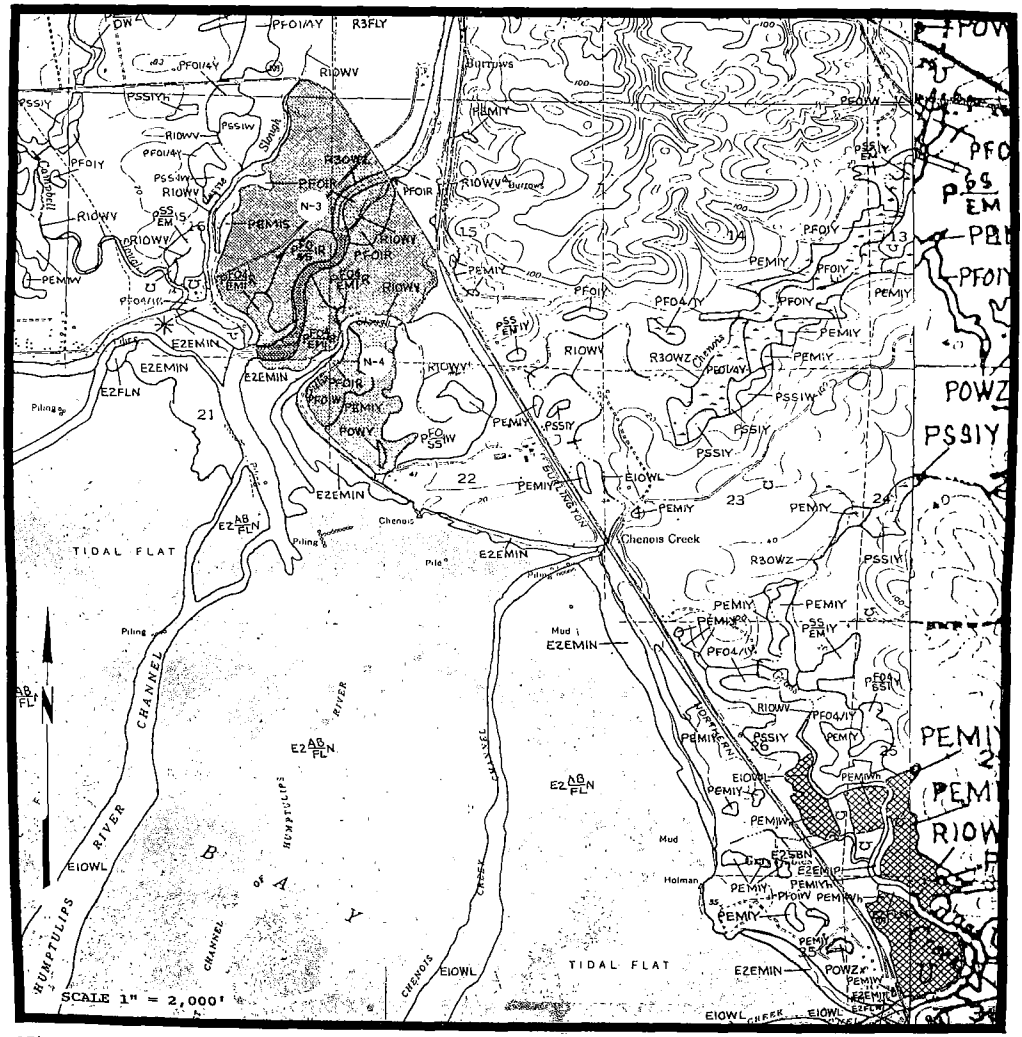
USGS Quads: COPALIS CROSSING, 7.5'
HUMPTULIPS, 15'
COE Photo #: S87-009-101-7

(a) There are four pasture areas located along Grass Creek which are mapped as impounded freshwater wetlands. The USGS quad, which is the base map for the NWI maps, does not indicate these areas as being diked. The aerial, however, indicates the presence of dikes.

All four sites are currently in use for agricultural purposes. All would appear to provide some restoration potential if the dikes were removed or breached. The GHEMP (1982) also identifies these areas adjacent to Grass Creek as mitigation sites.

The areas vary in size: two are approximately 15 acres each piece, one is over 40 acres, and the other is over 20 acres. It is unknown to what extent tidal influence would extend.

The GHEMP (1982) also identifies potential restoration sites within the delta of the Humptulips River. It identifies (but does not specifically map) diked lands within the delta and just to the southeast of the main channel of the river as GHEMP Mitigation Sites N3 and N4. It notes that N4 may provide the best potential mitigation site in the entire estuary. It is assumed that the more detailed analysis done for the GHEMP provides accurate field assessment of these sites.



27) GRASS CREEK, WASHINGTON

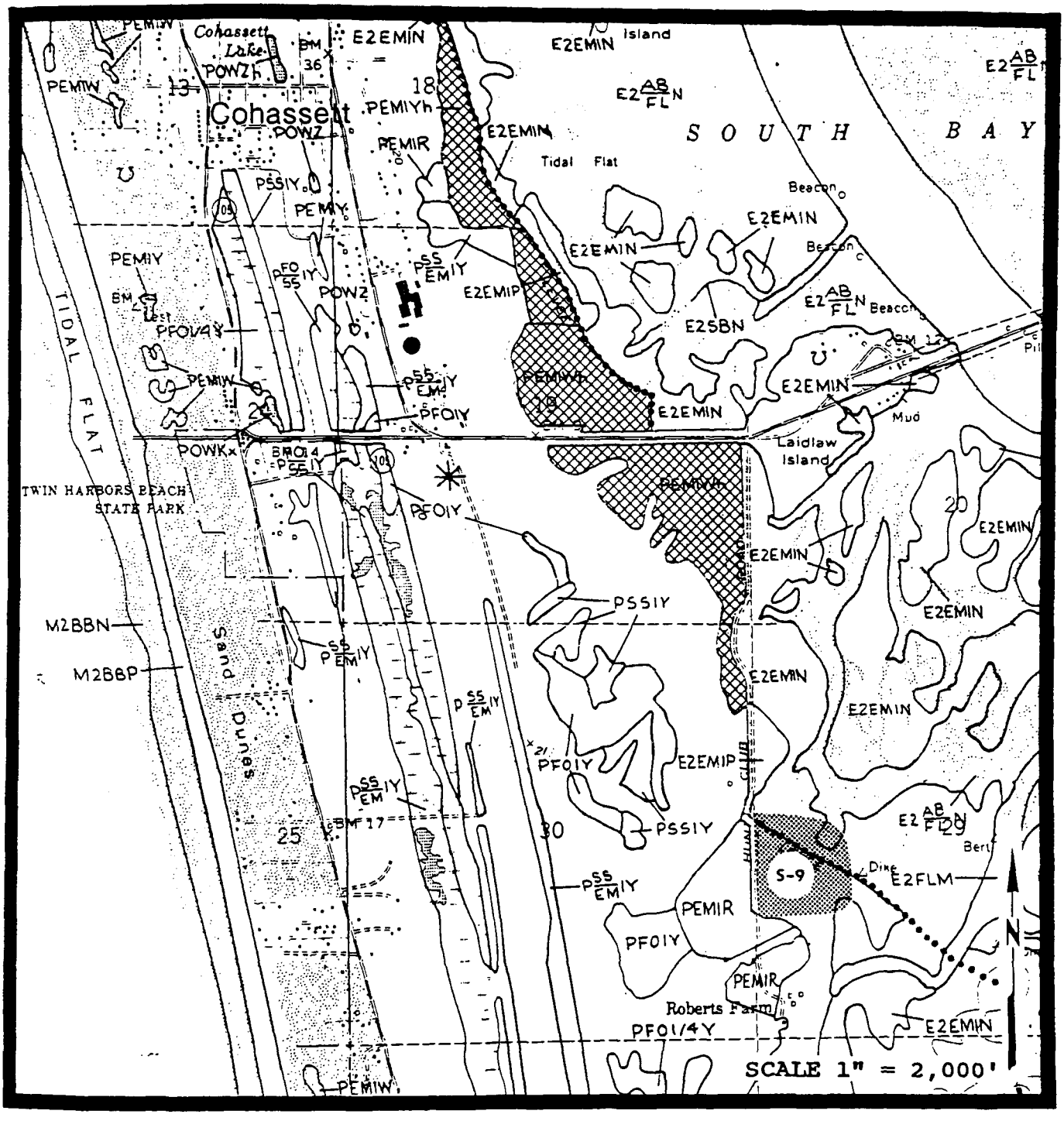
28) SOUTH BAY

USGS Quad: GRAYLAND, 7.5'
COE Photo #: S87-009-99-3

These sites are located along the southwest shore of South Bay of Grays Harbor. The areas are not agricultural lands but are mapped by the NWI as freshwater wetlands which have been formed behind the dikes and roadways along the bay shore. Removal of the tidegates and breaching of the dikes would restore these areas to tidal influence. It may be necessary to place culverts under the existing roadway, if none exist, in order to restore tidal influence.

The conversion of functioning freshwater systems to estuarine systems requires a detailed analysis of the potential values and functions anticipated in comparison to those being provided by the existing system.

The GHEMP (1982) identifies these areas as mitigation sites S10 and S11. The sites total more than 120 acres. The GHEMP (1982) also identifies mitigation site S9 to the south as a diked pasture area with potential for restoration to tidal influence. This site is estimated to be 47 acres (GHEMP 1982).



28) SOUTH BAY, WASHINGTON

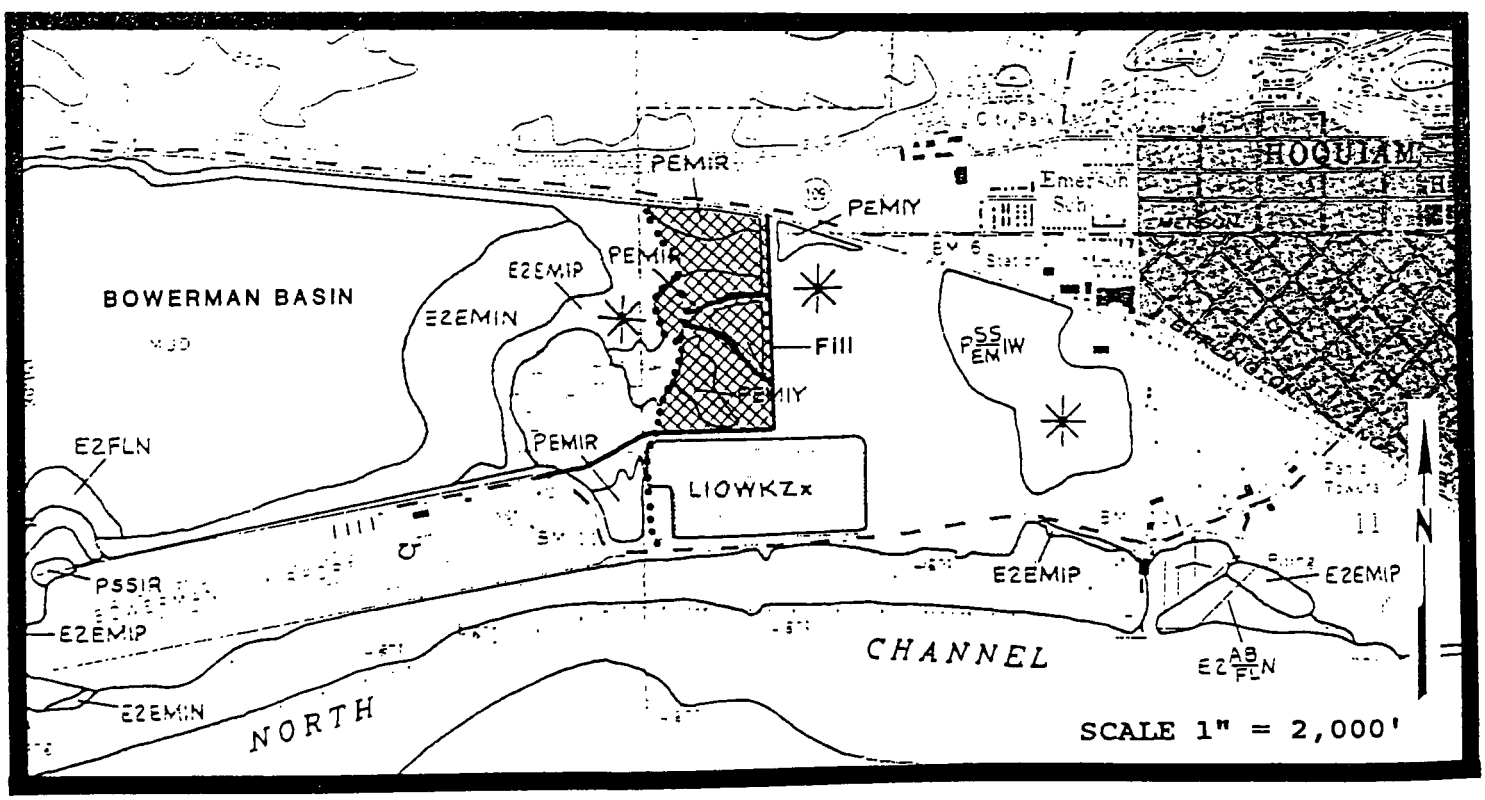
29) BOWERMAN BASIN

USGS Quad: HOQUIAM, 7.5'
COE Photo #: S87-009-103-5

To the east end of the basin there is a dike present which impacts the tidal range. Removal or breaching of the dike would restore at least a portion of this area to tidal influence.

The NWI maps two palustrine sites behind the dike, and the aerial indicates areas of fill as well. Restoration of estuarine flushing in this area would entail detailed field analysis including the feasibility of removal of the fill. The area is approximately 40 acres in size.

It is unknown what impact the newly created National Wildlife Refuge status will have on this area and its potential restoration. **



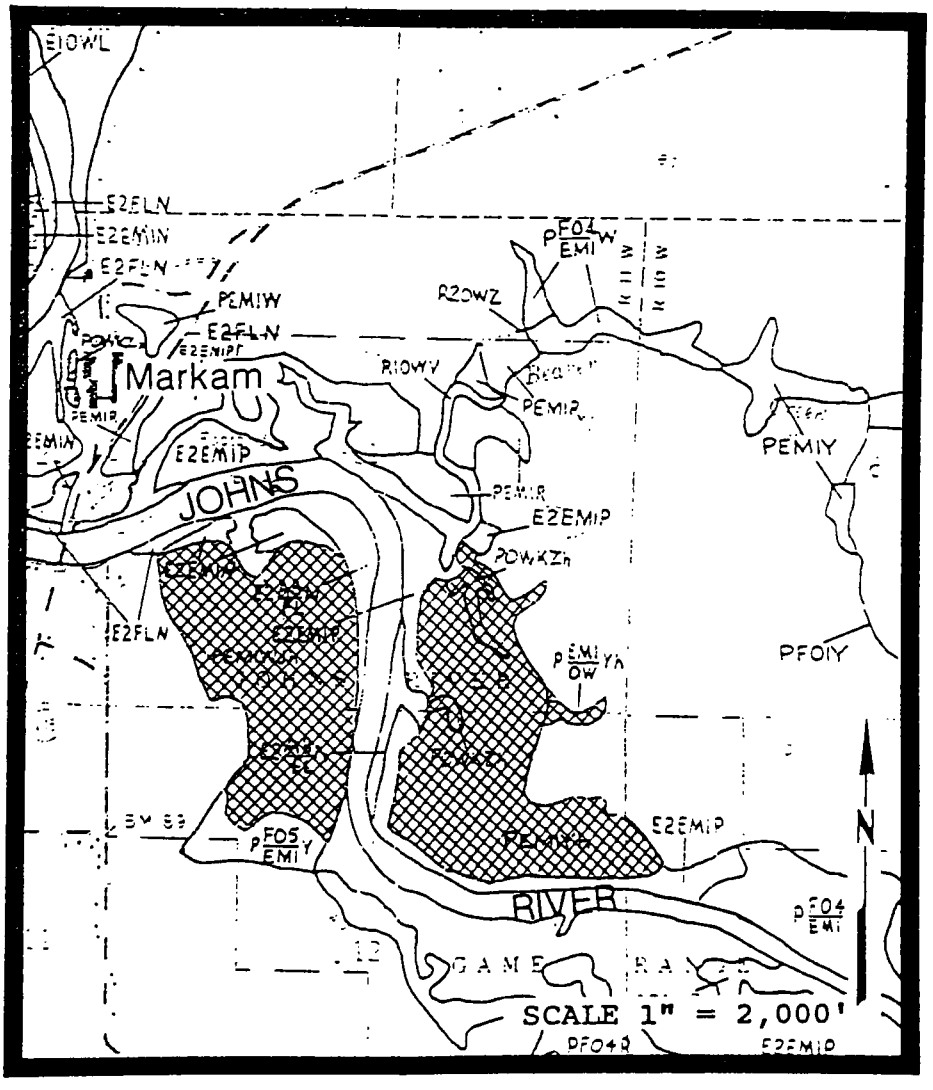
29) BOWERMAN BASIN, WASHINGTON

30) JOHNS RIVER

USGS Quad: HOQUIAM, 7.5'
COE Photo #: S87-009-96-9

There are two large sites on each side of the Johns River east of the main highway bridge. The sites are not mapped as diked on the USGS quad used as a base map for the NWI, however the aerials clearly show the presence of both dikes and extensive ditching on both sites. It is unclear from the aerial if the areas are currently used for hay fields. The vegetation appears quite regular and uniform. The NWI maps both areas as palustrine emergent freshwater wetlands.

Removal of the tidegates or breaching of the dikes would restore at least a portion of these areas to tidal influence. The river in this vicinity is mapped as estuarine. Total area of each site is over 60 acres. It is unknown how much of this area would actually be under saline tidal influence.



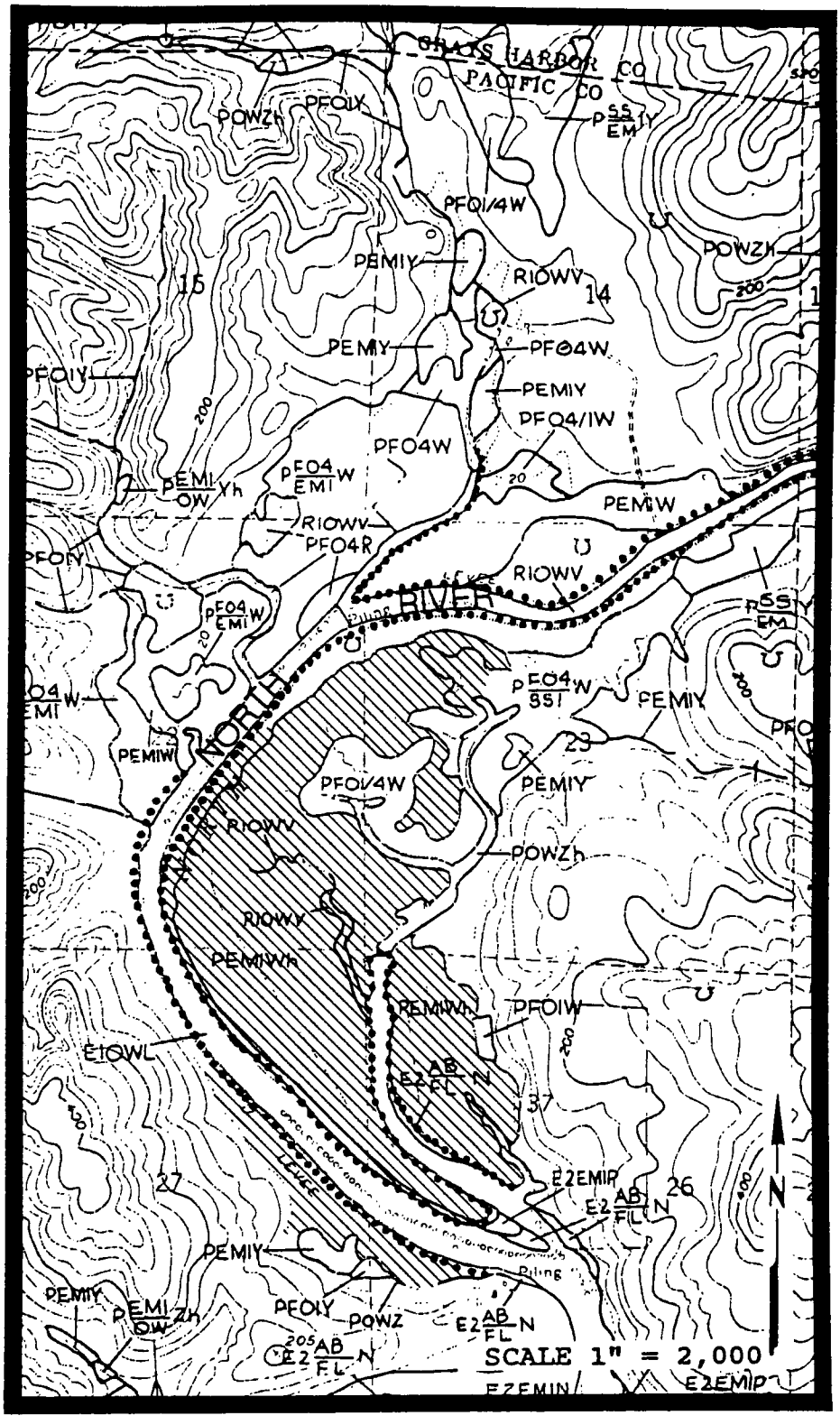
30) JOHNS RIVER, WASHINGTON

31) NORTH RIVER

USGS Quad: WESTERN, 7.5'
COE Photo #: S87-009-319-3

Two sites are mapped by the NWI as freshwater emergent wetlands; however, the aerials indicate that the areas may be used for pasture. Removal of the dikes along the river would restore tidal influence to these areas. The larger system north of the river is over 120 acres.

The smaller area to the south of the river shows a higher degree of saturation from review of the aerial. It is approximately 30 acres.



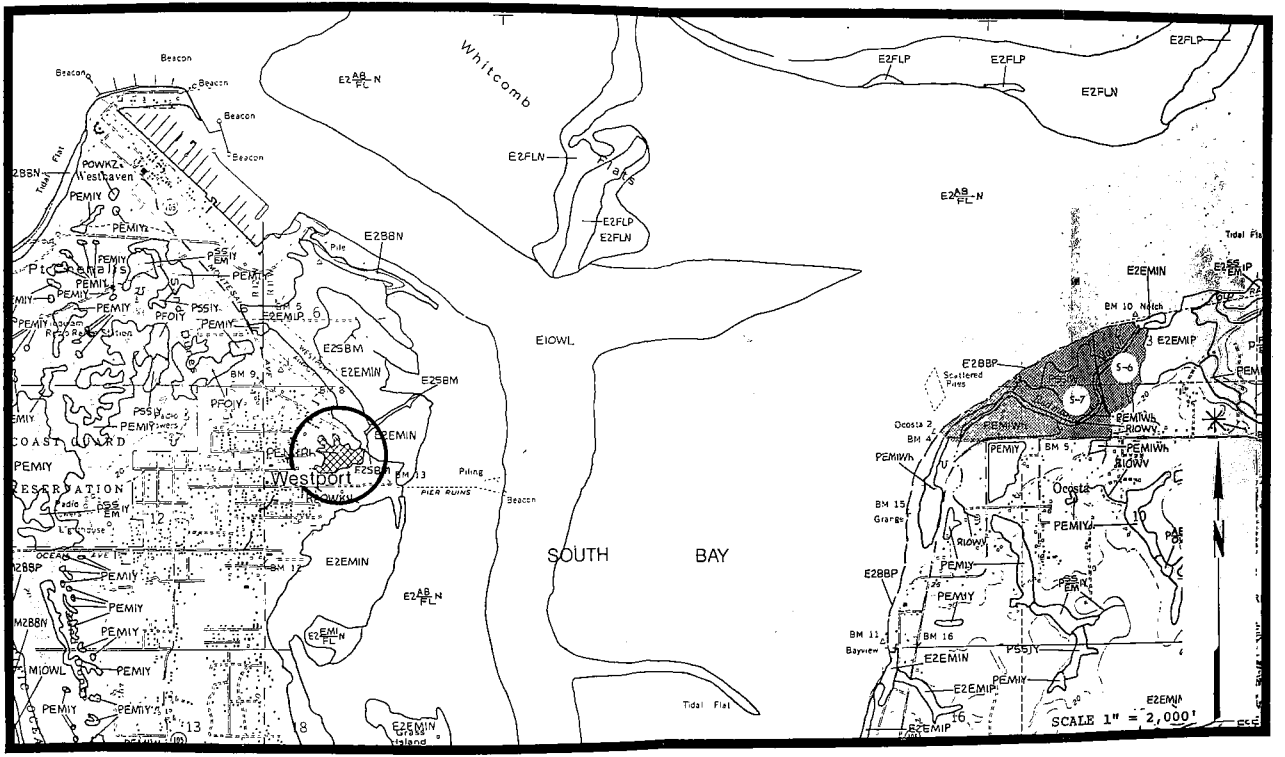
31) NORTH RIVER, WASHINGTON

32) WESTPORT

USGS Quad: WESTPORT, 7.5'
COE Photo #: S87-009-9,11

On the east side of the City of Westport the NWI has mapped a freshwater wetland as diked. The aerial indicates that the area may be at least partially former estuary. Removal of the dikes would restore a portion of the area to tidal influence. The total area is just over 10 acres.

The GHEMP (1982) identifies Mitigation Sites S6 and S7 on the east side of the bay, across from the town of Westport. It is noted that both areas are diked pastures. Site 6 is approximately 25 acres, site 7 is approximately 75. It is also noted that complex ownership patterns exist on these parcels.



32) WESTPORT, WASHINGTON

PACIFIC COUNTY

33) KINDRED SLOUGH

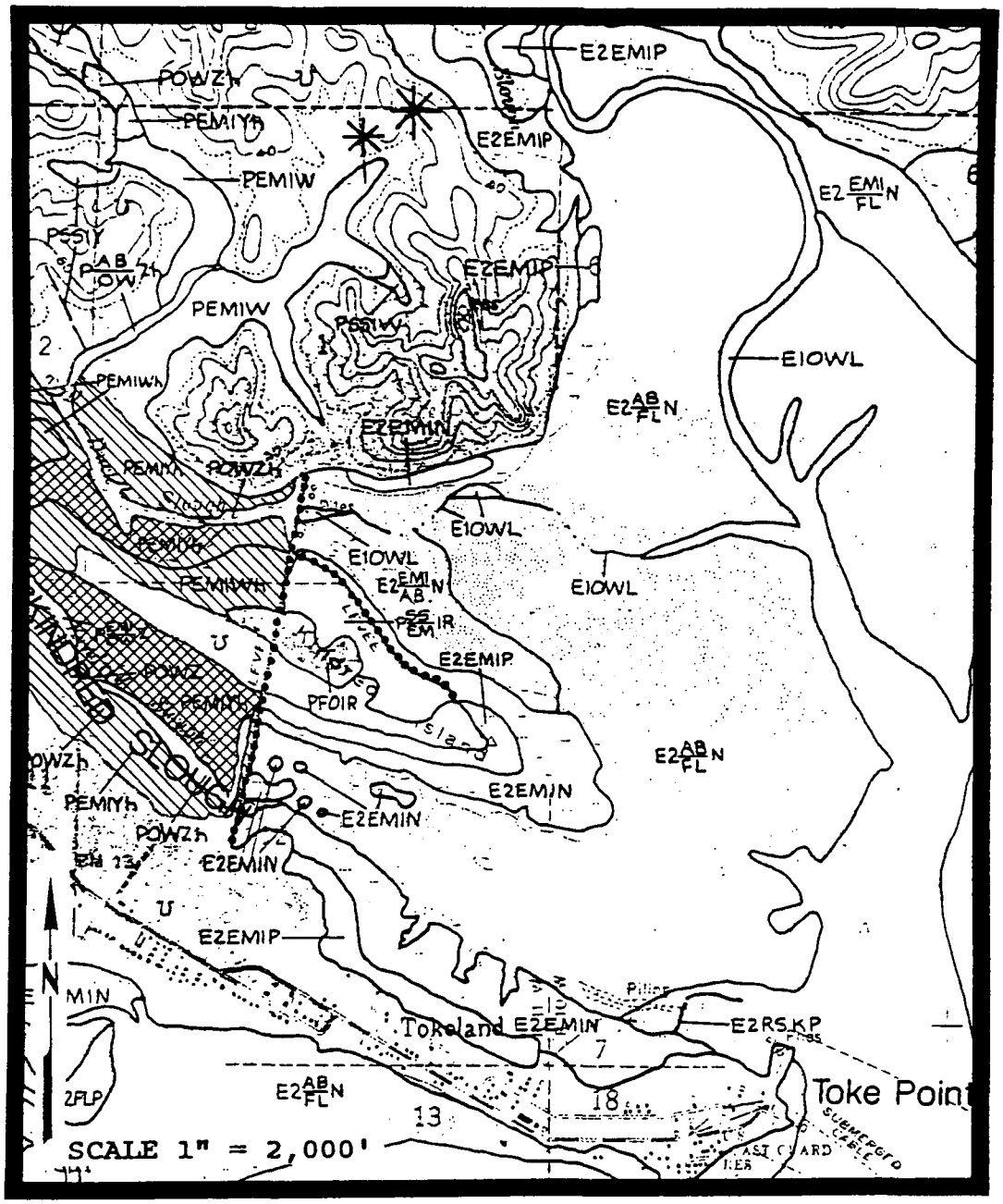
USGS Quad: BAY CENTER, 7.5'
COE Photo #: S87-009-118-5

The mouth of the Cedar River is diked in the area of Duck and Kindred Sloughs. The two areas mapped as potential mitigation on the north and south sides of Kindred Island may still be within agricultural use; however, the aerials indicate that the area is still very saturated and the channels are poorly maintained.

The areas to the north and south of the two mapped restoration sites are in agricultural use as well. The sites do not appear as saturated as are the labeled potential restoration sites, and therefore these areas are mapped as agricultural only. Tidal influence may be restored to all of these areas with removal of the dikes.

Total area is over 120 acres. Tidal influence would probably extend at least as far west as the roadway which crosses the estuary just to the west of the edge of the available map (not shown on this quad).

The potential restoration sites are approximately 40 acres each; the agricultural sites are both less than 35 acres each.



33) KINDRED SLOUGH, WASHINGTON

34) BEAR RIVER

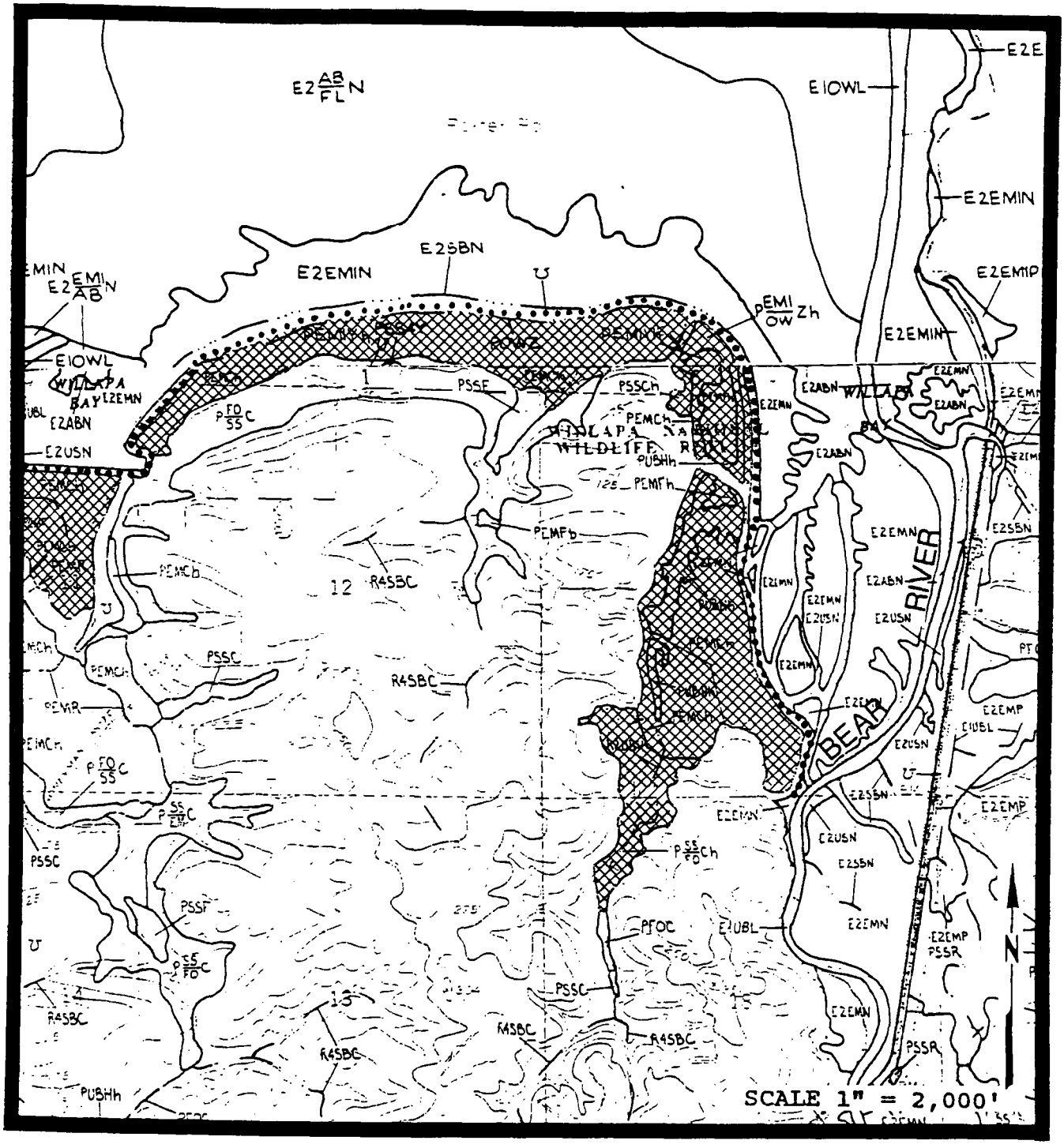
USGS Quad: CHINOOK, 7.5'
LONG ISLAND, 7.5'
COE Photo #: S87-009-123-7,9,11

a) The west side of the mouth of the Bear River has been diked resulting in an extensive impounded freshwater marsh system. This freshwater system is mapped by the NWI as impounded or diked, however, it is unknown how far to the southwest the tidal influence would extend. The areas immediately adjacent to the tidal channel would certainly respond to restored tidal influence.

The aerial photographs indicate that the area behind the dikes is saturated and that the former tidal channels are still intact. To the north of the small road which crosses the area east to west an area of open water has been impounded, to the south of the road, the area is emergent wetlands. The total area of over 120 acres is not used for agricultural purposes currently.

b) A small area of approximately 30+ acres is mapped by the NWI as diked palustrine emergent systems at the south end of Willapa Bay. The area appears to be potentially within tidal influence if the dikes were breached or tide gates were removed.

c) The USGS base quad map does not indicate the presence of any dikes on the southeastern portion of the peninsula, however the aerial photographs clearly indicate the presence of diking and channels. The old slough channels are still present behind the dikes, although the area appears to be currently used for pasture. Removal of the tide gates or breaching of the dikes would restore this area to tidal influence. The area is between 80 and 100 acres in size.



34) BEAR RIVER, WASHINGTON

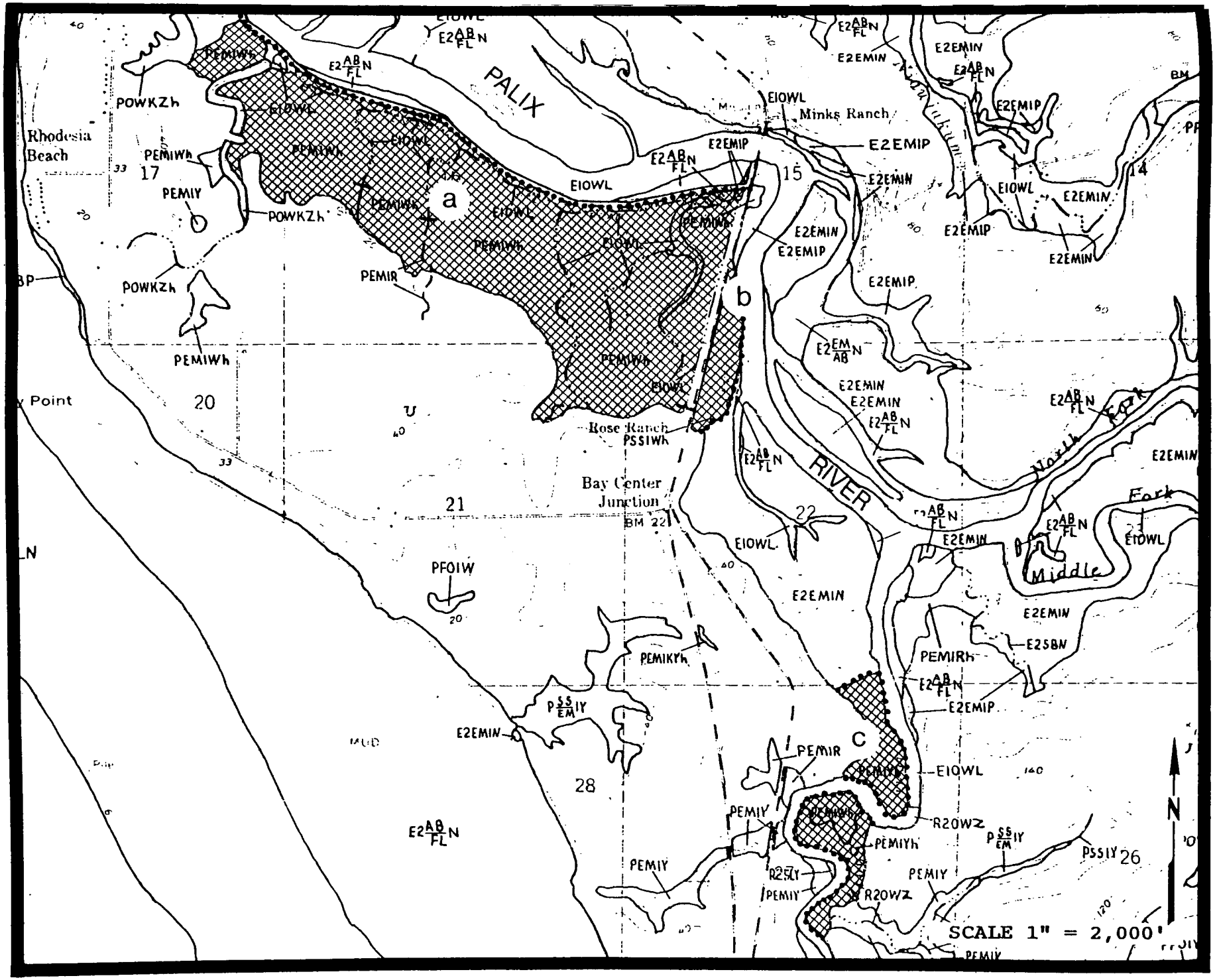
35) PALIX RIVER USGS Quad: NEMAH, 7.5'
COE Photo #:S87-009-120-3,5,7

a) South of the main stem of the Palix River: This area is large (over 300 acres) and is currently actively used for hay and pasture. It is mapped by the NWI as a palustrine system; however, the aerial indicates pasture usage.

Old slough channels are still present throughout the site. Removal of the tidegates and breaching of the dikes would restore a substantial area to tidal influence. In the northwest end of this site is a freshwater pond which possibly could also be restored to tidal influence.

b) East of (a): This area is east of the major road and west of the river. It is mapped as a palustrine scrub/shrub wetland. Removal of the dike would clearly restore it to tidal influence. The site is approximately 20 acres in size.

c) South Fork Palix River: These two sites are located north and south of the South Fork. Both are mapped as freshwater wetlands in the NWI; however, the aerials indicate there may be some pasture usage. Removal of the dikes would restore the areas to tidal influence. Both sites are approximately 20 acres in size.

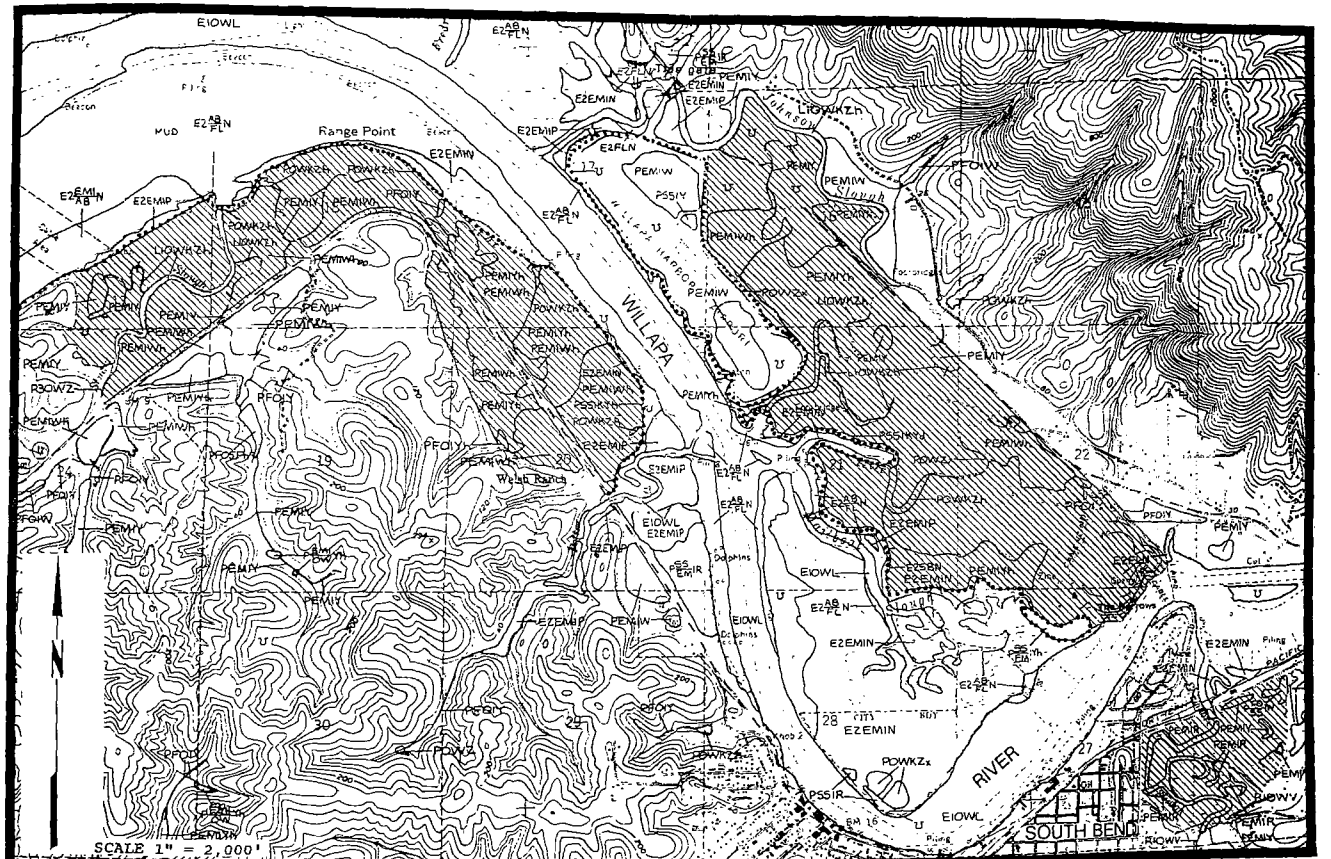


35) PALIX RIVER, WASHINGTON

36) WILLAPA RIVER USGS Quad: SOUTH BEND, 7.5'
COE Photo: S87-009-116,1,3,5

On both sides of the Willapa River there are several hundred acres of land which are currently in active agricultural usage. The areas are all diked, and the dikes and tide gates are all well maintained. The NWI maps these areas as uplands with an intricate mosaic of remnant freshwater wetlands along the old channels and ditches.

Removal of the dikes and tide gates would restore a significant portion of these areas to tidal influence. No acreage estimate is given because of the unknown extent of tidal influence if tidal flushing were restored.



36) WILLAPA BAY, WASHINGTON

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APPENDIX A

POTENTIAL RESTORATION SITES BY USGS QUAD

OREGON

Quad	Site
Bandon	Coquille River
Bullard	Coquille River
Cape Foulweather	Siletz Bay
Charleston	Coos Bay
Coos Bay	Coos Bay
Empire	Coos Bay
Gearheart and Tillamook Head	Necanicum River
Hebo	Nestucca Bay
Hebo	Salmon River
Newhalem	Newhalem Bay
Newhalem and Tillamook	Tillamook River
North Bend	Coos Bay
Reedsport	Umpqua River
Siltcoos Lake	Siuslaw River
Tillamook	Netarts Bay
Tillamook	San Lake
Waldport	Alsea Bay
Yaquina and Toledo	Yaquina Bay

WASHINGTON

Quad	Site	County
Anacortes, South	Padilla Bay	Skagit
Belfair	Lynch Cove	Mason
Bow	Padilla Bay	Skagit
	Samish River	Skagit
Brinnon	Dabob Bay	Jefferson
Cresent Harbor	Clinton	Island
	Dugalla Bay	
Conway	Skagit	Skagit
Dungeness	Meadowbrook Creek	Clallam
Hansville	Useless Bay	Island
Joyce	Crescent Bay	Clallam
Juniper Beach	Stillaguamish	Snohomish
Lofall	Squamish Harbor	Jefferson
LaConner	Padilla Bay	Skagit
	Swinomish Ch.	Skagit
Marysville	Snohomish R.	Snohomish

WASHINGTON - continued

WASHINGTON - continued

Quad	Site	County
Maxwelton	Cultus Bay	Island
	Maxwelton	
	Useless Bay	
Mukilteo	Picnic Point	Island
Nisquallly	Nisqually R.	Pierce
Potlatch	Anna's Bay	Mason
Quilcene	Quilcene Bay	Jefferson
Sequim	Batelles Lagoon	Clallam
	Grays Marsh	Clallam
Shelton	Little Skookum	Mason
Stanwood	Stillaguamish	Snohomish
Ustalady	Skagit	Skagit
	Stillaguamish	Snohomish
Vashon	Quartermaster H.	King

Willapa Bay and Grays Harbor

Aberdeen	Chehalis R.	Grays Harbor
Bay Center	Kindred Slough	Pacific
Chinook	Chinook R.	Pacific
Copalis Beach	Copalis R.	Grays Harbor
Copalis Crossing	Grass Creek	Grays Harbor
Grayland	South Bay	Grays Harbor
Hoquim	Bowerman Basin	Grays Harbor
Long Island	Bear River	Pacific
Nemah	Palix River	Pacific
South Bend	Willapa River	Pacific
Western	North River	Grays Harbor
Westport	Westport	Grays Harbor