# Feasibility Study of Proposed Water Quality, Drainage, and Habitat Improvement Activities in the No Name Slough Watershed, Skagit County, Washington

Prepared Pursuant to Washington Department of Ecology
Centennial Clean Water Fund Grant No. G030051
"No Name Slough Implementation Phase 1"

Skagit Conservation District
Padilla Bay National Estuarine Research Reserve
March 2005

# Table of Contents

# Figures



# Tables

# Executive Summary

## Background

No Name Slough and its tributaries drain a watershed of about 2,780 acres in western Skagit County, Washington. The watershed drains into Padilla Bay, one of America's 26 designated National Estuarine Research Reserves. The slough and its main tributary creek were listed in the federal Clean Water Act Section 303(d) list for violating state water quality standards due to non point source runoff pollution. In addition to its water quality problems, the watershed suffers extreme ranges of runoff flow, from zero flow in summer to frequent flooding in the wet season. The extreme range of flows impact both farming and aquatic habitat conditions in the watershed.

In response to local farmers' and other citizens' desire to correct the water quality and flooding problems, Skagit Conservation District and the Padilla Bay National Estuarine Research Reserve obtained a Washington Department of Ecology Centennial Clean Water Fund grant to complete a detailed characterization of the watershed conditions and to prepare an engineering feasibility study of a slate of proposed projects for improving water quality, providing more consistent stream flows, and supporting fish and wildlife habitat. This document represents the feasibility study portion of the grant.

## Specific Objectives

The following specific objectives were developed for correcting the problems that were identified in the *No Name Slough Watershed Characterization Report* (SCD/ PBNERR, 2004):

Upland Headwaters and No Name Creek

1. Decrease the peak stormwater runoff flows
2. Increase the summer base flow
3. Preserve and enhance the existing forests and wetlands
4. Reduce channel entrenchment and improve structural complexity of the creek channel
5. Provide fish passage upstream of Bay View Road
6. Consistently comply with the Washington Water Quality Criterion for dissolved oxygen
7. Consistently comply with the Washington Water Quality Criterion for fecal coliform.

Flats and No Name Slough

1. Increase storage capacity for floodwater
2. Increase the conveyance capacity of the upper slough to at least 40 cubic feet per second
3. Increase the hydraulic connectivity between the slough and wetland and nearshore habitat areas
4. Improve the habitat value of riparian vegetation
5. Consistently comply with the Washington WQC for dissolved oxygen
6. Consistently comply with the Washington WQC for temperature
7. Consistently comply with the Washington WQC for turbidity.

**Identification of Alternatives for Achieving the Objectives**
Several potential projects that could help achieve the drainage, water quality, and habitat objectives were identified. For the upland area, these include:

- No Action
- Wetland Enhancement Projects
- Riparian Buffers
- Roadside Bioswales
- Creek Channel Stabilization and Floodplain Reconnection
- Septic System Replacement
- Bay View Road Fish Passage Blockage Removal
- Permanent Forest Conservation Easement
- Modification of Paccar Detention Pond

Project alternatives for the Flats include:
- No Action
- Constructed Wetlands
- Preserve and Enhance Existing Riparian Buffer
- Filter Strips and Field Ditch BMPs
- Widening the Upper Slough
- Widen and Enhance Existing Channels at the Padilla Demonstration Farm
- Improve the Existing Tidegates at the Pump House Reservoir
- Extend a New Dike From Padilla Bay to Farm to Market Road

Three policy-related alternatives were also identified:
- Drainage Tax Credits for On-site BMPs
- Small Grants for BMP Implementation
- Coordinate Port and County Mitigation Activities with Overall Watershed Objectives

**Evaluation and Ranking of the Alternatives**
Each of the alternatives was evaluated according to three basic criteria: 1) effectiveness in achieving the specific objectives, 2) potential detrimental impacts, and 3) cost. The alternatives were then ranked relative to each other in accordance with their relative "benefit" versus their cost. A second ranking was done based on more subjective criteria of "public acceptance" and "likelihood of implementation," as determined by the members of the No Name Slough watershed citizen advisory committee. The results of both the cost-benefit and public acceptance rankings are shown in the following table.

## Summary of Rankings of Alternatives

| Project Alternative | Number of Projects | 10-year Present Worth Cost | Public Acceptance Ranking | Cost per Benefit Ranking |
|---|---|---|---|---|
| **UPLAND ALTERNATIVES** | | | | |
| Septic Tank Replacement | 1 | $18,000 | 1 | 1 |
| Modify Paccar Pond Outlet | 1 | $21,000 | 2 | 2 |
| Permanent Forest Conservation Easement | 1 | $358,000 | 3 | 5 |
| Creek Channel Stabilization and Floodplain Reconnection | 3 | $143,000 | 4 | 4 |
| Wetland Enhancements | 5 | $316,000 | 5 | 6 |
| Upland Riparian Buffers | 4 | $101,000 | 6 | 3 |
| Bay View Road Fish Passage Blockage Removal | 1 | $234,000 | 7 | 7 |
| Roadside Bioswales | 5 | $288,000 | 8 | 8 |
| **FLATS ALTERNATIVES** | | | | |
| Upgrade Tidegates | 1 | $23,000 | 1 | 3 |
| Constructed Wetlands | 3 | $225,000 | 2 | 6 |
| Widen and Enhance PDF Slough Channels | 2 | $218,000 | 3 | 5 |
| Widening and Dredging the Upper Slough | 1 | $122,000 | * | 4 |
| Enhance Existing Buffer along the Slough | 1 | $33,500 | 4 | 2 |
| Build New Dike from Padilla Bay to Farm to Market Road | 1 | $4,016,000 | 5 | 7 |
| Filter Strip and Field Ditch BMPs | 1 | $18,700 | 6 | 1 |
| **POLICY ALTERNATIVES** | | | | |
| Drainage Tax Credits for Implementing BMPs | | NA | 1 | Unranked |
| Coordination of Port and County Mitigation Activities | | NA | 2 | Unranked |
| Small Grants for Implementing BMPs | | NA | 3 | Unranked |

*No ranking, since the scope was revised after completion of the public ranking process

# 1 Introduction

## 1.1 Location of the Study Area

The No Name Slough watershed is located in western Skagit County, Washington. The watershed, which consists of No Name Slough, its upland creek tributaries, and a system of agricultural drainage ditches, drains an area of about 2,780 acres. This watershed is part of the greater Padilla Bay / Bay View watershed that drains into Padilla Bay, one of America's 26 designated National Estuarine Research Reserves. Figure 1.1 shows the boundaries of the watershed and its key land features.

## 1.2 Policy Background

Section 319 of the federal Clean Water Act requires states to identify water bodies which, without control of non-point source pollution, cannot attain applicable water quality standards. In response to this federal mandate, the Washington Department of Ecology (WDOE) funded local initiatives to identify and rank such water bodies and to develop action plans for addressing non-point source (NPS) pollution. In 1988 the Skagit County Watershed Ranking Committee ranked the Padilla Bay / Bay View watershed as Skagit County's second highest priority for management of non-point source pollution (Skagit County WRC, 1988). In response to the high priority ranking, the Skagit County Department of Planning and Community Development and a committee of stakeholders developed the *Padilla Bay / Bay View Watershed Nonpoint Action Plan* (Padilla Bay / Bay View Watershed Management Committee, 1995). This plan recommended several activities for controlling non-point source pollution in the local area, including the No Name Slough watershed.

A related provision of the federal Clean Water Act is Section 303(d), which requires states to identify water bodies for which implementation of the various point source effluent limitations will not by itself attain the relevant water quality standards. Further, states must develop plans for limiting the total point source and non-point source pollution discharges to such water bodies, in order that water quality standards can be attained. No Name Slough is identified in WDOE's 1998 303(d) listings as a water body that, without control of non-point source pollution, cannot attain the State of Washington Water Quality Criteria for temperature and fecal coliform bacteria. (WDOE, 1998). WDOE's revised 303(d) listing includes dissolved oxygen and fecal coliform (WDOE, 2004). At the present time, WDOE has not yet formulated a plan for regulating "total maximum daily loads" (TMDLs) of point source and non-point source pollution in No Name Slough for the purpose of attaining and maintaining 303(d) list water quality parameters (i.e. dissolved oxygen and fecal coliform).

At the mouth of the No Name Slough watershed lies the Padilla Demonstration Farm (PDF), a publicly-owned institution set up to provide education and research opportunities related to minimizing the impacts of agricultural non-point source pollution on the waters of the State of Washington. More specifically, over the past ten years, PDF research has focused on improving annual cropping practices to improve water quality and fish habitat in the slough and Padilla Bay. An agricultural advisory committee representing local resource management organizations, farmers, and other landowners determines the PDF's general policies for research and operations. In response to the 303(d) listing of No Name Slough and other recent regulatory

Figure 1.1. No Name Slough Watershed

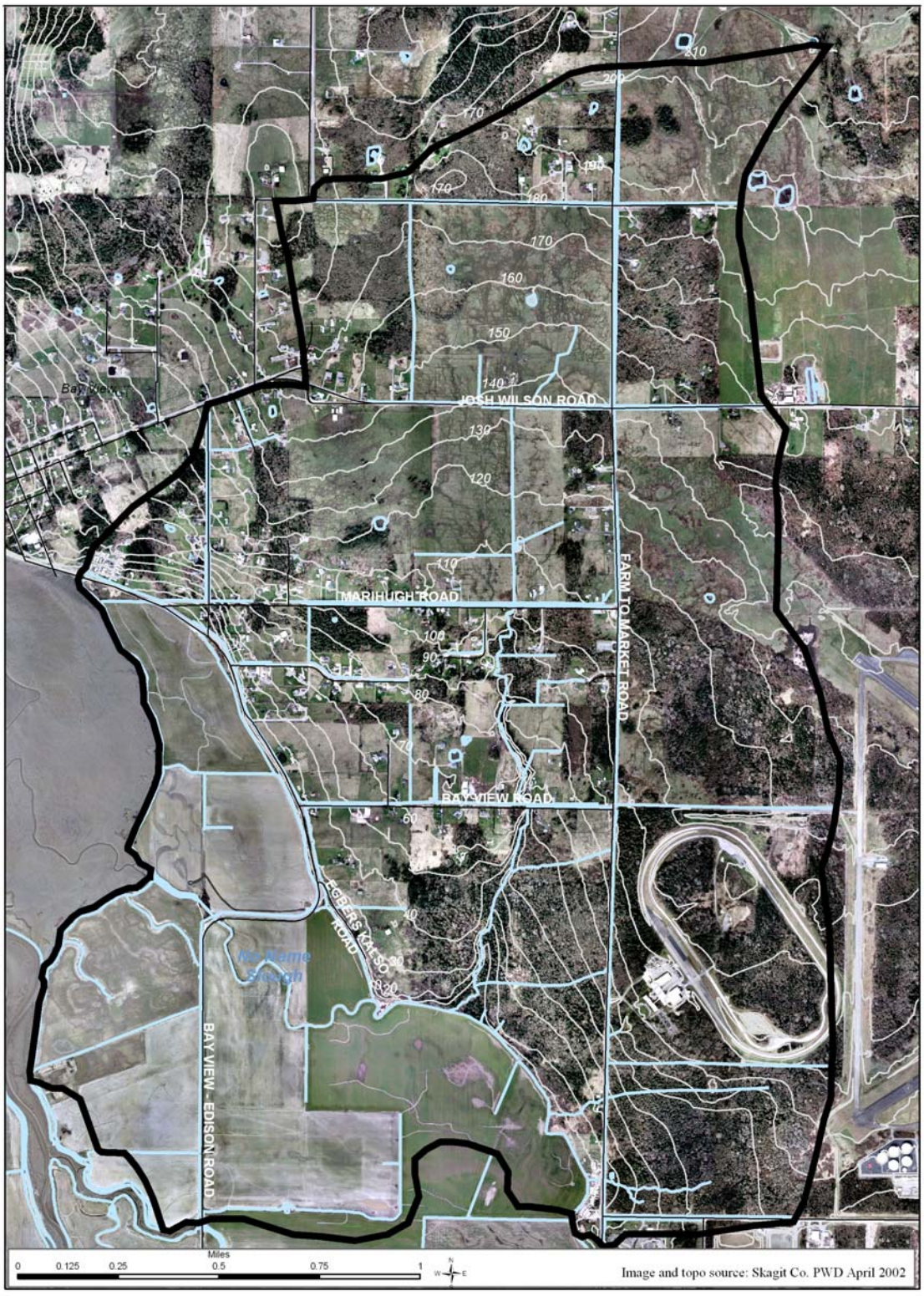



Figure 2.2 Watershed boundaries, roads, streams, and 10' topographic contours.

developments, the agricultural advisory committee agreed that programs for improving water quality in the watershed should integrate solutions for improving agricultural drainage as well.

## 1.3 Purpose

In response to the PDF advisory committee's policy, in 2002 Skagit Conservation District (SCD) and the Padilla Bay National Estuarine Research Reserve (PBNERR) obtained a Centennial Clean Water Fund (CCWF) grant from WDOE to complete a suite of activities titled *No Name Slough Implementation Phase 1*. The activities focus on 1) completing a detailed characterization of existing hydrology, water quality, and habitat conditions in the watershed, 2) carrying-out public education and public consultation activities to encourage community participation, and 3) completing a feasibility study of a slate of proposed projects for improving water quality, providing more consistent stream flows, and supporting fish and wildlife habitat.

SCD and PBNERR completed the report *No Name Slough Watershed Characterization* in May 2004 (WDOE, 2004) and have been jointly conducting public education and public consultation activities since 2003. This document represents the third activity of the CCWF grant, a feasibility study of a slate of proposed projects for improving water quality, providing more consistent stream flows, and supporting fish and wildlife habitat. Based on the results of the watershed characterization and input from stakeholders during the public outreach activities, this feasibility study identifies and evaluates a range of proposed projects for addressing the non-point source pollution, drainage, and habitat problems in the watershed.

# 2 Problem Description

The *No Name Slough Watershed Characterization* report presents the results of several studies of water quality, surface water hydrology, and natural habitat conditions, which PBNERR, SCD, and other local stakeholders have conducted in the watershed since the 1990s. The most significant problems that were identified in the report are presented below.

## *2.1 Hydrology*

Figure 2.1 shows key surface water hydrology features of the No Name Slough watershed. Problems associated with drainage and other hydrologic conditions include flooding, erosion, and sedimentation. Specific problem areas associated with these conditions are described below.

### 2.1.1 Upland

There are three main surface water hydrology problems in the upland part of the watershed. First, the relatively impervious soils and lack of forest cover in the upland areas result in intense, "flashy" runoff after the soil has become saturated by fall rains. The excessive runoff causes erosion of the creek channel and accompanying elevated sediment transport, particularly in the sub-basins that drain to No Name Creek. During one rain event in November 2003, the creek channel cross sectional area was increased by 0.7 square feet due to erosion. Measurements of bed load particle size distribution and critical channel depth in the No Name Creek channel shows that the channel is incised and has the potential for further incision.

Land development activities have increased the amount of impervious surface in the watershed, which in turn has exacerbated flashy runoff conditions and channel erosion problems. While currently the amount of imperious surface in the sub-basins that drain to No Name Creek is relatively low, the elevated peak runoff rates that are typical in the more intensely-developed Bridgewater Estates subdivision and the Paccar Technical Center will probably occur in the No Name Creek sub-basins too as those areas become more developed.

The second hydrology problem in the upland area is that the headwaters and main channel of No Name Creek tend to be disconnected from the floodplain and nearby wetland areas. This disconnection from the floodplain results in a lack of upland storage of runoff. Upstream of Marihugh Road, the disconnection is caused by dredging and straightening of the channel. Downstream of Marihugh Road, the disconnection is caused by channel incision. By comparison, the East Fork tributary east of Farm to Market Road and the unnamed tributary north of Ovenell Road are better connected to their floodplains and, consequently, have better runoff storage capacity.

The third upland hydrology problem is the fast, flashy runoff and lack of upland storage associated with the extensive system of field and roadside ditches, particularly the rock-armored ones. The ditches efficiently collect both road runoff as well as much of the runoff from the surrounding land and convey it at high flow rates to either No Name Creek, the East Fork tributary, or directly to drainage ditches on the Flats. Ditch runoff tends to erode the natural creek channels and overwhelms the capacity of the drainage system on the Flats, causing flooding. County Public Works Department crews clear vegetation from un-lined road ditches

Figure 2.1. Key Surface Water Hydrology Features

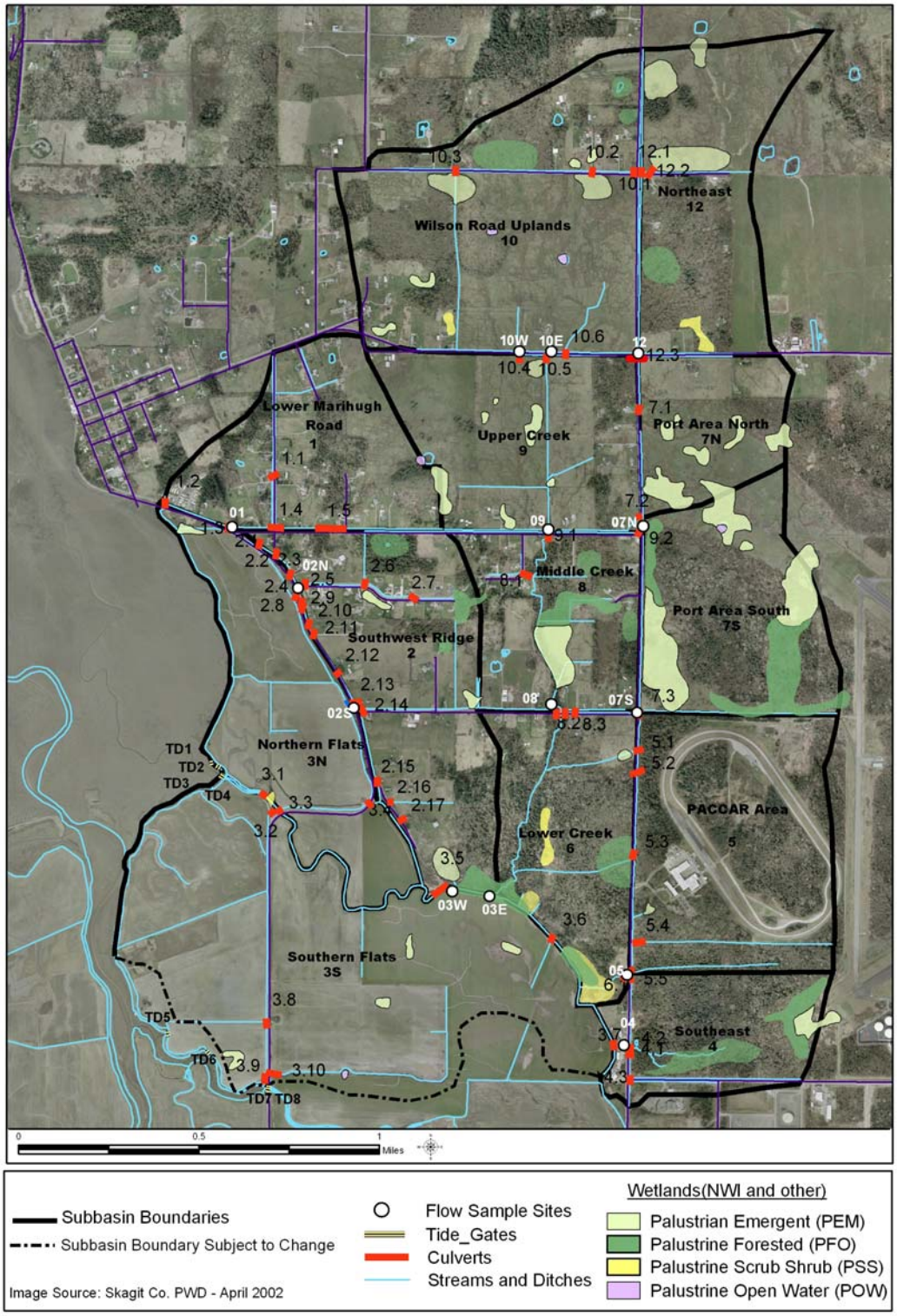



Figure 6.2 Surface water hydrology features of the No Name Slough Watershed.

each year to maintain their water conveyance efficiency.

Unfenced Field Ditching through Upland Cattle Pastures

### 2.1.2 Flats

The main surface water hydrology problem in the Flats is the lack of capacity to store and convey upland runoff. The lack of storage and flow capacity in the drainage system regularly causes flooding at three locations: 1) fields adjacent to the dredged slough channel upstream of the confluence of the East Fork tributary (Parcel No. P21137 and P 21141), 2) fields adjacent to the outfall of the Marihugh Road ditch (PP35064), and 3) the interior of Parcel No. P21143 on the Padilla Demonstration Farm, which lie below the level of the banks of adjacent field ditches.

Seasonal Flooding of Farm Fields in the Flats

## 2.2 Water Quality

### 2.2.1 Water Quality Standards

No Name Slough, its natural upland tributaries, and its associated system of drainage ditches are "surface waters of the State of Washington" whose water quality is regulated by the Washington Water Quality Standards (Washington State Attorney General, 1969). In the slough, the water gradually changes from freshwater to brackish and/or salt water in the reach between the Egbers culvert and the Padilla Demonstration Farm. The regulations classify the surface water upstream of this transition zone according to the Class A freshwater standards and the surface water downstream of the transition zone according to the Class A marine water standards. Characteristic uses for both freshwater and marine Class A water include water supply, stock watering, fish and shellfish rearing, spawning, and habitat, wildlife habitat, recreation, and commerce and navigation. Selected criteria are presented in Table 2.1.

**Table 2-1 Selected Washington Class A Water Quality Criteria**

| Criteria | Class A Freshwater | Class A Marine |
|---|---|---|
| Fecal coliform organisms | Not to exceed a geometric mean of 100 colonies per 100/ml; no more than 10 percent of samples may exceed 200 colonies per 100/ml | Not to exceed a geometric mean of 14 colonies per 100/ml; no more than 10 percent of samples may exceed 43 colonies per 100/ml |
| Dissolved oxygen | Shall exceed 8.0 mg/l | Shall exceed 6.0 mg/l |
| Temperature | Shall not exceed 18.0°C due to human activities | Shall not exceed 16.0°C due to human activities |
| Turbidity | Shall not exceed 10% over natural background turbidity | Shall not exceed 10% over natural background turbidity. |

Based on extensive monitoring of these and other water quality parameters during the *No Name Slough Watershed Characterization Study,* the following non-point source water quality problems have been identified in the watershed.[1]

### 2.2.2 Upland

During summer low flow conditions, dissolved oxygen concentrations at No Name Creek sampling stations between Josh Wilson and Bay View Roads ranged from 0.5 to 8.5 mg/l, with means in the range of 3 to 6 mg/l, which are well below the Class A water quality criteria (WQC) of 8.0 mg/l. It is believed that lack of summer base flow combined with biochemical oxygen demand resulting from septage seepage are the primary causes of the depressed dissolved oxygen. Septage has been observed seeping into the creek on Parcel No. 35297, just downstream of the Marihugh Road culvert.

During the wet winter months, the primary water quality problem in No Name Creek is elevated fecal coliform counts. From 1999 to 2003, fecal counts measured at the Bay View Road

[1] All data and conclusions in this section are referenced from Section 7 of the *Watershed Characterization Study.*

monitoring station ranged from geometric means of 300 to 800 colonies per 100/ml, which consistently exceeding the maximum WQC of 200 colonies per 100 ml. It is suspected that septage seepage observed on Parcel No. 35297 is at least one of the sources of elevated fecal coliform counts. Cattle grazing at upland pastures may be another source of fecal pollution in the creek. Between Marihugh Road and Josh Wilson Road, a narrow but dense thicket of riparian shrubs and trees effectively prevents cattle access to the creek. Upstream of Josh Wilson Road, though, cattle apparently have unrestricted access to field ditches and wetland swales areas on Parcels No. P34970, P34971, P34972, and P34973 apparently have unrestricted access to field ditches and wetland swale areas.

No monitoring data is available to evaluate whether there are water quality problems in the other upland tributaries of the No Name Slough watershed, including the East Fork Creek, the creek north of Ovenell Road, or roadside ditches.

### 2.2.3 Flats

Several years of monitoring at three stations along No Name Slough in the Flats have shown that during summer, the slough water regularly fails both the freshwater and marine water quality criteria for temperature and dissolved oxygen. Mean temperatures at all stations are consistently above 18°C; dissolved oxygen concentrations average about 4 mg/l. The causes of the elevated temperatures and depressed dissolved oxygen are believed to be lack of shading by riparian trees and lack of water exchange, both by freshwater base flow and tidal exchange.

During winter and fall wet weather conditions, turbidity in the slough regularly violates both the freshwater and marine water quality criteria. Assuming that "background conditions" are represented by the 5 to 30 NTU turbidity range measured in the upland creek during winter sampling events, the 60 to 110 NTU turbidity range common in the slough greatly exceeds the "ten percent above background condition" criterion.[2] Sediment-laden runoff from agricultural field ditches and V-ditches, and, to a lesser extent, directly from the fields, is the primary cause of the turbidity violations in the Slough.

The Clean Water Act Section 303(d) listing of No Name Slough includes fecal coliform as a listed parameter. Water samples of the slough at the Egbers culvert (Site No. NN 3, located upstream of the freshwater/marine water transition zone) occasionally have violated the freshwater WQC for fecal coliform, but only slightly. Likewise, water samples at the PDF culvert (Site No. NN 4) have occasionally violated the marine WQC for fecal coliform, but again, relatively modestly. Since there are no obvious sources of fecal coliform pollution in the Flats area, it is believed that the occasional violations are due to the obvious sources in the upland creek. Therefore, for the purpose of this feasibility study, it is assumed that correcting the sources of fecal coliform pollution in the upland part of the watershed will also eliminate fecal coliform WQC violations in the slough.

[2] Likewise, the slough's typical winter turbidity greatly exceeds its typical summertime turbidity range of 1 to 18 NTU.

## *2.3 Fish and Wildlife Habitat*

Chapter 8 of the *No Name Slough Watershed Characterization Study* inventories and evaluates the quality of existing habitat conditions in upland, flats, and nearshore areas of the No Name Slough watershed. The most significant problems that limit the function and value of fish and wildlife habitat in the watershed are described below.

### 2.3.1 Upland

In the headwaters of No Name Creek north of Marihugh Road, fragmentation of forests and isolation or draining of wetlands are the main habitat problems. In general, these habitat limitations also impact the hydrology of the watershed. Figure 2.1 shows drainage ditches, culverts, roads, and other development that has impacted upland and forest wetland habitat. Drainage of wetlands and fragmentation of forests has also occurred in the headwaters of the East Fork tributary in Sub-basin No. 5. Forest and wetland habitat is still largely intact and in good quality along the Ovenell Road creek in Sub-basin No. 4, but may be at risk from proposed Port of Skagit County development in the area.

There are three main problems impacting habitat along No Name Creek itself. First, entrenchment of the channel isolates the creek from its floodplain and limits the complexity of creek morphology. Fish and other aquatic animals have little access to wetlands, side channels, or other flow refuges during high water. North of Marihugh Road, the dredged and straightened channel has essentially no in-stream habitat features. Further downstream, the frequency and quality of pools, riffles, undercut banks, and large woody debris cover gradually increases, but for much of the creek's length is lacking.

Second, the flashy hydrology of the watershed impacts in-stream habitat both by causing excessive stream flow velocities to juvenile fish during peak runoff as well as drying-out all but a few pools in the lower reaches of the creek during dry late summer conditions. Third, the perched culverts at the crossing beneath Bay View Road constitute a complete barrier to fish migration upstream of this point.

### 2.3.2 Flats

Habitat in the dredged slough is poor due to the absence of in-stream structures for cover and flow refuge, lack of shading, and the water quality problems described above. Dredging and the placement of dredge spoil berms have disconnected the slough from the few remaining wetland areas on the flats. The few brush and tree thickets that remain along part of the slough bank provide limited cover and food for birds and small mammals, but the quality of this riparian habitat is low. While some of the field ditches potentially could connect to isolated remnant estuary channels on the flats, presently the connectivity is limited. At the mouth of the slough, dikes and tidegates provide only very limited access between nearshore areas seaward of the dikes and slough habitat landward of the dikes.

No Name Creek May 2003 Showing Dewatered Channel,
Excessive Sediment Deposits, and Eroded Banks

No Name Slough at Pump House Reservoir September 2002

## 2.4 Summary of Problems in the Watershed

Based on the discussion above, Table 2.2 summarizes the primary hydrology, water quality, and habitat problems in the No Name Slough watershed.

**Table 2-2 Summary of Environmental Problems in the No Name Slough Watershed**

| | |
|---|---|
| **Surface Water Hydrology** | |
| Upland | ▪ Soil and land cover conditions cause intense, flashy runoff<br>▪ Lack of storage caused by disconnection from floodplain and wetlands<br>▪ Lack of flow attenuation in ditch system |
| Flats | ▪ Lack of capacity to store and convey peak runoff flow |
| **Water Quality** | |
| Upland | ▪ Dry season dissolved oxygen WQ violations<br>▪ Wet season fecal coliform violations |
| Flats | ▪ Dry season temperature and dissolved oxygen violations<br>▪ Wet season turbidity violations |
| **Fish and Wildlife Habitat** | |
| Upland | ▪ Fragmentation of forests and isolation or draining of wetlands<br>▪ Channel entrenchment<br>▪ Extreme high and low flows<br>▪ Bay View Road culvert fish passage blockage |
| Flats | ▪ Poor riparian vegetation conditions<br>▪ Disconnection of slough from wetlands and remaining nearshore habitat |

# 3 Objectives for Addressing the Problems

This section presents objectives for correcting the environmental problems that are identified in Section 2. The objectives are designed to be practicable in the overall context of the No Name Slough watershed.

## *3.1 Restore Hydrologic Function*

Objectives for restoring hydrologic function in the upland area must address the problems of 1) fast, flashy runoff from pasture and developed upland areas, 2) lack of natural upland storage of runoff caused by the disconnection of upland creeks from their floodplains and wetlands, and 3) the lack of flow attenuation in the upland drainage ditch system. In the flats, the objectives must address the slough and associated drainage system's lack of capacity to store and convey peak runoff flows.

### 3.1.1 Upland

Two general objectives have been identified for addressing the problems with hydrologic function in the upland area. The first objective is to decrease peak stormwater runoff flow rates from upland areas, particularly in sub-basins that drain to No Name Creek. Reduction of peak flow rates would reduce erosion in the creek channel and help to reduce flooding in the Flats.

Peak flow rate is a function of rainfall amount, intensity, soil conditions, and ground cover conditions. While the rainfall patterns and the soil characteristics in the watershed cannot be changed, it is possible to increase the "time of concentration" of runoff by improving ground cover conditions and effectively increasing the length of flow. The relation of ground cover and soil type is commonly described in terms of the USDA Natural Resources Conservation Service's "curve numbers." In the upland areas of the No Name Slough watershed, which have hydrologic group "D" soils[3], curve numbers typically range from a low of 77 (forests in good condition) to 89 (pasture in poor condition). In most areas, the natural flow length of runoff has been shortened by ditching. In order to decrease peak runoff flow rates, therefore, the first objective is to modify land use practices to decrease the curve number and lengthen runoff flow lengths to the extent practicable, given the constraints of existing development in the watershed.

The second objective is to increase upland storage capacity for runoff by improving the connectivity of No Name Creek and other runoff channels with their floodplains and hydraulically-connected wetlands. Increase storage will help reduce peak flow rates and the associated flooding and erosion, at least until the upland storage capacity is filled. At the point where the existing drainage infrastructure capacity on the Flats is reached, every acre-foot of water stored in the upland area is one less acre-foot of flooding on the agricultural fields in the Flats.

Increasing upland storage will also address the problem of low summer base flow by providing a natural reservoir of water that will drain off more slowly than it currently does. In typical weather years, the upland creeks usually dry out by May. Providing more upland storage would prolong in-stream flow conditions into early summer.

[3] The primary soils are Bow gravelly silt loam, Bellingham silt loam, and Skipopa silt loam.

### 3.1.2 Flats

The main objective for restoring hydrologic function in the Flats is to increase the storage and conveyance capacity of No Name Slough and its associated drainage ditches sufficiently to reduce flooding of adjacent agricultural fields. Downstream of the Egbers culvert the slough's conveyance capacity is limited to the capacity of the dike district pumps. Upstream of the Egbers culvert, the flow capacity of the slough is limited by the channel size and slope. When the pumps are running, the upstream channel capacity is estimated to be about 30 cubic feet per second (cfs).[4] When the pumps aren't running and the pump house reservoir is full, water begins overtopping low points in the bank at flows above 18 cfs.

Hydrologic modeling of the watershed predicted peak runoff flow from a two-year storm event in the upper slough of 39.2 cfs. Monitoring of flows at selected locations during 2003 indicated that the modeling underestimates the actual flows[5] In order to reduce or eliminate flooding from two-year storm events, therefore, the conveyance capacity of the upstream end of the slough should be increased to at least 40 cfs.

Based on limited cross section surveys completed for the *Watershed Characterization Study*, the existing total storage capacity of the slough is estimated to be roughly 7 acre-feet. Any increase in storage capacity above this quantity would be considered an improvement.

## *3.2 Improve Water Quality*

### 3.2.1 Upland

The objective for improving water quality in the upland area is to eliminate the violations of the Washington Class A Water Quality Standards in No Name Creek that were identified in Section 2.2.2. Specifically, the following criteria will be achieved:

- During the dry season, the dissolved oxygen concentration in the creek will consistently exceed 8.0 mg/l.
- During the wet season, the levels of fecal coliform in creek water samples will not exceed a geometric mean of 100 colonies per 100/ml, with no more than 10 percent of samples exceeding 200 colonies per 100/ml.

### 3.2.2 Flats

The objective for improving water quality in the slough is to eliminate the violations of the Washington Water Quality Standards that were identified in Section 2.2.3. Specifically, the following criteria will be achieved:

- During the dry season, the dissolved oxygen concentration in the slough will consistently exceed 8.0 mg/l upstream of the Egbers culvert and will consistently exceed 6.0 mg/l downstream of the Egbers culvert.
- During the dry season, the temperature in the Slough will consistently be below 18.0°C upstream of the Egbers culvert and will consistently be below 16°C downstream of the Egbers culvert.

[4] Watershed Characterization Report, p. 40.
[5] For example, flow in the slough upstream of the Egbers culvert following a less than two-year event in November 2003 was measured at 45.9 cfs.

- During the wet season, the turbidity in the Slough will not exceed ten percent over the "background" turbidity. For the purpose of this feasibility study, the background turbidity in the slough water is assumed to be 30 NTU, which is the highest level measured in No Name Creek during winter.[6]

## *3.3 Support Fish and Wildlife Habitat*

Objectives for supporting fish and wildlife habitat must address the problems of isolation of wetlands and fragmentation of forests in the uplands; unstable hydrology and degradation of in-stream habitat in No Name Creek; and the slough's disconnection from adjacent wetland, riparian, and nearshore habitat.

### 3.3.1 Upland

The objectives for supporting fish and wildlife habitat in the upland area focus on preserving or enhancing habitat in the remaining forests and wetlands in headwater areas and improving habitat conditions in No Name Creek. Most importantly, the existing forests and especially the existing forested wetlands in the watershed's headwaters areas should be preserved. As a second priority, the existing pasture (palustrian emergent) wetlands should be preserved and their habitat functions and values enhanced where practicable.

In No Name Creek, there are three objectives for supporting habitat. First, peak runoff flow velocity should be reduced and summer low base flow should be increased to provide more consistent stream flow conditions. Second, modifications should be made to the channel to reduce channel entrenchment and increase the structural complexity of the existing fish habitat.

Third, fish passage should be provided past the blocking culverts at Bay View Road. While assurance of fish passage at road crossings is a requirement of Washington law, the available in-stream habitat upstream of the Bay View Road culverts is of marginal value for anadromous and resident fish. For this reason, the third objective is viewed as a lower priority than the other two objectives.

### 3.3.2 Flats

Two objectives for supporting habitat in the Flats adjacent to No Name Slough have been identified. First, the hydraulic connectivity between the Slough and adjacent freshwater wetland and estuary nearshore habitat features should be increased. Second, the habitat value of riparian vegetation along the banks of the slough should be improved.

[6] This turbidity level will be considered to be provisional pending further monitoring and determination of a generally-accepted winter background turbidity level in the Slough.

Little Indian Slough showing its hydraulic connectivity with adjacent salt marsh and mud flat nearshore habitat. Little Indian Slough is located about three quarters of a mile south of No Name Slough.

## 3.4 Summary of Objectives

The objectives identified in the preceding sections for restoring hydrologic function, improving water quality, and supporting habitat are not mutually exclusive, but instead tend to overlap and support each other. For example, increasing the connectivity of the creek with its floodplain and hydrologically-connected wetlands not only reduces peak flows, but increases upland storage of stormwater, potentially improves wetland habitat value, and provides more consistent in-stream flow conditions for fish habitat. Table 3.1, condenses the overlapping objectives from the three categories.

**Table 3-1 Summary of Objectives**

Upland Headwaters and No Name Creek

1. Decrease peak stormwater runoff flow
2. Increase summer base flow
3. Preserve and enhance existing forests and wetlands
4. Reduce channel entrenchment and improve structural complexity of channel
5. Provide fish passage upstream of Bay View Road
6. Consistently comply with the dissolved oxygen water quality criterion
7. Consistently comply with the fecal coliform water quality criterion

Flats and No Name Slough

1. Increase storage capacity of floodwater
2. Increase conveyance capacity of upper slough to at least 40 cfs
3. Increase hydraulic connectivity with wetlands and nearshore habitat areas
4. Improve habitat value of riparian vegetation
5. Consistently comply with the dissolved oxygen water quality criterion
6. Consistently comply with the temperature water quality criterion
7. Consistently comply with the turbidity water quality criterion

# 4 Methods for Achieving the Objectives

This section describes several methods that could be implemented to try to achieve the objectives listed in Table 3.1. The methods were selected based on two basic criteria. First, it is believed that they are technically feasible and practicable in the context of the No Name Slough Watershed. Second, it is believed that each method, either by itself or in combination with other methods, would be effective in achieving one or more of the objectives.

## *4.1 Upland*

### 4.1.1 Preservation of Forest and Wetlands

Existing forests and wetlands in the upland part of the watershed would be preserved in their present state. While land use regulations established under the Washington Forest Practices Act, the Washington Growth Management Act, and the federal Clean Water Act require a limited degree of protection to forests and wetlands in the watershed, other land use controls such as the sale of conservation easements that limit development rights on parcels containing these natural features provide a stronger degree of protection.

### 4.1.2 Wetland Enhancement

Wetland enhancement involves improving the water storage and habitat values of wetlands. Enhancement activities could include planting native wetland shrub and tree species in degraded PEME wetlands and restoring original hydrology by removing man-made drainage ditches and other artificial water control structures. While wetland protection regulations generally prohibit the manipulation of wetlands to function as stormwater detention ponds, they do allow the modification of ground topography and other site features to increase the storage of naturally-occurring runoff and groundwater seepage, as well as other *bona fide* enhancement of wetland functions and values, when appropriate.

### 4.1.3 Enhancement of Riparian Vegetation Buffers

Streamside vegetation can be expanded and improved to provide shading, bank stabilization, recruitment of woody debris, filtration and attenuation of runoff from adjacent agriculture or development, and habitat for birds and small mammals. Along some reaches of No Name Creek, the existing dense riparian thickets of blackberry and native rose would be thinned and inter-planted with a more diverse community of native trees and shrubs. In reaches of the creek that currently do not have any riparian vegetation, tree and shrub buffers of a minimum acceptable width, for example, 30 feet, would be planted.

### 4.1.4 Cattle Fencing

Wire fencing can be installed around pasture wetlands, natural runoff swales, and field ditches to exclude cattle from these areas and thus reduce the potential for manure runoff to enter the creek.

### 4.1.5 Construction or Enhancement of Detention Ponds

Runoff detention ponds could be constructed at upland headwater sites which, while not qualifying as jurisdictional wetlands, are still hydrologically connected to either No Name Creek or to roadside drainage ditches by either field ditches or natural drainage swales. The ponds would be designed to provide habitat features as well as water storage, in effect mimicking the functions of natural wetlands. Outlet structures would be designed to slowly meter out the stored water over long time periods in order to provide increased base flow in No Name Creek during the summer. The watershed's one existing detention pond, located at the Paccar facility, could likewise be modified to retain more water and meter it out more gradually during the dry season.

### 4.1.6 Field Ditch Flow Controls

In order to lengthen the flow path of runoff from the upland headwaters, existing drainage ditches in pasture and forest areas where it is no longer necessary to maintain artificial drainage could be abandoned. For example, in pastures where cattle are only grazed during the summer, or woodlot areas that are not maintained for forest production, the historic network of ditches could be plugged with small amounts of fill. Ditches could be re-opened later if needed for more intensive usage of the land. Alternatively, simple flow control weirs could be installed in these ditches to attenuate peak runoff flows, but not block them altogether.

### 4.1.7 Converting Roadside Ditches to Bioswales

Portions of roadside ditches would be modified to serve as bioswales in order to attenuate runoff flow velocities and provide a limited amount of bio-filtration of stormwater. Bioswales typically are wider than standard roadside ditches and are constructed with rock grade controls and planted with emergent wetland plants. Where subsoil conditions are permeable enough, bioswales also allow some of the runoff to infiltrate into the water table. While the presence of plants in bioswales tends to reduce the flow conveyance capacity relative to standard roadside ditches, the reduction is offset by their greater storage and infiltration capacity.

### 4.1.8 Septic System Replacement

Failing residential septic systems would be removed and replaced with properly operating systems that meet current county health department standards.

### 4.1.9 Creek Erosion Control and Floodplain Reconnection

Grade controls would be constructed at selected locations in the No Name Creek channel to prevent further channel incision and to promote re-connection of the creek with its floodplain. Appropriate grade control structures for No Name Creek would typically consist of placement of large woody debris (LWD) across the channel. The LWD would simulate existing conditions in the few remaining, relatively pristine reaches of the creek by trapping bed load and floating wood debris, thus building-up the channel and encouraging the natural formation of side channels and bank overflow terraces. In addition to reducing channel erosion, the installed LWD would eventually enhance habitat complexity in the channel by forming pools and providing cover and velocity refuge for fish.

### 4.1.10 Fish Passage Blockage Removal

Several methods could be used to provide fish passage upstream of Bay View Road, including replacing the existing perched culverts with properly-sized and properly-located new culverts; "stepping up" the downstream channel grade using rock weirs and installing baffles in the existing culverts; or other methods.

## *4.2 Flats*

### 4.2.1 Increase Storage in Existing Ditch and Slough Channels

Existing ditch and slough channels in the Flats would be widened provide more "live" (i.e. above the elevation of the existing tidegate inverts) water storage. Dredge spoils would be formed into low berms to protect adjacent farmland from flooding.[7] Depending on the availability of land, the berms could be set back 50 feet or more from the new channels and estuary plant communities would be allowed to develop on the intervening riparian area. In some cases, expanded ditches would be connected to each other to improve water circulation during low flow / low tide conditions, similar to the function of natural estuary distributary channels.

The widened channel cross section would slope up from a small deep channel in the center to higher mud flat and salt marsh areas along the edges. In this way, water would flow in the central channel even during summer low flow conditions, thus reducing the tendency for sediment to settle out of the water column and accumulate in the channel bottom. Water would cover the higher mud flat and salt marsh edges only during high flow / peak runoff conditions. This design minimizes the need for continuous maintenance dredging of the channel. Figure 4.1 illustrates the widened channel design.

### 4.2.2 Wetland Water Storage Enhancement

Historic dredge spoil mounds and other man-made blockages would be removed to allow greater connection between the upper slough and existing wetlands during high runoff events. Depending on the availability of land, isolated areas of farmland that are typically not cultivated would be graded and connected to the slough and allowed to develop into freshwater or brackish wetlands. Excavated soil would be formed into setback berms to protect the adjacent farmland. Both the reconnected existing wetlands and the new constructed wetlands would provide flood storage and wildlife habitat benefits.

### 4.2.3 Culvert Replacement

The 4-foot diameter culvert on the Egbers property would be replaced with a culvert that is properly-sized to convey at least the target flow of 40 cfs, given the expected backwatering effects present during peak winter tidal and storm runoff conditions.

### 4.2.4 Targeted Channel Dredging

Areas of the slough where sediment has reduced or, in some cases, reversed the channel bed slope would be dredged to produce a consistent downhill grade for the entire length of the Slough. Dredge spoils would be formed into berms along the slough bank in areas where the local field elevation is lower than the existing slough bank elevation. This method could be

[7] Ditches would be widened only in areas where the local field elevation is lower than the surrounding farmland.

**Figure 4.1 Typical Widened Channel Cross Section**

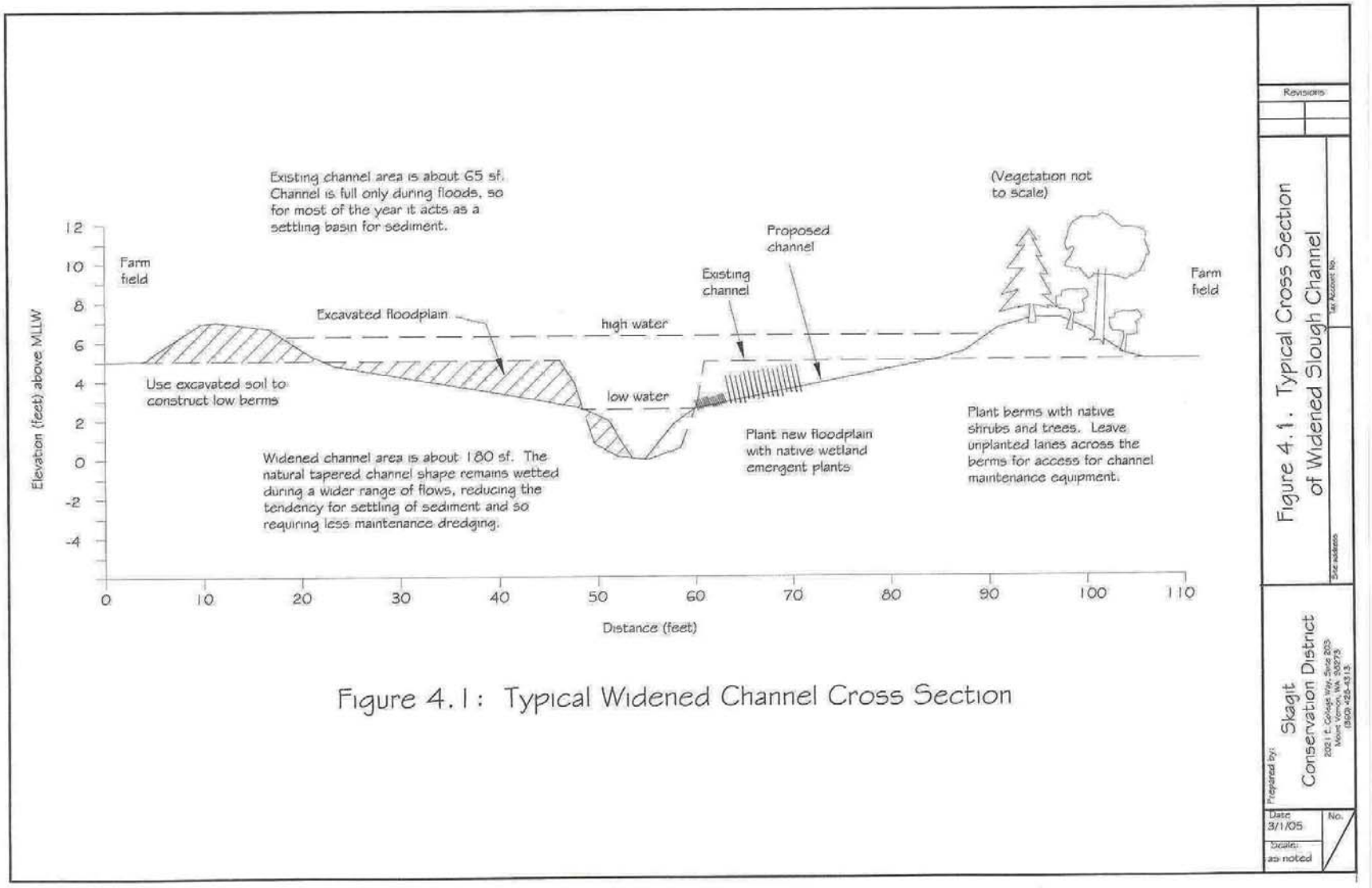



Figure 4.1: Typical Widened Channel Cross Section

combined with channel widening (Item 4.2.1). It is believed that after the implementation of erosion control measures in the upland areas and the flats (Items 4.1.8, 4.2.5, and 4.2.6), the need for continued future dredging would be reduced.

### 4.2.5 Riparian Vegetation Planting

The existing vegetation along the banks of the slough would be expanded and improved to provide shading, stabilize the banks, filter out sediment from runoff from adjacent agriculture fields, and provide cover for birds and other wildlife. Along some parts of the slough, the existing dense thickets of blackberry and native rose would be thinned and inter-planted with a more diverse community of native trees and shrubs. Along other banks that currently do not have any riparian vegetation, narrow shrub buffers or grass buffer strips of a minimum acceptable width (for example, three feet) would be planted. These buffers would be design to allow access for equipment to do future maintenance dredging of the channel. In areas where setback berms are constructed (e.g. Item Nos. 4.2.1 and 4.2.2), the berms would be planted more intensely with native shrubs and trees.

### 4.2.6 Field Ditch Runoff Controls and BMPs

The beds and sides of seasonal V-ditches that drain into the slough and connected field ditches would be planted with a fast-growing grass cover crop immediately after construction. The grass would stabilize the ditches somewhat to reduce soil erosion, as well as filter out some of the sediment that drains off of the adjacent farmland during winter rains. V-ditches that drain into the slough along sections of bank that have set-back berms would terminate in a flap-gated culvert beneath the berm. In subsequent years, the new V-ditches would be constructed in the same locations, in order to connect to the culverts beneath the berms. Other runoff controls that could be implemented include placing silt fencing across the mouths of V-ditches or planting whole fields in cover crop.

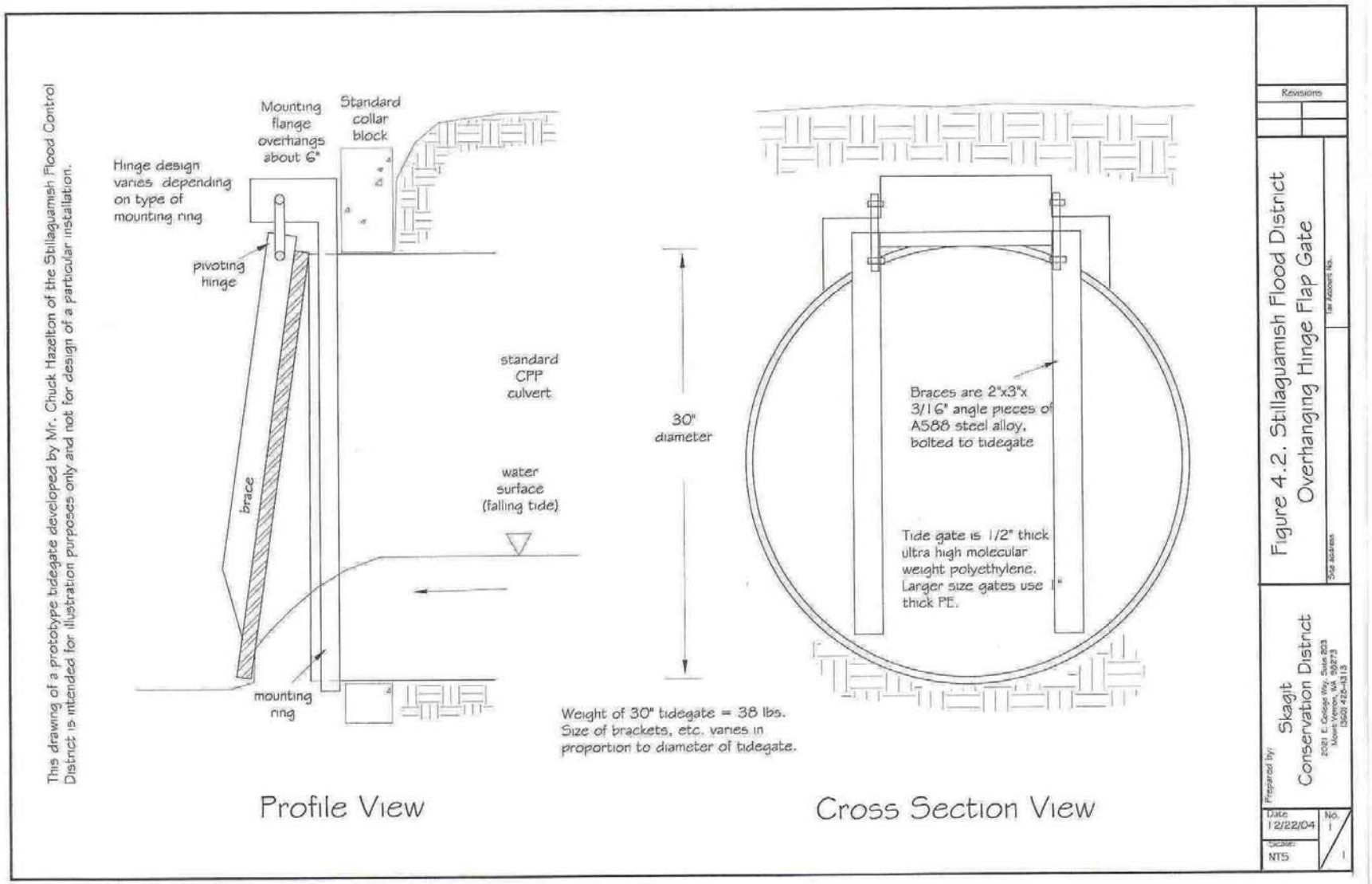
### 4.2.7 Improve Flap Gate Efficiency

Aging flap gates on the tidegates through the dikes would be replaced with high-molecular weight polyethylene flap gates to improve their efficiency, reduce maintenance costs, and allow limited passage for fish and other marine life during the falling tide cycle. An overhanging, pivoting hinge design developed by the Stillaguamish Flood Control District allows the flap gate to open more easily and stay open longer on falling tides, while still sealing shut on rising tides. Figure 4.21 illustrates this design.

### 4.2.8 Dike Setbacks

A portion of the existing Padilla Bay dike would be set back along No Name Slough or other areas on the Flats and the intervening land would be allowed to be flooded by daily tides. With proper grading and elevational control, the intervening land would eventually revert to mud flat, low marsh, and high marsh habitat, similar to the land between the dikes along lower Little Indian Slough. Setting back of dikes would require re-installation of tide gates, pump stations, and other infrastructure that now exists to drain water through the existing dike.

## Figure 4.2 Pivoting Hinge Tide Gate Design



## *4.3 Policy Methods*

### 4.3.1 Drainage Tax Credits for On-site BMPs

Local legislators would be urged to revise the county drainage utility tax structure to provide a tax credit or other form of financial incentive for property owners in the No Name Slough watershed (as well as elsewhere in Skagit County) who implement best management practices (BMPs) related to reducing peak flows and improving the quality of stormwater runoff from their property.

### 4.3.2 Small Grants Program for BMP Implementation

Skagit County government would be urged to provide a source of funding to provide relatively small grants to landowners or resource management agencies to implement BMPs on individual properties for the purpose of reducing peak runoff flows and improving the quality of stormwater runoff. The small grant program could be administered directly by the county government, or by a local non-government agency such as the Skagit Conservation District.

### 4.3.3 Improved Coordination of Land Development Permitting

The Skagit County Planning and Permit Office would be encouraged to improve the quality and comprehensiveness of permit review for development activities in the No Name Slough watershed by actively engaging technical input from not only Skagit County government agencies but also Dike District 12, the Skagit Conservation District, the Padilla Bay National Estuarine Research Reserve, and other interested stakeholders that have technical expertise in drainage, water quality, habitat, and related issues in the watershed. Technical input should be sought prior to issuing a public notice of the intent to issue of Determination of Non-Significance, in order to give stakeholders ample opportunity to provide meaningful technical input. To the extent feasible and allowable by regulations, the technical review of drainage development plans should encourage the identification of mitigation opportunities on a coordinated, watershed-wide scale.

# 5 Identification of Project Alternatives

The following section describes several potential projects that could be implemented to help achieve the drainage, water quality, and habitat improvement objectives in the No Name Slough watershed. Each project consists of a unique combination of the methods identified in Section 4. The project sites are located throughout the watershed in order to disperse their benefits widely. Project side locations are shown in Figures 5.1 (Upland Area) and 5.2 (Flats Area). Appendix 2 describes the projects proposed at each individual location.

The suite of potential projects described in this section is by no means intended to be exclusive, nor is it assumed that they all will be feasible to implement. The project locations and designs were identified because of amenable existing site conditions, they are located on large, undeveloped land parcels, or had other attributes that were favorable. These attributes are presented and evaluated in detail in Section 6. Public review of the suite of projects by the Citizens Advisory Committee is summarized in Section 7.

## *5.1 Upland Projects*

### 5.1.1 No Action

The No Action alternative, in which no projects are implemented, is included as basis of reference for comparing the benefits and costs of other alternatives. Under the No Action Alternative, water quality, flooding, and habitat conditions would remain the same or gradually degrade as the upland area is developed further. The costs associated with continued dredging of sediment from the slough, flooding of agricultural land, and loss of fish and wildlife habitat would gradually increase over time.

### 5.1.2 Wetland Enhancement Projects

A conservation easement would be negotiated with the owners of up to five parcels in the upland part of the watershed. The specific parcels are listed in Appendix 2. Wet pasture areas and an existing farm pond would be enhanced to improve their hydrologic, water quality, and habitat functions and values. Shallow excavations would be made at each site and a low (e.g. 2-foot high) berm constructed to impound 1 to 2 acre-feet of water at each location. At one location, an existing drainage ditch would be blocked with a flow control structure to impound water at an existing pasture wetland during winter when the pasture was not being used for grazing. At other sites, existing drainage ditches would be routed into the impoundments and a flow control weir would be installed at the outlet to gradually meter flow out of the wetland into the creek or roadside ditch system. A 30-foot wide strip of native trees and shrubs would be planted on one or more of the sides of the wetlands to shade them and buffer them from pasture and road runoff. The wetland itself would be planted with bull rush and other native wetland herbaceous plants. The sites would be fenced to exclude cattle.

## Figure 5.1. Proposed Upland Project Alternatives

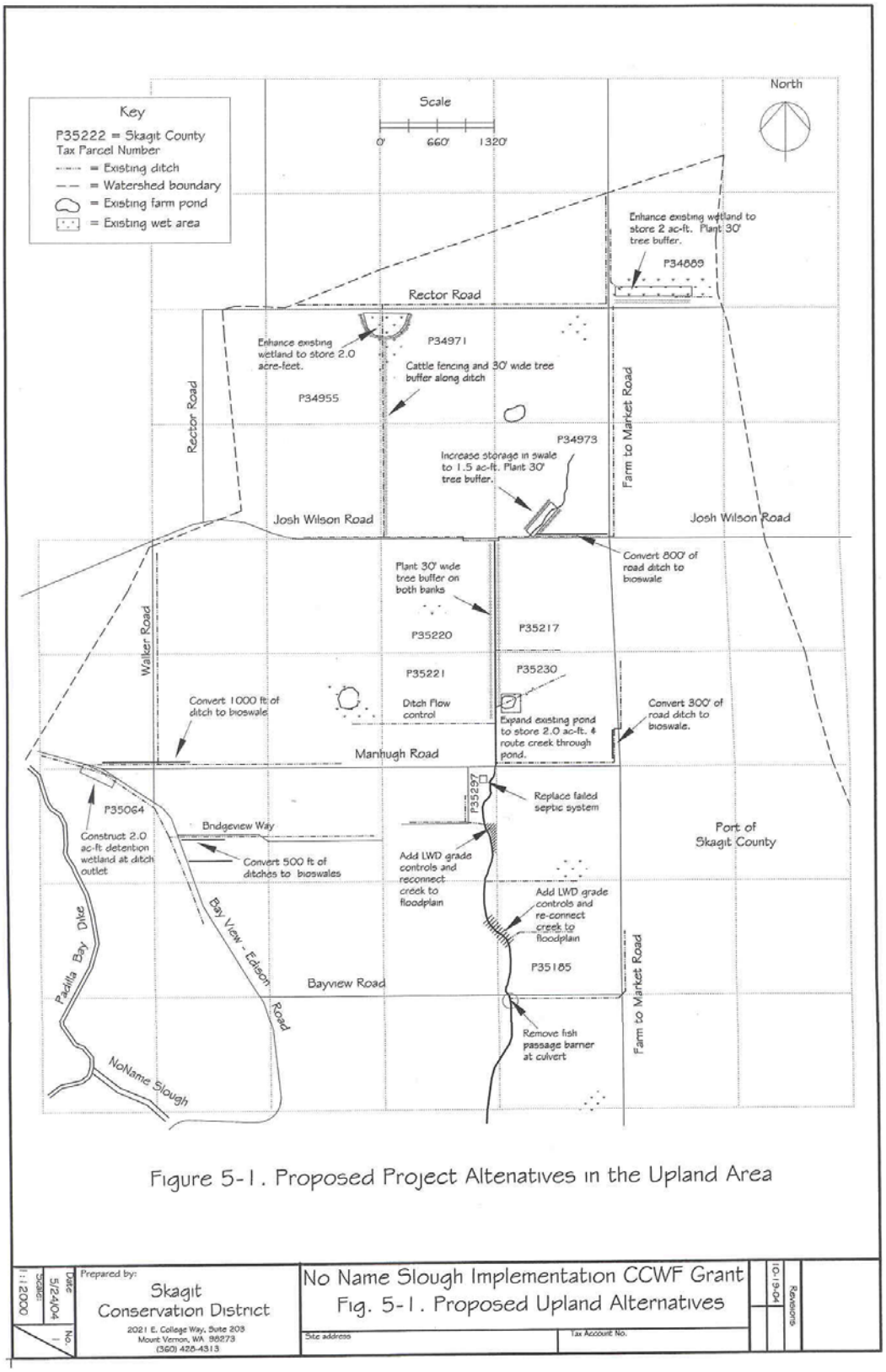



Figure 5-1. Proposed Project Altenatives in the Upland Area

| | | | |
|---|---|---|---|
| Scale: 1" = 2000' | Prepared by: Skagit Conservation District, 2021 E. College Way, Suite 203, Mount Vernon, WA 98273, (360) 428-4313 | No Name Slough Implementation CCWF Grant<br>Fig. 5-1. Proposed Upland Alternatives | Date: 5/24/04<br>No. —<br>Revisions: 10-19-04 |
| | | Site address | Tax Account No. |

### 5.1.3 Riparian Buffers

Permanent conservation easements would be purchased on narrow strips of land along the banks of a major field ditch and upper No Name Creek at four properties in the upper watershed. The width of the easements would depend on the landowner's preference, with 30-feet being a typical proposed width. The easements would be planted with native trees and shrubs. In some locations, where narrow thickets of blackberry and native rose line the creek, blackberry would be removed and the rose thickets would be inter-planted with native trees to improve the quality of habitat and shade. The tree buffers would be fenced to exclude cattle.

### 5.1.4 Roadside Bioswales

Portions of existing roadside drainage ditches at up to five sites on county road right-of-ways would be converted to bioswales to improve the quality of road runoff draining from upland areas of the watershed. The bioswales, which would be designed in accordance with the guidelines in WDOE's *Stormwater Management Manual for Western Washington*, would provide equal or greater flow capacity than the current ditches, while filtering the runoff through a bed of native grasses or wetland plant species. Depending on subsurface soil conditions and the available right-of-way space, the bioswales could also include subsurface, gravel-filled infiltration galleries, which would allow for some limited storage of base-flow runoff. Construction of the bioswales would have to be coordinated with Skagit County Public Works maintenance crews so that the crews would not clear plant material from the sites, as is currently done each year.

### 5.1.5 Creek Channel Stabilization and Floodplain Reconnection

Large woody debris (LWD) grade controls would be installed and severely incised creek banks would be re-graded to shallower slopes on three parcels along No Name Creek. The LWD installations would reduce channel erosion and the accompanying release of sediment at high creek flows, while also encouraging formation of small scour pools in the channel and providing habitat for aquatic invertebrates and other resident aquatic life. At two sites, the banks would be re-graded to permit flood flows to overflow onto the floodplain, providing up to 1.0 acre-foot of flood storage. The re-graded areas would be planted with native wetland emergents and shrubs.

### 5.1.6 Septic System Replacement

Water quality monitoring in No Name Creek has identified a non-point source seepage of septage along the right bank of the creek on Parcel No. P35297. It is presumed that a failing septic system and/or gray water drain line on this property is the source of the water pollution. Financial assistance would be obtained from Skagit County, USDA Rural Development Agency, or another source to replace the failing septic system with a properly-functioning system.

### 5.1.7 Bay View Road Fish Passage Blockage Removal

The existing fish passage blockage caused by the two perched culverts at the Bay View Road crossing of No Name Creek would be corrected, either by implementing the preferred design identified in the 1998 Leonard Budinot & Skodje, Inc. study (a concrete pool and weir fishway leading through the west culvert) or by another appropriate design.

### 5.1.8 Permanent Forest Conservation Easement

A permanent conservation easement would be purchased on the 71-acre parcel of high quality forest and forested wetland owned by the Callahan family (Parcel No. P21108). The easement would preserve this valuable conservation area along the west side of Farm to Market Road from potential future development.

### 5.1.9 Modification of Paccar Detention Pond

The outlet structure of the existing stormwater detention pond at the Paccar Technical Center would be modified to retain more storage at low to moderate runoff flow rates. The size of the lower outlet orifices would be reduced so that runoff would be released more gradually. Modifying the outlet structure would reduce flows in the downstream creek and slough as well as extend summer low base flow in the creek. The sizing of the highest orifices in the outlet structure would not be changed, so that the peak flow discharge rate would remain the same. Detailed engineering evaluation of the outlet structure would be done to determine the optimal orifice sizing and the resulting increase in storage capacity.

## *5.2 Projects on the Flats*

### 5.2.1 Constructed Wetlands

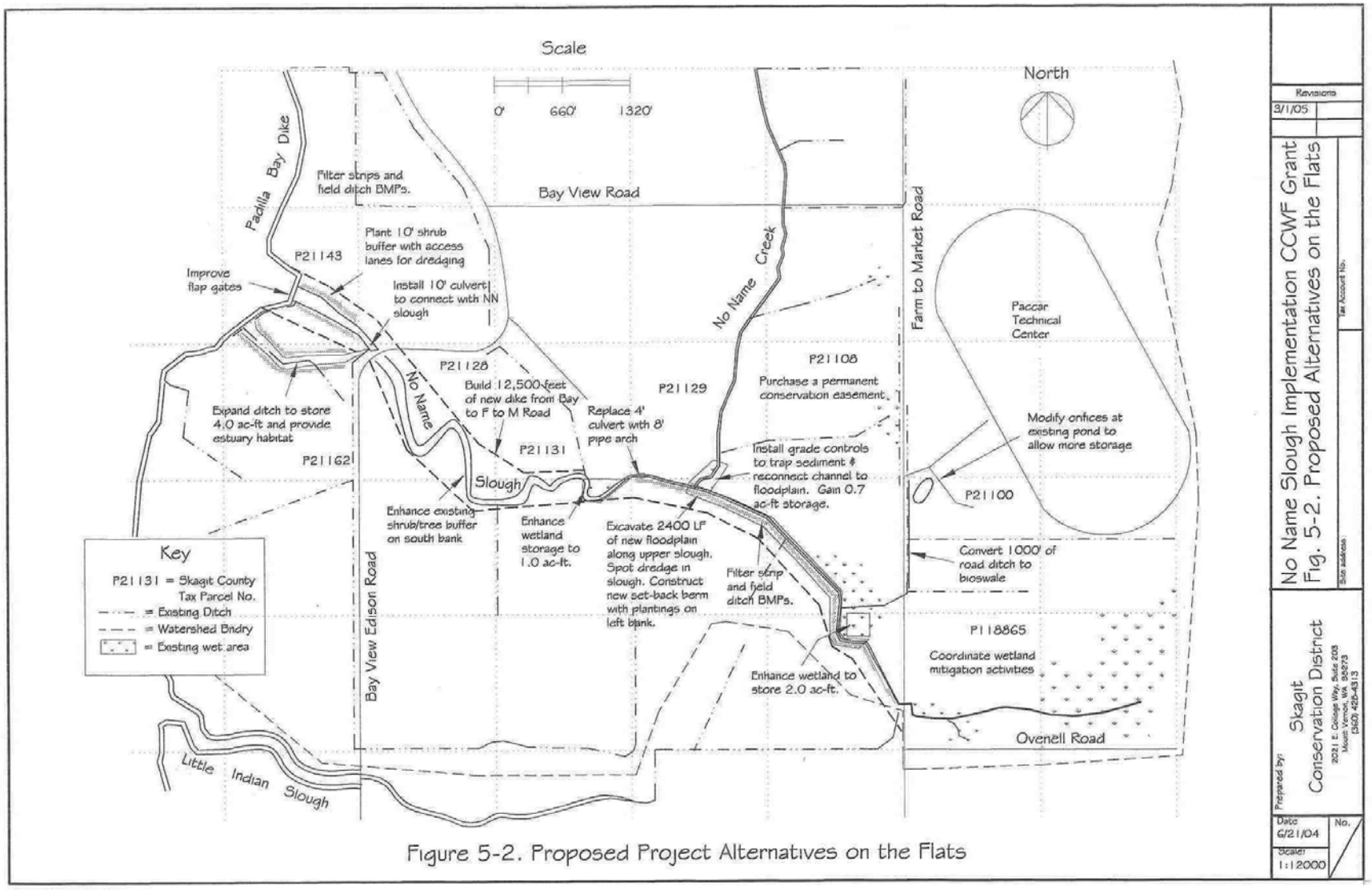
A conservation easement would be negotiated with the owners of up to three parcels of unused or frequently-flooded agricultural land. The parcels, which are listed in Appendix 2, are located either adjacent to No Name Slough or to major drainage ditches at the boundary between the upland area and the Flats. At each site about one acre would be converted to a shallow detention pond / artificial wetland by excavating and constructing perimeter berms. A flow control weir would be installed to gradually meter flow out of the pond into the slough or ditch. The weirs would be set to impound one to two acre-feet of water.

A 10 to 20-foot wide strip of native estuary shrubs would be planted along the berms to enhance the habitat value of the sites. The wetlands would be planted with bull rush and other native wetland emergent plants. At the Egbers site (Parcel No. P21132), the existing 4-foot diameter culvert beneath the farm access road adjacent to the wetland site would be replaced with an 8-foot wide pipe arch culvert to allow more flow capacity and reduce flooding at this location.

### 5.2.2 Preserve and Enhance Existing Riparian Buffer

A narrow thicket of native rose bushes, blackberry, and alder trees currently lines the south (left) bank of No Name Slough from the Bay View – Edison Road crossing to the confluence of the first major field ditch on Parcel No. P21134. A permanent conservation easement would be purchased on a narrow strip of land (for example, 40 feet) along this 2800-foot length. Blackberry and other invasive plants would be removed and replaced with trees and shrubs with higher-habitat value. Access for dredging equipment would be maintained along the north (right) bank (as is currently the case) and agreements would be negotiated with the dike district to retain the vegetation along the south bank. If the landowners are willing, the buffer on the left bank could be extended along the slough to the edge of the hillside or even further upstream.

## Figure 5.2. Proposed Project Alternatives on the Flats



### Filter Strips and Field Ditch BMPs

The south (left) bank of the slough between the upstream end of the existing shrub thicket (Parcel No. P21132) and the slough's head on the Dahlstedt property (Parcel No. P21141) would be planted with a permanent, 3-foot wide grass filter strip. The filter strip would reduce the loading of sediment and agricultural chemical residues in runoff into the slough. In addition, sediment control BMPs such as silt fencing, straw bales, or grassed filter strips would be installed at the mouths of all permanent field ditches and V-ditches that flow into the slough.

## 5.2.3 Widening the Upper Slough

Up to 2,400 lineal feet of the upper slough from the confluence with No Name Creek to the "right angle"" on the Dahlstedt property would be widened to a width of about 65 feet to provide up to 6.3 additional acre-feet of floodwater storage. Excavated soil would be formed into a low berm on the south (left) bank to protect low-lying farmland from flooding.[8] As illustrated in Figure 4.1, the widened slough would have a sloping cross section to provide a small low flow channel and a wide floodplain for storing floodwater. The floodplain would be planted in native wetland emergent plants to protect the soil from erosion and provide habitat value. A narrow buffer of trees and shrubs would likewise be planted on the south berm to shade the slough and provide some habitat value. At regular intervals, the berm would be left unplanted to provide access lanes for channel maintenance equipment. Flap-gated culverts would be installed through the berm at the locations where existing field ditches flow into the upper slough.

As part of this project, approximately 300 lineal feet of the slough channel in the vicinity of the confluence with No Name Creek would also be dredged to provide a uniform, downhill grade. An LWD revetment would be installed at the confluence to protect the bank from flood flows and to provide a limited amount of habitat structure for fish. Construction of this project in conjunction with the proposed No Name Creek floodplain reconnection project located immediately upstream of the confluence (Project No. 5.1.5) would significantly reduce the sediment bed load in the creek and greatly reduce the need for future maintenance dredging in the confluence area. Depending on the creek's bed load following these improvements, excavation of a small off-channel settling pond may be warranted for further sediment removal.

## 5.2.4 Widen Existing Channels at the Padilla Demonstration Farm

The existing remnant estuary "blind" channel located on the WDOE Padilla Demonstration Farm immediately south of the mouth of No Name Slough (Parcel No. P21162) would be widened and graded to provide an additional 4.0 acre-feet of flood storage capacity as well as to improve its estuary habitat value. The channel, which currently is a shallow ditch, would be widened to about 100 feet wide and deepened to approximate the gradually-sloping cross section of the nearby "reference" estuary channel at Little Indian Slough. The upstream end of the channel would be connected to No Name Slough just downstream of the Bay View – Edison Road crossing so that flow in the slough would "split" into both the existing and new channels. A 10-foot diameter culvert would be installed across the channel for the PDF access road. Dredge spoils would be formed into low mounds on each side of the new channel and a 10 to 20-foot

[8] The higher north (right) bank, located along the toe of the uplands, would not be bermed.

wide buffer of native estuary shrubs would be planted on the mounds. Depending on the salinity of the dredge spoils, some soil conditioning might be needed prior to planting the buffer on them.

The remaining dredge spoils would be formed into low mounds along both sides of the existing Pump House Reservoir (mouth of No Name Slough). A 10-foot wide buffer of native estuary shrubs would be planted on the mounds. Gaps could be left to provide several access lanes for equipment for future maintenance dredging. Alternatively, if installation of channel stabilization projects and sediment runoff BMPs reduced the sediment load in the slough sufficiently, the need for future dredging would be reduced or eliminated.

### 5.2.5 Improve the Existing Flap Gates at the Pump House Reservoir

The existing flap gates on the pump house reservoir outfalls would be replaced with improved designs that allow them to stay open more easily and reduce need for maintenance. The tidegate design that recently has been developed by the Stillaguamish Flood Control District, which features high density plastics flaps and overhung hinge structures, would probably be appropriate for retrofitting the gates at No Name Slough (See Figure 4-2). The improved gate design would allow increased drainage flow rate and limited passage for fish and other marine life during the falling tide cycle.

### 5.2.6 Extend New Dike From Padilla Bay to Farm to Market Road

Approximately 12,500 linear feet of new dikes would be constructed extending from the mouth of No Name Slough to the head near Farm to Market Road. The dikes, which would be at the same elevation and roughly the same cross section area as the existing Padilla Bay dike, would bracket a restored estuary area roughly following the course of the existing slough. About 300 feet of existing dike at the slough mouth would be removed to let the salt water extend up to the base of the hillside. The area between the dikes would be graded to roughly the cross section of Little Indian Slough, with varying elevations for mudflat, low marsh, and high marsh. The entire project site would cover over 34 acres, with about 6.5 acres on the WDOE Padilla Demonstration Farm and the remainder purchased from private landowners.

The project would include construction of a new bridge at Bay View Edison Road and installation of new tidegates through the dike at the junctures of existing permanent field ditches.

## *5.3 Policy Methods*

### 5.3.1 Drainage Tax Credits for On-site BMPs

Local legislators would be urged to revise the county drainage tax structure to provide a tax rebate or other form of tax credit for property owners in the No Name Slough watershed (as well as elsewhere in Skagit County) who implement best management practices related to reducing peak flows and improving the quality of stormwater runoff from their property.

### 5.3.2 Small Grants for BMP Implementation

Skagit County government would be urged to provide a source of funding to provide relatively small grants to landowners or resource management agencies to implement BMPs on individual properties for the purpose of reducing peak runoff flows and improving the quality of stormwater

runoff. The small grant program could be administered directly by the county government, or by a local non-government agency such as the Skagit Conservation District.

### 5.3.3 Coordinate Port and Skagit County Mitigation Activities with Overall Watershed Objectives

The Port of Skagit County and the Skagit County Permit and Planning Office would be encouraged to coordinate the wetland protection and drainage mitigation requirements that may be associated with development on local properties within the Port's and the County's jurisdiction with the overall objectives of improving hydrology, water quality, and habitat within the lower No Name Slough watershed as a whole, rather than solely on the individual properties. Such coordination might include implementing wetland and drainage mitigation activities on one or more of the sites identified in Sections 5.1 and 5.2.

Wetland and drainage mitigation might also be coordinated with the Washington State Department of Transportation's program to widen State Route 20 within a few miles south and east of the project area.

# 6 Evaluation of the Project Alternatives

This section evaluates each of the project types identified in Section 5 according to relevant evaluation criteria. The projects are then ranked relative to each other in accordance to their fit with the various criteria.

## *6.1 Evaluation Criteria*

Three general criteria are used for evaluating the project types:

- Effectiveness in Achieving the Objectives;
- Potential Detrimental Impacts; and
- Cost.

Each of these is explained below.

### 6.1.1 Effectiveness in Achieving the Objectives

In Chapter 3, specific objectives were developed for addressing the flooding, water quality, and habitat problems in the No Name Slough watershed. While the objectives are not mutually exclusive, for convenience they can be grouped into three general goals for the Upland and Flats areas of the watershed, as follows.

<u>Upland Headwaters and No Name Creek</u>

1. Improve Water Quality
   - Consistently comply with the dissolved oxygen and fecal coliform water quality criteria

2. Restore Hydrologic Functions
   - Decrease peak stormwater runoff flow
   - Increase summer base flow

3. Support Fish and Wildlife Habitat.
   - Preserve and enhance existing forests and wetlands
   - Reduce channel erosion and improve structural complexity of channel
   - Provide fish passage upstream of Bay View Road

<u>Flats and No Name Slough</u>

1. Improve Water Quality
   - Consistently comply with the dissolved oxygen, temperature, and turbidity water quality criteria

2. Restore Hydrologic Function
   - Increase storage capacity of floodwater
   - Increase conveyance capacity of upper slough to at least 40 cfs
   - Increase hydraulic connectivity with wetlands and nearshore habitat areas

3. Support Fish and Wildlife Habitat
   - Improve habitat value of riparian vegetation

### 6.1.2 Potential Detrimental Impacts

Detrimental impacts that may potentially be associated with implementing the various project alternatives include "short-term" and "long-term" impacts. Short-term impacts include those caused during construction and implementation of the project, such as traffic interruption and temporary increases in sediment runoff from disturbed soil. Long-term impacts include conversion of agricultural, forestry, or developable land to conservation uses; interruption in existing drainage patterns; purported increased potential for interference between water fowl and aircraft in the vicinity of the Skagit County Airport; and potential increase in salinity of soil on the Flats due to closer proximity of salt water.

### 6.1.3 Cost

The overall cost of implementing the various project alternatives identified in Chapter 5 includes such components as the cost of planning and permitting, property acquisition, construction, and long-term monitoring and maintenance.

## *6.2 Evaluation of Upland Projects*

The three general evaluation criteria are applied to each of the Upland project alternatives as follows. A summary of the evaluations of all Upland projects is shown in Table 6.1

### 6.2.1 No Action

Effectiveness in Achieving the Objectives

No improvement would be made towards improving water quality, restoring hydrologic function, and supporting fish and wildlife habitat. Due to inevitable development of the uplands on Bay View Ridge, it can be expected that the existing problems would gradually get worse over time.

Potential Detrimental Impacts

Not applicable

Cost

Due to the increase in peak runoff that is associated with increased development, the costs associated with lost agricultural production due to flooding and more frequent ditch maintenance due to increased sediment loads would increase over time. Quantification of such future costs is beyond the scope of this feasibility study. Similarly, quantification of the value of lost beneficial uses due to increased peak runoff, decreased summer base flow, and non-compliance with the water quality criteria, while undoubtedly substantial, is beyond the scope of this study.

### 6.2.2 Wetland Enhancement Projects

Effectiveness in Achieving the Objectives

The gradual release of up to 7.5 acre-feet of runoff during the late spring and early summer from upland wetlands, both by surface flow and hyporheic recharge to the creek, would likely result in a moderate improvement in the summer temperature and dissolved oxygen conditions in the creek and slough. Upland storage would also attenuate winter peak flows, which would moderately reduce creek channel erosion and flooding in the Flats. The creation of over 5 acres of emergent and shrub wetland habitat would significantly improve bird and other wildlife habitat as well as indirectly improve fish habitat in the creek and slough by improving water

## Table 6-1. Comparison of Evaluations of Upland Alternatives

| Project Type or Name | Description | No. Pro-jects | Estimated 10-year Cost | Acreage Impact-ed | Benefits | | | Detriments |
|---|---|---|---|---|---|---|---|---|
| | | | | | Water Quality | Flooding / Hydrology | Habitat Conditions | |
| 1. Wetland Enhancements | Convert existing wet pasture areas to shallow wetlands holding 1 to 2 ac-ft of water. Includes flow control structures at outlets and planting of emergent plants in wetland and 30' tree buffers outside of the berms | 5 | $316,000 | 11.0 | Moderate reduction in winter sediment loads; moderate improvement in summer DO and temp. by improving summer base flow and hyporheic flows | Moderate improvement by storing up to 7.5 acre feet of runoff, attenuating creek flows, erosion, and flooding. | Major increase in emergent and shrub wetland habitat for wildlife; indirect benefit to fish by prolonged summer base flow | Temporary sediment runoff during construction. Conversion of 11 acres. Attract more water fowl near airport. |
| 2. Roadside Bioswales | Convert road ditches to 10' to 15' wide bioswales | 5 | $288,000 | 1.0 | Minor improvement by filtering road and pasture runoff | Minor attenuation of peak flows / prolonging of base flows | Minor emergent wetland habitat value. | Interfere with traffic during construction. Temp. sedimentation. |
| 3. Creek Channel Stabilization and Floodplain Reconnection | Install grade controls and large woody debris to stabilize erosion and reconnect No Name Creek channel to its floodplain | 3 | $143,000 | 1.5 | Moderate reduction in turbidity; minor improvement in temp. | Moderate improvement in flood storage; major reduction in channel erosion. | Moderate increase in channel structure and complexity for fish habitat. | Temporary increase in sediment runoff in creek during construction |
| 4. Upland Riparian Buffers | Plant 30-foot wide buffers and install cattle fencing along creek and selected field ditches. Includes flow control weirs on selected ditches. | 3 | $101,000 | 5.0 | Major improvement in temp. by shading; minor improvement in fecal coliform by excluding cattle | Minor attenuation of runoff; minor prolonging of summer base flow | Moderate improvement of wildlife habitat; long-term improvement of fish habitat by LWD recruitment | Conversion of existing pasture and hay fields. |
| 5. Bay View Road Fish Passage Blockage Removal | Replace existing culverts under Bay View Road with a new culvert designed to allow upstream fish passage | 1 | $234,000 | N.A. | Minor improvement in reducing turbidity from channel erosion | Minor reduction of erosion by eliminating "jetting" flow | Moderate improvement by allowing access to 1 mile of marginal upstream habitat | Interfere with traffic and temporary increase in sediment runoff in creek during construction |
| 6. Marihugh Road Septic Tank Replacement | Replace failing septic system alongside creek with a new, properly-functioning system | 1 | $18,000 | N.A. | Major improvement by removing significant source of fecal coliform pollution | None | Indirect improvement of fish habitat by water quality improvements | None |
| 7. Permanent Forest Conservation Easement | Purchase a permanent conservation easement on a large forested parcel adjacent to lower No Name Creek | 1 | $358,000 | 71.3 | Potential major benefit by preserving valuable forest and wetland functions along creek | Potential major benefit by preserving valuable forest and wetland functions along creek | Potential major benefit by preserving valuable forest and wetland functions along creek | Prevent conversion of site to more lucrative future uses. |
| 8. Modify Paccar Detention Pond | Modify existing outlet structure to retain more water at non-peak runoff conditions | 1 | $21,000 | N.A. | Minor improvement to temp. by prolonging summer base flow | Minor improvement to summer base flow in "East Fork" creek | Minor indirect benefit to fish by prolonged summer base flow | Negligible |

quality and summer base flow conditions.

Potential Detrimental Impacts

During construction of the proposed wetland enhancement projects there would likely be a temporary increase in sediment runoff to field ditches and No Name Creek. Runoff would be mitigated as part of the project "Temporary Erosion and Sedimentation Control" (TESC) plans. Completion of the wetland enhancement projects at all five proposed sites would result in the conversion of about 11 acres of marginally-productive pasture and hay land. The proposed sites are poorly-drained, so agricultural use currently is limited at them. Completion of the wetland projects would likely attract more waterfowl, which FAA guidelines regard as unsuitable in the vicinity of the runway of the Skagit County airport.

Cost

Table 6.2 summarizes the costs associated with implementing the five proposed wetland enhancement projects. Detailed cost estimates for each project are included in Appendix 3. The estimated present worth of 10-year costs for this alternative is $316,000.

### 6.2.3 Riparian Buffers

Effectiveness in Achieving the Objectives

Effective shading of the over 3,000 lineal feet of north-south oriented creek and drainage ditch that is proposed under this alternative would likely result in a major improvement in summer temperature and dissolved oxygen conditions in the creek. Placement of fencing to exclude cattle from the water courses would probably also result in a minor improvement in fecal coliform conditions. As the trees and shrub buffers mature, they would likely have a minor effect in attenuating peak runoff flows and summer low base flows. They also would result in a moderate improvement in wildlife habitat along the creek and ditches, as well as a possible long-term improvement of fish habitat conditions in the creek due to eventual recruitment of large woody debris.

Potential Detrimental Impacts

Installation of riparian buffers at all four proposed sites would result in the conversion of about 5 acres of marginally-productive pasture and hay land. The proposed sites are poorly-drained, so agricultural use currently is limited at them.

Cost

Table 6.2 summarizes the costs for implementing the four proposed riparian buffer projects. Detailed cost estimates for each project are included in Appendix 3. The estimated present worth of 10-year costs for this alternative is $101,000.

### 6.2.4 Roadside Bioswales

Effectiveness in Achieving the Objectives

The five proposed bioswale projects would result in a minor improvement in water quality by filtering runoff from road and pasture areas. They would have a minor improvement in attenuating peak runoff flows and prolonging summer base flows and would create a small amount of additional emergent wetland habitat.

## Table 6-2. Summary of Project Cost Estimates

| Project Type or Name | No.of Projects | Project Design & Management | Property Acquisition | Construction & Implementation | 10-year Maintenance & Monitoring | Total Present Worth | Add 15% Contin-gency* |
|---|---|---|---|---|---|---|---|
| **UPLAND PROJECTS** | | | | | | | |
| Upland Wetland Enhancement | 5 | $53,400 | $51,500 | $142,577 | $27,257 | $274,734 | $315,944 |
| Roadside Bioswales | 5 | $38,700 | $23,000 | $153,337 | $34,964 | $250,001 | $287,501 |
| Creek Floodplain Reconnection | 3 | $34,200 | $8,500 | $66,332 | $15,057 | $124,089 | $142,702 |
| Upland Riparian Buffers | 4 | $4,500 | $24,500 | $37,348 | $21,119 | $87,467 | $100,587 |
| Bay View Rd Fish Blockage Removal | 1 | $12,600 | $0 | $191,056 | | $203,656 | $234,204 |
| Marihugh Rd. Septic Tank Replacement | 1 | $3,000 | $0 | $11,869 | $600 | $15,469 | $17,789 |
| Callaghan Perm. Conserv. Easement | 1 | $4,500 | $223,990 | $0 | $82,584 | $311,074 | $357,735 |
| Modify Paccar Detention Pond | 1 | $7,200 | $0 | $9,819 | $1,362 | $18,381 | $21,138 |
| **PROJECTS ON FLATS** | | | | | | | |
| Constructed Wetlands | 3 | $35,100 | $32,000 | $108,672 | $19,690 | $195,462 | $224,781 |
| Filter Strips and Field Ditch BMPs | 1 | $2,500 | $0 | $5,287 | $8,494 | $16,281 | $18,723 |
| Widen Upper Slough | 1 | $16,200 | $13,500 | $69,394 | $6,756 | $105,850 | $121,728 |
| Enhance Existing Buffer along Slough | 1 | $4,000 | $13,800 | $4,613 | $6,718 | $29,131 | $33,501 |
| Widen & Enhance PDF Slough Channels | 2 | $16,400 | $0 | $155,878 | $17,297 | $189,575 | $218,011 |
| Upgrade Tidegate Flap Gates | 1 | $5,400 | $0 | $8,632 | $6,177 | $20,209 | $23,240 |
| Construct New Dike to F to M Rd.* | 1 | $32,400 | $110,000 | $3,142,976 | $61,001 | $3,346,377 | $4,015,652 |
| * uses a 20% contingency | | | | | | | |
| **Totals** | **31** | | | | | | **$6,133,238** |

Potential Detrimental Impacts
Construction of the bioswales would temporarily interfere with traffic, particularly on heavily-used Farm to Market Road. Construction would have to be carefully timed so that the plantings in the swales could establish themselves before the winter rainy season, in order to prevent erosion of exposed soil in the swales during the first winter of use.

Cost
Table 6.2 summarizes the costs for implementing the five proposed bioswale projects. Detailed cost estimates for each project are included in Appendix 3. The estimated present worth of 10-year costs for this alternative is $288,000.

### 6.2.5 Creek Channel Stabilization and Floodplain Reconnection

Effectiveness in Achieving the Objectives
The gradual release of about 1.0 additional acre-feet of water during the late spring from re-connected and re-forested floodplain, and the formation of pools and cover associated with LWD grade control structures would likely result in a minor improvement in the summer temperature and dissolved oxygen conditions in the creek and slough. The grade controls would significantly reduce channel erosion and accompanying sediment bed load, while the increased floodplain storage would moderately attenuate winter peak flows. Floodplain reforestation and the increased channel complexity associated with LWD grade controls would result in a moderate improvement in fish habitat in the upper reach of No Name Creek.

Potential Detrimental Impacts
During construction of the three proposed in-stream projects there would be a significant temporary increase in sedimentation in No Name Creek. Runoff would be mitigated as part of the project TESC plans.

Cost
Table 6.2 summarizes the costs associated with implementing the three in-stream restoration projects. Detailed cost estimates for each project are included in Appendix 3. The estimated present worth of 10-year costs for this alternative is $143,000.

### 6.2.6 Septic Tank Replacement

Effectiveness in Achieving the Objectives
Replacement of the failed septic system on Parcel No. P35297 would eliminate a major source of both fecal coliform pollution and biochemical oxygen demand in the creek, resulting in a major improvement in water quality. Replacement of the tank would not have any affect on the watershed's hydrology. The affect on fish and wildlife habitat conditions would be indirect, through the elimination of a major water quality impact.

Potential Detrimental Impacts
Implementation of this alternative would not result in any significant detrimental impacts.

Cost
Table 6.2 summarizes the costs associated with replacing the septic system. A detailed cost estimate is included in Appendix 3. The estimated present worth of this alternative is $18,000.

### 6.2.7 Bay View Road Fish Passage Barrier Removal

Effectiveness in Achieving the Objectives

Removal of the fish passage barrier at Bay View Road would not result in a significant improvement in water quality. Installation of one or more properly sized and positioned culverts would result in a minor improvement in the creek hydrology by eliminating the jetting flow and its associated channel scouring, which characterizes the current culverts. The main benefit of this project would be to improve the watershed's fish habitat conditions by re-opening access to about 5,600 feet of marginal habitat that currently exists in No Name Creek between Bay View Road and Josh Wilson Road.

Potential Detrimental Impacts

Construction of this project would cause a major temporary interference in local traffic patterns, requiring the temporary closure of Bay View Road. Construction would also cause a significant temporary increase in sedimentation in No Name Creek. Runoff would be mitigated as part of the project's TESC plan. No long-term detrimental impacts are anticipated for this project.

Cost

Table 6.2 summarizes the costs associated with replacing the Bay View Road fish passage blockage. A detailed cost estimate is included in Appendix 3. The estimated present worth of 10-year costs for this alternative is $234,000.

### 6.2.8 Permanent Forest Conservation Easement

Effectiveness in Achieving the Objectives

The purchase of development and logging rights on the 71-acre forested Callahan parcel would result in a potential major benefit to water quality, flooding/hydrology, and habitat conditions in the lower watershed by preserving the existing valuable forest and wetland functions that it presently provides.

Potential Detrimental Impacts

Purchase of a permanent conservation easement would prevent the conversion of this parcel to other potentially lucrative future uses such as logging or residential development.

Cost

Table 6.2 summarizes the costs associated with purchasing a conservation easement on this parcel. A detailed cost estimate is included in Appendix 3. The estimated present worth of 10-year costs is $358,000.

### 6.2.9 Modification of Paccar Detention Pond Outlet

Effectiveness in Achieving the Objectives

Modifying the existing outlet structure of the Paccar Technical Center's stormwater detention pond would result in a minor improvement in late spring temperature and habitat conditions in the "East Fork" creek and upper No Name Slough by prolonging base flows later into the season. Depending on the final design, the project could potentially also have a minor benefit in reducing peak runoff flows from the pond as well.

Potential Detrimental Impacts
If designed properly, the project would not be expected to have any detrimental impacts.

Cost
Table 6.2 summarizes the costs associated with implementing this project. A detailed cost estimate is included in Appendix 3. The estimated present worth of 10-year costs is $21,000.

## *6.3 Projects on the Flats*

The three general evaluation criteria are applied to each of the Flats project alternatives as follows. A summary of the evaluations of all Flats projects is shown in Table 6.3.

### 6.3.1 Constructed Wetland Projects

Effectiveness in Achieving the Objectives
Construction of up to three shallow wetlands adjacent to drainage ditches or the slough would result in a minor improvement in summer temperature and dissolved oxygen conditions by prolonging the release of summer base flow and providing up to five acres of photosynthetic emergent plants. The wetlands would significantly improve flood water management by providing five additional acre-feet of storage. The replacement of the undersized culvert at the Egbers farm road (a component of the wetland project proposed on Parcel No. P21132) would also provide a moderate increase in the overall flow capacity of the slough. Each of the projects would provide an improvement in habitat conditions for shorebirds. The two projects on the Egbers property would also improve off-channel winter rearing habitat for fish.

Potential Detrimental Impacts
During construction of the proposed wetland projects there would be a temporary increase in sediment runoff to field ditches or No Name Slough. Runoff would be mitigated as part of the project TESC plans. Completion of the project at the McMoran property would result in the conversion of about 2 acres of frequently-flooded but otherwise productive crop land. The proposed project site on Parcel No. P21132 is currently unused land covered with reed canary grass and shrubs. The proposed project site on Parcel P21140 is emergent wetland. In order to mitigate construction impacts to this site, the function and value of the existing wetland would have to be substantially improved.

Cost
Table 6.2 summarizes the costs associated with implementing the three proposed wetland creation projects. Detailed cost estimates for each project are included in Appendix 3. The estimated present worth of 10-year costs for this alternative is $225,000.

### 6.3.2 Filter Strips and Field Ditch BMPs

Effectiveness in Achieving the Objectives
Installation of permanent grass filter strips and sediment control structures at the mouths of field ditches would significantly reduce wintertime sediment runoff from the fields, thus substantially improving the turbidity conditions in the slough. The projects would not significantly improve summer temperature or dissolved oxygen conditions. The projects would also not reduce flooding conditions in winter; in fact the silt fences or other sediment control structures at the mouths of ditches would be expected to reduce the drainage capacity of the ditches slightly. The

## Table 6-3. Comparison of Evaluations of Flats Alternatives

| Project Type or Name | Description | No. Pro-jects | Estimated 10-year Cost | Acreage Impact-ed | Benefits | | | Detriments |
|---|---|---|---|---|---|---|---|---|
| | | | | | Water Quality | Flooding / Hydrology | Habitat Conditions | |
| 1. Constructed Wetlands | Convert unused or frequently-flooded sites into wetlands holding 1 to 2 ac-ft of runoff each. Includes flow control structures and planting emergent plants and 30' tree buffers outside of the berms | 3 | $225,000 | 5.0 | Minor benefit to summer DO and temp. in the slough due to increased storage for base flow and photosynthetic plants. | Major improvement by storing up to 5 acre feet of runoff, minor improvement in summer base flow. | Major improvement in off-channel rearing habitat for fish; major improvement in shore bird and other wildlife habitat. | Temporary sediment runoff during construction. Conversion of 2 acres of crop land (McMoran site only). |
| 2. Filter Strips and Field Ditch BMPs | 3' wide strip along south bank of upper slough planted in grass. Filter fabric or V-notch weirs placed at outlets of all field ditches and V-ditches. | 1 | $18,700 | 0.4 | Major improvement in turbidity by reducing winter sediment loads | None. Possible slight reduction in drainage efficiency of ditches. | Minor improvement in in-stream habitat by reducing sedimentation and frequency of slough dredging | Requires annual maintenance by landowner. |
| 3. Widen Upper slough | Widen 2400 LF of upper slough to 65' with gradually-sloping bottom. Set-back berm on south side planted with trees and shrubs. Dredge about 300 LF of channel for more uniform slope. | 1 | $122,000 | 2.5 | Moderate reduction in turbidity by reducing flood runoff from fields. Minor shading of slough water. | Major reduction in flooding by adding 6.3 acre-ft of storage and improving channel hydraulics. | Moderate improvement with narrow riparian buffer and emergent wetland vegetation on floodplain. | Temporary sediment runoff during con-struction. Conversion of 20.5 acres of crop land. |
| 4. Enhance the Existing Riparian Buffer along Slough | Preserve existing riparian buffer along south bank of lower slough; clear blackberry and interplant with some trees. | 1 | $42,000 | 3.7 | Moderate long-term improvement in temp. by providing more shade | None | Minor improvement in wildlife habitat by improving quality of existing buffer. | Conversion of 2.6 acres of unused crop land. |
| 5. Widen and Enhance PDF Slough Channels | Widen the remnant channel located south of the slough to about 100 feet Connect to No Name Slough with a 10' diameter culvert. Plant narrow shrub buffers on channel and pump house reservoir. | 2 | $218,000 | 3.9 | Minor long-term improvement in temperature by providing shrub riparian buffer | Major improvement by adding about 4 acre feet of flood storage. | Major improvement in fish and wildlife habitat by providing additional 3.9 acres of mudflat, brackish marsh, and shrub buffer. | Temporary sediment runoff during con-struction. Conversion of 3.9 acres of publicly-owned agriculture land. |
| 6. Upgrade Tidegates | Replace existing flap gates with lighter design that allows gates to open under less hydraulic head. | 1 | $23,000 | 0 | Might exacerbate summer temperature and DO problems | Potentially a minor improvement in drainage capacity | Moderate improvement in fish passage into slough at falling tides. | None (except as described for water quality) |
| 7. Construct New Dike from Bay to Farm to Market Road | Construct about 12,500 LF of new sea dike. Dredge reservoir to resemble Little Indian Slough. Install new tidegates, bridge at BV-E Rd. riparian buffers, etc. | 1 | $4,016,000 | 34.3 | Tidal flushing would eliminate water quality problems in the slough. | Flooding would be eliminated on most fields but would increase on north fields at high tide. | Major improvement in fish and wildlife habitat due by restoring estuary processes on over 24 acres. | Major traffic and sediment runoff impacts during con-struction. Potential for localized increases in soil salinity. |

project would have a minor, indirect affect on habitat conditions by reducing the need to dredge the slough as frequently.

Potential Detrimental Impacts
Installation of 3-foot wide filter strips along about 5,800 feet of slough bank would not significantly impact agricultural use of the land, since this narrow width is typically not plowed anyway. Maintaining silt fencing, permanent filter strips, or other BMPs at the mouths of ditches would require minor annual maintenance by the landowners (maintenance costs are included in the cost estimate).

Cost
Table 6.2 summarizes the costs associated with implementing the filter strip and ditch BMP project. A detailed cost estimate is included in Appendix 3. The estimated present worth of 10-year costs for this alternative is $18,700

### 6.3.3 Widening the Upper Slough

Effectiveness in Achieving the Objectives
Widening 2,400 feet of the upper slough to provide 6.3 acre-feet of storage, combined with dredging a uniform downhill channel grade in the vicinity of the confluence of No Name Creek, would significantly reduce and perhaps even eliminate flooding of farmland in that area. The reduction in flooding and associated run-off of sediment load from adjacent fields would also reduce winter turbidity levels somewhat. The narrow buffer of trees or shrubs planted on the berm would provide some shading benefits to reduce summer temperature. The project would also provide a minor improvement in habitat conditions.

Potential Detrimental Impacts
Construction of the project would cause a large but temporary increase in sediment runoff to the slough. Runoff would be mitigated as part of the project's TESC plan. The project would convert about 2.5 acres of land from agricultural production to conservation / flood control use.

Cost
Table 6.2 summarizes the costs associated with implementing the project. A detailed cost estimate is included in Appendix 3. The estimated present worth of 10-year costs for this alternative is $122,000.

### 6.3.4 Enhance the Lower Slough's Existing Buffer

Effectiveness in Achieving the Objectives
Preserving and enhancing the approximately 2,800 lineal feet of existing riparian buffer along the left (south) bank of the lower slough would result in a moderate long-term improvement in summer temperature and dissolved oxygen conditions as the trees mature and provide effective shading. This alternative would provide improvements in hydrology only in the sense that erosion and field runoff would increase if the existing buffer were removed. Replacing some of the existing blackberry and rose thickets with native trees and higher-value shrubs would result in a minor improvement in current wildlife habitat conditions on the Flats.

Potential Detrimental Impacts
The project would convert 2.6 acres of cropland to conservation use; however, since this acreage currently is not use for agriculture, the impact in reality is negligible.

Cost
Table 6.2 summarizes the costs associated with implementing the project. A detailed cost estimate is included in Appendix 3. The estimated present worth of 10-year costs for this alternative is $42,000.

### 6.3.5 Widen and Enhance Habitat in PDF Slough Channels

Effectiveness in Achieving the Objectives
Substantially widening the remnant estuary channel on the PDF and planting narrow shrub buffers along the banks of this channel and the pump house reservoir would have a minor positive affect on summer temperature and dissolved oxygen conditions due to limited shading and improved water circulation. The project would result in a major improvement in flood control by providing an additional 4 acre-feet of flood storage. Constructing the widened channel to the same elevational cross section as Little Indian Slough would lead to a major improvement in fish and wildlife conditions by allowing for the development of mudflat, low marsh, and high marsh habitat features.

Potential Detrimental Impacts
During construction there would be a large but temporary increase in sediment runoff to No Name Slough. Runoff would be mitigated as part of the project's TESC plan. The project would involve converting about 3.9 acres of publicly-owned land, which is currently used for agriculture, to conservation use. The project is not likely to cause an increase in soil salinity in the vicinity of the site because there will be no significant increase in the flow of salt water into the slough and drainage ditch system.

Cost
Table 6.2 summarizes the costs associated with implementing the project. A detailed cost estimate is included in Appendix 3. The estimated present worth of 10-year costs for this alternative is $218,000.

### 6.3.6 Upgrade Tidegates

Effectiveness in Achieving the Objectives
Upgrading the four existing tidegates at the mouth of No Name Slough would result in a minor improvement in drainage capacity for the Slough and ditch system. Because the slough would drain more efficiently, there would be somewhat less water in it during summer low flow conditions, which might have a minor negative effect on temperature and dissolved oxygen. Notwithstanding, the upgraded tidegates would result in a moderate improvement to fish habitat conditions by allowing increased fish passage from the bay into the slough during falling tides.

Potential Detrimental Impacts
No detrimental impacts (except those discussed for water quality) are anticipated with this alternative.

Cost
Table 6.2 summarizes the costs associated with implementing the project. A detailed cost estimate is included in Appendix 3. The estimated present worth of 10-year costs for this alternative is $23,000.

### 6.3.7 Build New Dike from Padilla Bay to Farm to Market Road

Effectiveness in Achieving the Objectives
Opening the mouth of No Name Slough would allow the tides to fill and drain the slough each day, thus eliminating the temperature and dissolved oxygen problems. The new dikes extending to the toe of the uplands would isolate the majority of farmland on the flats from upland runoff, thus preventing flooding. An exception is the farmland located north of the current No Name Slough reservoir pond and Bay View – Edison Road, which would still be subject to flooding from runoff from the west end of Bay View Ridge (Sub-basin Nos. 1 and 2). Even though the ditches from these north fields would drain through tidegates under the new dike, the removal of the existing pumps would worsen temporary flooding in this area, because standing water could only drain into the slough during low tide. The project would result in a major improvement to fish and wildlife habitat by restoring estuary processes to over 24 acres of land.

Potential Detrimental Impacts
During construction of this large project, temporary water quality impacts and traffic impacts would be significant. Over the long-term, the project would result in the conversion of about 34 acres of productive crop land to conservation purposes. There is a potential that the project would cause localized increases in soil salinity in the vicinity of the new dike. Based on preliminary monitoring of water table salinity and soil transmissivity conducted as part of the *No Name Slough Watershed Characterization Report* (SCD / PBNERR, 2004), the problem of salt-water intrusion in the shallow water table appears to depend on very localized soil conditions. Most of the sites monitored had dense clay soils that showed little or no response to tidal influence, but some, where sandier conditions result in "salt boils," were strongly affected by the tide. Subsurface soil investigations may be required as part of the dike project's design in order to mitigate the impact of salt water on the surrounding agricultural land.

Cost
Table 6.2 summarizes the costs associated with implementing the project. Detailed cost estimates for each project are included in Appendix 2. The estimated present worth of 10-year costs for this alternative is $4,016,000.

## *6.4 Policy Methods*

The three general evaluation criteria are applied to each of the policy method alternatives as follows.

### 6.4.1 Drainage Tax Credits for On-site BMPs

Effectiveness in Achieving the Objectives
The effectiveness of this alternative depends upon the quantity and quality of BMPs that are implemented by individual landowners. It is assumed that the value of the tax credit would be correlated to how effective the landowner's activities are in reducing upland runoff.

Potential Detrimental Impacts
Potentially this alternative could divert significant tax revenues from the local dike and drainage district; however, if the program was effective, it would also lower the district's operating costs.

Cost
An economic evaluation of this alternative is beyond the scope of this feasibility study.

### 6.4.2 Small Grants for BMP Implementation

Effectiveness in Achieving the Objectives
The effectiveness of this alternative depends entirely upon the quantity and quality of BMPs that are implemented by landowners. It is assumed that the awarding of grants would be dependant on the likely effectiveness of the individual applicant's proposed projects.

Potential Detrimental Impacts
No detrimental impacts are anticipated from this alternative.

Cost
An economic evaluation of this alternative is beyond the scope of this feasibility study.

### 6.4.3 Coordinate Mitigation Activities with Overall Watershed Objectives

Effectiveness in Achieving the Objectives
The effectiveness of this alternative depends entirely upon the quantity and quality of mitigation activities that are implemented at individual sites. It is assumed that the approval of off-site mitigation activities by the local and state authorities would be dependant on the likely effectiveness of the individual permit applicant's proposed mitigation project.

Potential Detrimental Impacts
No detrimental impacts are anticipated from this alternative.

Cost
An economic evaluation of this alternative is beyond the scope of this feasibility study.

# 7 Public Review and Ranking of Alternatives

In this chapter, each of the project alternatives is ranked relative to the entire suite of proposed alternatives. The ranking is based on the evaluations in Chapter 6 and advice from the project's citizen advisory committee. The ranking procedures are described below.

## *7.1 Ranking Procedures*

Alternatives were ranked in accordance with two procedures. First, a cost-benefit ranking was done to evaluate each alternative's relative "benefit" compared to its cost, compared to the those of the other alternatives. Second, a citizen advisory committee (CAC) of local stakeholders was convened to discuss the various alternatives and to provide its opinions on the relative attractiveness of each alternative in terms of general acceptance to the local public.

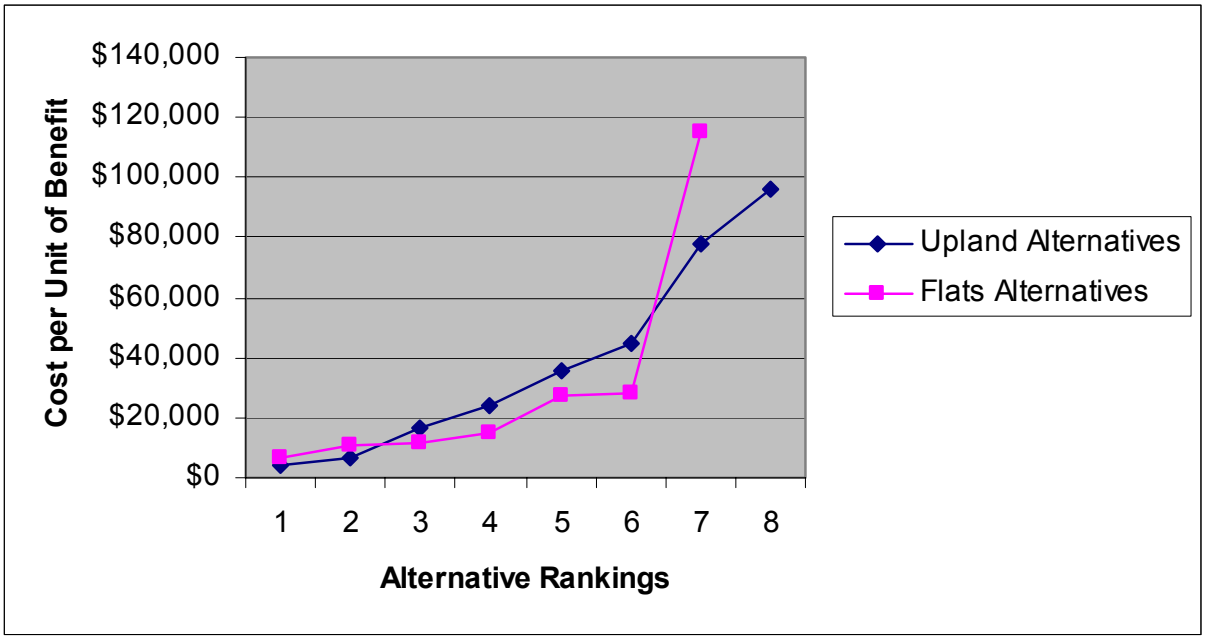
### 7.1.1 Cost Benefit Ranking

Alternatives were ranked in accordance with their relative "benefit" compared to each other, that is, their effectiveness in achieving the various objectives identified in Chapter 3. For each project, arbitrary benefit units ranging from "0" (no benefit) to "5" (highest benefit) were assigned to each category of objective (i.e. water quality, flooding/hydrology, and habitat conditions). Assignment of "benefit units" was based on the evaluation of each individual alternative in Chapter 6. In a few instances where an alternative potentially would have a negative impact (for example, would worsen water quality or flooding), negative-value benefit units were assigned.

Following a tabulation of the overall "benefit scores," a "cost per unit benefit" was calculated for each alternative. The cost per unit benefit is simply the quotient of the estimated 10-year cost divided by the overall benefit score. For example, if the estimate cost of an alternative is $200,000 and the overall benefit score is 8, the cost per unit benefit value is ($200,000 / 8) = $25,000. An alternative that included two or more individual project sites, for example, the "Upland Wetland Enhancement" alternative, which included five potential upland wetland restoration sites, was considered to be one single alternative for the purpose of cost-benefit ranking. Finally, the alternatives were ranked according to their cost per benefit value, with the least expensive values being ranked highest. Figure 7.1 graphs the cost per unit benefit of each alternative, showing a cost per unit benefit ratio in the range of $5000 for the top ranked alternatives to a ratio of $100,000 or more for the lowest ranked alternatives.

The proposed policy alternatives were not ranked because of uncertainties associated with estimating the cost of adopting and implementing them.

**Figure 7.1 Comparison of Project Cost versus Benefit**




*For the purpose of maintaining the scale on the cost axis, the unit cost of Flats Alternative No. 7 (constructing a new dike) is shown as 40% of the actual cost per unit of benefit.

### 7.1.2 Public Review by the Citizen Advisory Committee

A citizen advisory committee of local stakeholders was convened to review and provide comments and advice on the draft list of proposed alternatives. Based on input from the committee, the draft list of alternatives was substantially revised to take into account local priorities and interests. Following the completion of the cost-benefit ranking of the revised list of alternatives, CAC members completed a second ranking based on the more subjective criteria of "public acceptance" and "likelihood of implementation." The members and affiliations of the committee are listed in Appendix 1.

## *7.2 Results of Ranking*

Table 7.1 shows the results of the cost versus benefit rankings for the Upland and Flats alternatives. The summary of the results of both the cost-benefit and public acceptance rankings is shown in Table 7.2. The raw results from the public acceptance rankings of each CAC member are included in Appendix 1.

## Table 7-1. Comparison of Project Cost Versus Benefit

| Project Name or Type | No. Pro-jects | Estimated 10-year Cost | Benefit Scoring* | | | Overall Score | Cost per Unit of Benefit* | Relative Ranking |
|---|---|---|---|---|---|---|---|---|
| | | | Water Quality | Flooding / Hydrology | Habitat Conditions | | | |
| **UPLAND PROJECTS** | | | | | | | | |
| 1. Wetland Enhancements | 5 | $316,000 | 2 | 2 | 3 | 7 | $45,143 | 6 |
| 2. Upland Riparian Buffers | 4 | $101,000 | 3 | 1 | 2 | 6 | $16,833 | 3 |
| 3. Roadside Bioswales | 5 | $288,000 | 1 | 1 | 1 | 3 | $96,000 | 8 |
| 4. Creek Channel Stabilization and Floodplain Reconnection | 3 | $143,000 | 2 | 2 | 2 | 6 | $23,833 | 4 |
| 5. Marihugh Rd Septic Tank Replacement | 1 | $18,000 | 3 | 0 | 1 | 4 | $4,500 | 1 |
| 6. Bay View Rd Fish Passage Blockage | 1 | $234,000 | 1 | 0 | 2 | 3 | $78,000 | 7 |
| 7. Permanent Forest Conservation Easement | 1 | $358,000 | 3 | 3 | 4 | 10 | $35,800 | 5 |
| 8. Modify Paccar Detention Pond Outlet | 1 | $21,000 | 1 | 1 | 1 | 3 | $7,000 | 2 |
| **PROJECTS ON THE FLATS** | | | | | | | | |
| 1. Constructed Wetlands | 3 | $225,000 | 2 | 3 | 3 | 8 | $28,125 | 6 |
| 2. Filter Strips and Field Ditch BMPs | 1 | $18,700 | 2 | 0 | 1 | 3 | $6,233 | 1 |
| 3. Widen Upper Slough | 1 | $122,000 | 2 | 4 | 2 | 8 | $15,250 | 4 |
| 4. Enhance Existing Buffer along Slough | 1 | $33,500 | 2 | 0 | 1 | 3 | $11,167 | 2 |
| 5. Widen and Enhance PDF Slough Channels | 2 | $218,000 | 1 | 3 | 4 | 8 | $27,250 | 5 |
| 6. Upgrade Tidegates | 1 | $23,000 | -1 | 1 | 2 | 2 | $11,500 | 3 |
| 7. Build New Dike from Bay to Fto M Road | 1 | $4,016,000 | 5 | 4 | 5 | 14 | $286,857 | 7 |

Notes

1. Benefit scoring units are arbitrarily assigned from "0" (no benefit) to "5" (highest benefit) to reflect the relative qualitative and quantative differences between the various projects. Negative benefit means the project worsens a particular condition.
2. Cost per unit benefit is calculated as the overall cost per project type divided by the benefit score.

## Table 7-2. Summary of Rankings of Alternatives

| Project Alternative | Cost per Benefit Ranking | Public Acceptance Ranking |
|---|---|---|
| **UPLAND ALTERNATIVES** | | |
| Septic Tank Replacement | 1 | 1 |
| Modify Paccar Detention Pond Outlet | 2 | 2 |
| Upland Riparian Buffers | 3 | 6 |
| Creek Channel Stabilization and Floodplain Reconnection | 4 | 4 |
| Permanent Forest Conservation Easement | 5 | 3 |
| Wetland Enhancements | 6 | 5 |
| Bay View Road Fish Passage Blockage Removal | 7 | 7 |
| Roadside Bioswales | 8 | 8 |
| **FLATS ALTERNATIVES** | | |
| Filter Strips and Field Ditch BMPs | 1 | 6 |
| Enhance Existing Buffer along the Slough | 2 | 4 |
| Upgrade Tidegates | 3 | 1 |
| Widen Upper Slough | 4 | * |
| Widen and Enhance PDF Slough Channels | 5 | 3 |
| Constructed Wetlands | 6 | 2 |
| Build New Dike from Padilla Bay to Farm to Market Rd. | 7 | 5 |
| **POLICY ALTERNATIVES** | | |
| Drainage Tax Credits for Implementing BMPs | Unranked | 1 |
| Small Grants for Implementing BMPs | Unranked | 3 |
| Coordination of Port and County Mitigation Activities | Unranked | 2 |

*This alternative was not ranked because the scope was substantially revised after completion of the CAC ranking process. The revisions were made in response to comments by CAC members.

# 8 References

Leonard Budinot and Skodje. 1998. *Skagit County Culvert Evaluations Fish Passage Improvement (Task No. 1).* Prepared for Skagit County, Washington.

Padilla Bay / Bay View Watershed Management Committee. 1995. *Padilla Bay Watershed Non Point Action Plan.* Prepared for Washington Department of Ecology.

Skagit County Department of Planning and Community Development. 1988. *Skagit County Watershed Ranking Project.*

Skagit Conservation District and Padilla Bay National Estuarine Research Reserve. 2004. *No Name Slough Watershed Characterization Report*. Prepared for Washington Department of Ecology.

Washington State Attorney General. 1969. *Attorney General Opinion No. 4: Opinion given to James P. Behlke, Director, Water Pollution Control Commission*. 10 pp.

Washington Department of Ecology, 1998. Clean Water Act Section 303(d) list.

Washington Department of Ecology, 2001. *Stormwater Management Manual for Western Washington.* WDOE Publication No. 99-11 through 99-15.

Washington Department of Ecology, 2004. Clean Water Act Section 303(d) list.

# Appendix 1
# Citizen Advisory Committee
# Membership and Summary of Project Rankings

### Citizen Advisory Committee Members and Affiliations

| Member Name | Affiliation |
|---|---|
| Chuck Bennett | Commissioner, Skagit Co. Dike District No. 12 |
| Norm Dahlstedt | Dahlstedt Agricultural Properties LLC |
| Vernon Egbers | Farm owner, resident |
| Dave Henry | Padilla Bay National Estuarine Research Reserve |
| Rick Haley | Skagit County Department of Public Works |
| Carolyn Kelly | Skagit Conservation District |
| Pamela Kiesel | Farm owner |
| Jess Knutzen | J& D Welding Service (agricultural services supplier) |
| Don McMoran. | Farm owner |
| Kim Nelson | Nelson Construction Co. (local drainage contractor), resident |
| Paul Stannert | Port of Skagit County |
| Alison Studley | Skagit Fisheries Enhancement Group, resident |
| Terry Stevens | Director, Padilla Bay National Estuarine Research Reserve |
| Bob Warinner | Washington Department of Fish and Wildlife |
| Clare Wixsom | Paccar Technical Center |

## Summary of Citizen Advisory Committee Member Rankings of Project Alternatives

| Project Alternative | Individual Committee Member's Ranking | | | | | | | | | | | | | Median Value | Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Upland Alternatives* | | | | | | | | | | | | | | | |
| Upland Riparian Buffer | 10 | 8 | 10 | 7 | 3 | 13 | 11 | L | 11 | 11 | 11 | 11 | 3 | 11 | **6** |
| Septic Tank Replacement | 3 | 1 | 13 | 1 | 4 | 1 | 1 | H | 1 | 3 | 15 | 3 | 1 | 1 | **1** |
| Modify Paccar Pond Outlet | 4 | 2 | 7 | 2 | 5 | 7 | 5 | 4 | 2 | 4 | 12 | 15 | 2 | 4.5 | **2** |
| Creek Channel Stabilization & Floodplain Reconnection | 18 | 16 | 6 | 10 | 6 | 6 | 6 | H | 8 | 8 | 7 | 5 | 5 | 6 | **4** |
| Wetland Enhancements | 16 | 7 | 8 | 11 | 2 | 16 | 8 | 3 | 6 | 10 | 8 | 12 | 4 | 8 | **5** |
| Roadside Bioswales | 12 | 15 | 14 | 9 | 7 | 17 | 14 | L | 3 | 15 | 13 | 9 | 7 | 13 | **8** |
| Permanent Forest Conservation Easement | 11 | 14 | 2 | 12 | 1 | 5 | 13 | L | 3 | 6 | 3 | 10 | 6 | 6 | **3** |
| Bay View Road Fish Passage Barrier Removal | 6 | | 15 | 17 | 8 | 18 | 9 | L | 12 | 16 | 13 | 4 | 8 | 12.5 | **7** |
| *Flats Alternatives* | | | | | | | | | | | | | | | |
| Filter Strip & Field Ditch BMPs | 5 | 13 | 12 | 13 | 2 | 12 | 10 | M | 9 | 14 | 10 | 14 | 2 | 12 | **6** |
| Constructed Wetlands | 17 | 6 | 9 | 3 | 1 | 14 | 2 | 2 | 5 | 9 | 9 | 8 | 3 | 5.5 | **2** |
| Enhance Existing Buffer along the Slough | 9 | 12 | 4 | 14 | 4 | 15 | 7 | M | 10 | 12 | 4 | 7 | 6 | 7 | **4** |
| Upgrade Tidegates | 8 | 17 | 3 | 6 | 3 | 3 | 12 | M | 13 | 5 | 5 | 2 | 5 | 5 | **1** |
| Widen and Enhance PDF Slough Channels | 15 | 10 | 5 | 8 | 5 | 9 | 3 | H | 7 | 7 | 6 | 6 | 4 | 6 | **3** |
| Widen the Upper Slough* | | | | | | | | | | | | | | | |
| Build New Dike from Padilla Bay to Farm to Market Road | 14 | 18 | 1 | 16 | 7 | 2 | 15 | L | 15 | 1 | 2 | 1 | 7 | 7 | **5** |
| *Policy Alternatives* | | | | | | | | | | | | | | | |
| Drainage Tax Credits for Implementing BMPs | 1 | 4 | 1 | 18 | 1 | 10 | | | 17 | 2 | 1 | 1 | M | 2 | **1** |
| Small Grants for Implementing BMPs | 2 | 5 | 2 | 5 | 2 | 8 | | | 16 | 17 | 2 | 2 | M | 5 | **3** |
| Coordination of County Mitigation Activities | 13 | 3 | 3 | 4 | 3 | 4 | | | 18 | 18 | 3 | 3 | H | 3 | **2** |

*Not ranked because the scope was substantially revised based on comments from the CAC review process.

# Appendix 2
## Descriptions of Specific Projects

## Upland Projects

### 1. Wetland Enhancement Projects

Peth Enhanced Wetland

A conservation easement would be negotiated with the owners of Parcel No. P34889, located immediately east of the intersection of Rector and Farm to Market Road (the Peth Family). The PEME wetland located at the site would be enhanced to improve its hydrologic, water quality, and habitat functions and values. A 2.0 acre area could be impounded on the downslope side with a low (2-foot high) soil berm. Existing drainage ditches along the east side of Farm to Market Road and the east extension of Rector Road could be re-routed into the wetland. A flow control weir would be installed to gradually meter flow out of the wetland into the existing roadside ditches downstream. The weir would be set to impound a maximum of 2.0 acre-feet of water. A 30-foot wide strip of native trees and shrubs would be planted on the west and south sides to buffer it from road runoff. The wetland itself would be planted with bull rush and other native wetland herbaceous plants. The entire site would be fenced to exclude cattle.

Richards Enhanced Wetland No. 1

A conservation easement would be negotiated with the owners of Parcel Nos. P34955 and P34971, located along the south side of Rector Road (the Richards/Tollum Family). The existing palustrian emergent (PEME) wetland located at the site would be enhanced to improve its hydrologic, water quality, and habitat functions and values. A 2.0 acre area could be impounded on the downslope side with a low (2-foot high) soil berm. The existing swale/creek headwaters in the center of the site could be regulated with a flow control weir to gradually meter flow out of the wetland into the existing creek field ditch downstream. The weir would be set to impound a maximum of 2.0 acre-feet of water. A 30-foot wide strip of native trees and shrubs would be planted on all sides to provide shade and buffer it from pasture and road runoff. The wetland itself would be planted with bull rush and other native wetland herbaceous plants. The entire enhancement site would be fenced to exclude cattle.

Richards Enhanced Wetland No. 2

A conservation easement would be negotiated with the owners of Parcel No. P34973 (the Tollum/Richards family), which is located NW of the intersection of Farm to Market Road and Josh Wilson Road. The existing PEME wetland / drainage swale at the site would be enhanced to improve its hydrologic, water quality, and habitat functions and values. A 1.0 acre area could be impounded on the downslope side with a low (2-foot high) soil berm. The existing swale/creek headwaters in the center of the site could be regulated with a flow control weir to gradually meter flow out of the wetland into the existing roadside ditch downstream. The weir would be set to impound a maximum of 1.5 acre-feet of water. A 30-foot wide strip of native trees and shrubs would be planted on all sides to provide shade and buffer it from pasture runoff.

The wetland itself would be planted with bull rush and other native wetland herbaceous plants. The entire enhancement site would be fenced to exclude cattle.

Expansion of Tolum Pond

An existing small farm pond located on Parcel No. P35230 could be enlarged and enhanced to provide peak runoff storage, habitat value, and summer base-flow water storage. The parcel is owned by the Tollum/Richards family. The existing pond, which is built in a low lying wet pasture area at the outlet of a field drainage ditch, currently has about 0.4 acre-feet of storage capacity. The pond retains water throughout the year, even during the dry late summer months. Although situated only about 10 feet east of the bank of No Name Creek, the pond does not appear to have any surface connection to the creek.

A conservation easement would be negotiated with the landowners to expand and deepen the pond to provide about 2.0 acre-feet of storage. An inlet would be excavated to the creek on the upstream side. The inlet would be controlled by a porous rock weir or similar structure set at an elevation that would allow the pond to fill with peak flows from the creek, as well as to allowing the pond to gradually drain back into the creek during summer low-flow conditions. Native emergent wetland plants would be planted in the shallows of the pond and a 30-foot wide buffer of native trees and shrubs would be planted around the site.

Field Ditch Flow Control

The existing field ditch on Parcel P35221 that drains a PEME wetland on the adjacent parcel to the west would be abandoned by blocking it upstream of its confluence with the creek. Alternatively, a flow control weir could be installed to reduce the runoff flow rate from this area but not block it entirely. This project could be done either in conjunction with the nearby Tolum Pond expansion project, or as an individual project.

Egbers Wetland Enhancement

The existing large shrub-scrub wetland located at the confluence of the East Fork creek and the upper No Name Slough/field ditch would be enhanced to store more water and improve the wetland's habitat value. On Parcel No. P21140, owned by the Egbers Family, about 1 acre of reed canary grass-choked bottom land located east of the ditch would be dredged to an average depth of 2 feet to provide 2 acre-feet of water storage. Reed canary grass would be removed and the area replanted with native shrubs and trees that are adapted to wetland conditions. Bull rush and other native wetland herbaceous plants would be planted in the shallows. The East Fork creek would be routed into the pond and a weir would be installed at the outlet to gradually meter flow out of the pond into the slough. A conservation easement could be purchased on this land if desired to ensure preservation from future development.

**2. Bioswale Projects**

Josh Wilson Road Bioswale

About 800 linear feet of the existing drainage ditch along the north side of Josh Wilson Road would be converted to a bioswale to improve the quality of road runoff draining from the northeast portion of the watershed. The swale, which would be designed in accordance with the guidelines in WDOE's *Stormwater Management Manual for Western Washington*, would

provide equal or greater flow capacity than the current ditch, while filtering the runoff through a bed of native grasses or wetland plant species. Depending on subsurface soil conditions and the available right of way space, the bioswale could also include subsurface, gravel-filled infiltration galleries, which would allow for some limited storage of base-flow runoff.

Farm to Market Road Bioswale No. 1

About 300 linear feet of the existing drainage ditch along the west side of Farm to Market Road north of the intersection with Marihugh Road would be converted to a bioswale to improve the quality of road runoff draining from Sub-basin No. 7. The swale would be designed to allow equal or great flow capacity than the current ditch, while allowing the water to filter through beds of native wetland plant species. Depending on subsurface soil conditions and the available right of way space, the bioswale could also include subsurface, gravel-filled infiltration galleries, which would allow for attenuation of peak flows and some limited storage of base-flow runoff

Farm to Market Road Bioswale No. 2

About 1000 linear feet of the existing drainage ditch along the east side of Farm to Market Road downstream of the Paccar driveway would be converted to a bioswale to improve the quality of road runoff draining from Sub-basin No. 5. The swale would be designed to allow equal or great flow capacity than the current ditch, while allowing the water to filter through beds of native wetland plant species. Depending on subsurface soil conditions and the available right of way space, the bioswale could also include subsurface, gravel-filled infiltration galleries, which would allow for attenuation of peak flows and some limited storage of base-flow runoff.

Bridgewater Estates Bioswales

About 500 linear feet of existing, rock-lined drainage swales on the Bridgewater Estates subdivision would be converted to a bioswales to attenuate flows and improve the quality of runoff draining from Sub-basin No. 2. The lower 200 to 300 feet of each of the swales along Bridgeview Way and the south property line of the subdivision would be converted to bioswales. Depending on subsurface soil conditions and the available right of way space, the south property line bioswale could also include a subsurface, gravel-filled infiltration gallery, which would allow for attenuation of peak flows and some limited storage of base-flow runoff.

Lower Marihugh Road Bioswale

About 1000 linear feet of the existing drainage ditch along the north side of Marihugh Road would be converted to a bioswale to improve the quality of road runoff draining from Sub-basin No. 9. The swale would be designed to allow equal or great flow capacity than the current ditch, while allowing the water to filter through beds of native wetland plant species. Depending on subsurface soil conditions and the available right of way space, the bioswale could also include subsurface, gravel-filled infiltration galleries, which would allow for attenuation of peak flows and some limited storage of base-flow runoff.

### 3. Riparian Buffers

Richards/McDougle Ditch Buffer

A 30-foot wide native tree and shrub buffer would be planted on both sides of the existing drainage ditch leading south from the wetland identified in Project No. 10A to the ditch along the

north side of Josh Wilson Road. The 2.1 acre project site lies in parts of three parcels, Parcel Nos. P34955 and P34971, owned by the Richard/Tollum family and Parcel No. P120385, owned by the McDougle family. The tree buffer would be fenced to exclude cattle. The buffer and fencing would provide shade as well as protection from pasture runoff.

Upper No Name Creek Riparian Buffer

A 30-foot wide native tree and shrub buffer would be planted on pasture land along both banks of No Name Creek immediately south (downstream) of Josh Wilson Road. Trees would be interplanted within existing blackberry and native rose thickets to improve the quality of habitat and shade. Up to 2000 linear feet of tree buffer (2.8 acres) could be installed on parts of five parcels, Parcel Nos. P35216, P35217, and P35230, owned by the Richards/Tollum family and Parcel Nos. P35220 and P35221, owned by the Peth family. The tree buffer would be fenced to exclude cattle.

**4. Floodplain Reconnection and Creek Channel Stabilization Projects**

Greiner Floodplain Reconnection

Off-channel storage of peak runoff flows would be enhanced along the left floodplain of the creek on Parcel No. P99851, owned by the Greiner Family. Rock bank armoring would be removed and about 1.5 acres of land would be graded slightly to provide about 1.0 acre-feet of flood storage. A flow control weir would be installed at the downstream end of the wetland to gradually meter flow back into the creek during summer base-flow conditions. Native emergent wetland plants would be planted throughout the site.

Schaffer Creek Channel Stabilization

Large woody debris (LWD) would be anchored in the channel of No Name Creek on Parcel No. P35185 to serve as grade controls, reducing channel erosion and the accompanying release of sediment at high creek flows. The project site, which is owned by the Schaffer family, is near the upstream limit of active creek channel incision in the watershed. LWD would also encourage formation of small scour pools in the channel and provide habitat for aquatic invertebrates and other resident aquatic life in the creek. A ditch that flows through a natural swale on the left bank would be abandoned.

Egbers Floodplain Reconnection

Just upstream of the confluence of No Name Creek and No Name Slough (on Parcel No. P21129, owned by the Egbers Family), the creek runs though an extensive shrub-scrub wetland area. The incised creek channel at this location is disconnected from the floodplain. A series of large woody debris installations would be placed in the channel to trap sediment bed load and raise the grade of the channel in order to reconnect it to the wetland floodplain. It is estimated that a 6-inch inundation depth on the floodplain in this area would result in about 0.7 acre-feet of flood storage. The LWD installations would also improve habitat for juvenile salmon and other aquatic life in the creek by promoting pool formation and providing cover and a substrate for aquatic invertebrates.

.

### 5. Septic Tank Replacement

Marihugh Road Septic Tank Replacement
Water quality monitoring in No Name Creek has identified a non-point source seepage of septage along the right bank of the creek on Parcel No. P35297. It is presumed that a failing septic system on this property is the source of the water pollution. Financial assistance would be obtained from Skagit County, USDA Rural Development Agency, or another source to replace the failing septic system with a properly functioning system.

### 6. Modification of Existing Detention Ponds

Modification of Paccar Detention Pond
The outlet structure of the existing stormwater detention pond at the Paccar Technical Center (Parcel No. P21100) would be modified to retain more storage at low to moderate runoff flow rates. The size of the lower outlet orifices would be reduced so that runoff would be released more gradually. This would reduce flows in the downstream creek and slough as well as extend summer low base flow in the creek. The sizing of the highest orifices in the outlet structure would not be changed, so that the peak flow discharge rate would remain the same. Detailed engineering evaluation of the outlet structure would be done to determine the optimal orifice sizing and the resulting increase in storage capacity.

### 7. Removal of Fish Passage Barriers

Bayview Road Fish Passage Blockage Removal
The existing fish passage blockage caused by the two perched culverts at the Bay View Road crossing of No Name Creek would be corrected, either by implementing the preferred design identified in the 1998 Leonard Budinot & Skodje, Inc. study (a concrete pool and weir fishway leading through the west culvert) or by another appropriate design.

### 8. Permanent Forest Conservation Easements

Callahan Forest and Wetland Preservation
A conservation easement would be purchased on the high quality forested wetland on the Callahan property, Parcel No. P21108. The easement would preserve the wetland from potential future development along the west side of Farm to Market Road.

## Projects on the Flats

### 1. Constructed Wetland Projects

McMoran Constructed Wetland
A conservation easement would be negotiated with the owners of Parcel No. P35064, located immediately west of the intersection of Marihugh and Bay View – Edison Road (the McMoran Family). One acre of agricultural land at the outlet of the existing Marihugh Road drainage ditch

culvert would be converted to a shallow detention pond / artificial wetland by excavating and constructing perimeter berms. A flow control weir would be installed to gradually meter flow out of the pond into the existing field ditch downstream. The weir would be set to impound 2.0 acre-feet of water. A 10-foot wide strip of native estuary shrubs would be planted along the perimeter to enhance the habitat value of the site. The wetland itself would be planted with bull rush and other native wetland emergent plants.

Egbers Created Wetland

A conservation easement would be negotiated with the Egbers family to create a wetland for flood water storage and habitat on about 0.7 acres of Parcel No. P21131, located adjacent to No Name Slough just downstream of the Egbers farm road crossing. The site is located within a meander of the slough and is not currently farmed. Flood flows from the slough would be routed into the wetland. A flow control weir would be installed to gradually meter flow back out of the wetland into the slough. The weir would be set to impound about 1.0 acre-feet of water. A 10-foot wide strip of native trees and shrubs would be planted on the south and west sides to shade it and provide additional habitat value. The wetland itself would be planted with bull rush and other native wetland herbaceous plants.

As part of this project, the existing 4-foot diameter culvert beneath the Egbers farm access road would be replaced with an 8-foot wide pipe arch culvert to allow more flow capacity in the slough and reduce flooding at this location.

**2. Upgrade Tidegates**

Improve the Existing Flap Gates at the Pump House Reservoir

The existing steel flap gates on the two Pump House Reservoir outfalls would be replaced with lighter weight, fiberglass or aluminum flap gates with hinges offset from vertical. The improved gate design would allow increased drainage flow rate and limited passage for fish and other marine life during the falling tide cycle.

**3. Enlargement of Remnant Estuary Channel on the PDF**

The existing remnant estuary "blind" channel located on the WDOE Padilla Demonstration Farm immediately south of the mouth of No Name Slough (Parcel No. P21162) would be widened and graded to provide an additional 4.0 acre-feet of flood storage capacity as well as to improve its estuary habitat value. The channel, which currently is a shallow ditch, would be widened to 60 to 100 feet wide and deepened to approximate the cross section of the nearby "reference" estuary channel at Little Indian Slough. The upstream end of the channel would be connected to No Name Slough just downstream of the Bay View – Edison Road crossing so that flow in the slough would "split" into both the existing and new channels. A new culvert would be installed across the channel for the PDF access road. Dredge spoils would be formed into low mounds on each side of the new channel and a 10-foot wide buffer of native estuary shrubs would be planted on the mounds. Gaps would be left in the dredge spoil mounds to provide several narrow access lanes for equipment for future maintenance dredging.

A portion of the dredge spoils from Project 3B would be formed into low mounds along both sides of the mouth of No Name Slough (the Pump House Reservoir). A 10-foot wide buffer of native estuary shrubs would be planted on the mounds. Gaps would be left to provide several access lanes for equipment for future maintenance dredging.

**4. Maintain Existing Riparian Buffer**

A narrow thicket of native rose bushes, blackberry, and alder trees currently lines the south (left) bank of No Name Slough from the Bay View – Edison Road crossing to the farm crossing on the Egbers property. Agreements would be negotiated with Dike District 12 and the landowners (Wallace and Egbers families) to permanently retain the thicket as a riparian buffer. Access for dredging equipment would be maintained along the north (right) bank, as is currently the case.

**5. Filter Strips along Upper Slough and V-Ditches**

The south (left) bank of the slough between the Egbers farm access road (Parcel No. P21129 and its head water on the Dahlstead property (Parcel No. P21141) would be planted with a permanent, 3-foot wide grass filter strip. The filter strip would reduce the loading of sediment and agricultural chemical residues in runoff into the slough. In addition, all seasonal V-ditches that drain into the slough would be planted with a grass cover to reduce sediment and agricultural chemical loadings in runoff through the V-ditches.

**6. Widening and Dredging the Upper Slough**

Up to 2,400 lineal feet of the upper slough from the confluence with No Name Creek to the "right angle"" on the Dahlstedt property (Parcel No. 211141) would be widened to a width of about 65 feet to provide up to 6.3 additional acre-feet of floodwater storage. Excavated soil would be formed into a low berm on the south (left) bank to protect low-lying farmland from flooding. (The higher elevation north (right) bank, along the toe of the hillside, would not be bermed). The widened slough would have a sloping cross section to provide a small low flow channel and a wide floodplain for storing floodwater.

The floodplain would be planted in native wetland emergent plants to protect the soil from erosion and provide habitat value. A narrow buffer of trees and shrubs would likewise be planted on the south berm to shade the slough and provide some habitat value. At regular intervals, the berm would be left unplanted to provide access lanes for channel maintenance equipment. Flap-gated culverts would be installed through the berm at the locations where existing field ditches flow into the upper slough.

As part of this project, approximately 300 lineal feet of the slough channel in the vicinity of the confluence with No Name Creek would also be dredged to provide a uniform, downhill grade. An LWD revetment would be installed at the confluence to protect the bank from flood flows and to provide a limited amount of habitat structure for fish. Construction of this project in conjunction with the proposed Egbers Floodplain Reconnection project located immediately upstream of the confluence on Parcel No. P21129 would significantly reduce the sediment bed load in the creek and greatly reduce the need for future maintenance dredging in the confluence

area. Depending on the creek's bed load following these improvements, excavation of a small off-channel settling pond may be warranted for further sediment removal.

**7. Construct a New Dike from Padilla Bay to Farm to Market Road**

Approximately 12,500 linear feet of new dikes would be constructed extending from the mouth of No Name Slough to the head near Farm to Market Road. The dikes, which would be at the same elevation and roughly the same cross section area as the existing Padilla Bay dike, would bracket a restored estuary area roughly following the course of the existing slough. About 300 feet of existing dike at the slough mouth would be removed to let the salt water extend up to the base of the hillside. The area between the dikes would be graded to roughly the cross section of Little Indian Slough, with varying elevations for mudflat, low marsh, and high marsh. The entire project site would cover over 34 acres, with about 6.5 acres on the WDOE Padilla Demonstration Farm and the remainder purchased from private landowners.

The project would include construction of a new bridge at Bay View Edison Road and installation of new tidegates through the dike at the junctures of existing permanent field ditches.