US Army Corps of Engineers
Seattle District

Skagit River Flood Risk Management General Investigation

Skagit County, Washington

Draft Feasibility Report and Environmental Impact Statement

May 2014

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Executive Summary

The U.S. Army Corps of Engineers (USACE) prepared this draft integrated Feasibility Report and Environmental Impact Statement (draft FR/EIS) for the Skagit River Flood Risk Management General Investigation (GI) study. Skagit County is the non-Federal Sponsor of this study. The draft FR/EIS documents the process of developing potential solutions to reduce flood risk in the Skagit Basin which is located in the state of Washington, including: evaluation of flood risk in the Skagit River Basin (Basin); formulation, evaluation, and screening of potential solutions to these problems; and the recommendation of a plan to address flood risk in the Basin. This report also documents the environmental consequences analysis of the final array of alternatives per requirements of the National Environmental Policy Act (NEPA). The study team, comprised of USACE and Skagit County staff, is conducting this study consistent with the USACE Planning process and USACE SMART Planning principles.

Background: The study area is in the northwest corner of the state of Washington, approximately 60 miles north of the city of Seattle. The project area focuses on the lower Basin located within the floodplain and the Baker River Hydroelectric Project. In a large flood, the majority of the potential economic damages[1] and potential threats to life safety would be located in the Skagit River floodplain, downstream of the city of Sedro-Woolley in the cities of Burlington and Mount Vernon. Critical infrastructure in Sedro-Woolley includes State Routes (SR) 9 and 20 (critical local access routes), United General Hospital, the Sedro-Woolley wastewater treatment plant, and the Life Care assisted living facility. Critical infrastructure in and around Mount Vernon and Burlington includes Interstate 5, Burlington Northern Santa Fe (BNSF) Railroad, SR 20, SR 9, and SR 536), numerous water and gas pipelines, light industry, and municipal infrastructure. The lower Basin also includes highly productive agricultural land. The cities and critical infrastructure are protected by a system of levees and reservoirs along the Skagit River.

An evaluation of flooding issues in the Basin identified the following problem and purpose and need (per NEPA requirements) to be addressed in the GI study:

- Problem: The Skagit River Basin is subject to damaging floods resulting from intense winter rain storms. These large, warm weather systems originate in the tropical Pacific and contain so much moisture that they are technically termed atmospheric rivers. The existing reservoir and levee systems provide the lower river basin with flood risk reduction only up to about the 4% annual chance of exceedance (ACE) level. This level of risk is unacceptable for residential, commercial, and industrial areas; and infrastructure of the cities of Burlington and Mount Vernon and is a threat to life safety.
- Purpose and Need for Action: The purpose of the Federal action is to reduce flood risks, life safety threats, and damages in the Skagit River Basin as a result of flooding. The action is needed

[1] Throughout this document, the terms *damages* and *economic damages* are used interchangeably.

because the Skagit River Basin experiences frequent flooding resulting in damages to both rural and urban areas throughout the Basin.

Plan Formulation: More than 20 management measures were developed that could address the flood risk in the basin. Structural and non-structural measures included - but were not limited to - construction of new levees, modification of existing levees, construction of bypasses, flood proofing of existing structures, and education and outreach. Measures are strategies that decrease flood risk for a specific location. Alone, they cannot address basin-wide flood risk. Multiple measures were assembled into several alternatives in a preliminary array of alternatives. Alternatives in the preliminary array were then refined, in one case reformulated, and developed into the following final array of alternatives:

- No Action Alternative: This alternative was formulated to serve as a baseline condition for comparison of alternatives per USACE planning requirements and NEPA.
- Comprehensive Urban Levee Improvement (CULI) Alternative: This alternative would provide flood risk reduction for the urban areas of Burlington and Mount Vernon by raising existing levees along the Skagit River and constructing a new Burlington Hill Cross Levee along the eastern and northern edges of Burlington.
- Joe Leary Slough Bypass Wide Confined Channel: This alternative would provide flood risk reduction by diverting floodwaters out of the river starting upstream of the urban-damage areas. The diverted floodwaters would be channeled through a newly constructed confined bypass approximately 2,000 feet wide from the Skagit River to Padilla Bay.
- Swinomish Bypass Wide Confined Channel: This alternative would divert floodwaters from the Skagit River to the Swinomish Channel to lower flood risks to an acceptable level by constructing a confined bypass approximately 2,000 feet wide. This alternative would include levee improvements to the existing system and construction of a new Burlington Hill Cross Levee along the eastern and northern boundaries of Burlington.

Tentatively Selected Plan (TSP): The CULI Alternative is the tentatively selected plan. It is the alternative that most cost-effectively meets the objectives of reducing flood risk and risk to life safety. All three action alternatives would provide similar level of protection to urban areas (1% ACE); however, the preliminary evaluation shows that the bypass alternatives are likely to have considerably higher construction costs, real estate costs and environmental impacts than the CULI Alternative. Once the CULI Alternative was identified as the tentatively selected plan, the alternative underwent additional economic evaluation and it was determined that the 0.4% ACE CULI Alternative is the preliminary National Economic Development (NED) Plan. The NED Plan is the most cost-effective plan to reduce flood risk in the Basin.

Next Steps: A 45 day public comment period will be provided for the draft FR/EIS, expected to begin in June 2014 and end in July 2014, concurrent with required technical, peer, and policy reviews. The purpose of these reviews is to seek feedback on the TSP that will inform additional feasibility-level design and analysis that will be conducted to finalize the engineering, cost estimating, environmental, economic, and real estate elements of the plan. Results of the reviews and additional feasibility-level design and analysis will be incorporated into the final FR/EIS. The final FR/EIS will then be reviewed by the USACE Chief of Engineers who would make the final approval of the project recommendation.

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List of Abbreviations and Acronyms

ACE annual chance exceedance
AADT average annual daily traffic
ATR Agency Technical Review
BA Biological Assessment
BMP Best Management Practice
BNSF Burlington Northern Santa Fe
CAA Clean Air Act
CEQ Council for Environmental Quality
CERCLA Comprehensive Environmental Response, Compensation and Liability Act
cfs cubic feet per second
County Skagit County
CO_2 carbon dioxide
CNP conditional non-exceedance probability
CSO combined sewer outflow
CULI Comprehensive Urban Levee Improvement
CWA Clean Water Act
cy cubic yards
CZMA Coastal Zone Management Act
DAHP Department of Archaeology and Historic Preservation
DD Diking District
DO Dissolved Oxygen
DPS Distinct Population Segment
DQC District Quality Control
EAD Expected Annual Damages
EC Engineering Circular
EDNA environmental designation for noise abatement
EFH Essential Fish Habitat
EIS Environmental Impact Statement
EM Engineering Manual
EPA U.S. Environmental Protection Agency
EQ Environmental Quality
ER Engineer Regulation
ESA Endangered Species Act
ETL Engineering Technical Letter
FDA Flood Damage Analysis
FCSA Feasibility Cost Sharing Agreement
FERC Federal Energy Regulatory Commission
FEMA Federal Emergency Management Agency
fps feet per second
FR/EIS Feasibility Report/Environmental Impact Statement
FWCA Fish and Wildlife Coordination Act
GHG Greenhouse Gas
GI General Investigation
HEC Hydrologic Engineering Center
H&H Hydrology and Hydraulics
HTRW Hazardous, Toxic and Radioactive Waste
IDC Interest during construction
IEPR Independent External Peer Review
LPP Locally Preferred Plan
IWR Institute for Water Resources
JLS Joe Leary Slough
LERRD lands, easements, right-of-ways, relocations, and disposals
LWD large woody debris
MCACES Micro-Computer Aided Cost Estimating System
MVWWTP Mount Vernon Wastewater Treatment Plant
NAGPRA Native American Graves Protection and Repatriation Act
NEPA National Environmental Policy Act
NED National Economic Development
NGVD National Geodetic Vertical Datum
NHPA National Historic Preservation Act
NMFS National Marine Fisheries Service
NOAA National Oceanic and Atmospheric Administration
NOI Notice of Intent
NPDES National Pollutant Discharge Elimination System
NAAQS National Ambient Air Quality Standards
NRCS National Resources Conservation Service
NRHP National Register of Historic Places
NWD Northwestern Division
NWI National Wetlands Inventory
NWS Seattle District
OMRR&R Operations, Maintenance, Repair, Replacement and Rehabilitation
OSE Other Social Effects
O&M Operations and Maintenance
PA Programmatic Agreement
PCE primary constituent element
PDT Project Delivery Team
PL Public Law
PNP probable non-failure point
PNW Pacific Northwest
PPA Project Partnership Agreement
PSE Puget Sound Energy
PSNERP Puget Sound Nearshore Ecosystem Restoration Project
RED Regional Economic Development
River Skagit River
RM River Mile

SCC	Skagit County Code
SCDD	Skagit County Dike District
SCL	Seattle City Lights
SHPO	State Historic Preservation Officer
SLC	sea level change
SLR	sea level rise
SMA	Shoreline Management Act
SMAQMD	Sacramento Metropolitan Air Quality Management District
SR	State Route
TCP	Traditional Cultural Properties
TSP	Tentatively Selected Plan
U&A	Usual and Accustomed
USACE	U.S. Army Corps of Engineers
USCB	U.S. Census Bureau
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
UST	underground storage tank
VFZ	Vegetation-Free Zone
WAC	Washington Administrative Code
WBS	work breakdown structure
WDFW	Washington State Department of Fish and Wildlife
WDNR	Washington State Department of Natural Resources
WDOE	Washington Department of Ecology

1. Introduction

1.1 Study Purpose and Scope*

The purpose of the Skagit River Flood Risk Management General Investigation (Skagit River GI) is to evaluate flood risk in the Skagit River Basin (Basin); to formulate, evaluate, and screen potential solutions to the problem of flood risk; and to recommend a plan to address flood risk in the Basin. The recommended plan must accomplish flood risk management within the Basin; must be technically viable and economically sound; and must be supported by the local jurisdictions and the non-Federal sponsor. This report, the *Skagit River Flood Risk Management, General Investigation, Draft Feasibility Report and Environmental Impact Statement* (FR/EIS), documents the alternatives formulation process and the evaluation of alternatives per National Environmental Policy Act (NEPA).

1.2 Lead Federal Agency and Non-Federal Sponsor

The lead Federal agency is the U.S. Army Corps of Engineers (USACE). The non-Federal sponsor is Skagit County, Washington.

1.3 Study Authority

The authority for the Skagit River General Investigation is derived from Section 209 of the Flood Control Act of 1962 (Public Law 87-874). The authorizing language includes the following:

> Flood Control Act of 1962, Section 209: "The Secretary of the Army is hereby authorized and directed to cause surveys for flood control and allied purposes, including channel and major drainage improvements, and floods aggravated by or due to wind or tidal effects, to be made under the direction of the Chief of Engineers, in drainage areas of the United States and its territorial possessions, which include the following named localities: Provided, That after the regular or formal reports made on any survey are submitted to Congress, no supplemental or additional report or estimate shall be made unless authorized by law except that the Secretary of the Army may cause a review of any examination or survey to be made and a report thereon submitted to Congress, if such review is required by the national defense or by changed physical or economic conditions: Provided further, That the Government shall not be deemed to have entered upon any project for the improvement of any waterway or harbor mentioned in this title until the project for the proposed work shall have been adopted by law: …" "…Puget Sound, Washington, and adjacent waters, including tributaries, in the interest of flood control, navigation, and other water uses and related land resources."

1.4 Study Area*

The study area is the Skagit River Basin (Figure 1-1), encompassing the larger Basin watershed. The Basin is located in the northwest corner of the state of Washington, approximately 60 miles north of the city of Seattle. The Basin has a total drainage area of 3,115 square miles and extends about 110 miles in a north-south direction.

The Skagit River (River) originates 28 miles inside British Columbia, Canada near the 8,000-foot level of the Cascade Mountains and flows south through the Cascades, crosses the US-Canadian border, flows though Whatcom County, into Skagit County, and then west to the Skagit delta where it discharges into Puget Sound through two distributaries, the North Fork and South Fork. The Skagit River is the most productive river in the Puget Sound for salmon, including species listed as threatened or endangered under the Endangered Species Act (ESA-listed). There are five tribal nations with reservations or Usual and Accustomed (U&A) fishing rights in the Basin (see Section 3.1). The tribal nations are active influential participants in management of the River and have strong cultural and economic interests in the Basin. For purposes of description, the Basin can be divided into two segments: the upper Basin and the lower Basin.

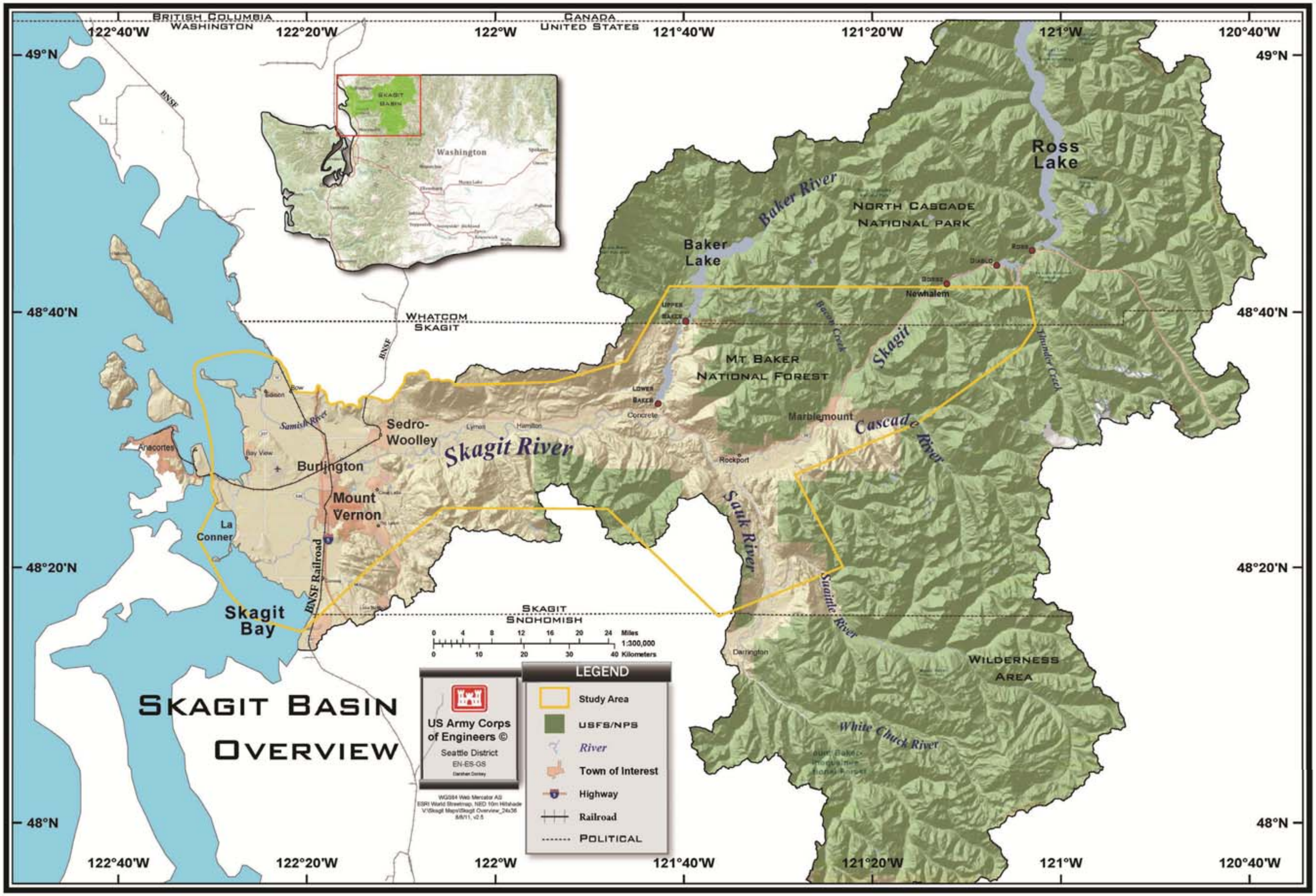

Figure 1-1. Skagit River Basin Map

1.4.1 Upper Basin

The upper Basin is mountainous, largely forested, and sparsely populated. Almost 90 percent of the upper Basin is either designated as national forest or national park (Ross Lake National Recreation Area and portions of the North Cascades National Park and the Mt. Baker Snoqualmie National Forest). There are three major tributary rivers to the Skagit: Sauk-Suiattle, and Baker. [The Sauk-Suiattle and the Cascade Rivers are designated as wild and scenic and their flows are not controlled by dams or other structures]. The Upper and Lower Baker Dams (together, the Baker River Hydroelectric Project) located on the Baker River are owned and operated by Puget Sound Energy (PSE), a private power utility. The USACE is authorized to use flood control storage in Upper Baker Dam. Ross Dam is located on the Skagit River and owned by Seattle City Light (SCL), a public power utility. The Federal Energy Regulatory Commission (FERC) license for Ross Dam provides for flood control storage managed by USACE.

1.4.2 Lower Basin

The Basin topography transitions from a river valley surrounded by steep forested slopes to open coastal lowlands. Sedro-Woolley (population 11,024) is located in the upstream portion of the lower Basin, in an area of low density residential development with some commercial and industrial land use. Extensive diking of the lower river, dating back to the last part of the nineteenth century, has allowed the floodplain to be farmed and developed for residential, commercial, and industrial purposes. The majority of the population and development in the basin is clustered around the Interstate 5 (I-5) corridor in the lower Basin, including the cities of Mount Vernon (population 32,139) and Burlington (population 8,704). Infrastructure located in the lower Basin includes State Route (SR) 20, a gas pipeline, the Sedro-Woolley Waste Water Treatment Plant, and a water supply line located on Fidalgo Island that is critical to the City of Anacortes. The area between the North and South Forks of the Skagit River is known as Fir Island. Fir Island and its surroundings are rural. Agriculture is the predominating land use in the lower Basin.

1.5 Project Area

The project area focuses on the lower Basin within the floodplain along with the Baker River Hydroelectric Project. The majority of the potential economic damages and potential threats to life safety are located within the Skagit River floodplain downstream of Sedro-Woolley in the cities of Burlington and Mount Vernon. The project area focuses on the lower Basin because this is the area with more potential damages, which would likely justify Federal interest in the project. Critical infrastructure in and around Mount Vernon and Burlington include I-5, Burlington Northern Santa Fe (BNSF) Railroad, State Routes 9, 20, and 536, numerous water and gas pipelines, light industry, and municipal infrastructure. There is also critical infrastructure in Sedro-Woolley includes State Routes 9 and 20 (critical local access routes), United General Hospital, the Sedro-Woolley wastewater treatment plant, and the Life Care assisted living facility that are included in the project area. The lower Basin also includes highly productive agricultural land. The cities and critical infrastructure are currently protected by the system of levees and reservoirs described in Section 3.1 Upriver communities such as the towns of Lyman and Hamilton have also experienced flooding; however, the project area is largely focused on the lower Skagit River floodplain.

1.6 Flood History in the Project Area

Major floods on the Skagit River are the result of winter storms moving eastward across the basin with heavy precipitation and warm snow-melting temperatures. Several storms may occur in rapid succession, raising antecedent runoff conditions and filling various river storage areas. Flood risk reduction is provided by a combination of reservoirs and levees. In the upper watershed, Ross and Upper Baker dams provide flood regulation. In the lower basin, levees line the river starting near the mouths of the North and South Forks and continuing upstream past Burlington. Generally, the most serious flooding in the study area would be due to levee failure or overtopping. Flood depths could be up to 8 feet in some places, with flood durations of 2-3 days. The flood-prone area includes the cities of Burlington and Mount Vernon, with their high population densities and critical infrastructure, such as roads, hospitals, water treatment plants, and commercial and industrial development.

The four largest documented floods on the Skagit River occurred in 1897, 1909, 1917, and 1921, before the construction of any dams in the basin. The largest floods since the completion of Ross Dam in 1953 occurred in 1990, 1995, and 2003. In 1990, two significant floods occurred in November. Both floods broke through the Fir Island levee and inundated most of the island’s farmland. Both floods required extensive flood fighting in the vicinity of Mount Vernon. The 1995 flood also occurred in November, but this time the flood fight efforts were successful at preventing a levee failure at Fir Island and significant damage to downtown Mount Vernon. In 2003, there were again two floods in one month, this time in October. The Skagit River at Mount Vernon was above the zero-damage stage for 64 hours and above the major-damage stage for 47 hours. Due to reservoir regulation and sandbagging efforts, levees at Mount Vernon and Fir Island were able to withstand the flood without failing. Based on the flood peaks at Concrete, the 1990, 1995, and 2003 floods had annual chances of exceedance (ACEs) of approximately 10%, 4%, and 4%, respectively.

In this report, as in all new USACE reports dealing with flood risk management, the risk of an individual storm or flood event occurring is expressed as the *annual chance of exceedance* (ACE), which is the probability that the specified discharge, or flood event, could be equaled or exceeded during any given year. A "1% ACE flood" has in the past commonly been referred to as a "100-yr flood". The occurrence of a specific ACE flood in one year, does not alter its ACE in the next year. Many documents referenced in this report, along with maps and other supporting materials, use “x-year flood” expressions, in which the number of years is sometimes known as “the return interval.” To aid in understanding these differing expressions, Table 1-1 provides a cross-reference between ACE and return-interval expressions.

Table 1-1. Annual Chance of Exceedance (ACE) Conversion from Return-Interval in Years

Annual Chance of Exceedance (ACE) in %	Average Return Interval in Years
50	2
10	10
5	20
4	25
2	50
1	100
0.4	250
0.2	500

There were no levee failures in 1995 or 2003, but that was largely due to the flood fighting efforts that occurred. However, future flood fighting efforts may be overwhelmed in large flood events and are not sustainable for long term flood risk management. Throughout this report, the locations of levees, structures adjacent to the river and events such as levee failures are described referencing their position on either the right bank or the left bank of the river looking downstream. A more detailed flood narrative is provided in Section 3.1.

1.7 History of the Investigation

1.7.1 Prior Reports and Existing Projects

Prior USACE studies in the Skagit River Basin date back to the late 1800s. Key studies are listed below:

- **Skagit River Avon Bypass Flood Control Project**

  This proposed USACE project would have included a diversion channel carrying water from near Burlington to Padilla Bay with a gated control structure near the intake, a control weir near the outlet, and a levee on the right bank upstream from the bypass. This project was first authorized by the Flood Control Act of 1936, but was classified inactive in 1952 because local requirements could not be met. In the 1960s, site selection studies were completed and construction was authorized again. However, the sponsor was not able to meet local participation requirements. The project was de-authorized January 1, 1990, under provisions of Public Law 99-662.

- **Skagit River Levee and Channel Improvements Flood Control Project**

  This USACE project was authorized by Congress in 1966. The project would have involved levee raising and strengthening and channel modifications from the BNSF railroad bridge in Mount Vernon to the mouth of the Skagit River. Advance engineering and design studies were started in 1977 and a general design memorandum was completed in 1979. The report recommended a change in the authorized project to provide 2% annual chance exceedance (ACE) flood protection to rural lands downstream of Mount Vernon and 1% ACE flood protection for the urban areas from Mount Vernon to Sedro Woolley. Non-structural measures were included to reduce flood damages in the Nookachamps Valley and the Sterling area. In November 1979, Skagit County voters rejected a proposition to provide funding for the local share of costs. Skagit County withdrew as the non-Federal sponsor, and, consequently, further effort on this project was terminated. The project was de-authorized in July 1995 under provisions of Public Law 99-662.

- **Skagit River Flood Risk Management General Investigation**

  In 1993, a Reconnaissance Study on flood damage reduction in the Lower Skagit River Basin determined that levee improvements with overtopping segments and non-structural measures were worthy of further investigation under a Flood Risk Management General Investigation. In 1994, Skagit County asked that further work be deferred. Following the November 1995 flood, Skagit County requested the study be resumed. In July 1997, Skagit County and USACE executed a Feasibility Cost Sharing Agreement (FCSA) and initiated the current feasibility study.

1.8 Proposal for Federal Action*

The proposal to implement flood risk management in the Skagit River Basin triggered the NEPA process recorded in this document (40 CFR 1501.2). Based on study results reported in this document, USACE proposes flood risk management in the lower Skagit River Basin. The proposed Federal (USACE) action area is focused on the lower Basin due to high flood risks in this area.

1.9 Cooperating Agencies*

The USACE has requested that each of the following agencies become a cooperating agency as defined in NEPA regulations at 40 CFR 1501.6:

- U.S. Environmental Protection Agency (EPA)
- Federal Emergency Management Agency (FEMA)
- Natural Resources Conservation Service (NRCS)
- National Marine Fisheries Service (NMFS)
- U.S. Fish and Wildlife Service (USFWS)
- U.S. Coast Guard (USCG)

FEMA, NRCS, and USCG accepted the request and are cooperating agencies for this project. The other agencies did not respond. The cooperating agencies have not yet reviewed this report. The Corps has been closely coordinating with NRCS with regard to the status of this GI and their conservation easement program.

1.10 Planning Process and Report Organization

This report is an integrated USACE planning document, incorporating a USACE Feasibility Report (FR) and an Environmental Impact Statement (EIS) as required by NEPA. The USACE planning process is outlined in ER 1105-2-100, Planning Guidance Notebook, and consists of six major steps:

1. Specification of water and related land problems, constraints and opportunities;
2. Inventory, forecast, and analysis of water and related land resources within the study area;
3. Formulation of alternative plans;
4. Evaluation of the effects of the alternative plans;
5. Comparison of the alternative plans; and
6. Selection of a recommended plan based upon the comparison of the alternative plans.

In addition, the study team is conducting this feasibility study consistent with the risk-informed decision making process in the USACE SMART Planning principles:

1. Uncertainty and Level of Detail. Balancing the level of uncertainty and risk with the level of detail of the study. The level of detail required to make planning decisions will grow over the course of the study, as the study team moves from an array of alternatives to a single recommended alternative.

2. Vertical Team Integration. Early and ongoing vertical team engagement of decision makers. The Vertical Team for this study includes Seattle District, Northwestern Division and HQUSACE, as well as Skagit County.
3. Determine Federal Interest. Identify the Federal interest early in the study, including the level of Federal and USACE interest and level of Federal investment.
4. Alternative Comparison and Selection. There is no single "best" plan, and there are a variety of approaches (quantitative and qualitative) to multi-criteria decision making.
5. Funding and Resourcing. Ensure that all resources needed for the study, including funding, human resources, data and information, are identified and available for the duration of the study.

A public comment period will be provided for the draft FR/EIS concurrent with required technical, peer, and policy reviews. The purpose of these reviews is to seek feedback on the TSP that will inform additional feasibility-level design and analysis that will be conducted to finalize the engineering, cost estimating, environmental, economic, and real estate elements of the plan. Results of the reviews and additional feasibility-level design and analysis will be incorporated into the final FR/EIS.

1.10.1 Plan Formulation Process

Alternative plans were formulated in consideration of study area problems and opportunities, as well as study goals, objectives, and constraints, with consideration of the USACE four Principles and Guidelines (P&G) listed in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, March 10, 1983 criteria (USACE 1983): completeness, effectiveness, efficiency, and acceptability. The plan formulation process is summarized in this report. Additional details of the plan formulation process are in Appendix A (Plan Formulation).

1.10.2 Report Organization

The six steps of the planning process and the EIS are discussed in this report as follows:

- Section 2: Need for and Objectives of Action. Covers the first step in the planning process (specification of problems; constraints and opportunities).
- Section 3: Plan Formulation. This section describes the planning second step (inventory, forecast, and analysis of resources), third step (formulation of alternative plans), fifth step (comparison of the alternative plans), and the first stage of the sixth step (selection of the recommended plan).
- Section 4: Describes the planning second step (inventory, forecast, and analyze resources) and fourth step (evaluation of the effects of the alternative plans) from a NEPA perspective and contains the bulk of the evaluation and analysis typically found in an EIS document.
- Section 5: Covers the economic analysis of the sixth step (selection of the recommended plan).
- Section 6: Documents compliance with environmental statutes per NEPA.
- Section 7: Documents compliance with public involvement and agency coordination requirements per NEPA.

- Section 8: This section summarizes the recommendations of this study.
- Section 9: Lists the preparers of this document.
- Section 10: This section lists all source documents referenced in this report.

2. Need for and Objectives of Action

This section first presents the results of the first steps of the USACE planning process: the specification of problems, opportunities, and constraints in the study area. The section concludes with the establishment of planning objectives and planning constraints which serve as the basis for the formulation of alternative plans.

2.1 Problem and Opportunity

- Problem: The Skagit River Basin is subject to damaging floods resulting from intense winter rain storms. These large, warm weather systems originate in the tropical Pacific and contain so much moisture that they are technically termed atmospheric rivers. The existing reservoir and levee systems provide the lower river basin with flood risk reduction only up to about the 4% ACE level. This level of risk is unacceptable for the residential, commercial, and industrial infrastructure of the cities of Burlington and Mount Vernon and is a threat to life safety.
- Opportunity: Reduce flood risks and life safety risk in the Skagit River Basin from overland flow resulting from October to March rain floods.

*2.2 Purpose and Need for Action**

The purpose of the Federal action is to reduce flood risks, life safety threats, and damages in the Skagit River Basin as a result of flooding. The action is needed because the Skagit River Basin experiences frequent flooding resulting in damages to both rural and urban areas throughout the Basin.

2.3 Federal Objective

Per the Economic and Environmental Principles and Guidelines For Water and Related Land Resources Implementation Studies (USACE 1983), the Federal objective of water and related land resources planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.

2.4 Planning Goal and Objectives

The Federal objective is a general statement and not specific enough for direct use in plan formulation. Specific planning objectives provide focus for the formulation and evaluation of alternatives.

- Goal: The goal of the Skagit River General Investigation is to identify a plan that reduces flood risks and contributes to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.
- Objective: Reduce flood damages in the Skagit River Basin over the 50 year project life from 2020 to 2070.

- Objective: Reduce threats to life safety in the Skagit River Basin over the 50 year project life from 2020 to 2070.

2.5 Planning Constraints

Some of the constraints for this planning process are universal and some are specific to this study.

Universal Constraints:

- USACE shall ensure that the project would not jeopardize the continued existence of any endangered species or threatened species (including three ESA-listed species of salmonids) or result in the destruction or adverse modification of the habitat of such species.

Study-specific Constraints

- Wild and Scenic River status of the upper Skagit, Cascade, and Sauk-Suiattle Rivers precludes formulation of flood risk management measures that would permanently harm the rivers' free flowing condition for these areas.
- To comply with Skagit County Code, the project should avoid direct and indirect loss of agricultural lands wherever there is a practicable alternative.

3. Plan Formulation

This section contains an overview of management measures, formulation of alternative plans that address the planning objectives, evaluation and comparison of the alternatives, and selection of the tentatively selected plan (TSP). The TSP is synonymous with the Preferred Alternative (as used in NEPA documentation). A more detailed explanation of the plan formulation process can be found in Appendix A (Plan Formulation). This section begins with establishment of the existing without-project condition and the future without-project condition, which is the inventory (existing), forecast (future), and analysis of water and related land resources within the study area. The future without-project condition, which is the most likely scenario if no Federal (USACE) flood risk management project were implemented in the study area during the 50-year period of analysis from 2020 to 2070, is synonymous with the No Action Alternative (as used in NEPA documentation). Detailed descriptions of the existing and the future without-project condition are provided in Section 4.

3.1 Existing Condition in the Study Area

The existing (without-project) condition for the study area must be established in the second step of the USACE planning process. Establishment of the existing condition requires documentation of present day conditions and serves as the foundation for development of alternatives that address identified problems and constraints, and the formulation of alternatives.

3.1.1 Existing Flood Condition

Major floods on the Skagit River are the result of winter storms moving eastward across the basin with heavy rainfall and warm snow-melting temperatures. These large, warm weather systems originate in the tropical Pacific and contain so much moisture that they are technically termed atmospheric rivers. Winter rainfall floods usually occur in November or December but may occur as early as October or as late as March. Several storms may occur in rapid succession. Successive storms pose an increased flood risk because the first storm can increase soil moisture and fill reservoir storage, causing higher discharges during the second storm.

Spring snowmelt runoff is characterized by a relatively slow, moderate rise in discharge and a long duration. Reservoirs at power-generating dams are normally refilled during the spring snowmelt, which reduces the spring peak discharges. The Skagit River and all of its major tributaries usually have low flows during August and September after the high-elevation snowpack has melted and when the base flow has partially receded.

The Skagit River drains 3,115 square miles between the crest of the Cascade Range and Puget Sound. Of that total, 1,214 square miles are upstream of dams that currently have dedicated reservoir storage set aside for flood regulation and 1,901 square miles are uncontrolled. The Skagit River originates in a network of narrow, precipitous mountain canyons in Canada and flows south into the United States where it continues west to Skagit Bay. After entering the United States from Canada, the Skagit River passes through Ross Dam (at river mile [RM] 105), Diablo Dam (RM 101), and Gorge Dam (RM 97). The upper watershed is steep, forested terrain with almost 90% designated as national forest or national park

(Ross Lake National Recreation Area and portions of the North Cascades National Park and the Mt. Baker Snoqualmie National Forest). The primary land use in the upper Basin is recreation and open space preservation.

The three largest tributaries to the Skagit River are the Cascade, Sauk, and Baker rivers. The Cascade and Sauk rivers are the largest unregulated tributaries to the Skagit River. The Cascade River enters the Skagit River at RM 78.1, just upstream of the town of Marblemount, and has a drainage area of 185 square miles. The Sauk River is the largest tributary to the Skagit River and flows into it on the left bank at RM 67.2. The Sauk River has a drainage area of 732 miles, nearly 40% of the uncontrolled drainage area in the basin. As Wild and Scenic Rivers, the Sauk and Cascade Rivers cannot be controlled by dams or other structures. Other un-regulated discharges come from creeks that drain steep, heavily forested basins directly into the Skagit River. The Baker River is regulated as it flows through two dams Upper and Lower Baker Dams, before entering the Skagit River at Concrete (RM 56).

From Concrete, the Skagit River flows west through a narrow valley past the communities of Hamilton (RM 40) and Lyman (RM 36). Large tracts of both old-growth and secondary growth coniferous forests dominate this landscape. Primary land uses along this sparsely populated river reach are recreation and timber. The Skagit River then crosses a broad outwash plain between Sedro-Woolley (RM 24) and Skagit Bay. This coastal plain is mostly agricultural land with the main cities being Sedro-Woolley (RM 24), Burlington (RM 17), and Mount Vernon (RM13). Although Burlington's city center is upstream of Mount Vernon's, they both border the river on opposite sides for a few miles. Downstream from Mount Vernon, the river divides into two principal distributaries, the North Fork and the South Fork that discharge into Skagit Bay. In addition to the cities with their individual residential, commercial, and industrial areas, this reach of the river contains a prosperous agricultural community, and critical regional infrastructure such as I-5 and State Routes 9 and 20, the BNSF railroad, United General Hospital, and water and wastewater facilities.

The four largest documented floods on the Skagit River occurred before stream gages were installed on the river. Based on the peak discharges at Concrete, the largest occurred in November 1897 and had a peak discharge of 265,000 cfs. The others, all with peak discharges greater than 210,000 cfs, occurred in 1909, 1917, and 1921. Between l920 and late 1950, Ross Dam on the upper Skagit River provided only incidental flood regulation and the largest flood during this time had a peak discharge at Concrete of 154,000 cfs. Since 1953 Ross Dam has provided 120,000 acre-feet (ac-ft) of flood control storage. In 1977, Upper Baker Dam began providing 74,000 ac-ft of flood control storage. The largest flood discharges at Concrete since 1953 were a 160,000 cfs peak in 1995 and a 166,000 cfs peak in 2003. Peak discharges for selected floods, including the currently published peak discharges for the four historical floods, are listed in Appendix B (Hydraulics and Hydrology). The current natural and regulated peak flood discharges that could occur at Concrete in floods of various ACE are listed in Table 3-1. Life loss associated with historic flood events includes one death in the 1917 flood, two deaths in a 1935 flood and one death in 1995.

Table 3-1. Current natural and regulated peak flood discharges at Concrete, in cubic feet per second.

ACE	50%	20%	10%	4%	2%	1.3%	1%	0.4%	0.2%
Natural*	77,300	120,500	153,300	201,200	229,300	255,500	272,400	325,400	363,600
Regulated**	77,300	101,100	127,700	165,300	189,100	211,400	225,400	279,700	324,400

* Natural discharges are those that would occur without any regulation via dams/reservoirs.
** Regulated discharges are regulated at Ross and Upper Baker dams according to current Water Control Manuals.

The majority of the Skagit River flood risks, both economic and life safety, are in the lower basin downstream from Sedro-Woolley. Of particular concern are the cities of Burlington and Mount Vernon, with their concentrations of population and infrastructure. The conceptual diagram in Figure 3-1 illustrates the relative locations and magnitudes of potential flooding. From RM 21 downstream to the mouths, most of the river is lined with levees that are located close to the river. The levee systems along the river generally have the capacity to contain a 4-5% ACE flood. Flooding in this area generally results from levee overtopping or failure. Once floods overtop or breach a levee, the levees prevent the floodwaters from returning to the river. If a levee fails, flood depths could be up to 8 feet in some places for a 1% ACE flood with a 2-3 day duration.

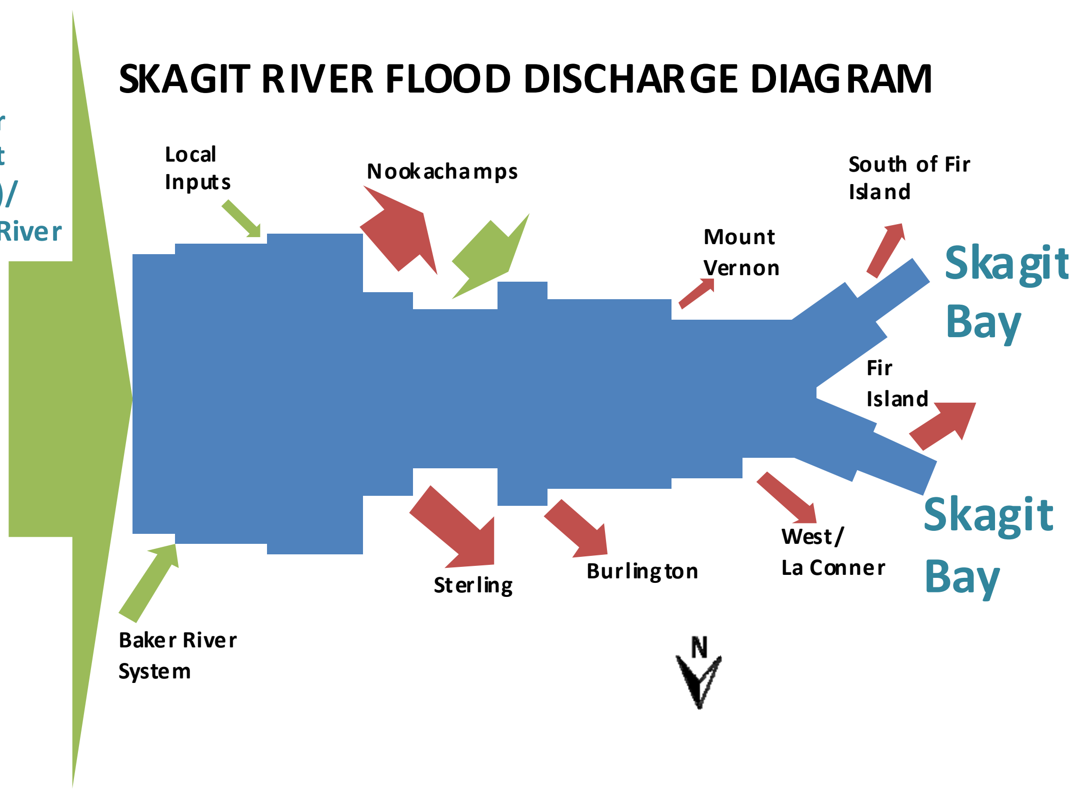

Figure 3-1. Skagit River Flood Discharge Conceptual Diagram

The floodplain depicted in Figure 3-2 is a composite of the flooding expected at the 1% ACE magnitude that could occur from individual levee failures allowing floodwaters into each of the separate floodplains. This degree of flooding is unlikely to occur during any single flood because a levee failure at one location would likely lower water surface elevations upstream and downstream, thus reducing risk of additional levee failures. This method of floodplain mapping has been chosen because it is not possible to reliably predict where a levee failure may occur during any individual flood. This floodplain, as expected in a 1% ACE flood, is the floodplain discussed throughout this report unless otherwise indicated.

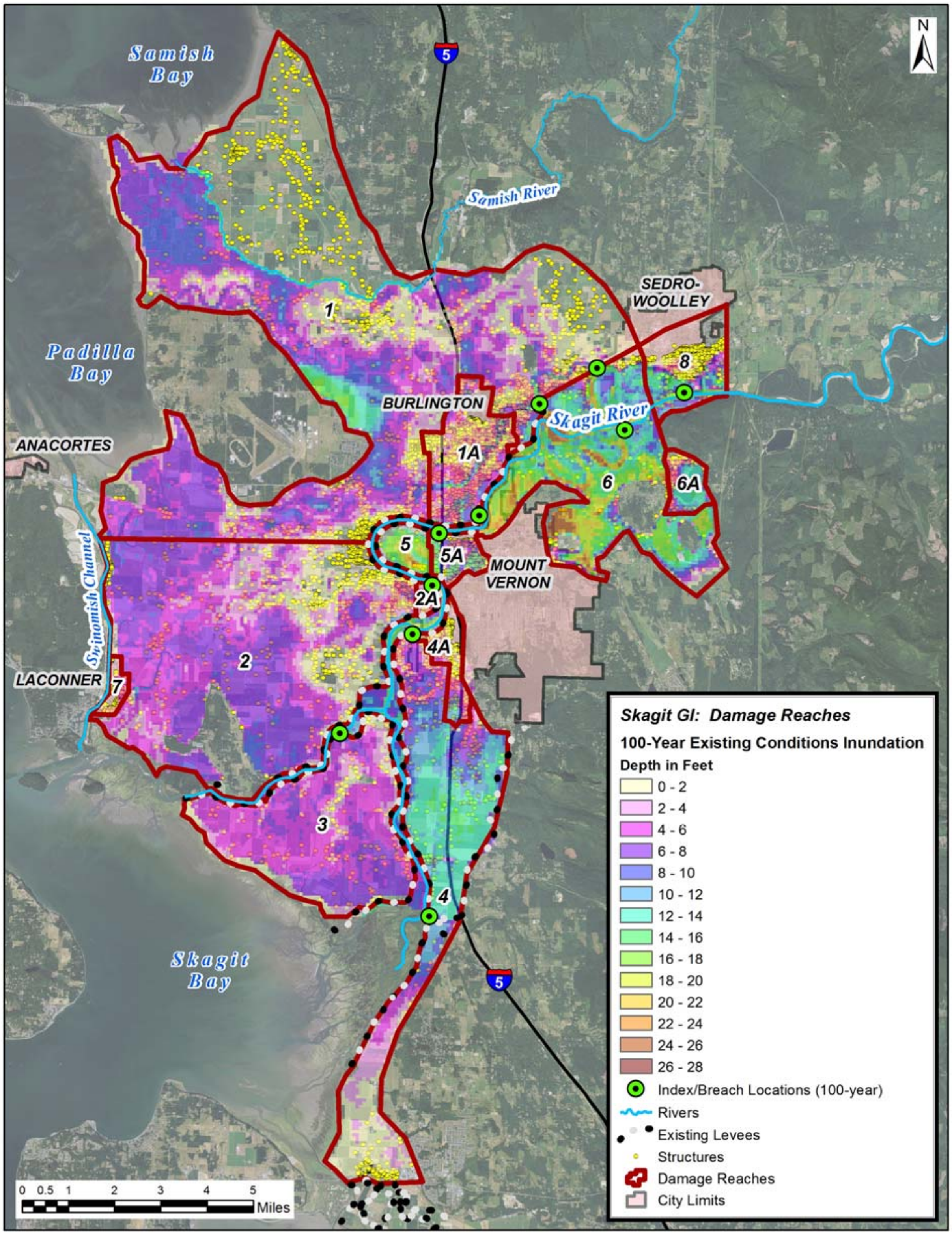

Figure 3-2. Skagit River 1% ACE floodplain with multiple levee failures

Between Sedro-Woolley and Mount Vernon, the Nookachamps Creek Basin is an un-leveed area along the left overbank of the Skagit River (RM 19-22) that floods frequently and provides substantial natural flood storage. Land use within the Nookachamps basin is largely agricultural, with the community of Clear Lake located in the southeast portion of the basin. The Nookachamps Basin also contains rich wetland and riparian habitat, and two wetland mitigation banks are under construction.

During floods greater than 4% ACE, there is the potential for the Skagit River to overflow the right bank in the Sterling area (RM 21) and in Burlington near RM 18. Floodwaters from both locations can flow west through Burlington and the western floodplain to Skagit Bay. Floodwaters from Sterling can also flow north across I-5 and the BNSF railroad and then through the rural floodplain to Padilla Bay.

At the BNSF Bridge (RM 17.5), levees and the natural topography restrict flood flows, forcing them to pass under the bridge. The hydraulics at the bridge are sensitive to debris accumulation and to floodwaters rising to the bottom of the bridge structure so that the bridge itself impedes downstream flow. The amount of debris accumulated at the BNSF Bridge affects the ability of floodwaters to pass efficiently under the bridge. With no debris accumulation, the bridge produces about a ¾ ft rise in the 1% ACE flood elevation. Debris accumulations on the order of 6,000 square feet (sq ft) can cause the water surface to rise above the bridge's structural low chord and raise the upstream water surface as much as 3 feet during a 1% ACE flood. Water surface elevations at the BNSF Bridge influence flood depths upstream in the Nookachamps area and the amount of floodwater flowing onto the floodplain that occurs at Sterling. As water surface elevations rise at Sterling, more water flows out of the river there and flood discharges downstream are reduced. The BNSF Bridge is the first of three bridges on a section of the Skagit River locally known as the Three Bridge Corridor, at RM 17.5 to 16.5. The three bridges in upstream to downstream order are: the BNSF Bridge, the Old Highway 99 Bridge, and the I-5 Bridge.

Several areas in Mount Vernon are at risk of flooding from 4-5% ACE floods, including Riverbend, West Mount Vernon, and the southern edge of the city. In the past, flood fighting has been used to reduce damages to high risk areas, such as downtown Mount Vernon. The City of Mount Vernon has plans for a new floodwall to protect the downtown area. The Mount Vernon Floodwall is partially complete, with completion planned for the near future. The floodwall will reduce the flood risks in the downtown area to less than 1% ACE. This floodwall has been included as an existing feature in this flood study.

The agricultural areas west of Mount Vernon have a 4-5% ACE flood risk. Fir Island experienced a levee failure in 1990. The town of La Conner is located north of the North Fork on Skagit Bay on the Swinomish Slough, a federally authorized navigation channel. La Conner is a local center for artists and boaters and has a strong tourist trade.

3.1.2 Existing Flood Risk Management in the Skagit River Basin

In the Skagit River Basin, flood risk reduction is provided by a combination of reservoirs and levees. In the upper watershed, Ross Dam provides 120,000 ac-ft of flood storage and Upper Baker Dam provides up to 74,000 ac-ft of flood storage during the October through March time period. The dams provide flood regulation by storing floodwaters and releasing the stored water after the flood peak has passed downstream communities. USACE, Seattle District, manages the flood regulation operations at both dams through agreements with SCL and PSE. Together, the existing flood regulation at the two dams has the potential to reduce the 1% ACE flood peak by nearly 50,000 cfs at the flood regulation control point at Concrete. The license for the Baker River Hydroelectric Project Article 107 Flood Storage of the current Baker River Hydroelectric Project No. 2150 Federal Energy Regulatory Commission (FERC) license (FERC 2008) contains provisions that have not been implemented, for increasing the amount of time available for flood storage at Upper Baker Dam (74,000 acre feet) and/or purchasing flood storage at Lower Baker Dam (up to 29,000 acre feet) to interested parties in the lower Basin. Additional flood regulation provisions in the FERC license are not considered to be part of the existing flood regulation.

A complex system of approximately 50 miles of non-Federal levees and 39 miles of sea diking in the lower Basin is overseen by eleven different autonomous diking districts (Figure 3-3). Existing heights range from to 4-16 feet with an existing average height of 9 feet. The levee systems along the river generally have the capacity to contain a 4-5% ACE regulated flood. The diking districts are responsible for construction, repair, and maintenance of the levee and dike systems within the boundaries of their districts. Each diking district has the power to levy taxes for construction and maintenance of their respective levees. Each district has a different tax base and a different budget, which results in varying degrees of flood protection throughout the system.

The existing levee system is based on earthen levees built for flood control during the 1890s by the original European settlers, farmers, and homesteaders of the Skagit Valley. Each levee is composed of various materials and may be equipped with additional features such as flattened slopes, stability berms, seepage berms, driven sheet-piles, and clay seepage-cutoff trenches. The embankment material is mostly silty sand, sandy silt, and silty sand with gravel. Nearly all the levees along the river are armored with riprap for erosion protection. The extent of armoring varies with riprap placed predominantly on the revetted banks, but it may also be placed on the levee embankment or the riverward toe. See Figure 3-4 for a typical levee section (Note: Actual cutoff trench location may vary depending on levee).

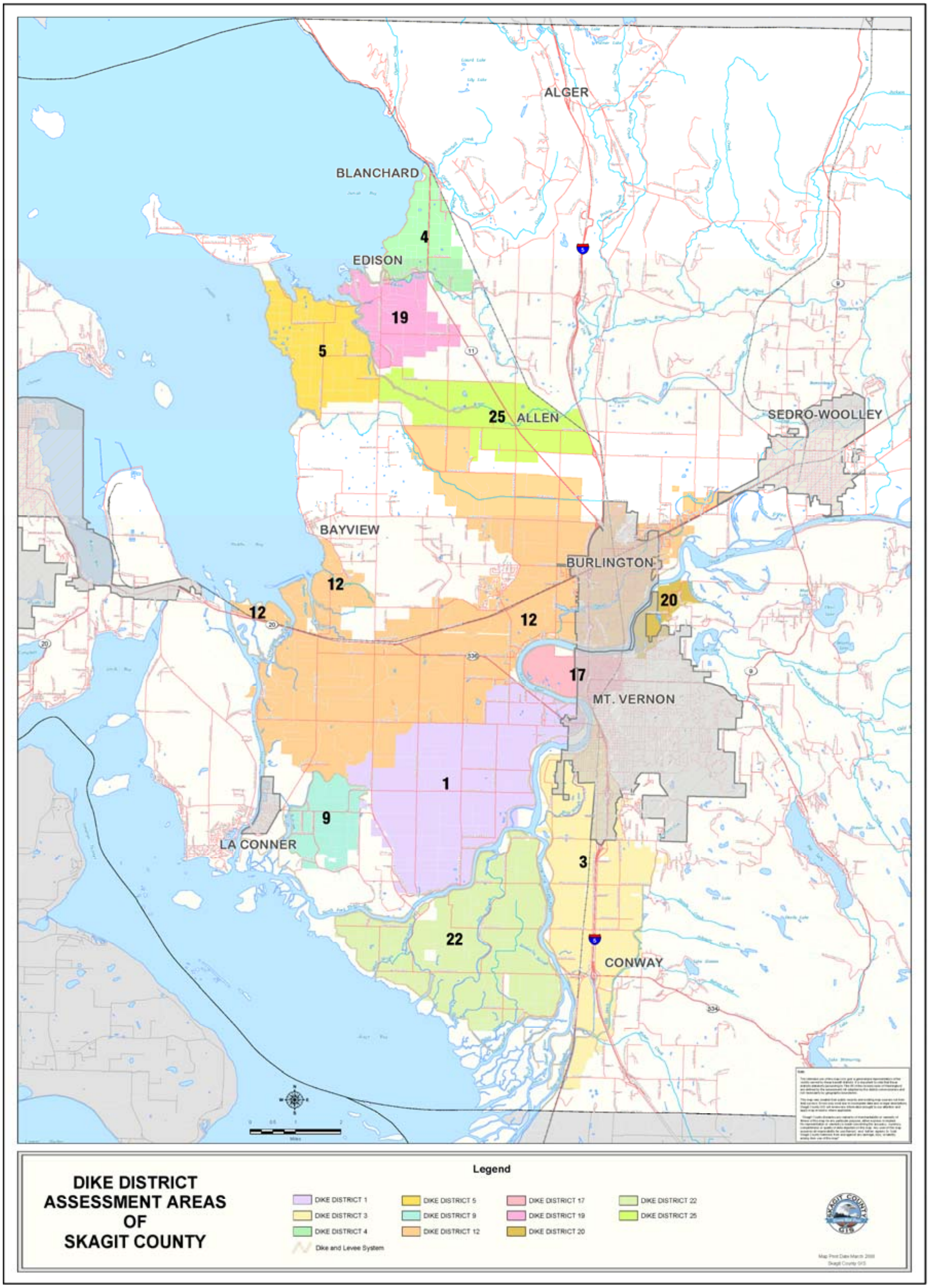

Figure 3-3. Skagit County Diking District Assessment Areas. Produced by Skagit County GIS. March 2008.

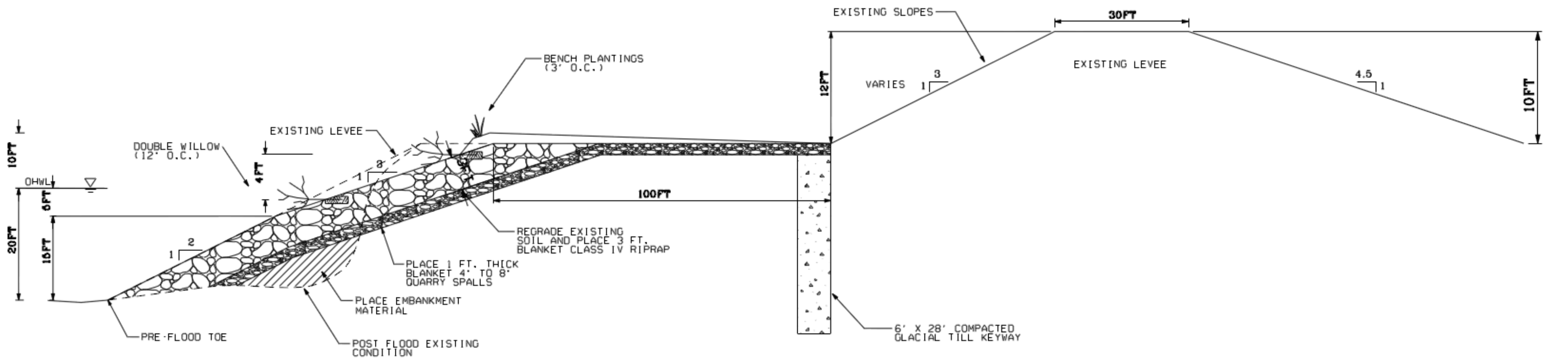

Figure 3-4. Typical levee section taken from a 2011 repair drawing.

Skagit County participates in the National Incident Management System (NIMS) when faced with hazards and incidents including floods. The County has a NIMS Standing Unified Command, consisting of the Emergency Management Director, the Sheriff, the Public Works Director, and the Public Health Director. The Flood Response is executed by the various affected fire districts, towns, cities, and diking districts. In upriver areas, response is generally needed for erosion, blocked culverts, landslides, and possible evacuations. Evacuations are led by the Sheriff's office. From Sedro-Woolley downriver, the Flood Response involves diking districts, the USACE, and cities, assisted by fire districts/departments. For larger events, the National Guard deploys to Skagit County and supports operations on the river.

Since the 1930s, USACE has been a partner with local entities during emergencies and subsequent repairs under the Public Law 84-99 Rehabilitation and Inspection Program (PL 84-99), which allows USACE to undertake activities including disaster preparedness, Advance Measures, emergency operations (Flood Response and Post Flood Response), rehabilitation of flood control works threatened or destroyed by flood, protection or repair of federally authorized shore protective works threatened or damaged by coastal storm, and provisions of emergency water due to drought or contaminated source. Most levees on the Skagit River are currently eligible in the PL 84-99 program. Personnel from the diking districts, as well as USACE and County, are very involved in annual flood fight exercises in the Basin. Flood fight efforts during past floods have helped to reduce flooding and damages in Sedro-Woolley, Mount Vernon, and Burlington. Known low points, such as along SR20 in Sterling between Sedro-Woolley and Burlington on the right bank of the River, may be sandbagged to prevent discharge of floodwaters into Burlington and the Samish Basin. The levee system in Mount Vernon on the left bank has regularly been sandbagged to protect the downtown area. However, flood fight efforts may be overwhelmed in large flood events and are not sustainable for long term flood risk management. As a result, the City of Mount Vernon has a partially completed floodwall with completion planned for the near future. The floodwall will reduce the flood risks in the downtown area to less than a 1% ACE. This floodwall has been included as a baseline condition in this flood study. It is also assumed that some minor levee reliability improvements will occur in the urban areas.

3.1.3 Existing Economic Overview

Skagit County: Skagit County has 116,901 residents, 50% of whom live in unincorporated Skagit County; covers 1,735 square miles; and contains 8 incorporated jurisdictions and numerous communities (U.S. Census Bureau, 2011). The majority of the urban population is in the cities of Mount Vernon, Burlington, Sedro-Woolley, and Anacortes. From 2000 to 2010, the County's population increased by 13.5%. The population at risk from flooding in the study area is 37,000.

Tribes: As noted earlier, five tribal nations have reservations or usual and accustomed (U&A) fishing rights in the Basin, and are active influential participants in management of the River with strong cultural and economic interests in the Basin. They are the Swinomish Indian Tribal Community, the Upper Skagit Indian Tribe, the Samish Indian Nation, the Sauk-Suiattle Indian Tribe, and the Lummi Nation.

City of Sedro-Woolley: The majority of the developed portion of Sedro-Woolley falls outside the floodplain. Large tracts of secondary growth coniferous forests dominate this landscape. This is an area of low density residential development.

City of Burlington: Burlington's population of 8,388 (U.S. Census 2010a) is located almost entirely in the floodplain. Since 1989 the city's assessed value of real property has increased more than tenfold. The City continues to be a hub of commercial growth (including big-box retailers) with some residential development. The city is protected by levees managed by Diking District 12.

Mount Vernon: This is a rapidly growing city with a population of approximately 32,000. Mount Vernon's core downtown area, many important public facilities, and the bulk of the city's commercial base are located in the Skagit River floodplain protected by levees in Diking Districts 17 and 3. Approximately 25% of the city area and 81% of the city's commercial zoned property is within the floodplain.

The City of Anacortes: Located on Fidalgo Island, which lies immediately west of the Skagit River Basin, Anacortes has a population of 16,933. The City of Anacortes is located outside of the Skagit River floodplain.

Critical Infrastructure in the Floodplain: Interstate 5 (I-5); BNSF Railroad; SR 20, SR 9, and SR 536; numerous water and gas pipelines; light industry; and municipal infrastructure are located in the floodplain. Interstate commerce between the state of Washington and British Columbia, Canada is substantial. I-5 and BNSF railroad are critical routes through Skagit County that carry commerce between the United States and Canada. The average daily traffic count along I-5 is 71,000, of which 12% are trucks transporting commerce (WSDOT 2012). I-5 is also the primary commute route for people who live in the Basin and work in the larger cities of Seattle and Everett to the south. SR 20, SR 9, and SR 536 provide the region with the transportation network to support the local and regional economy. SR 20 is the primary transit route from the "mainland" to Fidalgo and Whidbey Islands, Naval Air Station Whidbey Island, and the ferries to/from the San Juan Islands and British Columbia, Canada. BNSF Railroad and Amtrak operate a primary railroad that runs in a north-south direction through the floodplain. BNSF currently runs 13 trains per day across the Skagit River carrying 56 million tons of freight (WSDOT 2007).

Other critical infrastructure in the basin includes United General Hospital, a wastewater treatment plant, and the LifeCare assisted living facility in Sedro-Woolley. Burlington's critical public services that lie within the floodplain include five Burlington-Edison School District schools (a sixth school is located outside the floodplain), one fire station (another fire station is located outside the floodplain), a natural gas pipeline, the sole post office in the city, the sole police station in the city, and the city hall. Mount Vernon's critical public services that lie within the floodplain include SR 536, SR 538, Skagit Transit Station, Washington Elementary School, Mount Vernon School District Transportation Center, a wastewater treatment plant, the city hall, a fire station (another two fire stations are located outside the floodplain), the city's sole police campus, wastewater and surface water pump stations, Skagit County facilities, and the Skagit County Jail. Fidalgo Island is not in the study area, but infrastructure critical to the island runs through the Skagit floodplain, including a gas pipeline and a key water supply line.

The Anacortes Water Treatment Plant is located in Mount Vernon on the left bank of the Skagit River. It serves approximately 56,000 residential, commercial, and industrial customers. The plant is the primary source of water for two oil refineries (Tesoro Northwest and Shell Puget Sound Refining Company petroleum refineries); the cities of Anacortes, La Conner, and Oak Harbor; the Whidbey Island Naval Air

Station; and a significant portion of Skagit Public Utility District #1. The Tesoro Northwest and Shell Puget Sound Refining Company petroleum refineries, located in Anacortes, draw more than 60 percent of the potable water from the Anacortes Water Treatment Plant. Burlington, Mount Vernon, and Sedro-Woolley obtain their water from the Judy Reservoir System which is operated by the Skagit Public Utility District. The Judy Reservoir System is fed by tributaries draining the Cultus Mountains. The municipal wastewater treatment plants in Burlington and Mount Vernon serve more than 15,000 homes and businesses.

Four oil and gas pipelines that cross Skagit County are within the floodplain. These include: Kinder Morgan Pipeline, BP Olympic Pipeline, Williams Northwest Pipeline, and Cascade Natural Gas Pipeline. BP's Olympic Pipeline is the sole supplier of jet fuel for SeaTac airport (Olympic 2014).

<u>Industry</u>: Skagit County is home to diverse commercial enterprise. The largest private employers, include:

- Draper Valley Farms chicken processor, which employs approximately 500 people and has annual sales of approximately $80 million (WSU 2011);
- Shell Puget Sound Refinery (petroleum refinery) located in Anacortes, which produces 145,000 barrels per day (Shell 2014);
- Janicki Industries, which makes high precision tooling for aerospace, marine, wind energy and transportation, located in Sedro-Woolley;
- Tesoro Northwest (petroleum refinery) located in Anacortes, which processes 120,000 barrels per day (Tesoro 2013);
- Anacortes Casino owned by the Swinomish Indian Tribal Community, near the mouth of the Swinomish Slough;
- Regence BlueShield (healthcare);
- Dakota Creek Industries, a ship yard located in Anacortes;
- Trident Seafoods Corporation (seafood processing plant located in Anacortes); and
- Sierra Pacific Industries (sawmill located in Burlington).

Together, these private firms employ over 5,000 of the total county population.

Large public employers include three hospitals, five school districts, the five largest cities, and the County. Together, they employ an additional 6,000 people. Most of these private and public employers are located in the lower Skagit River Basin, although not all of these employers are located within the floodplain.

<u>Agriculture</u>: The lower Skagit River Basin has some of most productive farmland in Washington. As of the 2007 Census of Agriculture, Skagit County has 108,541 acres of land in farms (USDA 2007), a large portion of which is located in the Basin and is protected through Skagit County's Farmland Legacy Program, a county initiative that purchases agricultural easements on Skagit farmland. Agriculture in the Basin is predominantly fruit and vegetable, seed, flower production, and dairy, with some chicken production as well. Vegetable and fruit crops produced in the basin include blueberries, cauliflower,

broccoli, peas, potatoes, raspberries, and strawberries. The Basin is the fifth largest dairy producer in Washington. Organic farming is increasing in the Basin; in 2011, there were 5,627 acres in certified organic production (WSU 2011).

Seed production is a major agricultural industry in the Basin and requires coordination among the eight vegetable seed companies. Seed production is highly technical and involves long rotation intervals (years, even decades). Approximately 8% percent of the world's spinach seed, 25% percent of the world's cabbage seed, and 25% percent of the world's beet seed is produced in the Basin (WSU 2011). Other seeds produced in the basin include arugula, broccoli, Chinese cabbage, coriander, mustard, parsley, parsnip, rutabaga, swiss chard, and turnip.

The Skagit River Basin is a major producer of tulips, daffodils, and iris bulbs, with approximately 1,100 acres planted per year for bulbs and cut flowers. The Basin contributes approximately 75% of U.S. commercial tulip production (WSU 2011). Every April, over 300,000 people attend the Skagit Valley Tulip Festival which contributes to the local economy.

3.1.3.1 Existing Economic Flood Damages

The existing levee system provides protection from 4-5% ACE flood events. Overland flow due to larger, less frequent floods and levee failure cause damage to property and poses a risk to life safety. Thirteen study reaches were developed for analysis of flood damages, as shown in Figure 3-5. These 13 damage reaches were developed based on hydraulic characteristics, existing levees, and urban growth boundaries defined for the cities of Burlington and Mount Vernon. Urban areas include Burlington (reach 1A); Mount Vernon (reaches 2A, 4A, and 5A); and La Conner (7). Sedro-Woolley, which is partially in the floodplain, has no existing flood risk management infrastructure and is included in Reach 8. Overland flows from Sterling occupy much of the floodplain, including Reaches 1, 2, Burlington (Reach 1A) and La Conner (Reach 7) (see Figure 3-5). Most cropland and pasture land is located in the floodplain-delta area, with over 50,000 acres of harvestable cropland at risk of flood damages. Crops include field crops (hays and wheat), peas, potatoes, berries and vegetable seed.

An economic inventory was assembled following standard USACE methods. For the study area, a base geographic information system (GIS) inventory with parcel-attribute data was provided by Skagit County. Field visits were conducted to collect and validate the base inventory data. Parcels with structures were categorized by land use. There are more than 9,000 structures in the study area in the existing condition, as displayed in Table 3-2 and shown in Figure 3-5 (structures are denoted by yellow dots).

Table 3-2. Structures Inventory Under Existing Conditions

Damage Area (Reach)	Commercial	Industrial	Public	Residential	Farm	Total
Burlington (1A)	320	90	52	2,094	3	2,559
Mount Vernon (2A, 4A, 5A)	318	67	40	718	2	1,145
La Conner (7)	35	1	14	217	0	267
Rural Floodplain (all others)	128	59	43	4,535	298	5,063
Total	801	217	149	7,564	303	9,034

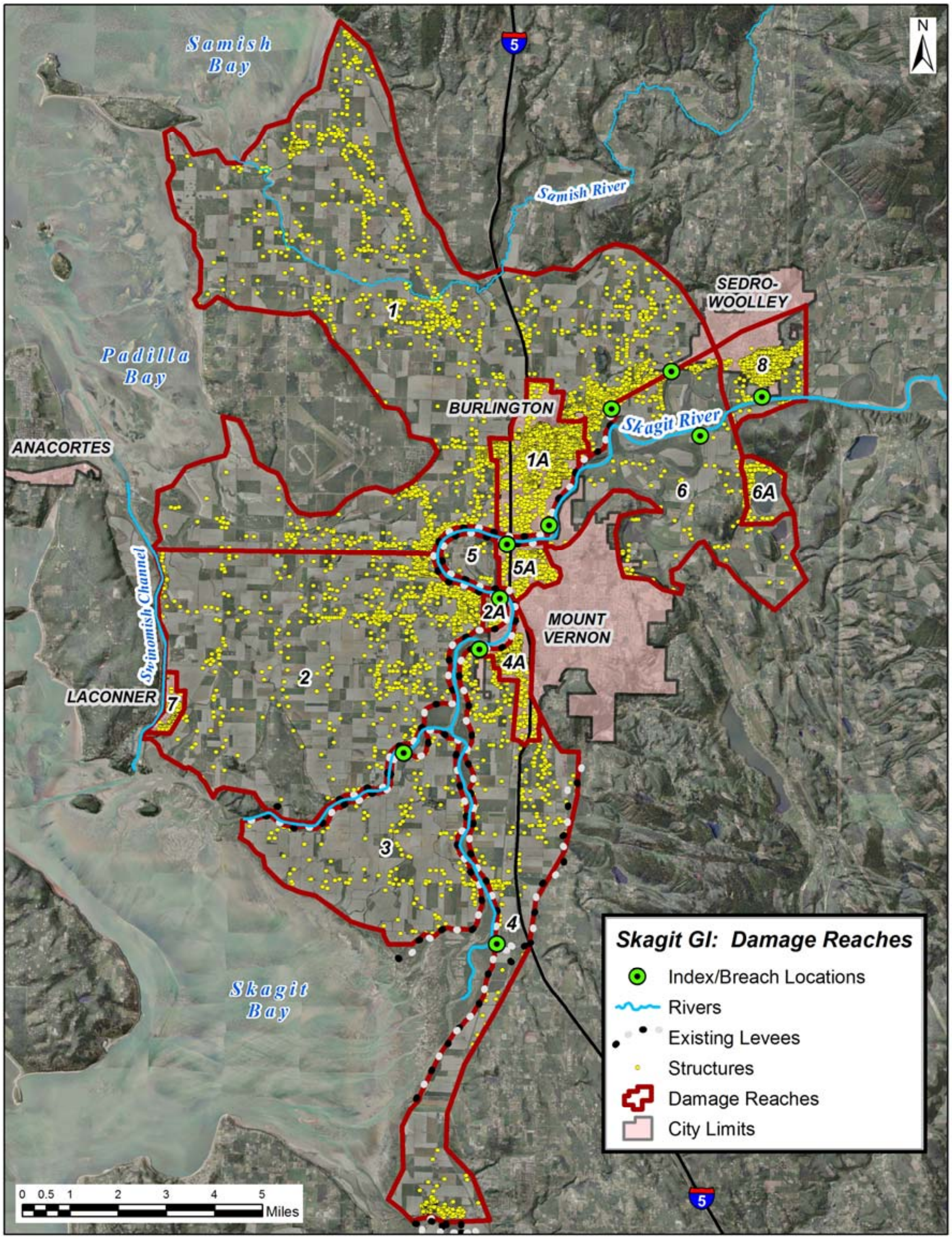

Figure 3-5. Skagit River GI Damage Reach Map

The value of the damageable structures was estimated based on depreciated replacement values. The total value of existing damageable property (structures and contents) within the Skagit study area is estimated` at $2.9 billion (October 2012 prices) as shown in Table 3-3. Approximately 3,700 structures are located within the Burlington (Reach 1A) and Mount Vernon (2A, 4A, and 5A) damage reaches, worth $1.7

billion. These two cities account for half of the property value (excluding agriculture) at risk of flooding in the 0.2% ACE floodplain.

Table 3-3. Value of Damageable Property (Value in $1,000s, October 2012 prices)

Damage Area (Reach)	Commercial	Industrial	Public	Residential	Farm	Total
Burlington (Reach 1A)	$497,950	$191,326	$83,890	$331,277	$440	$1,213,597
Mount Vernon (Reaches 2A, 4A, 5A)	271,289	49,331	64,063	106,494	178	$526,599
La Conner (Reach 7)	14,457	196	14,972	37,383	0	$79,169
Rural Floodplain (all other reaches)	43,212	168,876	159,894	760,616	85,437	$1,466,131
TOTAL	$826,908	$409,729	$322,819	$1,235,769	$86,055	$2,881,281

Inundation maps for the 4%, 1%, and 0.4% ACE floods for the existing condition are included in Figure 3-6, Figure 3-7 and Figure 3-8. Table 3-4 presents estimated single-event damages for different flood magnitudes for the existing without-project condition. There is a large jump in potential damages between a 10% ACE flood and a 4% ACE flood. The existing flood-protection infrastructure provides protection to about the 4-5% ACE level, when floodwaters start to spill out onto the floodplain or levees begin to overtop or breach. Nearly $1 billion in property damages to 7,000 structures is estimated for a 1% ACE event, and $1.3 billion to 9,000 structures is estimated for a 0.2% ACE event. Potential damages in the Burlington and Mount Vernon urban areas account for approximately 65 percent of total potential damages in a 1% ACE flood. Additionally, the population at risk for the 1% ACE event is estimated at 37,000 people.

Table 3-4. Skagit River Existing Condition Estimated Damages for a Single Event at Different Flood Magnitudes

	10% ACE (10-year)		4% ACE (25-year)		1% ACE (100-year)		0.2% ACE (500-year)	
Reach	**Structures Flooded**	**Damage ($K)**	**Structures Flooded**	**Damage ($K)**	**Structures Flooded**	**Damage ($K)**	**Structures Flooded**	**Damage ($K)**
Burlington (1A)	5	$170	1,942	$213,759	2,454	$374,958	2,559	$517,923
Mount Vernon (2A, 4A, 5A)	26	3,362	496	36,830	1,059	220,733	1,145	230,022
La Conner (7)	0	0	208	13,834	223	20,914	257	29,706
Rural Floodplain (all other reaches)	395	25,586	2,252	195,615	3,486	337,489	5,073	556,812
Totals	**426**	**$29,118**	**4,898**	**$460,038**	**7,222**	**$954,094**	**9034**	**$1,334,463**

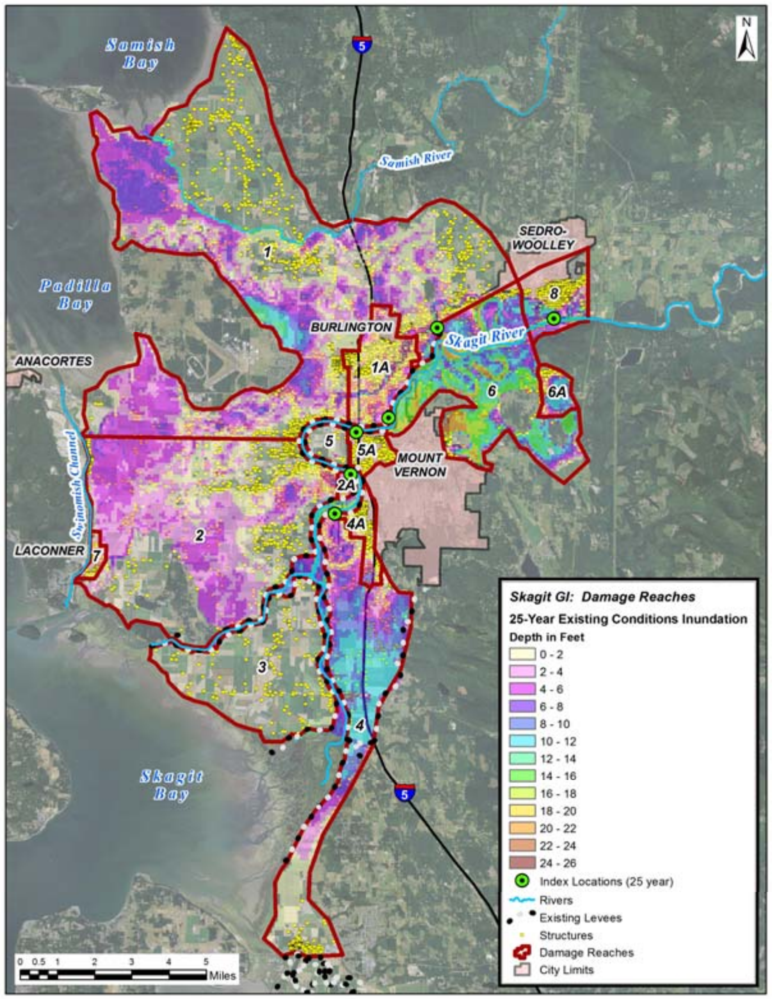

Figure 3-6. Inundation Map, 4% ACE

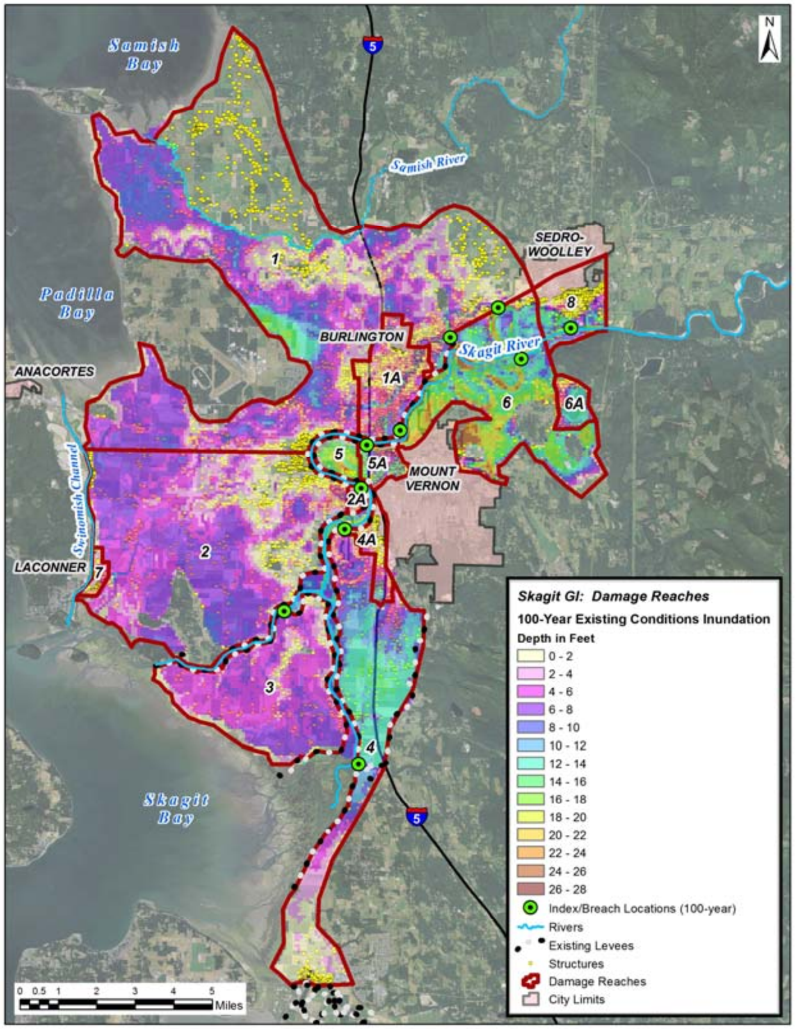

Figure 3-7. Inundation Map, 1% ACE (100-year)

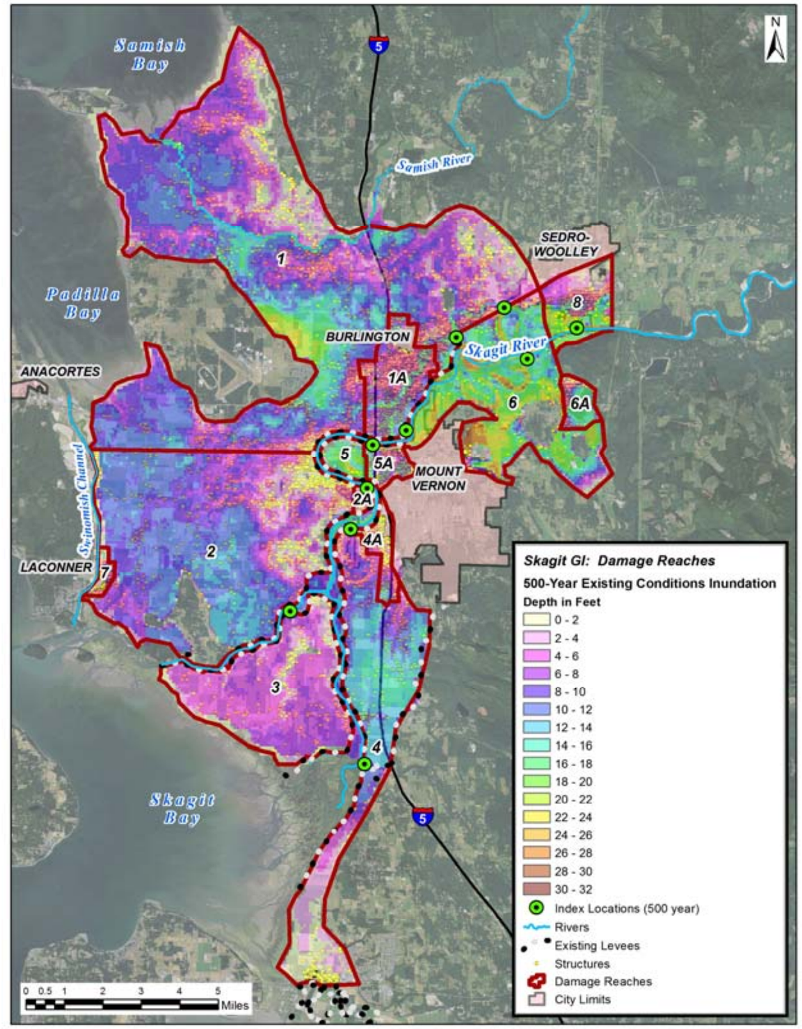

Figure 3-8. Inundation Map, 0.2% ACE (500-year)

3.1.4 Environmental Existing Condition

The Lower Skagit River Basin was historically dominated by Western red cedar and Western hemlock forest. Riverine wetland and riparian habitats were common in the lower basin prior to European settlement. The Skagit River delta was originally a large salt marsh/tidal wetland complex covering over 50 square miles. Downstream of Sedro-Woolley, intensive land modification for agriculture has occurred, including the construction of extensive levees and diking systems. Particularly within the Skagit River floodplain, the wetlands landward of the levees are often modified through farming. Fresh water wetlands in the lower river basin include emergent, scrub-shrub, and forested wetlands. Construction of levees along the Skagit River and adjacent channels has drastically reduced the quality of riparian habitat. Today, the majority of the riparian habitat zones downstream of Sedro-Woolley are either entirely devoid of trees or consist of sparse, narrow, and patchy strips of vegetation. Much of the vegetation on levees is composed of grasses and invasive species due to maintenance; however, along the revetments, there are willows and shrubs that were planted as mitigation for the 2011 Skagit Levee Rehabilitation Project. Local levee managers have chosen to participate in the Corps' Emergency Readiness and Response program (PL 84-99) such that approximately 45 miles of Skagit River levees are subject to the Corps' levee maintenance requirements. Additionally, the quality of river and channel bank habitats has also been drastically reduced by the placement of riprap along the edge of the river and channels for levee erosion control. There are eelgrass beds at subtidal elevations between the north and south forks of the Skagit River and north of the North Fork in Skagit Bay (McBride et. al 2006), as well as in Padilla Bay. The extensive eelgrass beds in Padilla Bay compose the largest contiguous eelgrass meadow in the state of Washington (approximately 7,500 acres), and one of the largest on the west coast (Bulthuis et al. 2006). Padilla Bay is designated as a National Estuarine Research Reserve and, based on this status, has strict guidelines regarding its management and protection.

Of all the drainages in Puget Sound, the Skagit River is the largest and produces the greatest abundance of salmonids and the greatest number of salmonid stocks. The Skagit is the only river system in Washington that supports all six species of Pacific salmon (including the ESA-listed Puget Sound Chinook Salmon and Puget Sound steelhead), and sea-run cutthroat. The Skagit River and its tributaries also host the largest population of ESA-listed Puget Sound bull trout. In addition, the Skagit River is the origin of the most abundant wild Chinook salmon populations, approximately 30 percent of the total Puget Sound Chinook originate in the Skagit Basin (Washington Conservation Commission 2003). The historic loss of tidal wetland and channel habitat has been identified as one of the most significant limiting factors in the recovery of Skagit Chinook.

3.1.5 Existing Hazardous, Toxic, and Radioactive Waste Sites in the Basin

Per USACE guidance (USACE 1992), hazardous, toxic, and radioactive waste (HTRW) includes any material listed as a "hazardous substance" under the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. 9601 et seq (CERCLA). A database search of the EPA's Enviro Facts and Washington State Department of Ecology's Integrated Site Information System (Web Reporting) was performed in June 2012 to identify potential HTRW concerns in the immediate study area of Skagit County. At the time of the search, 21 facilities were identified with reported toxic releases, and 306 facilities were identified with reported hazardous waste activities. Four of the facilities with hazardous waste activities are part of the EPA's Superfund program; however, none of the four sites have been listed on the National Priorities List nor do they have published Records of Decision. All four sites are located in the City of Anacortes. All other facilities identified with known releases or hazardous waste activities are located throughout Skagit County but primarily concentrated along major roadways and within the urban areas of Mount Vernon, Burlington, and Sedro-Woolley.

3.2 Future Without-Project Condition

The following conditions were forecasted for the most likely scenario if no Federal (USACE) flood risk management project were implemented in the study area for the time period of 50 years from 2020 to 2070. This establishment of the future without-project condition is required in the second step of the USACE planning process (inventory, forecast, and analysis of water and related land resources within the study area). The future without-project condition is used as the baseline against which the results and impacts of proposed study alternatives are compared. The future without-project condition is synonymous with the No Action Alternative under NEPA.

3.2.1 Future Flooding Condition in the Basin

Hydrologic and geomorphic conditions in the upper Skagit River Basin are not expected to change significantly over the next 50 years[2]. The upper watershed is generally national park, wilderness, or forest service lands. No changes that would alter flood hydrology are expected in the park or wilderness lands. Logging on U.S. Forest Service land could increase or decrease depending on Federal policy, but either course is unlikely to have a significant impact on annual flood hydrology.

Ross and Upper Baker dams are committed to continuing to provide the current levels of flood regulation storage. The recent Baker Dam FERC license does provide an option for the purchase of additional flood regulation storage. Purchase of this additional storage by local governments would have the potential to reduce future peak flood discharges at Concrete by up to 17,000 cfs, reducing the flood risk to downstream communities. These provisions have not been implemented; therefore, they are not considered to be part of the future without-project condition, and future without-project flood discharges are expected to be the same as in the existing condition.

Flood risks in the lower Skagit River, downstream of Sedro-Woolley, will change when planned improvements to levees in Mount Vernon and Burlington are completed. The City of Mount Vernon has plans for a new floodwall to protect the downtown area. The Mount Vernon Floodwall is partially complete, with completion planned for the near future. The floodwall will reduce the flood risks in the downtown area to less than a 1% ACE. This floodwall has been included as an existing and future feature in this flood study. Diking District 12 has proposed raising the right bank levee upstream of Burlington, between RMs 18 and 21. Those improvements involve raising the top of levee by up to 4 feet and increasing the width of the levee. If completed, the Burlington levee improvements would be expected to reduce the risk of floodwaters spilling over the levee and into Burlington. This proposed levee raise is

[2] Climate change may cause unprecedented alterations to the hydrology and hydraulics in the Skagit Basin, but the effects are uncertain, and were not included in the future without project condition. Sea level change (SLC) was evaluated consistent with existing Corps policies. Both climate change and sea level change are discussed in detail in Section 4.5.2.

consistent with the levee improvements proposed in the tentatively selected plan (TSP) for this study. Burlington would still face flood risks from floodwaters overflowing near Sterling and possible levee breaching. Overtopping reductions that would result from the Burlington levee raise might slightly increase flood risks not only upstream but also downstream of as more floodwater would pass downstream into the urban areas.

3.2.2 Future Flood Risk Management

In general, except for improvements to the Burlington levee and Mount Vernon floodwall, existing levees would continue to be maintained to their current conditions and alignments in the future without-project condition. Levee strengthening and reliability improvements, such as adding seepage berms, would continue. Local communities would continue to flood fight at known weak or low points in the levee system during flood events. USACE would continue to assist during emergencies and repairs of levees, for each levee system that remained active in the PL 84-99 program. Debris removal during floods would continue at the BNSF Bridge.

3.2.3 Future Without-Project Economic Condition

3.2.3.1 Future Economic Overview

By 2060, the County's population is expected to reach almost 218,000, an increase of 86% from 2010, or 101,100 new residents (Skagit County 2011). To plan for this growth, the County has developed a 50-year plan titled Envision Skagit 2060, to ensure the protection of the watershed and promote the economic growth of the region. The Envision 2060 planning effort ended in December 2012. Implementation of recommendations is pending funding.

Bulk goods traffic on the BNSF line is expected to increase if the proposed Gateway Pacific Terminal in Whatcom County is constructed. If constructed, the train traffic through Skagit County could increase with the transport of coal and other bulk commodities exports (Gateway 2014).

3.2.3.2 Future Without-Project Economic Flood Damages

The existing economic development was assumed into the future over the 50-year period of analysis ending 2070. Significant long-term flood risk would remain over the period of analysis. Assumptions related to the economic flood damage evaluation not previously mentioned include the following:

- The current land use and zoning maps for Skagit County would be followed, and all areas within existing Urban Growth Areas (UGAs) would develop to accommodate anticipated population growth by 2030. Some of these areas are located within the floodplain at Burlington and Mount Vernon. Other UGAs are located outside of the floodplain in Mount Vernon and Anacortes.
- Currently developed areas subjected to flood damage in the lower Skagit Basin would redevelop.
- New development within the floodplain is expected to comply with land use regulation pursuant to the Federal Disaster Protection Act of 1973 (Public Law 93-234) and Skagit County Code Section 14.34, and be flood proofed with the lowest floor elevated above the 1% ACE flood level.

- Currently the distribution of population growth is 80 percent to urban areas and 20 percent to rural areas. Under the Envision Skagit 2060 plan, the County will attempt to concentrate population and development within urban areas, with a population distribution goal to direct 90 percent of new population to urban areas (mostly cities and towns), and limit new rural development to 10 percent.
- Under the Envision Skagit 2060 plan, the County will attempt to prohibit UGAs from expanding into environmentally sensitive areas, including the floodplain, agricultural lands, and sensitive stream basins (including the East Fork Nookachamps).

A Monte-Carlo analysis of flood damages was conducted using the HEC-FDA model (Flood Damage Analysis), which considers uncertainties related to hydraulics, hydrology, levee performance, and economics. Expected annual damages (EAD) for the lower floodplain, which considers a full range of flood events that could occur, are estimated to be nearly $40 million as shown in Table 3-5. These include damages to property, crops (agricultural damage), and traffic delays due to inundation of I-5 and SR 9 and SR 20 in the floodplain. The greatest damage would be to residences, followed by commercial and industrial structures. Damages in the Burlington and Mount Vernon urban reaches account for approximately 46% percent of total EAD for the study area. Appendix C includes more information about the economic analysis of future without-project conditions.

Table 3-5. Without-Project Condition Expected Annual Damages (EAD) (in $1,000s)

Damage Area	Commercial	Industrial	Public	Residential	Farm Buildings	Traffic Delays	Agricultural Damages	Total EAD
Burlington (1A)	$7,007	$3,512	$848	$3,358	$13	$0	$0	$14,738
Mount Vernon (2A, 4A, and 5A)	1,980	648	467	643	467	0	0	4,205
La Conner (7)	157	2	253	381	0	0	79	872
Rural Floodplain (all other reaches)	964	4737	439	6,950	1,017	$770	5,206	20,083
Total	$10,108	$8,899	$2,007	$11,332	$1,497	$770	$5,285	$39,898

3.2.4 Environmental Future Without-Project Condition

The majority of the riparian areas downstream of Sedro-Woolley would continue to be constricted by levees and would continue to be entirely devoid of robust vegetation. Lack of or low quality riparian, riverine, and estuarine habitat would continue to be major limiting factors to the recovery of Puget Sound Chinook salmon, bull trout, and Puget Sound steelhead and would continue to adversely affect other salmonid populations. Skagit River fish have already experienced a variety of pressures caused by the diking of the river and estuary, construction of dams, insufficient riparian vegetation and large woody debris recruitment, and the development of the floodplain. Off-channel habitat will likely continue to decline in the future. Continued construction and maintenance of levees and revetments will negatively influence water temperature by reducing shade and detrital input, increasing relative humidity and water temperature, altering channel dimensions, and reducing overhead cover in the future.

The decline in extent and quality of wetlands is expected to continue due to continued development as well as the continued maintenance and construction of levees that constrain the river and limit inundation of floodplain wetlands. Predicted sea level rise would impact freshwater tidal marshes and brackish marshes. Storm surges and higher levels of inundation would increase salinity to these systems. If landward migration of these systems is blocked by development or man-made structures, they may transition to salt marshes or transitional marshes (SITC 2009).

Factors influencing future eelgrass bed distribution in the Skagit River Delta and Padilla Bay include sediment erosion and accretion, storm surge, sea-level rise, geologic uplift/subsidence, and land use practices and allowance for these ecotypes to shift landward (Hood 2012). Combined with projected sea level rise, depths in Padilla Bay may be too deep to sustain eelgrass, particularly in the deeper areas. Padilla Bay is also confined by dikes and uplands, making inland migration of eelgrass beds unlikely. As the sea levels rise in Skagit Bay eelgrass beds have more room to migrate landward to areas where salt marsh currently exists, but they would also be limited by the extensive dike system that surrounds much of the delta, as well as water quality issues from agricultural run-off.

3.2.5 Future Hazardous, Toxic, and Radioactive Waste Sites

The HTRW existing without-project condition is not expected to change significantly in the future in the absence of a flood risk management project. The Washington State Department of Ecology will likely continue to monitor and identify facilities with hazardous waste activities and, as necessary, remediate facilities with reported toxic releases.

3.3 Management Measures

Once the existing and future without-project conditions are established, the next step in the formulation of alternatives is to develop management measures (measures). Measures are actions that address the study objectives in specific discrete locations. A wide variety of structural and non-structural measures were developed in collaboration with the non-Federal Sponsor, Basin stakeholders, and resource agencies to address flood risk management objectives listed in Section 2. Structural measures are constructed elements that alter the existing hydrology and/or hydraulics. Levees and reservoir flood storage are examples of structural measures. Non-structural measures reduce specific risks and damages within the floodplain. They are sustainable over the long term with minimal costs for operation, maintenance, repair, rehabilitation, or replacement. Examples of non-structural measures include; purchasing high risk properties, elevating structures above expected flood elevations, and flood-proofing structures. Each measure was then evaluated and screened against the criteria listed below to determine whether it should be retained for the formulation of alternative plans.

3.3.1 Evaluation and Screening Criteria for Management Measures

The following criteria were used to evaluate measures:

- Does the measure address the objective of reducing flood damages (including property damage)?
- Does the measure address the objective of reducing life safety risk?
- Does the measure minimize adverse impacts to environmental, agricultural, and/or cultural resources?

- Is the measure cost effective (based on preliminary evaluation of costs and professional judgment)?

The following criteria were used to screen measures:

- Measures that do not address the objective of reducing flood damages were not carried forward.
- Measures that do not address the study objective of reducing life safety risk were not carried forward.
- Measures that address the first two criteria and minimize adverse impacts to environmental, agricultural, and cultural resources were carried forward.
- Measures that address the first two criteria and are cost effective were carried forward.

3.3.2 Measures Carried Forward and Eliminated From Further Consideration

Table 3-6 lists measures eliminated (screened out) from further consideration.

Table 3-7 and Figure 3-9 present measures carried forward into the initial phase of alternatives formulation and meet the measure-screening criteria specified above. However, not all of the measures listed in Table 3-7 were incorporated into the final array of alternatives.

Table 3-6. Management Measures Eliminated From Further Consideration

Measure	**Rationale for Elimination**
Dredging of the Skagit River for the entire length between Sedro-Woolley and Skagit Bay	Significant adverse environmental impacts and high non-Federal Sponsor maintenance requirements. This measure does not meet criteria of minimizing adverse impacts to environmental, agricultural, and/or cultural resources.
Construct new dams on rivers and tributaries with no existing flood control storage	Not institutionally viable due to "Wild and Scenic River" status of Sauk and Cascade Rivers. This measure does not meet criteria of minimizing adverse impacts to environmental, agricultural, and/or cultural resources.
Operational and structural modifications to Seattle City Light's Gorge and Diablo Dams	Flood capacity of the dams is too small to provide significant flood storage. This measure does not address the objective of reducing flood damages.
Structural modifications to Ross Dam, Upper Baker Dam, and Lower Baker Dam (includes provision of 74,000 acre feet of flood storage at Upper Baker Dam)	Structural changes to Ross, Upper Baker, and Lower Baker Dams would require compliance with Corps Dam safety policies and re-opening of respective FERC licenses. This measure is likely to not be cost effective due to associated costs to modify dams to obtain compliance with Corps Dam safety policies and re-open respective FERC licenses.
Imminent flood operations at Upper and Lower Baker Dam (Per Baker River Hydroelectric Project No. 2150 - Federal Energy Regulatory Commission [FERC] license Article 107 Flood Storage (c) referencing imminent flood operations; and Article 106 referencing modification of flow implementation plans (Aquatics Table 2) (FERC 2008)	Lack of high precision long-lead weather forecast technology now and in the foreseeable future makes it extremely difficult to design a measure for imminent drawdown without a significant level of risk to operation of the dam once flood danger has passed. This measure does not meet the objectives of reducing flood damages or reducing life safety risk.
Operational modifications to Ross Dam	Modification of operations would likely require reopening of Seattle City Light's FERC license and treaty negotiations with Canada. International treaty negotiations are likely to be outside the scope of this study, therefore this measure was eliminated from further consideration.
Setback Levees with bank excavation to increase conveyance	Adverse environmental impacts, high maintenance costs. Bank excavation would destabilize the channel leading to erosion and altered sediment deposition patterns. This measure does not meet criteria of minimize adverse impacts to environmental, agricultural, and/or cultural resources.
Overtopping Levees	High residual damages of areas situated behind the levee, requires purchase of substantial acreage for flowage easements, overtopping floodwaters may be a source of pesticides or other contaminants decreasing the water quality of receiving water bodies. This measure does not address the objective of reducing life safety risk. This measure does not meet criteria of minimizing adverse impacts to environmental, agricultural, and/or cultural resources.
Relocation of the City of Hamilton	Not economically justified. This measure does not meet the criteria of cost effectiveness.
Anacortes Water Treatment Plant Levee	Plant management has begun levee design and construction, therefore this measure has been eliminated from further consideration.

Measure	**Rationale for Elimination**
Bridge Replacement (Within the Three Bridge Corridor)	Costs of bridge replacement is cost prohibitive and would not likely result in net benefits . *Note: The GI can recommend removal/modifications to the highway bridges; however, this will be a local sponsor or another agency responsibility (ER 1105-2-100, page E-130). This measure does not meet the criterion of cost effectiveness.
Nookachamps Storage	Minimal storage capacity, adverse environmental impacts. A dam structure would be needed to regulate the flow into and out of these areas. This measure does not address the objective of reducing flood damages. This measure does not meet criteria of minimizing adverse impacts to environmental, agricultural, and/or cultural resources.
Hart's Slough Storage	Minimal storage capacity, adverse environmental impacts. A dam structure would be needed to regulate the flow into and out of these areas. This measure does not address the objective of reducing flood damages. This measure does not meet criteria of minimizing adverse impacts to environmental, agricultural, and/or cultural resources.
Cockreham Island	Storage capacity is too small to provide significant flood storage. A dam structure would be needed to regulate the flow into and out of these areas. This measure does not address the objective of reducing flood damages. This measure does not meet criteria of minimizing adverse impacts to environmental, agricultural, and/or cultural resources.
Riverbend storage	Storage capacity is too small to provide significant flood storage. A dam structure would be needed to regulate the flow into and out of these areas. This measure does not address the objective of reducing flood damages. This measure does not meet criteria of minimizing adverse impacts to environmental, agricultural, and/or cultural resources.

Table 3-7. Summary of Management Measures Carried Forward to Formulation of Alternatives

Management Measures Carried Forward to formulation of alternatives		
Map #	**Operational Modifications to Existing Dams**	**Description**
D	Upper Baker Dam and/or Lower Baker Dam	Purchase additional flood storage at Upper Baker River reservoir (up to 74,000 acre feet) and/or Lower Baker Dam (up to 29,000 acre feet) resulting in modified operations of Upper and Lower Baker Dams per Baker River Hydroelectric Project No. 2150 - Federal Energy Regulatory Commission (FERC) license Article 107 Flood Storage
	Raise Levees	**Description**
Yellow	Raise Existing Urban **Levees**	Raise existing urban levees to reduce flood risk to urban areas
	Levee Setbacks	**Description**
*Not shown on map	Setback existing levees	Setback of existing levees to increase conveyance for floodwaters in the setback reach. Setback reach ranges from setbacks of levees downstream of Mount Vernon to setting back levees along the entire system. * Setback of levees is represented by the existing levee alignment
	New Levees	**Description**
L1	Sterling Levee	Construct a levee to prevent floodwaters from leaving the mainstem Skagit River at Sterling.
L2	Sedro-Woolley Urban Levee	Construct a levee to reduce flood risk to Sedro-Woolley
L3	Burlington Urban Levee	Construct a levee to reduce flood risk to the City of Burlington
L4	Riverbend Cutoff Levee	Construct a levee and floodwall system to reduce flood risk to North Mount Vernon
L5	West Mount Vernon Urban Levee	Construct a levee surrounding the western part of the city of Mount Vernon to reduce flood risk
L6	East Mount Vernon Urban Levee	Construct a levee surrounding the eastern part of the city of Mount Vernon to reduce flood risk
L7	La Conner Urban Levee	Construct a levee to reduce flood risk to the La Conner area
L8	Clear Lake Levee	Construct levee to reduce flood risk to the Clear Lake area
	Bypasses (Confined Channel and Unconfined Channel)	**Description**
BP1	Joe Leary Slough Bypass	Construct a bypass to divert floodwaters from the Skagit River upstream of the Three Bridge Corridor along the Joe Leary Slough to Padilla Bay.
BP2	Swinomish Channel Bypass	Construct a bypass to divert floodwaters downstream of the Three Bridge Corridor from the Skagit River to the Swinomish Chanel
BP3	Mount Vernon Bypass	Construct a bypass to overcome the constriction of flow of the Skagit River at the Division Street Bridge in Mount Vernon
BP4	Fir Island Bypass	Construct a bypass to divert water from the North Fork Skagit River out to Skagit Bay
	Bridges	**Description**
B	Modify bridges of the Three Bridge Corridor only. (No levee setbacks)	Modification to the Interstate 5, Burlington Northern Santa Fe (BNSF) Railroad, and the Burlington Boulevard bridges to increase the conveyance of floodwaters through the Three Bridge Corridor. (Note: The GI can recommend removal/modifications to the highway bridges; however, this will be a local sponsor or

		another agency responsibility [ER 1105-2-100, page E-130])
	Drainage	**Description**
Not shown on map	Interior drainage for agricultural and urban areas	Improve, modify or construct flood water drainage infrastructure in agricultural and urban areas.
	Non-Structural Measures	**Description**
WTP	Sedro-Woolley Sewage Treatment Plant Urban Levee	Improve existing levee surrounding the Sedro-Woolley Sewage Treatment Plan
H	Sedro-Woolley Hospital Urban Levee	Construct a levee around the Sedro-Woolley Hospital
Not shown on map	Debris Management	Remove and/or manage woody debris from bridges and river constrictions to avoid blockages and other situations that jeopardize flood risk management systems
Not shown on map	Other Non-Structural Measures	Examples of non-structural measures that may be evaluated during alternatives formulation include: flood proofing, relocations, landscape features, and flood warning evacuation systems that could be implemented throughout the basin as needed.

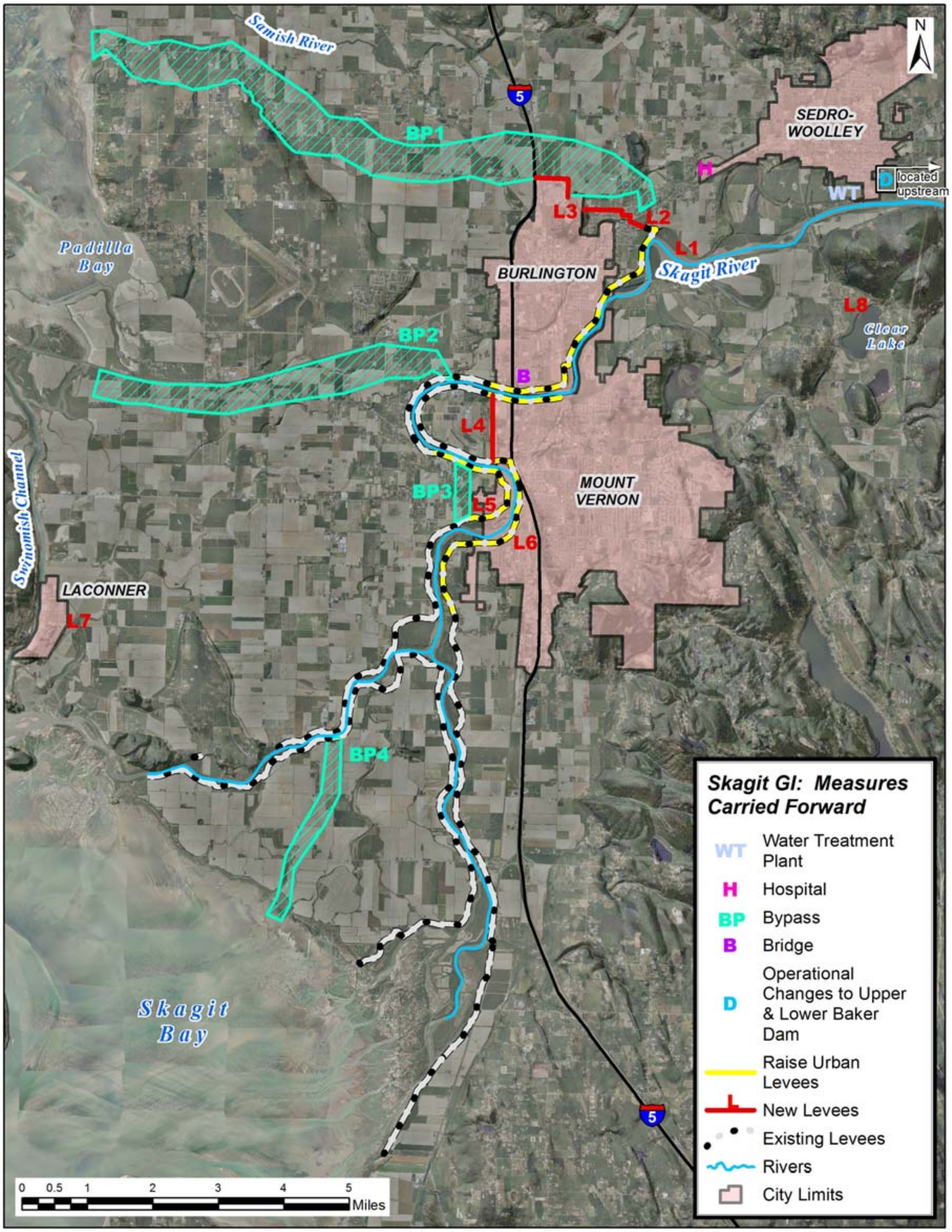

Figure 3-9. Management Measures Carried Forward to the Preliminary Stages of Alternatives Formulation. (Map Key is located in the right column of Table 3-7.)

3.4 General Design Assumptions in the Plan Formulation Process

The following general design assumptions were used to assist with the formulation of alternatives throughout the plan formulation process. Specific design assumptions were also made and they are identified in Appendix A (Plan Formulation).

- A preliminary array of alternatives was developed, evaluated and screened based on existing data and professional judgment in accordance with USACE SMART Planning guidelines. Any incomplete and unavailable information relevant to reasonably foreseeable adverse impacts is disclosed along with an assessment of how it might influence decisions, pursuant to 40 CFR 1502.22.
- The Final Array of Alternatives was developed to a conceptual level of design. Only the alternative that is selected as the TSP will undergo feasibility-level design.
- For purposes of establishing a common baseline for evaluation and comparison of alternatives, all conceptually designed alternatives were formulated to provide 1% ACE level of flood risk management in urban areas including the cities of Burlington and Mount Vernon. For additional detail regarding this assumption, see Section 3.5.Strategy for Reduction of Flood Damages in Urban vs. Rural Areas).
- The Upper and Lower Baker Dam Operational Modification Measures (Baker Dam Measures) were assumed to be a measure that could be added to any alternative because preliminary evaluation of the Baker Dam Measures indicated that the combination of the Upper and Lower Baker Dam operational modifications would contribute to lower flows on the Skagit River downstream of Concrete. The Baker Dam Measures provide the system-wide benefits in an increment that would be equal amongst all alternatives. Because of this, Baker Dam Measures were included in modeling of the preliminary with-project condition modeling for the three alternatives

3.5 Strategy for Reduction of Flood Damages in Urban vs. Rural Areas

The alternatives proposed in this study do not provide equal level of flood risk reduction to rural and urban areas in the lower Skagit River Basin and some areas may experience induced flooding. The original intent of the study was to reduce flood risk throughout the entire basin. As described earlier, the lower Basin includes highly productive agricultural land. However, upon evaluation of the without-project conditions, it was determined that the lower Skagit River floodplain is approximately 100 square miles. The urban cities of Burlington and Mount Vernon contain nearly half of the economic development in the floodplain concentrated within a few square miles, while the development in the rural areas is of lower density and spreads out over the rest of the floodplain. Therefore, it would be much more costly to provide the rural areas with greater flood risk reduction. Flood risk reduction in the rural areas is not likely to have enough benefits to offset the costs in order to justify a Federal Interest.

Establishment of Federal Interest is critical for advancement of the study beyond the feasibility phase into pre-construction engineering and design (PED), and ultimately construction of the recommended plan. The alternatives proposed in this study were formulated with the assumption that alternatives that focused on providing flood risk reduction to urban areas are likely to result in a benefit-cost ratio greater than 1.

The alternatives provide a comprehensive flood risk reduction strategy, allowing for reduction of flood risk to critical infrastructure, roads and urban centers allowing for economic activities and public services that benefit the entire Basin to continue following a large flood event. The alternatives provide opportunities to decrease flood risk in rural areas by utilization of non-structural measures such as raising and or flood proofing of individual structures and improved warning and evacuation process. These opportunities are described conceptually in this study and will be further developed during feasibility level design.

The existing system provides less than 1% ACE flood risk management. For purposes of establishing a common baseline for evaluation and comparison of alternatives, the conceptual designs of the alternatives were formulated to provide 1% ACE level of flood risk management to urban areas, including the cities of Burlington and Mount Vernon and at the minimum maintain existing level of flood risk in the remainder of the Basin. This strategy was for comparison of alternatives during the plan formulation process, and coincides with the non-Federal sponsor's interests in providing a minimum of 1% ACE level of flood risk management to the urban areas of Burlington and Mount Vernon, and maintaining, at a minimum the existing level of flood risk reduction to rural portions of the lower Skagit River Basin. The rural floodplain includes the areas outside of Mount Vernon, Burlington, and La Conner. While half of damages are within the rural areas, these damages are largely composed of lower density of development spread out across the rural floodplain. The Skagit River levee systems have an existing capacity of 150-160,000 cfs, approximately a 4% ACE flood. Under the existing and future without-project condition the rural levee systems, do not have the capacity to contain larger, less frequent, high flow events and it would be very costly to reduce flood risk in these rural areas with structural measures.

In summary, preliminary analysis indicates that rural areas do not have enough flood damages to justify Federal Interest in construction of a structural measure to reduce flood risk and non-structural measures will be evaluated to provide more cost effective flood risk reduction to the rural areas.

3.6 Alternatives

3.6.1 Preliminary Array of Alternatives

Five preliminary alternatives were developed for the preliminary array of alternatives, based on the management measures carried forward following the screening of management measures described above. Descriptions of the preliminary array and evaluation of the preliminary array are in Appendix B (Plan Formulation).

- No Action Preliminary Alternative
- Non-Structural Preliminary Alternative:
- Joe Leary Slough Bypass Confined Channel or Overland Flow Preliminary Alternative
- Swinomish Bypass Confined Channel or Overland Flow Preliminary Alternative
- Urban Areas and Critical Infrastructure Protection Preliminary Alternative
- Levee Setback Preliminary Alternative

Preliminary alternatives were formulated to divert flood waters from the river system or improve conveyance of flood waters though the river system. All preliminary alternatives are conceptual level designs that were formulated using existing H&H data. Additional H&H analysis was conducted on the focused array of alternatives to determine the hydraulic effectiveness of the alternatives.

The preliminary array of alternatives was presented to the public during April-June 2012. Comments received are documented in Appendix I of the Draft FR/EIS (Public Involvement).

3.6.2 Evaluation Criteria for Alternatives

This section outlines the criteria used to evaluate the alternatives. Criteria listed in bold were given priority consideration in the evaluation and screening process: alternatives not meeting priority criteria were immediately screened out from further consideration. Evaluation assumptions are listed in Appendix A (Plan Formulation).

The evaluation criteria are as follows:

- **Does the alternative achieve the study objective of reducing flood risk?**
- **Does the alternative reduce flood risk in a cost effective manner?**
- **Does the alternative reduce life safety risk?**
- What are the preliminary estimates of construction costs for the alternative?
- What are the real estate impacts associated with each alternative?
- What are the potential impacts to infrastructure associated with each alternative?
- Does the alternative adversely impact existing sedimentation patterns?
- Does the alternative adversely impact agricultural resources?
- Does the alternative impact environmental resources?
- Does the alternative impact cultural resources?
- Does the alternative impact HTRW sites?
- What is the preliminary assessment of sponsor and public support.

3.7 Eliminated Alternatives from Preliminary Array

The alternatives discussed above were developed during the preliminary alternatives-formulation stage but were not brought forward for additional consideration; those that were brought forward are discussed in the following section. All preliminary alternatives were formulated to divert flood waters from the river system or improve conveyance of floodwaters though the river system or both. The preliminary array of alternatives was presented to the public during the months of April – June 2012. Comments received are documented in Appendix I (Public Involvement).

- Non-Structural and Dam Storage Only Preliminary Alternative
- Urban Areas and Critical Infrastructure Protection Preliminary Alternative

- Levee Setback Preliminary Alternative

3.7.1 Non-Structural and Dam Storage Only Preliminary Alternative

The Non-Structural Preliminary Alternative focused on implementation of dam operational modifications of the Upper and Lower Baker Dam and various non-structural measures. Dam operational modifications would be implemented per specifications of management for river bridges during floods in the Baker River Hydroelectric Project No. 2150 - Federal Energy Regulatory Commission (FERC) license Article 107 Flood Storage (Article 107; FERC 2008). Non-structural features include education and outreach, evacuation routes, outlet structures in sea dikes, additional stream gages, flood warning systems, relocation of structures, elevation of structures, and flood-proofing of buildings.

The Non-Structural Preliminary and Dam Storage Only Alternative was not carried forward as an alternative to be considered as the Tentatively Selected Plan because it would not provide comprehensive flood risk reduction for the Basin however, it would provide some benefits. Therefore, every alternative in the final array incorporates all the features of the Non-structural and Dam Storage Only Alternative.

3.7.2 Urban Areas and Critical Infrastructure Protection Preliminary Alternative

This alternative focused on providing flood risk reduction for urban areas, such as the cities of Sedro-Woolley, Burlington, and Mount Vernon; and critical infrastructure such as wastewater treatment plants and hospitals in the Skagit River Basin (see Figure 3-10). Levees/ring dikes would be constructed around the urban centers of Burlington, Mount Vernon and La Conner. Ring levees would be constructed around critical infrastructure such as the Sedro-Woolley Wastewater Treatment Plant and the United General Hospital. This alternative prioritized flood risk reduction for areas with the potential for high economic and infrastructure damages during a large flood. This alternative also included the non-structural measures and dam operational modifications described above.

This alternative was not brought forward because it would not provide flood risk reduction for rural areas and has high residual life safety risk for residents within the urban ring levees.

3.7.3 Levee Setback Preliminary Alternative

The Levee Setback Alternative (see Figure 3-11) focused on increased conveyance of floodwaters though the river system and containing floodwaters within the river system by setting back the entire levee system (including along Fir Island), modifying river bridge structures, and constructing bypasses. Components of this alternative included dam operational modifications; setback of the majority of the Skagit River levee system; structural modifications to the Burlington Northern Santa Fe railroad bridge, and potential modification to the Division Street Bridge if needed; a West Mount Vernon Bypass and a Fir Island Bypass, a new Sterling levee, and non-structural features.

This alternative was not brought forward and was reformulated into the Comprehensive Urban Levee Improvement Alternative (CULI), which is summarized in the following section.

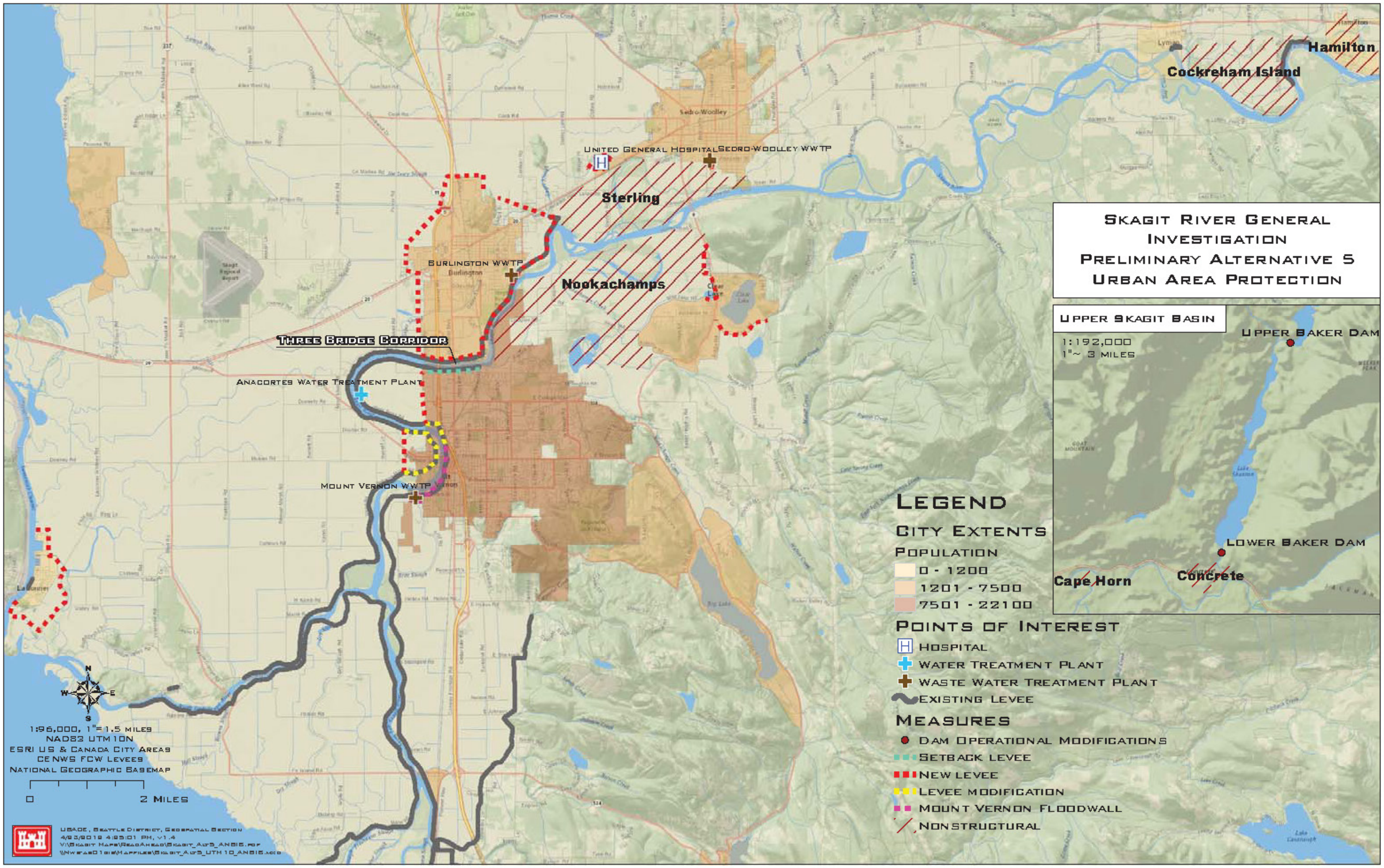

Figure 3-10. Urban Areas and Critical Infrastructure Protection Preliminary Alternative

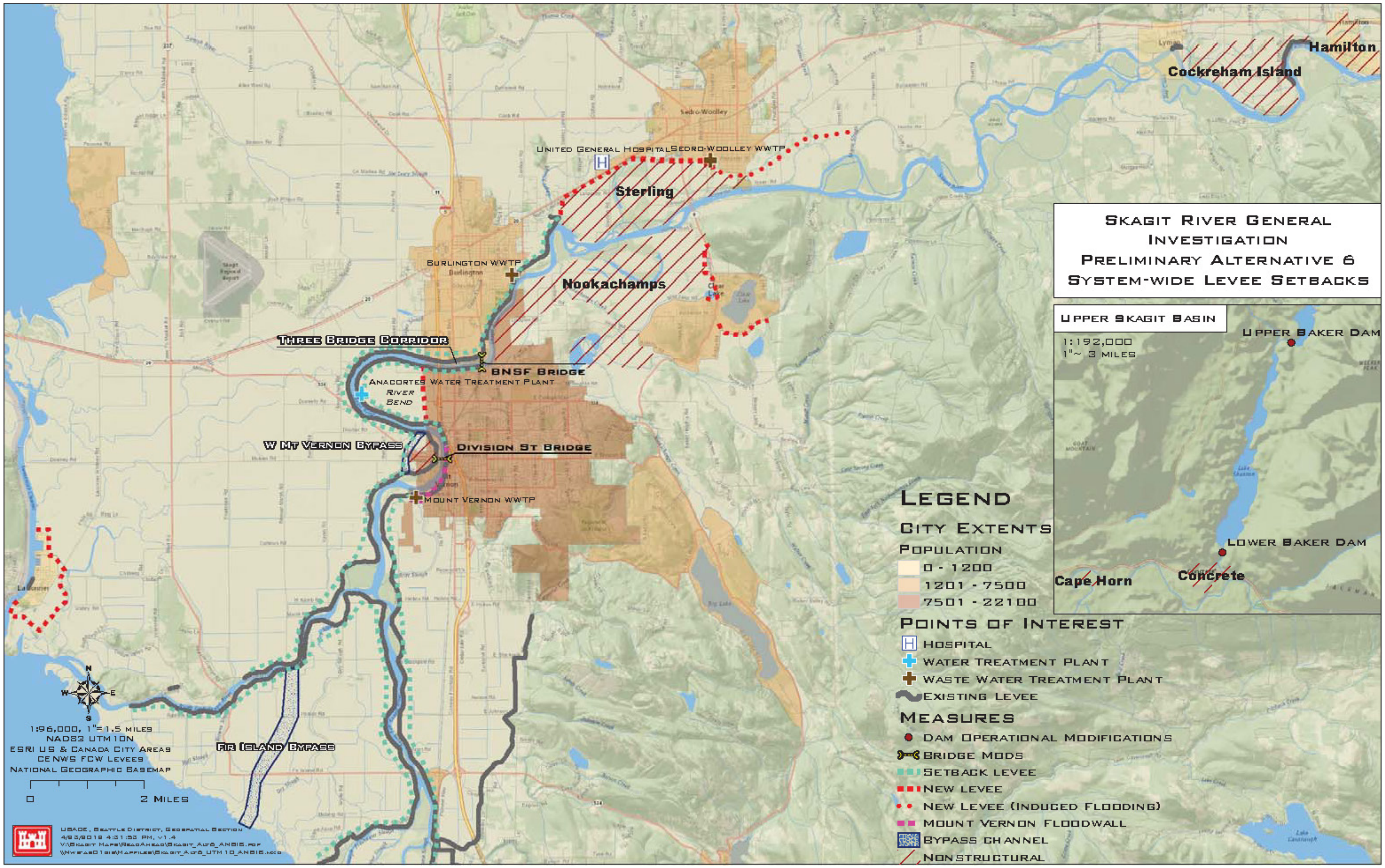

Figure 3-11. Levee Setback Preliminary Alternative

3.7.3.1 Reformulation of the Levee Setback Alternative into the Comprehensive Urban Levee Improvement Alternative

During evaluation of the focused array of alternatives, the Levee Setback Alternative was reformulated into the Comprehensive Urban Levee Improvement (CULI) Alternative. The CULI Alternative would involve raising approximately 9.2 miles of existing urban levees 3 to 5 feet, constructing 2.9 miles of new levee to the east and north of Burlington, and constructing a mile of new levee in Riverbend. There are no large-scale levee setbacks associated with the CULI Alternative. The Levee Setback Alternative was revised based on hydraulic analysis of the alternative. In summary, in order for the levee setbacks to be effective for Burlington and Mount Vernon, the levee setbacks had to extend upstream to these cities. It was also determined that those levee setbacks would not be adequate to protect Burlington from upstream overflows at Sterling and other measures would be needed as well.

The initial Levee Setback Alternative, as presented in the preliminary array of alternatives, called for setback of the entire levee system. The hydraulic analysis evaluated setback combinations, starting with the downstream levees. The initial setback levee combination was along the North and South Forks only. This would not have the desired reductions in water surface elevation in the urban areas, so the modeled setbacks were extended upstream to Mount Vernon. This still would not provide the desired reductions in Burlington, so they were extended farther upstream. This was continued until the levee setbacks extended all the way to the BNSF Bridge.

In addition to the levee setbacks, levee improvements would have been necessary upstream of the BNSF Bridge, existing levees that were not set back would have needed to be raised, and the Mount Vernon bypass would have been required. Costs of these levee setbacks and modification of existing levees would likely be high due to construction costs, real estate costs, and likely require relocation of utilities. At this point it became apparent that the potential flood risk reduction associated with levee setbacks would likely not be cost effective. Therefore, this alternative was reformulated into the less complex CULI Alternative.

Subsequent hydraulic modeling of the CULI Alternative determined that flood risk in urban areas could be reduced solely with modification to existing urban levees and is not dependent on setback of levees at Fir Island to achieve the benefit needed for the urban areas. Levee setbacks at Fir Island would have the greatest benefit for Fir Island; however, Fir Island is not an urban area and has mostly agricultural land use. Setback levees to protect Fir Island would not accomplish the project goal of reducing the flood risk in the urban areas and are not included in the CULI Alternative. See Appendix B (Hydraulics and Hydrology) and Appendix C (Economics) for additional information related to this analysis.

3.8 Final Array of Alternatives

Listed below are the alternatives that were considered for selection as the TSP. These four alternatives were developed to an equal level of conceptual level design for evaluation and comparison to determine the TSP.

- No Action
- Comprehensive Urban Levee Improvement (CULI)

- Joe Leary Slough Bypass Wide Confined Channel
- Swinomish Bypass Wide Confined Channel

3.8.1 No Action Alternative

Per USACE planning guidance, the No Action Alternative was evaluated. The No Action Alternative assumes that that no project would be implemented by either the USACE or by local interests to achieve flood risk management objectives. The NEPA-required No Action Alternative is synonymous with the USACE future without-project condition.

In general, flood risk in the Skagit Basin will get worse if no action is taken. The No Action Alternative does not address the study objectives to reduce flood risk and life safety risk in the Skagit River Basin. The non-Federal sponsor predicts that there will be an increase in future population and there are numerous environmental challenges to maintenance of existing levees to comply with regulations which further renders the No Action Alternative ineffective. The No-Action Alternative is used as a baseline against which to compare alternatives for plan formulation and is used in evaluation of the range of alternatives during NEPA-required analysis.

3.8.2 Comprehensive Urban Levee Improvement (CULI) Alternative

3.8.2.1 CULI Overview

The CULI Alternative would provide flood risk reduction for the urban areas of Burlington and Mount Vernon by raising existing levees along the Skagit River and constructing a new Burlington Hill Cross Levee along the eastern and northern edges of Burlington (Figure 3-12). This is a conceptual design and will be further refined during feasibility design analysis as the feasibility study progresses.

3.8.2.2 CULI With-Project Condition

As discussed in Section 3.5, the CULI Alternative was designed to provide 1%ACE level flood risk reduction to urban areas while the level of flood risk in the rural areas would remain in the current range of approximately 4-5% ACE. The Nookachamps Basin is currently used as an overflow area. The Nookachamps Basin would receive elevated levels of flood waters for less than a day. The elevated water levels in the Nookachamps Basin are not uniform across the basin area. In general, the CULI Alternative may increase the 1% ACE flood elevations in the Nookachamps Basin by about 1 ft. The overflow at Sterling would increase, causing a rise of 1/2 to 3/4 ft in 1% ACE floodwater elevations in the northern portion of the floodplain. There would also be increased overtopping along some of the un-improved levees that would cause a slight rise in the flood risk in the western rural floodplain and in the Riverbend area. No significant changes in flood discharges or levels of protection, compared with the existing condition, would occur along the North and South Forks of the river.

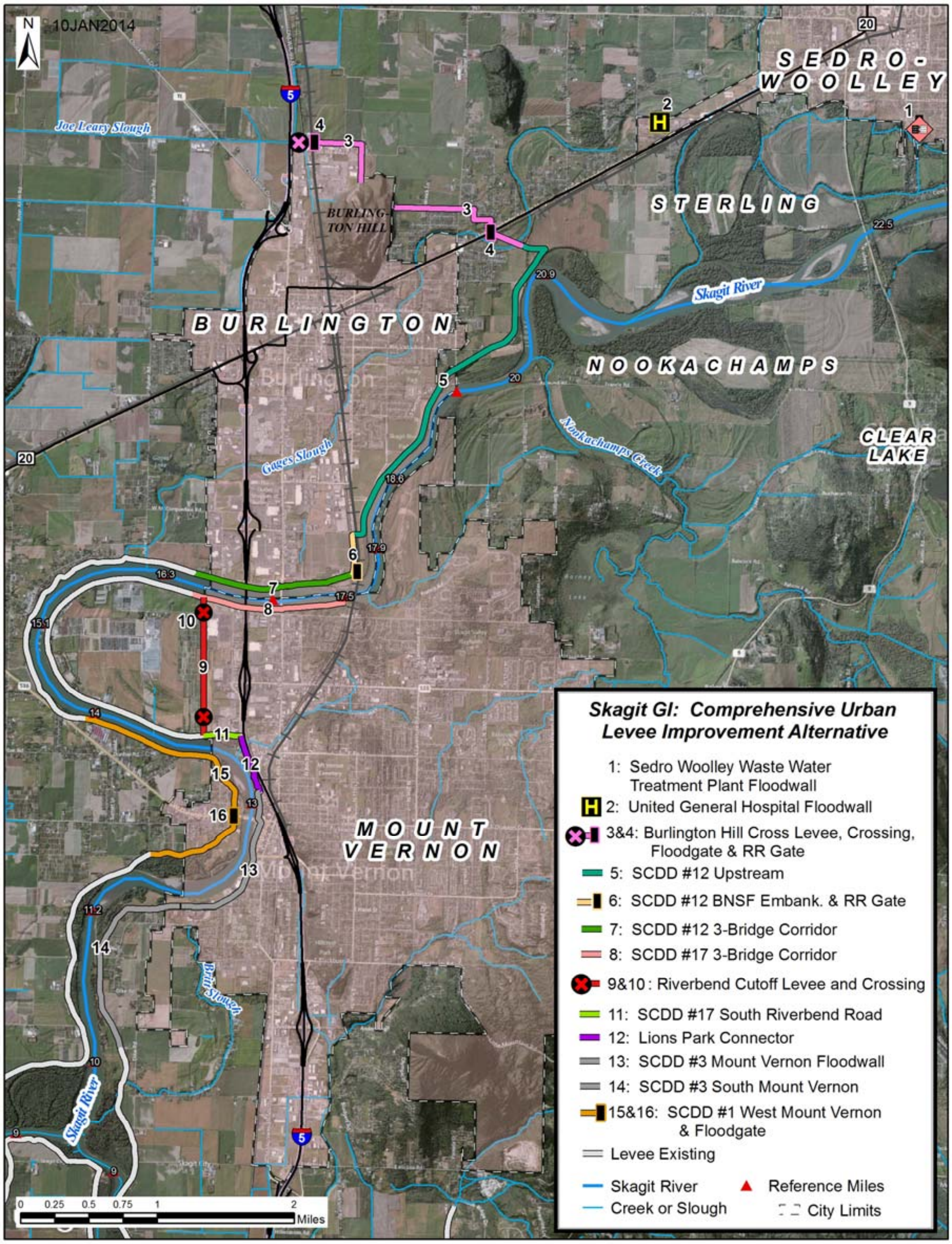

Figure 3-12. Comprehensive Urban Levee Improvement Alternative

3.8.2.3 CULI Feature Descriptions

The CULI Alternative contains the features listed below. For more detail, please see Appendix A (Plan Formulation).

Structural Components

- Burlington Hill Cross Levee: A new levee would be constructed along the northern and eastern edges of Burlington to prevent floodwaters from Sterling (RM 21.6) from entering the Burlington urban area. This new levee would be in two segments; one starting at the upstream terminus of Skagit County Diking District (SCDD) #12 (RM 20.9) and running mostly to the west, away from the river, and tying into the eastern side of Burlington Hill. One additional levee segment would then extend from the north end of Burlington Hill, then run west to I-5, and terminate at Hwy 99. The following elements would be required as part of the Burlington Hill Cross Levee:
    - Gages Slough Culvert: A culvert structure would need to be constructed to accommodate daily flows into and out of Gages Slough but to restrict floodwaters from flowing into the Burlington area.
    - Burlington Hill Floodgate: A mechanical floodgate would be constructed in the Burlington Hill Cross Levee to provide throughway for SR20 and the BNSF railroad (near RM 21).
- Riverbend Cutoff Levee: This levee would bisect the Riverbend area in a north-south direction along the urban growth boundary/city limits boundary and would prevent Riverbend floodwaters from flowing east into Mount Vernon's west side. The existing levees in the Riverbend area would not be raised, therefore allowing some floodwaters to fill the Riverbend area before reaching the new cutoff levee.
    - Lions Park Connector (Floodwall): This new structure would connect SCDD #17 South Riverbend Road to SCDD #3 Mount Vernon Floodwall.
    - SCDD #17 South Riverbend Road: Construction of the Lion's Park Connector would require rising of the existing levee system between the new Riverbend Cutoff Levee and the new Lion's Park Connector (RM 13.6 to 13.3).
- Raise Existing Urban Levees: The CULI Alternative would require that sections of existing urban levees be raised to provide increased flood risk management. In regard to levee reliability, all raising of urban levees and improvements to existing levees would need to address existing levee reliability issues. Levees that would be raised include:
    - SCDD #12 Upstream: the existing right bank levee system from RM 18.0 to the start of the new Burlington Hill Cross Levee system (RM 20.9).
    - SCDD #12 BNSF Embankment: the right bank levee system along the BNSF embankment (RM 18.0 to 17.5).

- SCDD #12 Three-Bridge Corridor: the existing right bank levee system between RM 17.5 and 16.5.
- SCDD #17 Three-Bridge Corridor: the existing left bank levee system between RM 17.5 and 16.5.
- SCDD #1 West Mount Vernon: the existing right bank levee system between RM 14.0 to 11.7.
- SCDD #3 South Mount Vernon: the existing left bank levee system downstream of the Mount Vernon Waste Water Treatment Plant (MVWWTP) (RM 11.7 to 10.6).

- Improve Bank Protection: Bank protection is necessary to protect the levees from erosion. A critical component of that is toe protection to prevent undercutting that otherwise occurs in levees. Toe protection would be installed along 2.7 miles of the right bank and 1 mile of the left bank between RM 16.5 and 20.9, and along 1 mile of the left bank between RM 12 and 13. Note that this protection should be applied to all three alternatives and is not exclusive to the CULI Alternative. Note that various reaches of the existing urban levees would need additional toe protection. The study team will continue to evaluate the need for toe protection during the feasibility-level design phase of the study to minimize the extent necessary to reduce impacts to the environment.
- Improve Rural Levees: The CULI Alternative requires improvements of rural levees on both sides of the Skagit River starting from the southern end of Mount Vernon (RM 11.7 on the left bank and RM 10.6 on the right bank) as well as along both banks of the North Fork and South Fork to Skagit Bay. The typical levee profile would remain unchanged riverward of the crown; levee improvements would be completed on the landward side of the levees. Improving rural levees would predominantly consist of raising irregular low spots in the system, as well as addressing levee reliability issues. Irregular low spots would be raised to be consistent with the adjacent levees and to build out the landward slope at the existing grade or gentler. The two main reliability concerns are the potential for under-seepage and the landside slope stability.
- Baker Dam Operations: Dam operational modifications of the Upper and Lower Baker Dam per Article 107a and b (FERC 2008). Article 107a refers to the operation of the Baker Lake reservoir to provide flood storage by October 15 (with same volume of storage to the existing condition). Article 107b refers to the operation of the Lower Baker reservoir to provide flood storage from October 1 to March 1.
- Major Road Crossings: Several roads may need to be shifted or relocated due to expanded levee profiles where levees are raised or improved. A permanent mechanical floodgate that can be opened and closed would be installed for closure of Division Street in West Mount Vernon (RM 12.9). No new crossing would be needed for I-5.
- BNSF Railroad Crossing: The CULI Alternative requires construction of railroad crossings at Burlington Hill Cross Levee and SCDD #12 Levee.

- Utilities: Major gas, electrical transmission, and water lines lie outside the project footprint. It is expected that relocation of minor utilities that cross the footprint will be required as it typically is for large construction projects.
- Real Estate: Preliminary real estate evaluations estimate that approximately 142 acres would be impacted at a cost of approximately $28 million, including utility relocations and all contingencies. Note that this cost does not include the real estate associated with the ring dikes for the WWTP and Hospital in Sedro Woolley; those costs will be determined during the next phase of design.
- General Operation and Maintenance (O&M): O&M of the levees would be unchanged from current activities including regular mowing (2-3 times annually), regular vegetation maintenance, replacement of displaced riprap, replacement of gravel and regarding (observation/inspection) of the driving surface (as required), video-inspection of culverts every 5 years, continual maintenance of an active animal control program, and additional tasks as required.
- Non-Structural Components: A combination of the following non-structural components would be implemented:
  - Ring dikes would be constructed around the Sedro-Woolley Wastewater Treatment Plant and the United General Hospital.
  - Debris Management for River Bridges: Debris buildup against the bridge piers would have to be managed during floods. Implementation of a final design would require continuation of existing debris management.
  - Education and outreach, evacuation routes, outlet structures in sea dikes, installation of additional gages, flood warning systems, real estate acquisition, relocation of structures, elevation of structures, and flood-proofing of buildings.

3.8.3 Joe Leary Slough (JLS) Bypass Wide Confined Channel Alternative

3.8.3.1 JLS Bypass Overview

The Joe Leary Slough Bypass Wide Confined Channel would divert floodwater from upstream of the urban damage-reaches from the Skagit River to Padilla Bay through a confined bypass channel approximately 2,000 feet wide (Figure 3-13). The design goal of the JLS Bypass Alternative is to lower the 1% ACE floodwater elevations in the urban areas and provide 4-5 % ACE protection (existing level) in rural areas. The JLS Bypass Alternative would lower flood risks to an acceptable level without major modifications to the urban levees. The confined bypass would only be used during flood events, and would have a 4% chance of being used in any given year. Some minor levee reliability improvements in the urban areas and the completed Mount Vernon floodwall and levee were assumed to be part of the existing condition for this alternative. This alternative does not include structural modification to bridges over the river or setback of existing levees. The current pattern of flooding at Nookachamps would continue under this alternative and flooding may occur in the Riverbend Area; however, floodwaters would be prevented from flowing from Riverbend into the urban areas of Mount Vernon by the Riverbend

Cutoff Levee. The JLS Bypass Alternative is comprised of several separate structural elements that are described below.

3.8.3.2 JLS Bypass With-Project Condition

The JLS Bypass Alternative would reduce 1% ACE flood elevations by about 3 feet in the Sterling/Nookachamps area and the new levee along Highway 20 would reduce the risk of flooding in the northern portion of the floodplain. Downstream, the flood risk in the Riverbend area would require a cutoff levee to reduce the flood risk to the adjacent Mount Vernon urban area. The discharge reductions, via the bypass, for the 1% ACE and larger floods would reduce the flood risks in the western, southern, and Fir Island portions of the floodplain.

3.8.3.3 JLS Bypass Description

The JLS Bypass Alternative would comprise several separate structural features that are described below. For more detail, please see Appendix A (Plan Formulation).

- Joe Leary Slough Bypass: The JLS Bypass would be a confined channel approximately 2,000 feet wide and approximately 9 miles long that would extend from an intake structure on the Skagit River to Padilla Bay, following the historic path of the Joe Leary Slough. New levees would be constructed on both sides of the bypass to form a confined channel. The average levee heights would be 10-17 feet. No excavation would be expected within the channel except near the intake and outlet structures. Other bypass design features include:
    - Intake/Outlet Structures: The intake structure consisting of a series of gates would be placed at the entrance of the bypass channel on the River. One or more mechanical gates would be placed at the intake to regulate the initial release of floodwater flows from the river into the bypass channel. Some excavation would occur for construction of the intake and outlet structures. Excavation is required near the intake because there is high ground at the JLS bypass entrance that needs to be removed from the bypass channel to provide adequate discharge capacity.
    - A fish screen was considered, at the intake, to prevent fish from entering the bypass. To meet National Marine Fisheries Service fish screen criteria for the 75,000-cfs design flow, the screen would have had to be approximately 3 miles long and been able to handle a large amount of floating debris. A screen of this size and complexity is considered infeasible and is not included in the final conceptual design of the bypass alternative. See section 4 for more details.
    - For the outlet at Padilla Bay, the sea dikes would be modified to allow overtopping flow to discharge most of the floodwaters. New larger tide gates would be required to drain ponded floodwaters after the flood has receded.
    - Intake Embankment: An additional levee would be constructed along the southern edge of Sedro Woolley and SR20 to accommodate the bypass intake structure.

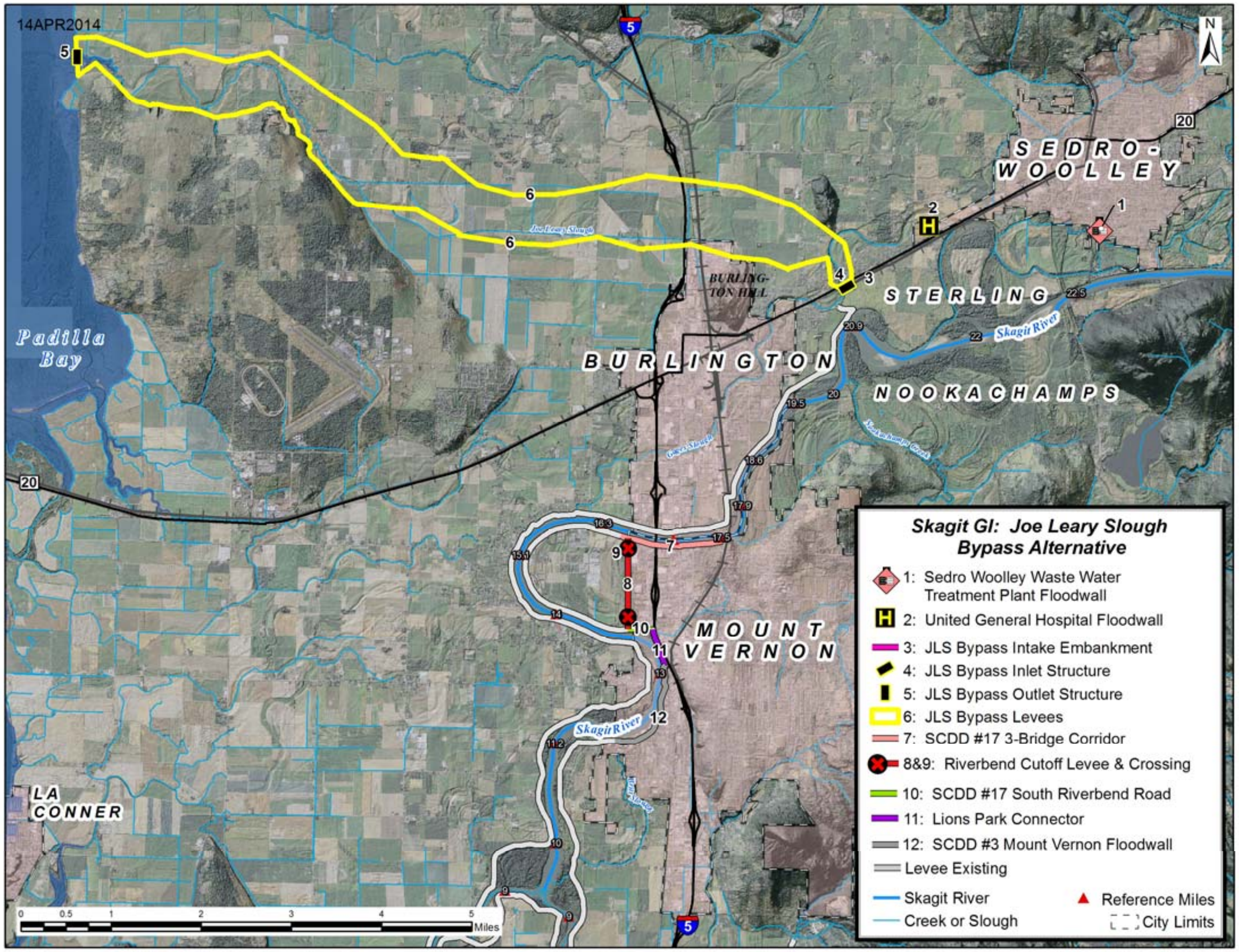

Figure 3-13. Joe Leary Slough Bypass Wide Confined Channel Alternative

  - Stilling basin and channel protection: A stilling basin and erosion protection would be required immediately downstream of spillway at bypass channel entrance.
  - Drainage during flood and after flood: Drainage will be provided for properties that lie within the bypass channel and Nookachamps.
- New Levees
  - Riverbend Cutoff Levee: The same as in the CULI Alternative (section 3.8.2.3).
  - Lions Park Connector: The same as in the CULI Alternative (section 3.8.2.3).
- The following existing urban levees would be raised :
  - SCDD #17 Three-Bridge Corridor: The same as in the CULI Alternative (section 3.8.2.3)
  - SCDD #17 South Riverbend Road: The same as in the CULI Alternative (section 3.8.2.3).
- Improve bank protection and toe protection for levees: The same as in the CULI Alternative (section 3.8.2.3).
- Interstate 5 Highway Crossing: The JLS bypass channel will cross I-5. Types of highway crossing needed will be determined if this alternative is selected as the TSP.
- Railroad Crossing: The same as in the CULI Alternative (section 3.8.2.3).
- Major Road Crossing: The JLS Bypass crosses several roads and will have significant impacts to the road infrastructure. The JLS bypass channel will cross SR 20, Old Hwy 99 North Road, Chuckanut Drive (SR 9), Farm to Market Road, Bayview Edison Road. It is likely that Hwy 99 would need to be closed during flood event or raised.
- Utilities: JLS bypass channel will cross several utilities natural gas and major petroleum pipelines.
- Real Estate: 1,285 acres and $28,230,374.00(results of RE analyses for the ring dikes and levee improvements associated with this alternative still need to be added to the total)
- General O&M: The same as in the CULI Alternative (section 3.8.2.3).
- Non-Structural: The same as in the CULI Alternative (section 3.8.2.3).

3.8.4 Swinomish Bypass Wide Confined Channel

The Swinomish Bypass would divert floodwaters from the Skagit River to the Swinomish Channel and out to Skagit Bay, through a confined bypass channel approximately 2,000 feet wide. The design goal was to lower the 1% ACE flood elevations in the urban areas on the existing levees and provide 4-5% ACE to rural areas. The Swinomish Bypass would not be able to lower flood elevations upstream of the BNSF Bridge enough to meet the 1% ACE goal in urban areas. Therefore, levee improvements between RM 17.5 and 20.9, construction of a new Burlington Hill Cross Levee, and some minor levee reliability improvements in the urban areas would also be necessary. The confined bypass would only be used during flood events; it would have a 4% chance of being used in any given year. This alternative does not include structural modifications of river bridges or setting back of levees.

3.8.4.1 Swinomish With-Project condition

The Swinomish Bypass Wide Confined Channel would lower the 1% ACE flood elevations upstream from the BNSF Bridge at RM 17.5 by about 1.25 feet. The water surface flood elevation reduction tapers down to only 0.25 foot by RM 21. As a result, the flood elevations in the Nookachamps Basin and the flood discharges to the northern floodplain would both be reduced slightly compared to the No Action Alternative. Downstream of the Swinomish Bypass, discharges would be reduced for all floods larger than 150,000 cfs (approximately 4% ACE). Flood risks in the rural western, southern, and Fir Island portions of the floodplains would be slightly reduced due to these discharge reductions.

3.8.4.2 Swinomish Bypass Detailed Description

The Swinomish Bypass Alternative (Figure 3-14) would comprise several separate structural features that are described below. For more detail, please see Appendix A (Plan Formulation).

- Channel and Associated Levees: The Swinomish Bypass Channel would be an approximately 2,000 ft wide, 7 mile long channel that would extend from the intake structure on the River to the Swinomish Channel (14 miles for both sides). The bypass would have about a 4% chance of being used in any given year. New levees would be constructed to form the bypass channel from the River to Swinomish Channel. The average levee heights would be 10-18 feet. Other bypass design features include:
- Intake And Outlet Structures: The intake structure would consist of series of mechanical and fuse-plug gates. One or more mechanical gates would be placed at the intake to regulate the initial release of floodwater flows into the bypass channel. Construction of these gates would likely require restructuring of the existing levee on the Skagit River. No excavation is expected within the channel or at the intake and outlet structures since the Swinomish Bypass Intake does not have the high ground at the intake unlike the Joe Leary Bypass. Therefore excavation is not needed.
    - Fish screen: The same as in the JLS Bypass Alternative (section 3.8.3).
    - It is assumed the area between the outlet structure and the Swinomish Channel has been restored via another project separate from the Skagit GI and is in tidal influence. The existing sea dike along Swinomish Channel would be removed via this separate project.
    - Stilling basin and channel protection: The same as in the JLS Bypass Alternative (section 3.8.3).
    - Drainage Within The Bypass Channel: (during flood/post flood): The same as in the JLS Bypass Alternative (section 3.8.3).
- New Levees: This alternative would require construction of several new levees.
    - Burlington Hill Cross Levee The same as in the CULI Alternative (section 3.8.2).

  - Riverbend Cutoff Levee: The same as in the CULI Alternative (section 3.8.2).
  - Lions Park Connector: The same as in the CULI Alternative (section 3.8.2).
- Raise Urban Levee: This alternative would require raising of several new levees.
  - SCDD #12 Upstream: The same as in the CULI Alternative (section 3.8.2).
  - SCDD #12 BNSF Embankment: The same as in the CULI Alternative (section 3.8.2).
  - SCDD #17 Three-Bridge Corridor: The same as in the CULI Alternative (section 3.8.2).
  - SCDD #17 South Riverbend Road: The same as in the CULI Alternative (section 3.8.2).
  - Improve Bank Protection: The same as in the CULI Alternative (section 3.8.2).
- Major Road Crossing: The Swinomish bypass channel would cross Avon Allen Road, Hwy 536, Best Road, and La Conner Whitney Road.
- Utilities: Swinomish bypass channel would cross several utilities.
- Real Estate 1,027 acres and $16,594,587.00 (results of Real Estate analyses for the ring dikes and levee improvements associated with this alternative still need to be added to the total).
- General O&M: See above description.
- Non-Structural: See above description.

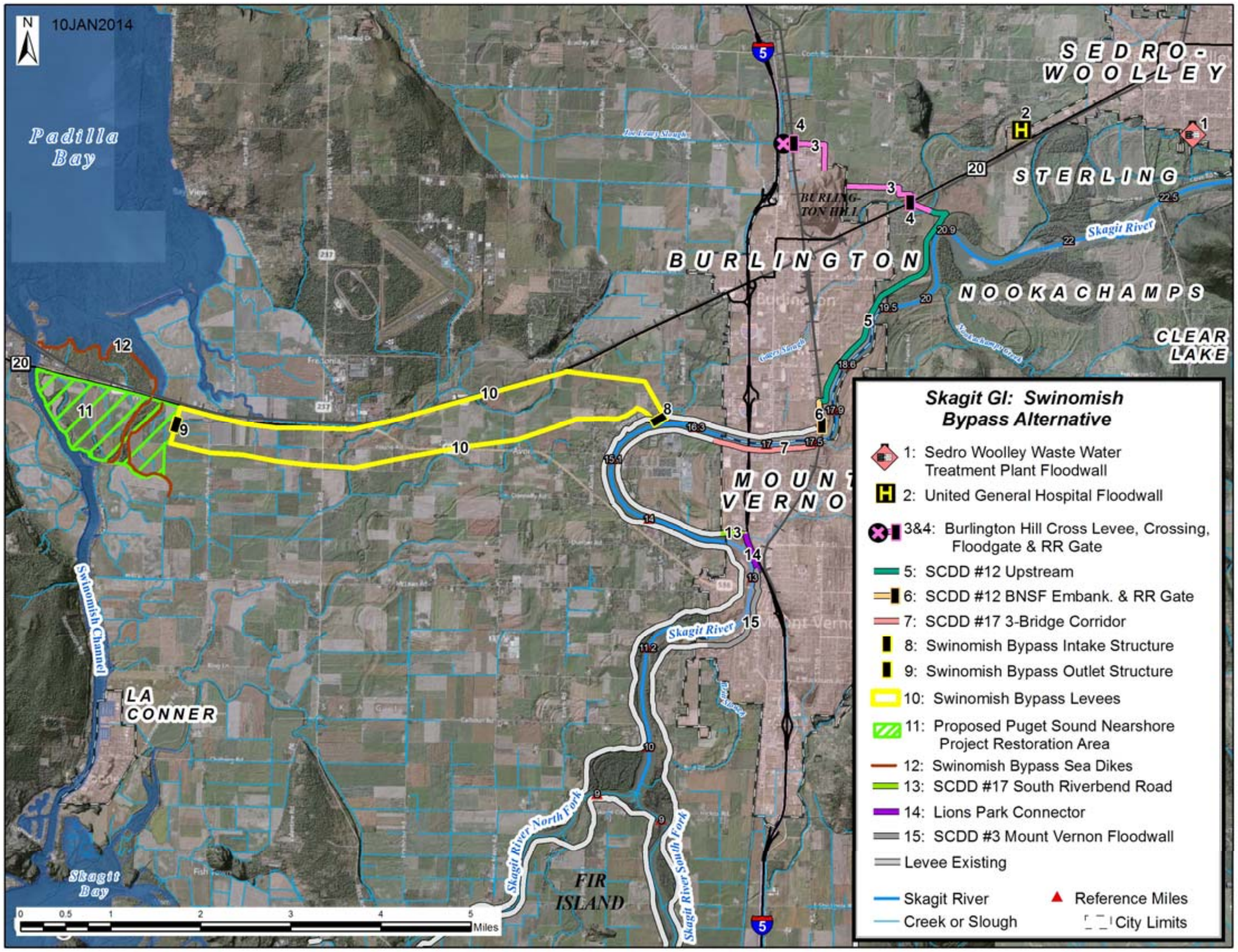

Figure 3-14. Swinomish Bypass Wide Confined Channel Alternative

3.8.5 Evaluation and Comparison of the Final Array of Alternatives

The conceptual designs of the alternatives in the final array were evaluated and compared to determine the alternative that best addresses the study objectives with the least resource impacts in the most cost effective manner, using the comparison criteria listed below.

- Which alternative best reduces flood risk to urban areas?
- Which alternative has most benefit to life safety in urban areas?
- Which alternative cost the least to construct (for preliminary evaluation/comparison purposes, which alternative utilizes the least amount of resources to construct).
- Which alternative provides the best incremental and incidental benefits to rural areas
- Which alternative has the least real estate impacts?
- Which alternative has the least potential infrastructure impacts?
- Which alternative has least adverse impacts to agricultural resources?
- Which alternative has least adverse impacts to environmental resources?
- Which alternative is most likely to be supported by the sponsor and the public?

3.8.5.1 Assumptions for Evaluation and Comparison of the Final Array of Alternatives

The following assumptions were developed as part of the risk-informed USACE SMART Planning decision-making process described in Section 1.10 above. These assumptions were coordinated with the Vertical Team, documented in the study Risk Register and were used in the evaluation and comparison of the final array of alternatives.

- Assumptions: Generally levees and ramps that do not require human intervention during a flood event are preferred over are preferred over floodwalls and closure structures that do. However, in confined areas and where the height of the structures is relatively low, a structure may be more desirable and cost effective.
- Only conceptual-level designs and preliminary estimates of quantities were used. Therefore, instead of preparing quantified cost estimates to determine which alternative cost more, the following assumptions were used to assess relative project costs.
    - Only major components of major/distinct features (levee length, levee quantities, and gates) of each alternative could be evaluated and compared to qualitatively assess preliminary construction costs.
    - Assumed that more land impacted by construction of the alternative or associated construction activities or greater number of structures associated with the alternative (such as intake gates) would result in increased environmental mitigation costs.
    - Assumed that large intake and outlet structures, necessary components of the two bypass alternatives, are technically complicated to design (increasing PED costs), expensive to construct, and difficult to operate and maintain.
    - Assumed that improving or raising a levee would not require complete reconstruction of the levee. In general all of the existing levees are stable, with the exception of a few

hundred feet along the BNSF Embankment levee, which has a riverward slope of 1H:1V and a 0.9 Factor of Safety against static slope stability. Reliability concerns will be further addressed when the TSP is refined. Select areas of levee could be completely reconstructed as needed.

- Assumed that levee modifications cost less per lineal foot than the construction of new levees such as those required in the bypass alternatives.
- Assumed that the unit cost of a feature of work would be the same regardless of the alternative it was included in. For example, excavating, hauling, and disposing of a cubic yard of soil would be roughly the same across all alternatives.
- Assumed all new levees would either require development of a new County-managed Diking District or incorporation into an existing County-managed Diking District. Assumed that setup of a new County-managed Diking District or coordination with an existing Diking District to do O&M of the bypass levees and/or any other new levees, along with increased total length/area of levees requiring O&M, would contribute to a greater project cost.
- Assumed the sponsor can purchase levee easements and flowage easements for new levees or levees outside of the existing levee footprints in a reasonable and timely manner.
- Assumed that risks and uncertainties related to construction and design would increase project costs.
- Assumed that impacting local infrastructure such as roads, utilities, oil transmission lines, and railroads would be more expensive compared to not impacting these items.
- Assumed all floodgates (closure structures) have inherent human and mechanical factors for closing the structures. They also have the factor of O&M costs.
- Assumed a closure-structure inspection program would be required to assure the structures are in good operational condition and timely repairs, if needed, are made.

3.8.5.2 Comparison of Alternatives

Table 3-8 below provides a comparative overview of all the alternatives.

Table 3-8. Comparison of Final-Array of Action Alternatives

Element	CULI	Joe Leary Bypass	Swinomish Bypass
Total # miles of new levee	Total: 2.9 1.9 (Burlington Hill Cross Levee) 1.0 (Riverbend Cutoff Levee)	Total: 20.5 1.5 (JLS Embankment) 1 (Riverbend Cutoff Levee) 18 (Bypass, including both sides)	Total 16 2 (Burlington Hill Cross Levee) 14 (Bypass, including both sides)
Estimated area and quantity of material needed	35.2 acres (footprint)	314 acres	259 acres

Element	CULI	Joe Leary Bypass	Swinomish Bypass
for NEW levee construction	280,959 CY levee embankment material 3,423 CY crushed gravel	3,267,516 CY levee embankment material 23,596 CY crushed gravel	2,973,799 CY levee embankment material 18,672 CY crushed gravel
Total # miles of RAISED levee	9.2	3 (approx.)	5 (approx.)
Estimated area and quantity of material needed to RAISE levees	75 acres (footprint only) 480,824 CY levee embankment material 15,619 CY crushed gravel	25 acres (approx.) 215,181 CY levee embankment material (approx.) 5,206 CY crushed gravel (approx.)	28 acres (approx.) 286,000 CY levee embankment material (approx.) 7,222 CY crushed gravel (approx.)
Placement of riprap	All alternatives would require placement of approx 170,000 CY of riprap between RMs 16.5 and 20.9, toe protection would be placed along 2.7 miles on the right bank and 1 mile on the left bank. It would also be placed along one mile on the left bank between RM 12 and 13.		

Note that the quantities, areas, and levee lengths shown in Table 3-8 for the CULI Alternative were derived from a more refined CULI Alternative design. All of the alternatives in the final array were initially developed to an equal conceptual level of design; however, as the alternatives were evaluated and compared it became apparent that the CULI Alternative was the most cost effective alternative. Therefore, the CULI Alternative was further refined. Due to the large magnitudes of difference between the quantities required for the CULI Alternative and either of the bypass alternatives, the selection of the CULI Alternative as the TSP would not be impacted by further refinement of the bypass designs.

Table 3-9 and Table 3-10 provide comparison of the three action alternatives, based on required construction and evaluation against criteria, respectively.

Table 3-9. Comparison of New Levees, Urban Levee Improvements, and Associated Construction Required for Each Action Alternative

New Levee and Urban Levee Improvements	CULI	Joe Leary Slough Bypass	Swinomish Bypass
Sedro Woolley WWTP ring dikes	X	X	X
United General Hospital ring dikes	X	X	X
Burlington Hill Cross Levee	X		X
Burlington Hill Floodgate	X		X
SCDD #12 Upstream	X		X
SCDD #12 BNSF Embankment	X		X
SCDD #12 Three-bridge corridor	X		
SCDD #17 Three-bridge corridor	X	X	X
Riverbend Cutoff Levee	X	X	X
SCDD #17 South Riverbend Road	X	X	X
Lions Park Connector	X	X	X
SCDD #3 Mt. Vernon floodwall	X	X	X
SCDD #3 South Mt. Vernon	X		

New Levee and Urban Levee Improvements	**CULI**	**Joe Leary Slough Bypass**	**Swinomish Bypass**
SCDD #1 West Mt. Vernon levee	X		
SCDD #1 West Mt. Vernon floodgate	X		
Intake Structure		X	X
Outlet Structure		X	X
Bypass Levees		X	X
JLS Bypass Intake Embankment		X	
Gages Slough Culvert	X		
Placement of riprap	All alternatives would require placement of approx 170,000 cy of riprap between RM 16.5 and 20.9, toe protection placement along 2.7 miles on the right bank and 1 mile on the left bank, and along 1 mile, on the left bank, between RM 12 and 13.		

Table 3-10. Evaluation and Screening of Alternatives Based on Criteria

Comparison Criterion	**"Best" Alternative**	**Summary of Evaluation and Comparison of the Final Array of Alternatives**
Which alternative best reduces flood risk in urban areas?	All three alternatives provide equal level of flood risk reduction in urban areas.	• Flooding would continue to be an issue at Sterling, Nookachamps, and the Riverbend area for all three alternatives. • The bypass alternatives would provide some incremental flood risk management benefits to agricultural lands, La Conner and Fir Island.
Which alternative has most benefit to life safety in urban areas?	All three alternatives provide equal level of life safety risk reduction in urban areas.	• Flooding would continue to be an issue at Sterling, Nookachamps, and the Riverbend area for all three alternatives. • The bypass alternatives would provide some incremental risk reduction to life safety in rural areas.
Which alternative costs the least to construct? (For preliminary evaluation/ comparison purposes, which alternative utilizes the least amount of resources to construct?)	The Comprehensive Urban Levee Improvement Alternative (CULI) Alternative.	• The bypass alternatives would require orders of magnitude more material to construct compared to CULI, comprise a large design footprint, potentially require more environmental mitigation, and require more real estate acquisition and/or easements. • Bypass alternatives would require large and complicated gate and/or fuse plug structure to control the flow of floodwaters moving from the Skagit River into the bypass. These gates/fuses would have large O&M costs (opening and closing the gates, repairing fuse plugs, clearing debris, periodic maintenance and inspections, etc.) • Bypass alternatives would require Diking Districts to take on new levees or the County would need to take ownership of the levees (they currently do not own levees) The bypass alternatives would also need O&M for channels in addition to O&M for levees. • Fish entrapment in the bypass is a concern. Initial discussions included the need for addition of a fish screen at the bypass intake; however, it was determined construction of a fish screen would be extremely difficult to implement due to the size of the bypass, the volume of the water flowing into the

Comparison Criterion	"Best" Alternative	Summary of Evaluation and Comparison of the Final Array of Alternatives
		bypass, and the high potential for debris clogging of the screen. Therefore, the project delivery team (PDT) determined that the conceptual design would not be able to incorporate a fish screen. This correlates to a much larger impact to fish species within the Skagit River.
Which alternative provides the best incremental and incidental benefits to rural areas?	None of the three alternatives provide greater incremental and or incidental benefits to rural areas.	• Bypass alternatives would have a larger impact on the quality of life in rural areas with regard to agricultural values in the basin. • Bypass alternatives would likely provide flood risk benefits to some rural lands • Bypass alternatives would protect a greater portions of the floodplain, which may induce future development • Bypass construction would require taking of land for construction of the bypasses and taking large acreage of land out of agricultural production (both from levee construction and land use restrictions placed on land within the bypass). • There are few or no options for replacement of lands or relocations of farms within the Skagit River Basin (there isn't extra farmland these farms could be moved to). • In general, a greater net loss of agricultural land will result in greater impacts to agricultural practices in the basin (the Basin needs a critical mass of farm land to support current industry including the need for critical mass of farmland for production of agricultural seed). • The CULI Alternative may provide incremental benefits to some rural areas and agricultural land, but may also induce flooding to greater portions of the floodplain or increase flood heights
Which alternative has the least real estate impacts?	The Comprehensive Urban Levee Improvements (CULI) Alternative.	• Construction of a bypass would require significantly more real estate than the CULI Alternative.
Which alternative has the least potential infrastructure impacts?	The Comprehensive Urban Levee Improvements (CULI) Alternative.	• The Joe Leary Slough Bypass Alternative crosses I-5 and BNSF corridors. • The exact number of crossings has yet to be determined, but the bypass alternatives will generally impact more roads and highways compared to the CULI Alternative. • The bypass alternatives would have adverse impacts to the existing agricultural drainage infrastructure. • The bypasses would impact more utilities, requiring modifications or replacements of those utilities.
Which alternative has least adverse impacts to agricultural resources?	The Comprehensive Urban Levee Improvements (CULI) Alternative.	• Bypass alternatives will have a larger impact on the quality of life in rural areas. • Bypass construction requires taking of land for construction of the bypasses and large acreage of land out of production (both from levee construction and land use restrictions placed on land within the bypass). • There are few or no options for replacement of lands or relocations of farms within the Skagit River Basin (there is not extra farmland where these farms could be moved to). • In general, a greater net loss of agricultural land will result in equal impacts to agricultural practices in the basin (Basin needs a critical mass of farm land to support current industry,

Comparison Criterion	"Best" Alternative	Summary of Evaluation and Comparison of the Final Array of Alternatives
		need critical mass of farmland for production of seed). • The CULI Alternative impacts the least acreage of agricultural lands.
Which alternative has least adverse impacts to environmental resources?	Comprehensive Urban Levee Improvements (CULI) Alternative.	• The CULI Alternative has the least potential acreage impacts to wetlands. • The CULI Alternative and the Bypass Alternatives have substantially different types of impacts to fish, riparian, and near shore habitats; CULI has slightly less impacts to fish and near shore habitats but not to riparian habitat. CULI has the least impacts to wetlands and agricultural lands.
Which alternative is most likely to be supported by the sponsor and the public?	The Comprehensive Urban Levee Improvements (CULI) Alternative.	• The CULI Alternative has the lowest amount of real estate that needs to acquired for project construction. • The CULI alternative has lowest impact to agricultural lands. • Bypass Alternatives: These alternative have high amount of real estate that needs to acquired for project construction; high impact to agricultural lands; and high preliminary project cost. In addition, there is no existing mechanism for O&M of new levees needed by bypass construction.

3.9 TSP Recommendation

The CULI Alternative best addresses the study objectives and is the recommended TSP. As noted in the alternatives descriptions, the design goal of all the alternatives is to lower the 1% ACE flood elevations in the urban areas and provide 4-5 % ACE protection (existing level) to rural areas. The Joe Leary Slough Alternative and Swinomish Bypass Alternative would provide increased flood protection in rural areas. These alternatives would require specialized outflow structures to divert flood flow that exceeds the river's capacity in less-frequent floods. Existing development in the bypasses would likely need to be removed and/or flood-proofed as depths and velocities within the bypass channels would be greater than in the without-project condition. The CULI Alternative is the alternative that is the most cost effective, has the least real estate impacts, has the least potential infrastructure impacts, has the least adverse impacts to environmental resources, would require less agricultural land for the project footprint, and is the most likely to be supported by the sponsor and the public. Evaluation and comparison of the final array of alternatives indicates that the two bypass alternatives would likely have considerably higher construction and real estate costs than the CULI Alternative.

The floodplain depicted in Figure 3-15 is an approximate composite of the flooding that could occur from individual levee failures into each of the different portions of the floodplain if the CULI Alternative (1% ACE in defined urban areas) were to be implemented. Note that this degree of flooding is unlikely to occur during any single flood because a levee failure at one location may lower water surface elevations upstream and downstream, thus reducing risk of additional levee failures. This method of floodplain mapping has been chosen because it is not possible to reliably predict where a levee failure may occur during any individual flood. The TSP would reduce flood elevations in urban damage-reaches 1A, 4A, and 5A, and in rural damage-reaches 2 and 4. There would be induced flooding in rural areas 1, 6, and 6A (Figure 3-15, right).

As shown in the existing without-project condition, Reach 1 (Figure 3-15, left), which is the portion of the Skagit River floodplain north of SR 20, accounts for almost half (46%) of the potential damages. In the feasibility-level design phase, the study will evaluate the potential for structural options such as low levees within the floodplain and improvements to gates at the sea dikes, which could reduce some of these damages, based on further analysis to be completed during the feasibility-level design analysis portion of the study. There may be some opportunities to look at the possibilities for flood risk reduction in the communities of Allen, Edison, and Bow in greater detail. Significant structural measures would be needed to provide flood risk management to the entire floodplain. In order to reduce flooding in rural areas, river capacity would need to be significantly increased or bypasses constructed to handle the flow which exceeds the existing river capacity. This would be very expensive and could require improvements to all levees and possibly some bridge modifications to increase capacity. However, the rural floodplain in the northern Skagit River floodplain should be re-examined during design, as there may be some cost effective measures that could be implemented.

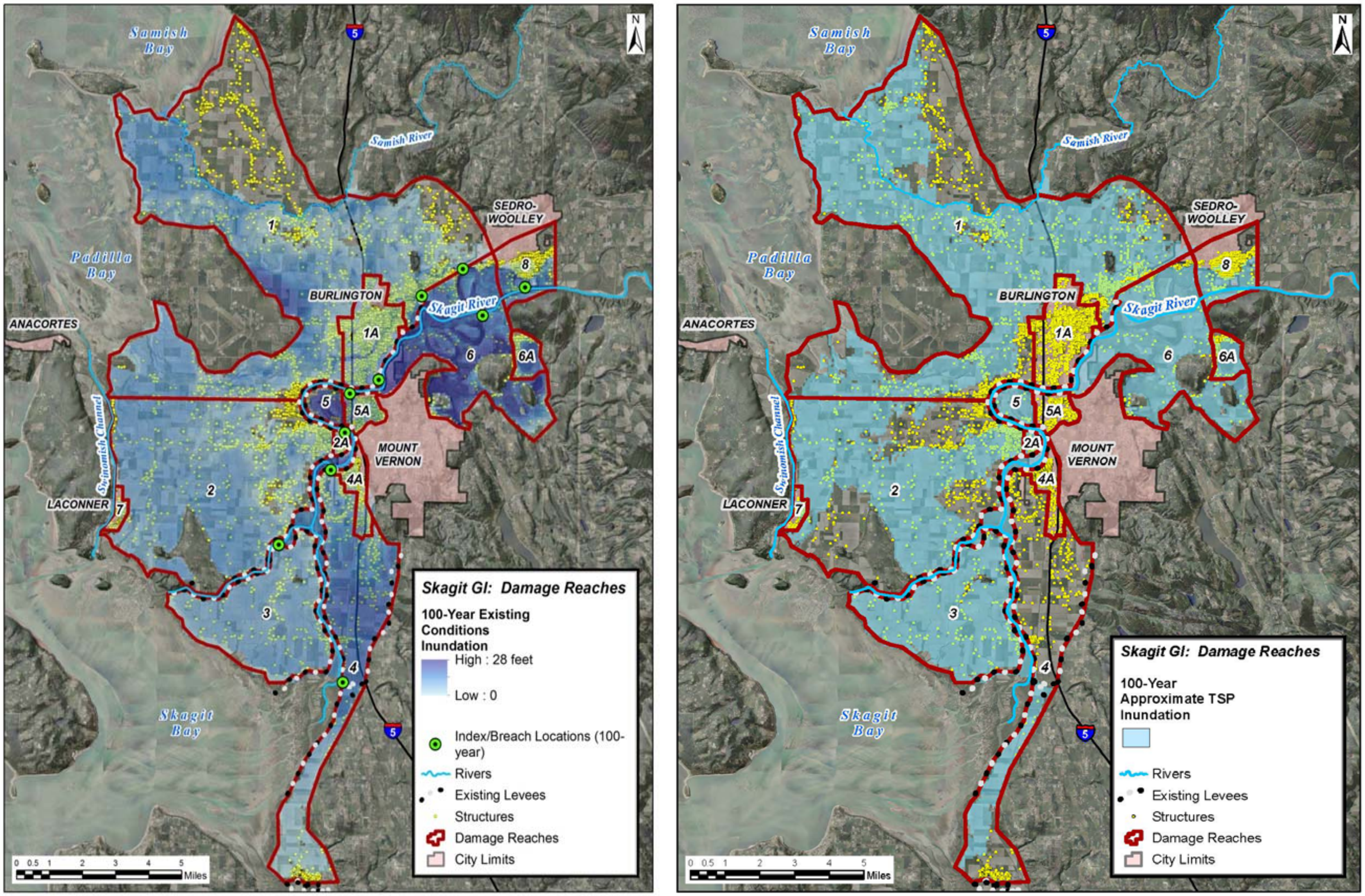

Figure 3-15. Comparison of Inundation for a 1% ACE Flood Inundation Under the Existing Condition (left) and Under the Recommended TSP (right)

4. Affected Environment and Environmental Consequences for the Alternatives

The final four alternatives were evaluated as required for the feasibility study, consistent with the USACE Planning process and as required by NEPA. These are the alternatives formulated and screened to become the final array of alternatives. As described earlier, this document is an integrated draft feasibility report and EIS. The final array of alternatives, and the plan formulation process to produce those alternatives, are detailed in Section 3 (Plan Formulation) with supplemental plan formulation information provided in Appendix A (Plan Formulation). Section 4 describes the existing condition (affected environment) and the future without-project condition used in analyses that support the Skagit River flood risk management feasibility study. Section 4 provides thorough descriptions of the physical, chemical, biological, and sociological resources in the existing condition and in the future without-project condition, all of which were considered when evaluating the final array of alternatives.

There is overlapping terminology between USACE plan formulation requirements (reflected in the feasibility study portion of this report) and NEPA-specified documentation. Equivalent terms are shown in Table 4-1.

Table 4-1. Equivalent Terms in USACE planning and NEPA requirements

USACE Planning Term	NEPA Term
Future without-project condition	No Action Alternative
Tentatively Selected Plan (TSP)	Preferred Alternative
Final Array of Alternatives	Considered Alternatives, Action Alternatives
Existing Condition	Affected Environment

This section also provides information relevant to the decision process for selecting the preferred alternative. The analysis investigates the potential for activities associated with the considered alternatives to affect the various issues of concern and provides a comparative assessment of each alternative's expected effect on the environment. The assessment of environmental effects is based on a comparison of conditions with and without implementation of the proposed plan and related alternatives; in this case, the three action alternatives that were brought forward from the formulation and screening process are compared to the No-Action Alternative. Direct and indirect effects are evaluated for each alternative including the No-Action Alternative. Effects can be short-term or long-term, and beneficial or adverse. Cumulative effects are discussed separately from direct and indirect effects. Climate change is considered along with cumulative effects. The analysis focuses on significant resources, which are those that are likely to have a material bearing on the decision-making process. The time scale for analysis is a 50-year period beginning in 2020 and extending to 2070.

A 45 day public comment period will be provided for the draft FR/EIS, expected to begin in June 2014 and ending in July 2014, concurrent with required technical, peer, and policy reviews. The purpose of these reviews is to seek feedback on the TSP that will inform additional feasibility-level design and analysis that will be conducted to finalize the engineering, cost estimating, environmental, economic, and real estate elements of the plan. Results of the reviews and additional feasibility-level design and analysis will be incorporated into the final FR/EIS.

4.1 Resources Screened Out from Further Analysis

Table 4-2 describes the resources screened out from further analysis including the rationale for their exclusion.

Table 4-2. Resources Screened Out from Environmental Consequences Evaluation

Resource	Rationale for exclusion
Groundwater	Minor, infrequent changes in flood hydrology are not expected to impact groundwater.
Aesthetics	None of the proposed alternatives will affect scenic resources or visual characteristics of the study area.
Recreation Resources	Significant recreation activities (boating, camping, bicycling, hunting, etc.) occur outside the study area in the upper watershed. Fishing occurs in the study area, but the proposed alternatives would not have more than a short term negligible effect on this activity.

4.2 Summary of Environmental Consequences

Table 4-3 summarizes the expected effects on resources analyzed for each of the action alternatives. The remainder of this section discusses the evaluations that resulted in these expectations.

Table 4-3. Summary of Environmental Consequences for the Alternative Actions

Resource & Section of This Report	Comprehensive Urban Levee Improvement (CULI) Alternative	Joe Leary Slough (JLS) Bypass Alternative	Swinomish Bypass Alternative
4.5 Hydrology and Hydraulics	An increase in water surface elevations; increase overbank discharges at Sterling; no effects from sea level change; under climate change scenarios, probability of the current 1% ACE discharge could be increased to 4% ACE; no cumulative impacts	Reduces maximum flood elevations; same effects as CULI Alternative for sea level change, climate change, and cumulative impacts	Reduces maximum flood elevations; increased downstream discharges for 4% ACE; same effects as CULI Alternative for sea level change, climate change, and cumulative impacts
4.6 Geomorphology and Sediment Transport	Slight reduction in sediment transport potential; slight increase in sedimentation due to reduced transport potential; no cumulative impacts	Slight change in long term sediment deposition no cumulative impacts	Same as JLS Bypass Alternative
4.7 Air Quality and Greenhouse Gases	Localized, short term increases in greenhouse gases and pollutants related to construction activities; cumulative impacts same as No Action Alternative (increase in air pollution as urbanization increases)	Substantially greater construction related emissions than CULI Alternative (greater number vehicles and equipment used than CULI Alternative); same cumulative impacts as the No Action Alternative	Same as JLS Bypass Alternative
4.8 Noise	Localized, temporary increases related to	Same as CULI Alternative	Same as CULI Alternative

Resource & Section of This Report	Comprehensive Urban Levee Improvement (CULI) Alternative	Joe Leary Slough (JLS) Bypass Alternative	Swinomish Bypass Alternative
	construction activities; same cumulative impacts as No Action Alternative (increase in noise pollution as urbanization increases)		
4.9 Soil Resources	Minimal soil impacts; cumulative impacts same as No Action Alternative (soils affected by urbanization increases)	Potential impacts to soil erosion and movement; cumulative impacts same as No Action Alternative	Same as JLS Bypass Alternative
4.10 Water Quality and Quantity	Minimal impacts (short term and localized) to water quality and no impacts to water rights (no water diversion); same cumulative impacts as No Action Alternative (water quality decreases as urbanization increases)	Minimal impacts from agricultural runoff; an increase of turbidity from soil erosion; no impact to water rights (only activated during flood events); same cumulative impacts as No Action Alternative	Same as JLS Bypass Alternative
4.11 Wetlands Habitat	Minimal impacts (approx 3 acres); limited increase in project footprint; same cumulative impacts as No Action Alternative (decrease in wetlands as urbanization increases)	Substantial impacts (57 acres); large increase in project footprint; same cumulative impacts as No Action Alternative	Considerable impacts (141 acres); large increase in project footprint; same cumulative as No Action Alternative
4.12 Riparian Habitat	Substantial impacts due to proposed toe protection; cumulative impacts contribute to overall loss of riparian habitat	Same as CULI Alternative	Same as CULI Alternative
4.13 Aquatic Habitat	Moderate impacts to off-channel habitat; minimal impacts to large woody debris (LWD); increased flow may scour downstream estuarine eelgrass beds; no cumulative impacts to LWD, tidal and distributary channels, or marine submerged vegetation; cumulative impacts to off-channel habitat	Minimal impacts to off-channel habitat and LWD recruitment; increased sediment and freshwater input may impact submerged marine vegetation and tidal channels in Padilla Bay; no cumulative impacts to LWD or off-channel habitat; cumulative impacts to tidal channels and marine submerged vegetation	Similar to JLS Bypass Alternative, with less of an impact to Padilla Bay due to buffering effect of wetland at Telegraph Slough wetland;
4.14 Wildlife and Fish	Temporary wildlife impacts related to construction; impacts to fish communities in Skagit River and Bay related to changes to hydrology and perpetuation of poor quality habitat; cumulative impacts to wildlife same as No Action Alternative (wildlife habitat	Severe impacts to fish communities in Skagit River due to high entrainment risk in bypass channels, moderate impacts to fish communities in Padilla Bay during flood events due to changes in salinity and sediment delivery; cumulative impacts to wildlife and fish in river same as	Severe impacts to fish communities in Skagit River due to high entrainment risk in bypass channels, minimal to moderate impacts to fish communities in Padilla Bay due to buffering effect of the wetland at Telegraph Slough; cumulative impacts same as CULI Alternative

Resource & Section of This Report	Comprehensive Urban Levee Improvement (CULI) Alternative	Joe Leary Slough (JLS) Bypass Alternative	Swinomish Bypass Alternative
	decreases); cumulative impacts to invertebrates and fish	CULI Alternative; cumulative impacts to fish in Padilla Bay	
4.15 Threatened and Endangered Species	see Section 4.10 Fish and Wildlife	see Section 4.10 Fish and Wildlife	see Section 4.10 Fish and Wildlife
4.16 Cultural Resources	Impacts to four unevaluated archaeological sites, historic levees and five unevaluated historic structures; cumulative impacts will not significantly contribute loss of cultural resources	Potential impacts to archaeological sites in levee corridor, adverse impacts to WA State Register Barn, 63 historic structures in corridor; cumulative impacts same as CULI Alternative	Direct impacts to the Historic settlement of Avon, potential increased erosion of significant prehistoric sites along the Swinomish Channel; cumulative impacts same as CULI Alternative
4.17 HTRW	No impact; no cumulative impacts	Minimal potential impacts; no cumulative impacts	Minimal potential impacts; no cumulative impacts
4.18 Land Use, Planning and Zoning	Beneficial impact from removing land in urban area and a small amount of rural land from 1% ACE floodplain; however slight overflow increases to Samish, Nookachamps, and Sterling areas; cumulative impact may increase development in rural areas.	Potential impact from removing rural land from 1% ACE floodplain which could change land use patterns, land use would be restricted within bypass footprint; cumulative impact greater than CULI Alternative.	Same as the JLS Bypass Alternative
4.19 Agricultural Resources	45 acres of land impacted; increase overbank discharges at Sterling; cumulative impact would contribute to overall loss of agricultural land	314 acres of land permanently taken out of production; major impacts to farmland and agricultural resources; cumulative impact greater than CULI Alternative	260 acres of land permanently taken out of production; major impacts to farmland and agricultural resources; cumulative impact same as JLS Bypass Alternative
4.20 Socioeconomic and Environmental Justice	Beneficial impacts within the urban areas; cumulative impacts same as No Action Alternative (indirect impact could include a higher potential for temporary interruption or permanent displacement during a flood event)	Greater impact than CULI Alternative due to greater amount of agricultural land affected; cumulative impact may result in potential changes in land use, changes in agricultural related economy	Same as JLS Bypass Alternative
4.21 Transportation and Traffic	Temporary and localized impacts related to construction; during flood events; no cumulative impacts	Similar or greater impacts than CULI Alternative	Similar or greater impacts than CULI Alternative
4.22 Public Services and Utilities	Beneficial impacts within the urban areas; no change in rural areas; cumulative impacts same as No Action Alternative (increase in	Beneficial impact to urban; minimal impact in bypass; cumulative impacts same as No Action Alternative	Same as JLS Bypass Alternative

Resource & Section of This Report	Comprehensive Urban Levee Improvement (CULI) Alternative	Joe Leary Slough (JLS) Bypass Alternative	Swinomish Bypass Alternative
	services as population increases)		
4.23 Public Health and Safety	Beneficial impact in urban areas; potentially adverse impact to no access to Burlington and hospital from the east; cumulative impacts same as No Action Alternative (increase in services as population increases)	Beneficial impact in urban areas; potentially adverse impact to public with the bypass during flood event; cumulative impacts same as No Action Alternative	Same as JLS Bypass Alternative

4.3 Assumptions

The analysis of each resource is based on best available existing information, studies, and reports relevant to the project area and best professional judgment.

Estimated condition under the No Action Alternative (future without-project) and action alternatives conditions is based on extrapolation of current trends, and does not account for possible changes in policy.

Diking districts would continue to participate in the USACE Levee Rehabilitation and Inspection Program, also known as the P.L. 84-99 program. The program requires certain maintenance standards to retain eligibility within the program.

Sea level rise may further alter habitat as salt water influenced ecosystems are forced farther inland by rising seas, reducing existing freshwater habitats and further constraining already limited salmonid and wildlife habitat. The extension of salt water inland may alter existing land use patterns, in particular agriculture as less land may be suitable for farming.

With regards to the Baker Hydroelectric Project, Puget Sound Energy (PSE) will regulate the system, specifically the minimum and maximum instream flows in accordance with Aquatic Table 1 or Table 2, if Articles 107a and/or b were implemented, in the 2008 FERC license.

For purposes of comparing alternatives and developing preliminary costs, we assumed a 2 year construction period. Use of the 2 year construction period is not likely to change our selection of the CULI Alternative as the TSP as preliminary NED evaluation indicates a construction schedule of 25 to 27 months (see Section 5 for additional discussion)

4.4 Past, Present, or Reasonably Foreseeable Future Projects

This section presents a general discussion of historical development in the project area and discusses how the Skagit River watershed has been changing since European settlement began in the middle 1800s. Much of the watershed has been logged and converted to agricultural or urban development, or is maintained as managed forest. Several major dams on the Skagit River or its tributaries, including Lower Baker, Upper Baker, Diablo, and Ross Dams have modified the hydrology of the river system. The vast lowland wetlands and estuary have been diked, drained, and otherwise disconnected from the river. Levees and dikes occur along virtually all lower portions of the river, and the floodplain has been developed from urban and agricultural uses. Ongoing levee maintenance is expected to continue. Mount Vernon is in the process of constructing a floodwall adjacent to the downtown. The new permanent I-5 bridge span has been completed September 2013. A number of restoration projects, such as the Fisher Slough project, have been constructed or will be constructed. The Fisher Slough Freshwater Tidal Marsh Restoration Project has been constructed, restoring 30 acres of freshwater tidal march and improving fish passage to 15 miles stream. An ongoing initiative is the Skagit Delta Tidegates and Fish Initiative which is a collaborative, multi-stakeholder process requiring that up to 2,700 acres of delta agricultural lands may be converted to estuarine habitat. Future projects in the Basin include the City of Burlington Levee Improvement Project and potential restoration sites from the PSNERP.

A floating surface collector has been operational at Upper Baker Dam since 2009. The collector attracts and safely holds juvenile salmon for downstream transport around the two Baker Dams. A similar floating surface collector has been constructed on Lake Shannon behind Lower Baker Dam in 2013.

Long-term effects associated with constructing and repairing levee systems along the river have included loss of floodplain function; loss of riparian function, including streamside cover and nutrient input; scouring; loss of channel and stream bank complexity; lower rates of LWD recruitment; and altered patterns of substrate formation. These effects have occurred throughout the lower Skagit River, and combined with the effects of dams have resulted in a reduction of the quality and quantity of habitat for anadromous and non-anadromous fish.

4.5 Hydrology and Hydraulics

4.5.1 Affected Environment

A brief description of the Skagit River Basin is presented here and more details can be found in Section 3.1. The Skagit River drains 3,115 square miles between the crest of the Cascade Range and Puget Sound. It crosses a broad outwash plain between Sedro-Woolley and Skagit Bay, where the cities of Sedro-Woolley (RM 24), Burlington (RM 17), and Mount Vernon (RM13) are located. Downstream from Mount Vernon, the river divides into two principal distributaries, the North Fork and the South Fork. Levees line the river from near the mouths of the North and South Forks, upstream to RM 17.5 on the left bank and RM 20.9 on the right bank. The levees provide flood risk reductions for regulated floods in the range of 4-5% annual chance exceedance (ACE).

In the upper watershed, Ross Dam on the upper Skagit River provides 120,000 ac-ft of flood storage and Upper Baker Dam on the Baker River provides up to 74,000 ac-ft of flood storage. USACE, Seattle District, manages the flood regulation operations at both dams during the October through March time period. The natural and regulated flood peak discharges at Concrete are given in Table 3-1 in Section 3.1.1. The Cascade and Sauk rivers are the largest unregulated tributaries to the Skagit River. The remaining un-regulated discharges come from creeks that drain steep, heavily forested basins, directly into the Skagit River.

The four largest documented floods on the Skagit River occurred before stream gages were installed on the river. Based on the peak discharges at Concrete, the largest occurred in November 1897 and had a peak discharge of 265,000 cfs. The others, all with peak discharges over 210,000 cfs, occurred in 1909, 1917, and 1921. Between l920 and late 1950, Ross Dam on the upper Skagit River provided incidental flood regulation and the largest flood during this time was a 154,000 cfs peak at Concrete in 1949. Since 1953 Ross Dam has provided 120,000 acre-feet of flood control storage. Upper Baker Dam on the Baker River began providing 74,000 acre-feet of flood control storage in 1977. The largest flood discharges at Concrete since 1953 were a 160,000 cfs peak in 1995 and a 166,000 cfs peak in 2003. Peak discharges for selected flood events, including the currently published peak discharges for the historical floods, are listed in Appendix B (Hydraulics and Hydrology).

The majority of the flood risks, economic and life safety, on the Skagit River are in the lower basin, downstream from Sedro-Woolley. Of particular concern are the cities of Burlington and Mount Vernon, with their concentrations of population and infrastructure. Most of the river downstream of Sedro-

Woolley is lined with levees. Flooding in this area generally results from levee overtopping or failure. Once floods overtop or breach a levee, the levees prevent the floodwaters from returning to the river and flood depths could be up to 8 feet for a 1% ACE event with flood durations of 2-3 days. Floodwaters that leave the river flow across the floodplains west toward Skagit Bay or north Padilla Bay.

Flood fight efforts during past floods have helped to reduce flooding and damages in these communities. The City of Mount Vernon has plans for a new floodwall to protect the downtown area. The Mount Vernon Floodwall is partially complete, with completion planned for the near future. The floodwall will reduce the flood risks in the downtown area to less than a 1% ACE. This floodwall has been included as an existing feature in this flood study. USACE policy requires new federally authorized cost shared levee projects be designed to meet the current vegetation management standards. A Vegetation-Free Zone (VFZ) as described by Engineer Technical Letter ETL 1110-2-583, Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures, (Vegetation ETL) would be established and vegetation removed to bring the levee into Vegetation ETL compliance.

Between Sedro-Woolley and Mount Vernon, the Nookachamps Creek Basin along the left overbank of the Skagit River (RM 19-22) floods frequently and provides substantial natural flood storage. During floods greater than the 4% ACE flood, there is the potential for the Skagit River to overflow the right bank in the Sterling area (RM 21) and in Burlington near RM 18. Floodwaters from both locations can flow west through Burlington and the western floodplain to Skagit Bay. Floodwaters from Sterling can also flow north across I-5 and the BNSF railroad, and then through the rural floodplain to Padilla Bay.

The agricultural areas west of Mount Vernon have a 2-4% ACE flood risk. Fir Island experienced a levee failure in 1990. The town of La Conner is located north of the North Fork on Skagit Bay on the Swinomish Slough, a federally authorized navigation channel.

4.5.2 No Action Alternative

Hydrologic and geomorphic conditions in the upper Skagit River Basin are not expected to change significantly over the next 50 years[3]. The upper watershed is generally national park, wilderness, or forest service lands. No changes that would alter flood hydrology are expected in the park or wilderness lands. Logging on Forest Service land could increase or decrease depending on Federal policy, but either course is unlikely to have a significant impact on annual or flood hydrology.

Ross and Upper Baker dams are committed to continuing to provide the current levels of flood regulation storage. The recent Baker FERC license does provide an option for the purchase of additional flood regulation storage. This would have the potential to reduce future peak flood discharges at Concrete by up to 17,000 cfs, lowering the flood risk to downstream communities. However, local governments have not taken concrete steps to implement those provisions, so it is not considered to be part of the future without-project conditions. Therefore, future without-project flood discharges are expected to be the same as the existing values.

[3] Climate change may cause unprecedented alterations to the hydrology and hydraulics in the Skagit Basin, but the effects are uncertain, and were not included in the future without project condition. Sea level change (SLC) was evaluated based on existing Corps policies. Both climate change and sea level change are discussed in detail in Section 4.5.2.

Flood risks in the lower Skagit River, downstream of Sedro-Woolley, will change when planned improvements to the right bank levee upstream of Burlington (RM 17.5-19) are completed. Those improvements involve raising the top of levee by up to 4 ft and increasing the width of the levee. The Burlington levee improvements should reduce the risk of floodwaters overtopping the levee and flowing into Burlington. Burlington would still face flood risks from floodwaters that overflow the river near Sterling and possible levee breaching. The reduced levee overflows may slightly increase flood risks upstream and downstream of this levee improvement, as more floodwater would pass downstream into the urban areas.

4.5.2.1 Climate Change

Climate change may cause unprecedented alterations to the hydrology and hydraulics in the Skagit Basin. The basin's seasonal hydrology and flood conditions may both be altered. The three main parameters of interest in this study are; sea level rise, increased flood discharges, and increased sediment yields. Each of these factors can have an impact on future flood risks.

USACE Engineering Circular 1165-2-212; 1 October 2011 (SLC Circular) requires feasibility studies examine three scenarios to consider the sensitivity and adaptability of projects to sea level change (SLC). These scenarios include a "low, "intermediate" and "high" forecast of future SLC for the period-of-analysis, which is a period extending 50 years beyond the year when the first project benefits can be expected. For this study, the period-of-analysis is 2020-2070. For the mouth of the Skagit River, the three forecasted sea level changes are; low 0.37 ft, intermediate 0.79 ft and high 2.15 ft. Each of these three sea level rise scenarios would aggravate flooding near the mouths and along the Skagit Bay shoreline. The high SLC was investigated to see what the maximum impact to flood elevations might be under climate change. Hydraulic modeling of the 2.15 ft rise indicates the impact on flood profiles on the North or South Forks would vary with discharge and distance from the mouth. Both Forks have levees beginning about 3 miles upstream of the mouths. Within the levees the river hydraulics dampen the tidal effects moving upstream and as discharges increase. About two miles upstream of the start of the levees, the 2.15 ft SLC water surface increase is reduced to around 0.3-0.4 ft for discharges in the 40-60,000 cfs range (approximately 50-10% ACE floods) and to 0-0.2 ft for higher discharges. At the Forks, RM 9.5, the water surface increase is approaching zero for all discharges over 40,000 cfs (50% ACE flood). There would be no measurable flood elevation increase on the main stem (upstream of RM 9.5) from a 2.15 ft SLC. The hydraulic impacts of the low and intermediate SLC would be smaller and have no impact on flood risk in the urban areas.

The effects of climate change on flood hydrology are, in general, highly uncertain. The Skagit River Basin Climate Science Report (Lee and Hamlet 2011), prepared for Envision Skagit and Skagit County, explores the potential impacts of three climate change scenarios on Skagit River hydrology. That report describes potential changes in seasonal discharges (higher winter flows and lower summer flows) and increasing flood discharges. Of importance to this flood risk reduction study is the possibility of higher flood discharges. That report forecasts flood peak increases could range from 4 to 64 percent by 2040, with an average of 23 percent, and 0 to 98 percent, with an average increase of 40 percent by 2080. Those numbers would yield an average increase of 33% at the end of the project planning horizon in 2070. Should this climate change scenario occur, the risk of large, damage causing floods would become much greater. The risk of floods on the order of the current 1% ACE (225,400 cfs at Concrete) would increase to about a 4% ACE. The risk of floods exceeding the levee capacity in the Burlington-Mount Vernon area would increase from near 4% ACE to >10% ACE. A comparable flood risk increase would occur all along the Skagit River. The Ross and Baker reservoirs could still provide flood discharge regulation, but they would not be able to offset the increased flood discharges. The frequency of flooding could increase significantly in the study area. The depths of water in the floodplains would increase, but amount would vary by location.

Higher winter flows, especially flood discharges, could result in an increase in sediment transport. As discussed in Appendix B (Hydraulics and Hydrology), discharges over 50,000 cfs at Mount Vernon now produce 21% of the annual sediment yield. Those flows are currently only exceeded 1% of the time. Should climate change result in those high discharges becoming more common, the sediment yield will increase accordingly. Higher sediment yields would likely cause increased deposition around the mouths of the North and South Forks. The potential impacts to river deposition are harder to estimate. That will depend on the future balance between sediment transport potential and the available sediment supply.

4.5.2.2 Cumulative Impacts to Hydrology and Hydraulics

Cumulative impacts including climate change would be similar to those described above.

4.5.3 Comprehensive Urban Levee Improvement Alternative

The recommended project would involve increased flood discharge regulation at Upper and Lower Baker reservoirs, raising five sections of existing urban levees, and construction of two new levees. These project features are shown on Figure 3-12. These actions would combine to reduce flood risks to the urban areas of Burlington and Mount Vernon from 4-5% ACE to 1% ACE.

The Upper Baker project currently provides 74,000 ac-ft of flood storage by 15 November of each year. About 30% of the annual peak discharges have occurred before 15 November. Providing early season flood storage at Upper Baker Dam would reduce the seasonally weighted 1% ACE discharge at Concrete from 225,900 cfs to 219,100 cfs. Adding an additional 20,000 ac-ft of flood storage at Lower Baker Dam would further reduce the seasonally weighted 1% ACE flood peak to 208,000 cfs. Other flood peaks could be similarly reduced and those are listed in Table 4-4. To provide the additional storage would require both reservoirs to be drawn down in the September-early October time period. It appears this could be accomplished within the FERC license guidelines with average drawdown rates in the range of 1,000 cfs for 47 days to 1,600 cfs for 30 days; however, it may take some careful reservoir release planning and management by Puget Sound Energy (PSE) to meet all the FERC criteria.

Table 4-4. Current and future regulated peak flood discharges at Concrete, in cubic feet per second.

ACE	50%	20%	10%	4%	2%	1.3%	1%	0.4%	0.2%
Current	77,300	101,100	127,700	165,300	189,100	211,400	225,400	279,700	324,400
Future	77,300	94,200	118,600	151,200	173,500	194,000	208,000	259,000	312,400

In the City of Burlington, levees along the Skagit River between RM 16.5 and RM 20.9 would be raised and a new levee constructed around the east and north sides of the city. These levee improvements would raise the level of flood protection from the current 4% ACE to 1% ACE. The levee along the east and north sides of the City would tie into the existing levee and prevent floodwaters from Sterling from flowing through Burlington.

At Mount Vernon, left bank levees between RM's 10.6-11.7 and 16.5-17.5 would be raised, as would the right bank levee between RM's 11.7-14. New levees would be built across Riverbend area and between RM's 13.3-13.6 to limit floodwaters entering the urban area. These actions would work in conjunction with the Mount Vernon Floodwall to provide a 1% ACE level of flood protection for the City.

Raising the levees would contain more floodwaters within the river channel, causing an increase in water surface elevations. The additional flood regulation to be provided by Upper and Lower Baker dams would lower specific flood frequency discharges and offset some of those water surface increases. Upstream of the BNSF Bridge (RM 17.5), the 1% ACE flood elevations may increase by about 1 ft in the Nookachamps Basin. The overflow at Sterling would increase by 10,000-15,000 cfs, with all the floodwaters flowing northwest towards Padilla Bay. This increase in Sterling overflow could cause a ½ - ¾ ft rise in 1% ACE flood elevations the northern floodplain. This increase may cause flooding to spread across the Samish River near Edison. There would also be increased overtopping flows along some of the un-improved levees between RM 12 and RM 21. The increased overtopping flows would increase flood risk in areas near the overtopping locations and in the Riverbend area. There would be a slight rise in the flood risk in the western rural floodplains; however, that would be offset by the reduction in floodwaters coming from Burlington and any additional volume of floodwaters flowing into the western floodplain is not expected to have much impact on flood elevations due to the very large size of those floodplain areas. Channel capacity limitations on the main stem outside of the urban areas, result in no significant changes in flood discharges or levels of protection along the North and South Forks of the river.

4.5.3.1 Climate Change

The flooding impacts of sea level rise would be the same with the proposed project as for Future Without-project conditions. Coastal and river flooding could increase near the Skagit and Padilla Bay shorelines. The impacts on flood elevations from higher tidal elevations would be limited to the North and South Forks. The proposed project features are all located upstream of the effects of sea level change on flood elevations.

Possible future with-project flood hydrology changes due to climate change are the same as those described for the Future Without-project conditions; specifically an average flood discharge increase of 33% at the end of the project planning horizon in 2070. Should this climate change scenario occur, the risk of large, damage causing floods would increase. The risk of flood discharges exceeding the current 1% ACE would increase to about a 4% ACE. The project levees may be able to contain the higher discharges of the 1% ACE flood envisioned under the climate change scenarios, but with less than the 90% reliability desired for USACE projects.

Under the climate change scenario, higher discharges would likely result in higher sediment yields. As described in the Future Without-project conditions, higher sediment yields would likely cause increased deposition around the mouths of the North and South Forks. The potential impacts to river deposition are harder to estimate. That would depend on the future balance between sediment transport potential and the available sediment supply, and the degree that channel velocities would be altered.

4.5.3.2 Cumulative Impacts

Possible effects associated with this alternative due to cumulative impacts are the same as those described for the No Action Alternative, Section 4.5.2.

4.5.4 Joe Leary Slough Bypass Alternative

The Joe Leary Slough (JLS) Bypass would divert floodwater near RM 20.9, upstream of the urban damage areas, to lower flood risks to an acceptable level without major modifications to the urban levees. The design goal was to lower the 1% ACE flood elevations in the urban areas to below the 15% probability of failure elevations on the existing levees. This would be accomplished by diverting 75,000 cfs into the bypass at the peak of the 1% ACE flood. Discharges in the river downstream of the diversion would be approximately 150,000 cfs. The inlet structure would consist of twenty five gates, each 36 feet wide, and have a total width of 900-1,000 feet.

The JLS Bypass would be an approximately 2,000 ft wide channel that would extend from the inlet structure near RM 20.9 to Padilla Bay, following the historic path of the Joe Leary Slough, for approximately 9 miles. The combined length of new levee is approximately 17.6 miles total. The floodway would have about a 4% chance of being used in any given year. Peak flood depths within the Bypass would generally be in the 7-10 ft range; however they do vary with topography and maximum flow depths could reach 20 feet in places. Maximum velocities would generally be in the 3-4 ft/sec range and also vary with topography. The velocities are low enough that there would not be significant erosion in the Bypass if it has a good grass cover. It is anticipated that a winter cover crop such as grass would be grown as a requirement of the flowage easement. Outlet structures would be provided at Padilla Bay to drain floodways.

The proposed alternative reduces maximum flood elevations by about 3 ft in the Sterling/Nookachamps area, but not enough to prevent overtopping of Highway 20 upstream of the inlet structure. Therefore a new levee is recommended paralleling the highway upstream towards Sedro Woolley. This is the same area that has required flood fighting during large floods historically. A new levee section would also be required running south from the west end of the inlet structure to tie in to the existing SCDD#12 levee. Further downstream, the flood risk is higher for the left bank levee in the Riverbend area than it is for right bank levee. Rather than targeting lower flows to reduce flood levels further, it is assumed that the Riverbend cutoff levee is part of this alternative. This separates the levee system into urban (1% ACE) and rural (>1% ACE) protection segments. Some improvements would be necessary to other parts of the levees in the urban protection areas, although the lengths requiring improvement are greatly lessened due to the cutoff levee.

Discharges in the main stem Skagit River downstream of the JLS Bypass would be reduced for all floods larger than 150,000 cfs, approximately the 4% ACE. For floods in the 1-4% ACE range, this discharge reduction would amount to around 10-20,000 cfs through the urban areas between RM's 12 and 17.5. The 1% ACE flood elevations in this reach would be lowered by 1-2 ft. Flooding in the rural areas downstream of RM 17.5 would be slightly reduced due the discharge reductions. Flood discharges would be generally unchanged in the North and South Forks.

4.5.4.1 Climate Change

The flooding impacts of sea level rise would be the same with the proposed JLS Bypass project as for Future Without-project conditions. Coastal and river flooding could increase near the Skagit and Padilla Bay shorelines. The impacts on riverine flood elevations from higher tidal elevations would be limited to the North and South Forks. The proposed project features are all located upstream of the effects of sea level change on flood elevations.

Possible future with-project flood hydrology changes due to climate change are the same as those described for the Future Without-project conditions; specifically an average flood discharge increase of 33% at the end of the project planning horizon in 2070. Should this climate change scenario occur, the risk of large, damage causing floods would increase. The risk of flood discharges exceeding the current 1% ACE would increase to about a 4% ACE.

Under the climate change scenario, higher discharges would likely result in higher sediment yields. As described in the Future Without-project conditions, higher sediment yields would likely cause increased deposition around the mouths of the North and South Forks. The potential impacts to river deposition are harder to estimate. That would depend on the future balance between sediment transport potential and the available sediment supply, and the degree that channel velocities would be altered.

4.5.4.2 Cumulative Impacts to Hydrology and Hydraulics

Possible effects associated with this alternative due to cumulative impacts are the same as those described for the No Action Alternative, Section 4.5.2.

4.5.5 Swinomish Bypass Alternative

The original goal of the Swinomish Bypass Alternative was to divert floodwater near RM 15.7, near the middle of the urban damage areas, to lower flood risks to an acceptable level without major modifications to the urban levees. The design goal was to lower the 1% ACE flood elevations in the urban areas to below the 15% probability of failure elevations on the existing levees. This could not be accomplished by the diversion alone. The final alternative included the bypass; plus a new levee around the east and north of Burlington, and levee raises on the right bank between RMs 17.5 and 20.9, and on the left bank around RMs 13 and 17. The Bypass would divert nearly 70,000 cfs at the peak of the 1% ACE flood. Peak discharges in the river downstream of the diversion would be reduced to approximately 140,000 cfs. The inlet structure could consist of twenty five gates, each 36 feet wide, and have a total width of 900-1,000 feet.

The Swinomish Bypass would be an approximately 2,000 ft wide channel that would extend from the inlet structure near RM 15.7 to Swinomish Channel near Padilla Bay. The bypass channel would be approximately 7 miles long. The combined length of new levee would be approximately 14 miles total. The floodway would have about a 4% chance of being used in any given year. Peak flood depths within the Bypass would generally be in the 16-20 ft range. Maximum velocities would generally be in the 2.5-3.5 ft/sec range and also vary with topography. The velocities are low enough that there would not be significant erosion in the Bypass if it has a good grass cover. It is anticipated that a winter cover crop such as grass would be grown as a requirement of the flowage easement.

From the Bypass upstream to the BNSF Bridge, flood elevations would drop, but the in channel discharges would increase for floods larger than the 4% ACE flood. The discharge increase occurs because of the drop in water surface and the increase in energy slope caused by the Bypass diversion allow more discharge to past through the BNSF Bridge. Upstream from the BNSF Bridge the Swinomish Bypass is not effective in reducing water levels to the target 15% PNP elevations. This is especially the case with the assumed 6,000 sq. ft. debris blockage on the BNSF Bridge. Immediately upstream of the bridge the 1% ACE water level reduction is about 1 ¼ ft. The water surface reduction tappers down to only ¼ ft by RM 21. As a result, the right bank levees from the BNSF Bridge (RM 17.5) upstream to Lafayette Road (RM 21) must be improved to prevent overtopping and to raise the 15% levee PNP elevations.

It is assumed that the existing ground elevation along on SR-20 and in the Sterling area would remain unchanged, thereby allowing floodwaters to continue to flow across the road and onto the right bank floodplain in the vicinity of Sterling and the potential for continued flooding of Burlington. Burlington would be protected from those floodwaters by a levee extending around the eastern and northern sides of the City to Interstate 5.

Discharges in the main stem Skagit River downstream of the Swinomish Bypass would be reduced for all floods larger than 150,000 cfs, approximately the 4% ACE. For floods in the 1-4% ACE range, this discharge reduction would amount to around 10-20,000 cfs. The 1% ACE flood elevations in the vicinity of Mount Vernon would be lowered by 1-2 ft. Flooding in the downstream rural areas would be slightly reduced due the discharge reductions. Flood discharges would be generally unchanged in the North and South Forks.

Climate Change

The flooding impacts of sea level rise would be the same with the proposed Swinomish Bypass project as for Future Without-project conditions, except within the Bypass outlet and channel. The outlet structure and levees could be built high enough to accommodate the 2.15 ft SLC, thus reducing the risk of coastal flood within the Bypass channel. SLC would increase coastal flooding risks along the remainder of the Skagit and Padilla Bay shorelines. The impacts on riverine flood elevations from higher tidal elevations would be limited to the North and South Forks. The proposed Swinomish Bypass diversion point would not be impacted by SLC, as it is located upstream of the effects of sea level change on flood elevations.

Possible future with-project flood hydrology changes due to climate change are the same as those described for the Future Without-project conditions; specifically an average flood discharge increase of 33% at the end of the project planning horizon in 2070. Should this climate change scenario occur, the risk of large, damage causing floods would increase. The risk of flood discharges exceeding the current 1% ACE would increase to about a 4% ACE.

Under the climate change scenario, higher discharges would likely result in higher sediment yields. As described in the Future Without-project conditions, higher sediment yields would likely cause increased deposition around the mouths of the North and South Forks. The potential impacts to river deposition are harder to estimate. That would depend on the future balance between sediment transport potential and the available sediment supply, and the degree that channel velocities would be altered.

4.5.5.1 Cumulative Impacts to Hydrology and Hydraulics

Possible effects associated with this alternative due to cumulative impacts are the same as those described for the No Action Alternative, Section 4.5.2.

4.6 Geomorphology and Sediment Transport

4.6.1 Affected Environment

The Skagit River can be divided into five geomorphic reaches based on river slope and channel configuration. The lower river is the main focus of this flood risk reduction study.

In the upper basin the Skagit River occupies the narrow, steep-walled canyon upstream of the Cascade River. The channel is steep and its location is controlled by geology.

The middle river extends from the confluence of the Cascade River downstream to Sedro-Woolley. The Sauk and Cascade rivers contribute large amounts of sediment in this reach, as the valley floor widens through this reach and the channel becomes more sinuous and complex. Large woody debris (LWD) is common in the middle river reach, both in water and as recruitable trees. Concentrations of LWD can be found at the upstream end of islands, or the entrance to side channels. There is some evidence of aggradation in this reach as; there was a 2 ft rise in bed elevations between RM 19.4 and 22.4 from 1975 to 1999.

The lower river runs from Sedro-Woolley downstream to RM 9, where the river splits into the North and South Forks. Within this reach the river occupies a single channel, typically 600-700 ft wide with 20-30 ft high banks. This reach has been extensively modified with levees, bank protection, and dredging over the past 100 years or more. Levees line both sides of the river, with minimal setback distances. The banks are armored with riprap. There is a limited amount of LWD in the lower reach. Most of the LWD that exists are individual pieces scattered along the riverbed.

The average annual sediment yield estimates range up to 3.8 million tons/yr. Large floods are important factors in sediment production as evidenced by the highest 1 % of the daily water discharges producing 21% of the average annual suspended sediment yield. The grain size distribution for the suspended sediment is estimated to be 50% sand and 50% silt and clay.

Upstream of RM 17, the riverbed is a mixture of gravels and coarse sand. Downstream of RM 17, the bed generally consists of medium and coarse sands, with very little gravel or fine (silt or clay) material. There is inconsistent evidence related to bed aggradation or degradation in this reach. Cross-section surveys indicate there has been an average increase in overall bed elevation of 1.4 ft for the 25 year time period between 1975 and 1999. However, records for the USGS gage in Mount Vernon (RM 17) indicate there has been about a 1 ft drop since 1959.

Downstream of Mount Vernon, the river splits into two distributary estuary channels, the North and South Forks, before discharging into Skagit Bay on Puget Sound. Bed material samples identified a medium/coarse sand bed in both forks. The North Fork had an average increase in overall bed elevations of 1.6 ft, while the South Fork had an average increase of 1.0 ft. The South Fork, while also constrained by levees, does not have continuous bank protection along its banks. LWD is present through much of the main South Fork channel and there is a riparian corridor along much of South Fork that provide a local supply of LWD. LWD is scarce within most of the North Fork channel.

The Skagit River nearshore covers an area approximately 8 miles long, north to south, and 2.5 to 5 miles wide, with shallow tidal flats extending nearly to Whidbey Island. Since the completion of the Skagit River levee systems, sediment discharges have been concentrated at the mouths of the North and South Forks. Sand from the Skagit River is deposited on the river delta, while silts and clays are transport beyond the delta. Several feet of recent sand deposits overlay older mud deposits. The deposition has created new marsh habitat in the delta, replacing some of the marsh lost due to levees and agricultural development. LWD is present along the shoreline of many delta islands.

4.6.2 No Action Alternative

Few changes are expected along the upper and middle reaches of the Skagit River. Available sediment supplies are not well defined, and it can only be assumed that sediment yields will continue to be similar to those that have occurred during the past 50 years. Between Concrete and Sedro-Woolley, the sinuous channels in this reach can be expected to continue to slowly migrate across the valley. LWD is likely to continue to accumulate, especially at the upstream end of islands or side channels.

Downstream of Sedro-Woolley the main stem, and North and South Fork channel alignments have been stable for 20 years and are expected to remain stable. This stability is largely due to the existing bank armor. The bank armor is expected to be maintained in the future by the diking districts. LWD can be expected to continue to slowly accumulate in the main stem and North Fork channels. The South Fork has more local LWD sources and accumulations rates may be higher.

Historic riverbed sediment aggradation information for the study area indicates 50 year rates could range from 0-3 ft over the next 50 years (Appendix B, Hydraulics and Hydrology). Given the inconsistent evidence, it seems reasonable to expect the average 50 year deposition in the study area to be in the 1-ft +/- 0.5-ft range. This range of deposition is a small portion of the flood discharge cross-section and its impact on future flood elevations would depend on timing and location. The hydraulic modeling results, shown in Figure 4-1, suggest that during large floods a large amount of deposition may occur in the river between RM's 18 and 22, due to low channel velocities (1.5-4 ft/sec) caused by floodwater diversions into the Nookachamps area. This reach is where the riverbed currently changes from gravel to sandy. Deposition would also occur in the Nookachamps and northern floodplains where large amounts of floodwaters, and therefore sediments, would be diverted. Downstream of RM 18.5 the reduced sediment load, combined with increasing channel velocities (6-9 ft/sec) would likely cause riverbed scour during those large floods. During moderate discharges, around bank full, sediment could be eroded from the RM 18.5-22 reach and re-deposited in downstream channel. Under this sedimentation pattern, there would be little impact to the peak flood elevations of large floods. The floodplain at Nookachamps is very wide and channel deposition would have little or no impact on flood elevations. Scour downstream of RM 18.5 during floods could offset deposition that might occur during moderate discharges.

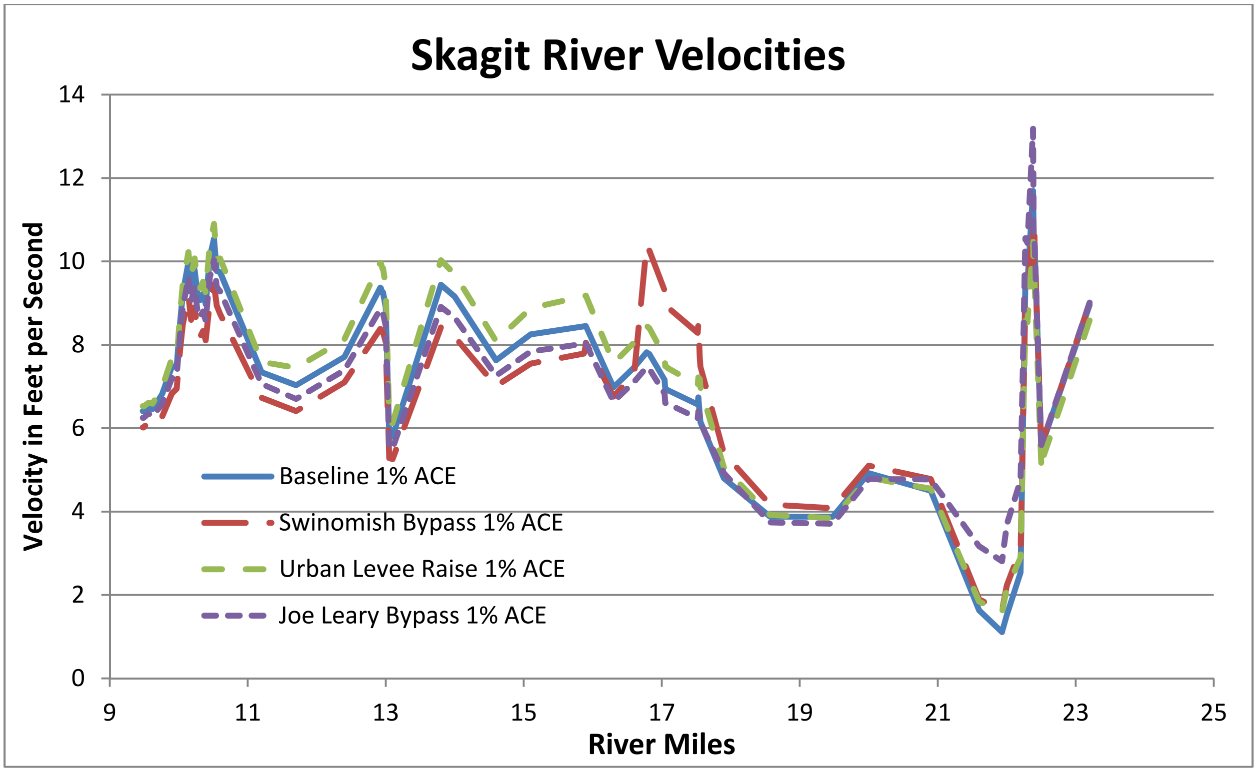

Figure 4-1. Skagit River 1% ACE Flood Average Channel Velocities.

Flood discharges and sediment transport would be generally unchanged in the North and South Forks. Along the nearshore, deposition can be expected to continue to be concentrated at the North and South Fork mouths. Islands and marsh areas should continue to grow at near current rates and LWD continue to accumulate.

4.6.2.1 Cumulative Impacts to Geomorphology and Sediment Transport

Cumulative impacts including climate change would be similar to those described above.

4.6.3 Comprehensive Urban Levee Improvement Alternative

The increased flood regulation to be provided by the Upper and Lower Baker projects would slightly reduce the sediment transport potential of the Skagit River downstream from Concrete. However, it is difficult to predict the impact of this reduced sediment transport potential in such a large river. The main sediment sources, the Cascade and Sauk rivers, are upstream of the Baker River, so sediment supplies during floods would be unchanged from without-project conditions. The Baker River discharges enter the Skagit River with very little sediment, thus they do not add to the sediment load, but the inflows do add to the sediment transport potential. The most likely outcome of increase Baker River flood regulation would be a slight increase in sediment deposition during floods due to reduced sediment transport potential resulting from reduced flood discharges. As described for without-project conditions, the focus of any flood deposition would likely be the riverbed between RM 18-22, in the reach where the riverbed currently becomes sandy. As shown in Figure 4-1 in Section 4.6.2 above, little change in velocity is expected in this reach. In the leveed reach between RM's 12 and 17.5, floods above the current 4% ACE capacity could have equal or greater discharges than would currently occur. Those increased, but infrequent, discharges may produce more scour and sediment transport through that reach over the 50 year project period.

Flood discharges and sediment transport would be generally unchanged in the North and South Forks. Along the nearshore, deposition can be expected to continue to be concentrated at the North and South Fork mouths. LWD can be expected to continue to slowly accumulate in the North Fork channel. The South Fork has more local LWD sources and accumulations rates may be higher. Islands and marsh areas should continue to grow at near the current rates and LWD continue to accumulate along the nearshore.

4.6.3.1 Cumulative Impacts to Geomorphology and Sediment Transport

Possible effects associated with this alternative due to cumulative impacts are the same as those described for the No Action Alternative, Section 4.6.2.

4.6.4 Joe Leary Slough Bypass Alternative

The diversions into the JLS Bypass would occur on an infrequent basis. The Bypass would only be activated for floods that exceed the 4-5% ACE range, with peak discharges larger than 150,000 cfs. The peak discharge into the Bypass could range from a few thousand cfs for floods only slightly greater than 150,000 cfs, up to 75,000 cfs for a 1% ACE flood. Those flood diversions would carry suspended sediment into the Bypass. It would be a very small percentage of the Skagit's sediment load for the smaller floods, but could approach 1/3 of the total inflowing sediment load during a 1% ACE event, based on the peak diversion. However, it is unlikely that the actual sediment diversion would be that high. The main factors that would limit sediment diversion are; 1) much of the water and sediment volumes of a 1% ACE flood would come before and after flow diversions into the Bypass, 2) during Bypass operations, most of the flood discharge (up to 150,000 cfs) would remain in the river and 3) as shown in Figure 4-1 in Section 4.6.2 above, channel velocities just upstream of the Bypass, between RM's 18 and 22, would be slow enough to cause some of the inflowing sediment to deposit in the river, similar to the Future Without-project Condition. Sediment transport and deposition in the JLS Bypass would likely be higher than under Future Without-project Condition due to the increased volumes of water and sediment diverted into the Bypass. Downstream of the Bypass, the reduced sediment load, combined with increasing channel velocities (6-9 ft/sec) would likely cause riverbed scour downstream of RM 18 during large floods. Compared to the Future Without-project conditions, the long-term river deposition may be slightly reduced due to the increased sediment diversion into the Bypass.

Flood discharges and sediment transport would be generally unchanged in the North and South Forks. Along the nearshore, deposition can be expected to continue to be concentrated at the North and South Fork mouths. LWD can be expected to continue to slowly accumulate in the North Fork channel. The South Fork has more local LWD sources and accumulations rates may be higher. Islands and marsh areas should continue to grow and LWD continue to accumulate along the nearshore.

4.6.4.1 Cumulative Impacts to Geomorphology and Sediment Transport

Possible effects associated with this alternative due to cumulative impacts are the same as those described for the No Action Alternative, Section 4.6.2.

4.6.5 Swinomish Bypass Alternative

The diversions into the Swinomish Bypass would occur on an infrequent basis. The Bypass would only be activated for floods that exceed the 4-5% ACE range, with peak discharges larger than 150,000 cfs. The peak discharge into the Bypass could range from a few thousand cfs for floods only slightly greater than 150,000 cfs, up to 70,000 cfs for a 1% ACE flood. Those flood diversions would carry suspended sediment into the Bypass. It would be a very small percentage of the Skagit's sediment load for the smaller floods, but could approach 1/3 of the total during a 1% ACE event, based on the peak diversion. However, it is unlikely that the actual sediment diversion would be that high. The main factors that would limit sediment diversion are; 1) much of the water and sediment volumes of a 1% ACE flood would come before and after flow diversions into the Bypass, 2) during Bypass operations, most of the flood discharge (up to 150,000 cfs) would remain in the river and 3) as shown in Figure 4-1 in Section 4.6.2 above, channel velocities upstream of the Bypass, between RM's 18 and 22, would be slow enough to cause some of the inflowing sediment to deposit in the river, similar to the Future Without-project Condition. Between Sterling and the Swinomish Bypass, the increased discharge and higher velocities (see Figure 4-1 in Section 4.6.2 above) could cause more scour than might occur without the project. If there is greater scour, there could be a local increase in deposition near the Bypass inlet. Compared to the Future Without-project conditions, the long-term river deposition may be slightly reduced by the sediment diversion into the Swinomish Bypass, but there could also be a change in the deposition pattern within the river.

Flood discharges and sediment transport would be generally unchanged in the North and South Forks. Along the nearshore, deposition can be expected to continue to be concentrated at the North and South Fork mouths. LWD can be expected to continue to slowly accumulate in the North Fork channel. The South Fork has more local LWD sources and accumulations rates may be higher. Islands and marsh areas should continue to grow and LWD continue to accumulate along the nearshore.

4.6.5.1 Cumulative Impacts to Geomorphology and Sediment Transport

Possible effects associated with this alternative due to cumulative impacts are the same as those described for the No Action Alternative, Section 4.6.2.

4.7 Air Quality and Greenhouse Gases

4.7.1 Affected Environment

4.7.1.1 Air Quality

In accordance with the Clean Air Act (CAA) and its amendments, National Ambient Air Quality Standards (NAAQS) have been established by the U.S. Environmental Protection Agency (EPA) for several criteria pollutants: lead, ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, and particulates with aerodynamic diameters of 10 micrometers or less (PM10) and 2.5 micrometers or less

(PM2.5). Areas of the country where air pollution levels persistently exceed the national ambient air quality standards are designated as “non-attainment” areas. The EPA has set de minimis threshold levels (100 tons/year for carbon monoxide and 50 tons/year for ozone) for non-attainment areas; however, there have been no standards set for green house gas emissions in Washington State. In Washington, the Seattle-Tacoma area is the only designated non-attainment area and this is due to particulate matter (PM2.5) levels. Air quality in the Skagit Basin is within the EPA standards for all air quality parameters (EPA 2007).

4.7.1.2 Greenhouse Gases

The Earth’s atmosphere is changing, the climate system is warming, and the changes are likely due in part to human activities that produce greenhouse gases (GHGs). GHGs include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3), and some hydrocarbons and chlorofluorocarbons. These compounds create a greenhouse effect when they accumulate in the Earth’s atmosphere. They act as a layer of insulation, retaining within Earth’s atmosphere some of the thermal radiation that originated from the sun.

At the Federal level, GHG is not regulated directly; however, some policies and guidance from the Council on Environmental Quality (CEQ) do provide some direction on how to address greenhouse gases in environmental impact statements. CEQ regulations and guidance further elaborate on how the analysis for GHGs should be formulated with the recognition that not only are there no formal thresholds for GHG emissions analyses, but also of the scientific limitations on how the analyses can be prepared. Specifically, the CEQ guidance states “agencies should recognize the scientific limits of their ability to accurately predict climate change effects, especially of a short-term nature, and not devote effort to analyzing wholly speculative effects.” Thus, the following analysis acknowledges to the extent scientifically possible the GHG emissions and sequestration of each alternative.

Estimating the total quantity of GHG that would be produced by each project alternative would require extensive analysis and numerous assumptions about each alternative’s final design and construction. Qualitative comparisons, however, can be drawn from a simplified estimation of GHG production. Therefore, USACE performed a simplified estimation of GHG emissions for hauling activities for all alternatives and compared the results.

4.7.2 No Action Alternative

Air pollution, most likely, will increase as urbanization and development occur in the urban areas, specifically Mount Vernon, Burlington and Sedro Woolley. Associated effects of urbanization include the need for more infrastructure such as roads which will increase motor vehicle use and emissions. Particulates can become an air pollutant of concern periodically (EPA 2007, EPA 2007a) and this may increase with future development and commerce.

4.7.2.1 Cumulative Impacts to Air Quality and Greenhouse Gases

Cumulative impacts would be similar to those described above. In addition to increased urbanization, the climatic changes would likely result in an increase in GHG.

4.7.3 Comprehensive Urban Levee Improvement Alternative

This alternative would have localized short-term increases in air quality and GHG during the two year construction schedule. Machinery and vehicles employed for the proposed repair work will release greenhouse gases. For every gallon of diesel fuel burned, 22 pounds of CO_2 are produced, and every gallon of gasoline produces 19.4 pounds of CO_2 (EPA 2009). Table 4-5 outlines assumed air pollutants and GHG emissions based on EPA (2009) and Sacramento Metropolitan Air Quality Management District (SMAQMD) (2008). Based on the amount of equipment needed for construction, including but not limited to dump trucks, compactors, graders, front end loaders, cranes, rollers, pile hammer, and excavators, operating varying hours, an estimated 89,079.5 tons of CO_2 would be emitted using a construction emissions spreadsheet model for non-road equipment from the SMAQMD and EPA's estimates of CO_2 emissions (SMAQMD 2008; EPA 2009). Carbon monoxide (CO); reactive organic gases (ROGs), which are ozone precursors; nitrogen oxides (NO_x); particulate matter (PM); and sulfur oxides (SO_x) were also calculated for dump trucks and construction equipment. In addition, emissions of CO_2 were calculated for personal vehicles.

Table 4-5. Estimated emission (tons) of air pollutants and greenhouse gases under the CULI Alternative

	Tons CO	Tons reactive organic gases	Tons CO_2	Tons NO_X	Tons PM	Tons SO_x
Trucks and equipment emissions *	111.9	67.4	86079.5	779.4	29.4	0.0
Personal vehicle emissions**			325			

*Based on spreadsheet model from SMAQMD (2008); assumes 500-hp diesel engines working 8 hrs per day, modeling data
**Assumes 20 mpg gasoline, traveling 665,600 total miles; data no available for pollutants other than CO_2

4.7.3.1 Cumulative Impacts to Air Quality and Greenhouse Gases

Possible effects associated with this alternative due to climate change and cumulative impacts are the same as those described for the No Action Alternative, Section 4.7.2.

4.7.4 Joe Leary Slough Bypass Alternative

The effects from air quality and GHG would be substantially greater than CULI Alternative. The JLS Bypass Alternative would have increased airborne pollutants and GHG emissions than the CULI Alternative because the number of construction vehicles and equipment would be considerably more than the CULI Alternative. More construction vehicles and equipment would be needed to transport the increase in construction materials for this alternative which would be approximately 425% more than the CULI Alternative.

4.7.4.1 Cumulative Impacts to Air Quality and Greenhouse Gases

Possible effects associated with this alternative due to climate change and cumulative impacts are the same as those described for the No Action Alternative, Section 4.7.2.

4.7.5 Swinomish Bypass Alternative

Similar to the JLS Bypass Alternative, the effects from air quality and GHG would be substantially greater than CULI Alternative. The Swinomish Bypass Alternative would have increased air borne pollutants and GHG emissions than the CULI Alternative because the number of construction vehicles and equipment would be considerably greater more than the CULI Alternative. More construction vehicles and equipment would be needed to transport the increase in construction materials for this alternative which would be approximately 390% more than the CULI Alternative.

4.7.5.1 Cumulative Impacts to Air Quality and Greenhouse Gases

Possible effects associated with this alternative due to climate change and cumulative impacts are the same as those described for the No Action Alternative, Section 4.7.2.

4.8 Noise

4.8.1 Affected Environment

Noise levels in the project area vary widely. The urban areas of the study area, Mount Vernon, Burlington, and Sedro-Woolley, have higher noise levels associated with larger populations and associated commercial and residential development and traffic. The agricultural areas in the delta and forested areas in the upper basin have lower noise levels associated with rural areas.

Skagit County Code (SCC) regulates Noise Control in unincorporated portions of Skagit County (SCC 9.50.010 – SCC 9.50.080). SCC 9.50.040 states that noise should not exceed those outlined in Washington Administration Code (WAC) Chapter 173-60. The City of Mount Vernon regulates noise within the city limits of Mount Vernon through Municipal Code Chapter 9.28. Code 9.28.060 regulates noise levels by “EDNA” or environmental designation for noise abatement. The City of Burlington regulates noise within the city limits of Burlington through Municipal Code Chapter 8.14. Code 8.14.040 regulates noise levels by EDNA.

4.8.2 No Action Alternative

The No Action Alternative would have no impact to existing noise levels in the project area. Existing noise generating activities in the basin would continue, including vehicular traffic, agricultural processes, residential activity, industrial activity, and construction activity.

Increased urbanization and development would likely increase noise pollution, especially in the urban areas such Mount Vernon, Burlington and Sedro-Woolley. Increasing population would create the need for more infrastructure, including roads. It is anticipated that noise in the upper basin and areas that remain agricultural would be maintained.

4.8.2.1 Cumulative Impacts to Noise

Increased urbanization and development would likely increase noise pollution, especially in the urban areas such Mount Vernon, Burlington and Sedro-Woolley. Increasing population would create the need for more infrastructure, including roads. It is anticipated that noise in the upper basin and areas that remain agricultural would be maintained. Possible climate change is not anticipated to result in effects to noise.

4.8.3 Comprehensive Urban Levee Improvement Alternative

This alternative would temporarily increase localized ambient noise levels from construction equipment operating in the immediate project area over the normal existing agricultural processes and vehicular traffic noise, but to a lesser extent than the Joe Leary Bypass Alternative and Swinomish Bypass Alternatives, based on a smaller and more localized construction footprint. No indirect impacts are anticipated with this alternative. Based on the types of machinery in use, ambient noise levels at greater than 50 yards would likely not exceed 80 decibels. Equipment would operate during daylight, typical construction hours, and five days a week. The estimated construction duration for this alternative would be two years.

4.8.3.1 Cumulative Impacts to Noise

Possible effects associated with this alternative due to climate change and cumulative impacts are the same as those described for the No Action Alternative, Section 4.8.2.

4.8.4 Joe Leary Slough Bypass Alternative

This alternative would temporarily increase noise in the immediate project area over the normal existing agricultural processes and vehicular traffic noise due to construction equipment and materials transport. No indirect impacts are anticipated with this alternative. The estimated construction hours and duration for this alternative would be daylight hours, five days a week for two years. Any residential or industrial construction activity would typically elevate current noise levels to a level commonly produced by equipment such as backhoes, bulldozer as well as gravel and cement trucks.

4.8.4.1 Cumulative Impacts to Noise

Possible effects associated with this alternative due to climate change and cumulative impacts are the same as those described for the No Action Alternative, Section 4.8.2.

4.8.5 Swinomish Bypass Alternative

This alternative would temporarily increase noise in the immediate project area over the normal existing agricultural processes and vehicular traffic noise, but to a lesser extent than the Joe Leary Slough Bypass Alternative, based on a smaller construction footprint. No indirect impacts are anticipated with this alternative. The estimated construction hours and duration would be the same as the JLS Bypass Alternative, Section 4.8.4.

4.8.5.1 Cumulative Impacts to Noise

Possible effects associated with this alternative due to climate change and cumulative impacts are the same as those described for the No Action Alternative, Section 4.8.2.

4.9 Soils

4.9.1 Affected Environment

The Basin, from the delta to just above Marblemount (RM 78), can be divided into four broad physiographic areas: (1) the low precipitation uplands, which include several islands; (2) the flood plain-delta; (3) the high precipitation uplands; and (4) the mountains. These areas are further subdivided into nine general soil map units: (1) Skagit-Sumas-Field; (2) Larush-Pilchuck; (3) Barneston-Dystric Xerorthents-Indinaola; (4) Tokul-Skipopa-Dystric Xerorchrepts; (5) Vanzandt-Montborne-Squires; (6) Chuckanut-Cathcart; (7) Bow-Coveland-Swinomish; (8) Skykomish-Jug-Saxon; and (9) Wollard-Kindy-Diobsud. No survey has been conducted upstream of RM 78 to the Canadian border in the Mount Baker-Snoqualmie National Forest; therefore no soil data is available. This FR/EIS will only focus on the conditions from Sedro-Woolley (RM 24) to the mouth at Skagit Bay.

The soils in the surveyed area range widely in texture, drainage, and other characteristics. The physiographic areas and associated soils in the lower basin include: the floodplain and the high precipitation uplands. The physiographic areas and associated soils in the upper basin include: the floodplain; the high precipitation uplands; and the mountains (upstream of study area) (Klungland and McArthur 1989).

The river is bound by levees made from fill soil on the right bank from Burlington (RM 20.9) to the mouth of the North Fork at Skagit Bay; on the left bank from Mount Vernon (RM 17.5) to the mouth of the South Fork at Skagit Bay (RM 0.0); and on both sides of Fir Island (RM 9.5 to 3.5). The existing levee materials along the delta reaches are very similar to the foundation soil in most cases and are predominantly fine sands and silty sands of loose-to-medium relative density.

In general, boring logs indicate that levee foundation soils consist of overbank deposits underlain by channel deposits. Over bank deposits range from 5 to 17 feet thick and generally consist of sands and silts with some clay. The channel deposits range from 4 to 40 feet thick and vary from slightly silty sand and gravel to sandy gravel. Channel deposits are underlain by soils similar in composition and characteristics to the overbank deposits. Estuary deposits were found near Skagit Bay and consist of silt and fine sand with shell fragments. Channel deposits are generally pervious. There is documented evidence of volcanic lahar material underlying the towns of Lyman, Hamilton, Sedro-Woolley, Burlington, and La Conner. Primary uses for these soils are agricultural cropping, pasture land, and recreation.

The levees along the right bank in Burlington and West Mount Vernon are primarily built upon floodplain alluvial sands and lahar soils from the Kennedy Creek assemblage. The levees downstream of Mount Vernon to the mouth are built atop extensive over bank deposits of alluvial clays and silts. Most of the farm fields and lowlands in the delta are also comprised of alluvium clays and silts. These soils are very deep and naturally poorly drained but have been artificially drained and protected in most areas. Undrained areas are high in salt content. These soils formed in recent alluvium and volcanic ash. Generally, the surface layer is silt loam about 1-2 feet thick. The underlying material is silty clay loam up to 2 feet thick, with fine sand beneath to a depth of 5 or more feet.

The low mountainsides and glacially modified plains around the basin are comprised of soils that are moderately deep and moderately well drained. They formed in volcanic ash and glacial till. The surface is covered with a mat of needles, leaves, and twigs. The surface layer and subsoil are very gravelly loam about 2 feet thick. The substratum is very gravelly sandy loam about 1 foot thick over dense glacial till. Depth to dense glacial till ranges from 1.5 to 3.5 feet.

4.9.2 No Action Alternative

Future changes to soils in the basin are expected to be minimal. The Future Without-project Condition would not change directly from Existing Conditions. Flood flows on the River typically carry a large suspended sediment (mostly silt), which is deposited along levee slopes and levee benches, as the floodwaters recede. If a flood event were to overtop or breach the levee system, the suspended sediment would also spread across the affected area of floodplain. There is generally minimal soil erosion associated with floodwaters, with the exception of localized scour at the overtopping or breach site.

4.9.2.1 Cumulative Impacts to Soils

Urbanization pressures in the lower basin could cause direct impacts to agricultural and wetland designated soils due to conversion of these soils; however Skagit County Code and other applicable local, State, and Federal regulations would minimize any of these potential impacts. In addition, some agricultural soils in the lower basin may be indirectly affected, becoming unproductive due to saltwater intrusion in the groundwater attributed to sea level rise. However, most of the agricultural land is protected by sea dikes and would not be subject to inundation (Glick et al. 2007).

4.9.3 Comprehensive Urban Levee Improvement Alternative

Due to the immediate proximity of levee raises to the existing structures, significant soil impacts are not expected with this alternative. Levee raises would be conducted atop the existing levee, as well as adjacent to the levee on the landward side (see Figure 4-2, c. below). All levee raises would be conducted in the landward direction to the maximum extent possible in order to avoid direct impacts to the river. Any impacts would be localized to the existing levee footprint area. A direct impact of minimal settlement of the levee would be expected, on the order of 0 to 4 inches (Golder Associates 2009).

The CULI Alternative allows for the continued overflow of floodwaters at Sterling, making the sediment deposition scheme similar to that of the No Action Alternative in the rural areas.

4.9.3.1 Cumulative Impacts

Cumulative impacts would be similar to those impacts described in the No Action Alternative, Section 4.9.2.

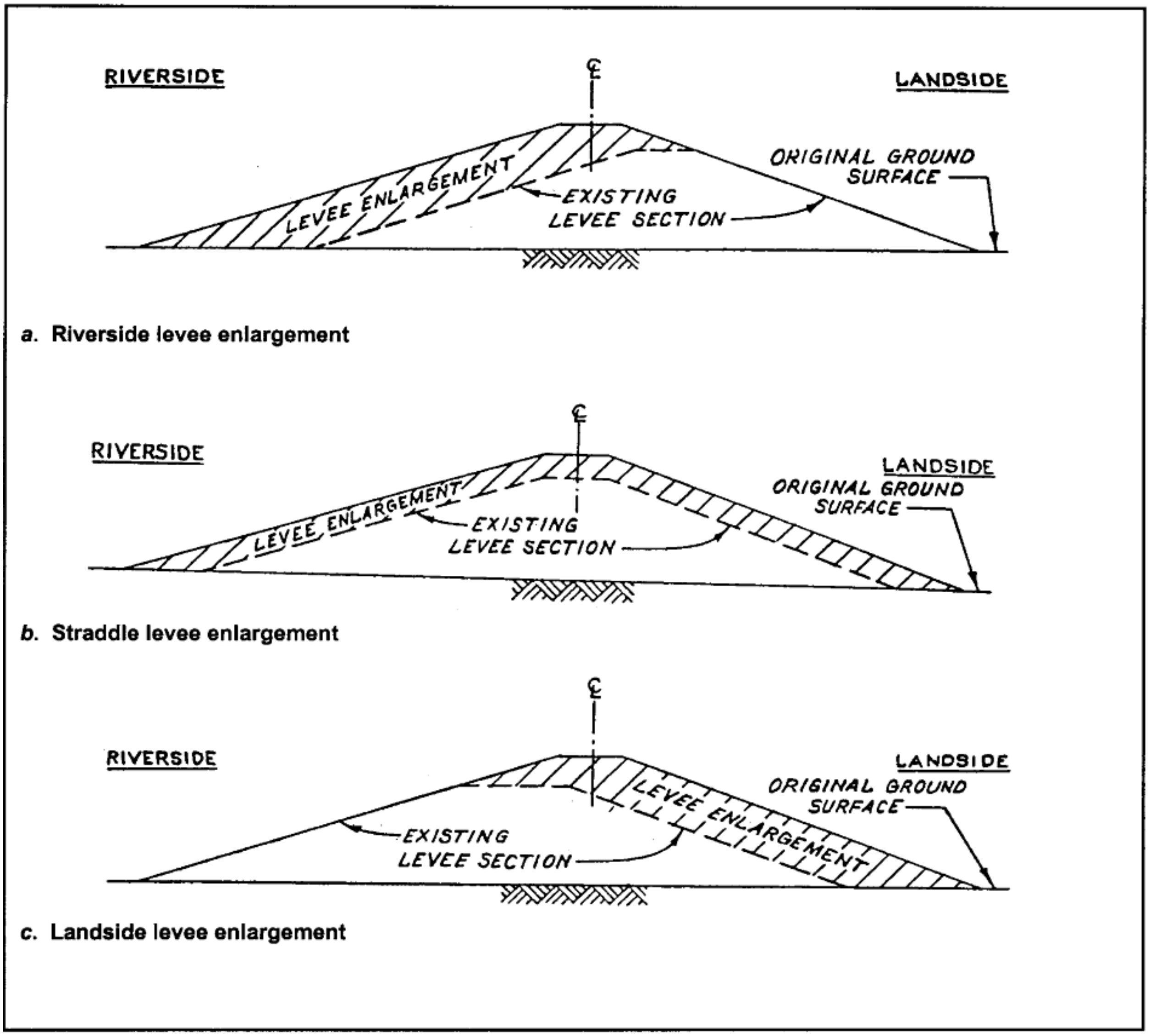

Figure 4-2. Typical levee raise configurations. Image from EM 1110-2-1913, Figure 8-6.

4.9.4 Joe Leary Slough Bypass Alternative

At the outlet structure from the River to the Joe Leary Slough Bypass, soil erosion potential is likely to be high as floodwaters enter the diversion channel, which would cause direct impacts. Therefore, the inlet structure would be equipped with erosion protection (concrete, riprap, geotextile, or otherwise) to a point where velocity in the channel drops to an acceptable level. For this alternative, a wider channel configuration was preferred and selected to keep flow velocity low, minimizing soil erosion potential and associated cumulative impacts. Grass sod cover or other cover crops would be required and maintained along the length of the bypass channel and slopes.

The bypass channel is likely to remove or heavily restrict large areas of farmland from production. The presence of levees to contain the channel will have an indirect effect on the existing drainage scheme through the affected area. However, maintaining proper drainage would be necessary and would be designed appropriately to work with the bypass channel.

Because the bypass channel would contain flows that would have otherwise overtopped levees under the No Action Alternative, sediment carried in the flow would only be dispersed along the bypass channel, rather than spread across the floodplain. This would directly affect the area within the channel, directly affect the outlet area in the Bay, indirectly affect the areas in the remaining floodplain, and have cumulative effects throughout the entire Basin. As an operations and maintenance (O&M) issue, the channel would require cleaning in order to maintain design capacity. Under the No Action Alternative, the sediments deposited by a flood would otherwise be left in place, removed by private landowners, or removed in cooperation with disaster assistance efforts.

Levee construction to contain the bypass channel would be required to overbuild by up to two feet to account for assumed settlement. This construction of new structures would directly affect the soils beneath by inducing settlement and consolidation.

4.9.4.1 Cumulative Impacts

Cumulative impacts would be similar to those impacts described in the No Action Alternative, Section 4.9.2.

4.9.5 Swinomish Bypass Alternative

Impacts are similar to the Joe Leary Slough Alternative, Section 4.9.4.

4.9.5.1 Cumulative Impacts

Cumulative impacts would be similar to those impacts describe in the No Action Alternative, Section 4.9.2.

4.10 Water Quality and Quantity

4.10.1 Affected Environment

4.10.1.1 Water Quality

In general, the upper reaches of the Skagit River meet state water quality standards. Because the lower watershed is more developed, areas with impaired water quality have been identified. Water quality in the sloughs and tributaries connected with the Skagit River were known to be poor as far back as 1975, but until 1991 the mainstem was believed to have good water quality with high flows (WDOE 2012a). When the Washington Department of Health restricted harvest of shellfish beds in the bay due to fecal coliform concentrations that affect water quality, concerns arose regarding the river's water quality. A major study in 1993 identified impairments for dissolved oxygen and fecal coliform, especially in the north and south forks, the sloughs, and in the Nookachamps system (WDOE 2012a). The suspected sources of fecal coliform were dairy farms, urban runoff, and failing septic systems. Based on the 1993 study, the lower Skagit River Basin was placed on Washington State's list of polluted water bodies, known as the 303(d) list (WDOE 2012a).

In response to this listing, efforts began to study and improve water quality in the river. In 2003, Skagit County established the Skagit County Water Quality Monitoring Program. This program established forty monitoring stations to determine if the County’s Critical Areas Ordinance for Ongoing Agriculture

(SCC 14.24.120) was sufficient to protect water quality agriculture (Skagit County 2012). The ordinance requires farmers to "do no harm" to adjacent watercourses and relies on protection measures and management practices to protect the watercourses. The Monitoring Program focuses on determining trends in water quality both within and outside of the agricultural zones. The analysis from the first eight years of the program found a mix of improving and worsening trends in approximately equal proportions, both inside and outside of the agricultural areas (Skagit County 2012). Data indicate that many streams do not meet state water quality standards for fecal coliform, temperature, and/or dissolved oxygen, ranging from occasional failures to a continual inability to meet the standard.

High fecal coliform counts are usually the result of failing on-site sewage systems, municipal wastes, livestock operations, and pets (Skagit County 2012). Washington State Department of Ecology (WDOE) initiated a water quality study in 1995 and produced a Cleanup Plan in 2000. The Cleanup Plan concluded that reduction in combined sewer overflows (CSOs) from municipalities in the basin was the single most important needed action (WDOE 2000). CSOs are a combined stormwater and sewage system. Mount Vernon is the only municipality with a CSO that discharges to the Skagit (WDOE 2012b). The first phase of the effort to reduce CSO discharge was constructed in 1998, reducing the overflows by about 90 percent (WDOE 2000). Further improvements are expected to occur in 2015 (WDOE 2012b).

Stream temperature in forested streams is largely determined by four factors: stream depth, air temperature, solar radiation/riparian vegetation, and groundwater (Adams and Sullivan 1989). WDOE performed a study in August 2001 and found that nine lower Skagit River tributaries have elevated temperatures during the late summer, low-flow season (WDOE 2012b). The average water temperature at the Highway 99 Bridge is approximately 8.9° Celsius (WDOE 2013). The upper Skagit River near Marblemount exceeds WDOE's criteria for temperature (WDOE 2012c). Additionally, there are several mid-Skagit tributaries and some sloughs in the delta area, including Joe Leary Slough, that are impaired due to high temperatures (WDOE 2008a). WDOE's modeling study of the nine lower Skagit tributaries determined that full, mature riparian shade along these creeks would reduce the heat load sufficiently to meet water quality standards.

Dissolved oxygen is affected by both organic material inputs and temperature, with cold water holding more oxygen than warm water. Waste inputs from CSOs and agricultural runoff can reduce dissolved oxygen levels. The organic material is decomposed by microorganisms, which use oxygen in the process. The Skagit County 2011 monitoring report (2012) showed that many streams in the Skagit County Monitoring Program meet oxygen standards all or most of the year. In some of the streams, oxygen levels show steep declines in summer associated with very low flows. In the main stem of Skagit River, dissolved oxygen has been reduced since 2004 (WDOE 2012c).

While the Skagit River has not been designated as impaired due to sediment or turbidity, the amount of sediment in the river is an important consideration. Sediment quantities and transport have been altered by the channelization of the Skagit River, human development, and activities such as logging (SCSC 2012). Large increases in coarse sediment supply can fill pools and aggraded channels, resulting in reduced habitat complexity and reduced rearing capacity for some salmonids (Beechie et al. 2003). Increases fine sediments may also reduce survival of incubating eggs and change benthic invertebrate production (Beechie et al. 2003). Channelization deposits larger material in the delta and bay, creating sandbars, but also pushes smaller sediment out into deeper waters. The offshore transport of fine sediments is detrimental to nearshore habitats such as eel grass beds (SCSC 2012).

The Skagit River is designated for aquatic life uses as core summer salmonid habitat (WAC 173-201A-602). The core summer habitat designation is characterized by the river's use from June 15 to September 15 as either salmonid spawning or emergence, adult holding, use as important summer rearing habitat by one or more salmonids, or as foraging habitat by adult and sub-adult native char. Other common characteristic aquatic life uses for waters in this category include spawning outside of the summer season, rearing, and migration by salmonids. Water quality standards (i.e., temperature, dissolved oxygen, and turbidity) are established based on this aquatic life use designation. In addition, the Skagit River is designated for primary contact recreational uses, all water supply uses, and all miscellaneous uses.

Gages Slough has impaired water quality with a cleanup plan approved by the EPA in 2000. The cleanup plan is designed to allow the slough to meet state standards, however the water is still considered "impaired" until effectiveness monitoring shows the conditions have been resolved. Bi-monthly water quality monitoring is completed by the Public Works Department. In addition, the Skagit Conservation District Stream Team has a committed team of volunteers that also does regular water quality monitoring in Gages Slough for temperature, turbidity, and fecal coliform, the total maximum daily load standards (Burlington 2012).

4.10.1.2 Water Rights

In 2001, WDOE adopted an in-stream flow rule for the Skagit River Basin that establishes minimum flows for the Skagit River at the Mount Vernon gauge. The minimum flows vary from 10,000 cfs to 13,000 cfs, depending on the time of year. The rule requires all surface water and groundwater users in the Skagit Basin, with a priority date later than the effective rule date, to curtail water use during times of year when the minimum flows are not achieved, unless it can be shown that such diversions or withdrawals do not affect flows in the Skagit River. These minimum flows are commonly not achieved during various times of the year, particularly in late summer and early fall. This rule was appealed in Thurston County Superior Court. As a result of the appeal, WDOE issued two proposed amendments to the rule to address future water needs in the County. An amended rule was adopted in May 2006 calling for the creation of reservations of a limited amount of water for specific future uses that are not subject to the existing in-stream flows and allowing for future withdrawal even when minimum flows are exceeded (WDOE 2006). On 3 October 2013, the Washington State Supreme Court ruled that the in-stream flow rule amendments were invalid which means that 2001 in-stream flow rule for the Basin is now effective.

4.10.2 No Action

4.10.2.1 Water Quality

The expected increase in urban development could negatively affect future water quality in the Skagit River Basin including Gages Slough. Improvements to the municipal sewer systems and strict water quality regulations could improve some aspects, such as fecal coliform levels. However reductions in forest cover and increases in impervious surfaces typically found in urban watersheds have been found to substantially impair watershed storage capabilities (The Watershed Company 2007). Increases in impervious surface coverage could reduce soil infiltration and increase velocity, volume, and frequency of surface water flows and subsequently increase sediment and pollutant delivery to local streams and Skagit River.

Increased development is also expected to require the continued construction and maintenance of levee and revetment systems. Vegetation maintenance for levee safety diminishes riparian habitat, potentially exacerbating temperature and dissolved oxygen concerns. The levee system will maintain the channelization of the river, exacerbating sedimentation concerns.

4.10.2.2 Water Rights

Future changes to water rights would follow the 2001 WDOE in-stream flow rules and any subsequent amendments that alter minimum flow requirements.

4.10.2.3 Cumulative Impacts to Water Quality and Water Rights

Cumulative impacts would be similar to those described above. Furthermore, climate change is expected to increase sedimentation as a result of changes in snowpack, glacial retreat, and more severe flooding (Binder et al. 2011, SCSC 2012). Overall, future water quality is expected to decline.

Cumulatively, future actions requiring a water right would follow the 2001 WDOE in-stream flow rules and any subsequent amendments.

4.10.3 Comprehensive Urban Levee Improvement Alternative

4.10.3.1 Water Quality

This alternative would involve short-term water quality impacts from placement of the riprap along the revetment in areas from RMs 20.9 to 13.0 and construction of the levee and culvert across Gages Slough. During construction there may be short-term, localized water quality impacts such as a minor increase in turbidity. During the construction of the 2011 Skagit Levee Rehabilitation Project, turbidity monitoring was conducted and no exceedances of the state standards (Washington State Code 173-201A-200) occurred. Based on this previous monitoring, it is expected that in water rock placement would not exceed state turbidity standards. Typical Best Management Practices (BMPs) as suggested by WDOE for other levee project would be implemented and turbidity monitoring may be conducted during sediment generating activities in order to minimize any turbidity. Large trees are not typically found on the revetment areas due to regular vegetation maintenance. As such if there is vegetation on the revetments, it is mainly young willows and alders. These young trees do provide water quality benefits including some shading and nutrient input to the system. Construction would require the removal of trees wherever revetment work is needed. The placement of rock along the river would further increase temperatures through thermal retention and light reflection of the rocks. The increase in water temperature may locally reduce dissolved oxygen levels in the water. No measurable effects to pH or dissolved oxygen would be expected. No pollutants are expected to be introduced to the river from levee repairs. Overall the CULI Alternative would have a minimal impact on water quality for the River.

Modifications to Baker Dam operations would have minimal effects to water quality because downstream flows would remain within normal dam releases and the drawdown for both reservoirs would be gradual and within existing reservoir elevations.

4.10.3.2 Water Rights

Effects to water rights would not occur with the CULI Alternative. The levee raise, floodwall, and nonstructural features of this alternative would not require a water right because it would not divert any water from the River.

A water right would not be required for the modification to Lower Baker Dam operations for the 20,000 ac-ft of additional flood storage because the modification would not result in exceeding the current reservoir storage capacity (Smith 2014). The existing Lake Shannon reservoir water rights or certifies are 50,000 ac-ft and 140,000 ac-ft, obtained in 1824 and 1926, respectively (Smith 2014). PSE would still be responsible to maintain instream flow requirements in Aquatics Table 2 with the implementation of Article 107b (FERC 2008) and therefore downstream flows would not affect the flows required by the WDOE's in-stream flow rule.

4.10.3.3 Cumulative Impacts to Water Quality and Water Rights

Possible effects associated with this alternative due to climate change and cumulative impacts are the same as those described for the No Action Alternative, Section 4.10.2.

4.10.4 Joe Leary Slough Bypass Alternative

4.10.4.1 Water Quality

Increasing agricultural runoff with activation of the bypass would not be expected to cause major impacts to water quality. Typically pesticide application occurs in mid-June to control weeds, insects, and fungi (Mayer and Elkins 1990). Timing of likely bypass activation in the fall and early winter could wash fertilizers applied to fields in the fall downstream into Padilla Bay. In addition, bacterial contaminants (fecal coliform) from manure could be washed out into Padilla Bay. Overall, the amounts of any agricultural runoff present in diverted floodwaters would be very dilute and limited effect to water quality would be expected.

Considerable soil erosion during activation of the bypass is not expected to occur with the assumption that all land within the bypass channel would be planted with overwinter cover crop to withstand erosive forces of the water. Maximum velocities in the JLS Bypass would be 3-4 ft/s at the peak of the 1% ACE flood. These velocities would not exceed the NRCS recommended velocities for erosion (4-5 ft/s) on land with a cover crop (Chow 1959, NRCS 2007). However, if the cover crop did not completely grow in and/or for some other reason, the bypass channel had areas of exposed soil, then soil could be eroded. Some of this sediment may settle within the bypass channel, but some would also be delivered to Padilla Bay. Therefore increased turbidity in Padilla Bay would be expected.

The other JLS Bypass Alternative features such as modification to existing levees and dam operations would have the same effects to water quality as discussed in the CULI Alternative, Section 4.10.3.

4.10.4.2 Water Rights

The JLS Bypass Alternative is not expected to affect Skagit River water rights. The bypass would only be used during flood events (4% ACE or greater) when discharges would be at least 150,000 cfs which would exceed the minimum flows. Since the bypass would only activated during flood events, a water right would not be required (Smith 2012). Effects to water rights related to modification to dam operations would the same as those described in the CULI Alternative.

4.10.4.3 Cumulative Impacts to Water Quality and Water Rights

Possible effects associated with this alternative due to climate change and cumulative impacts are the same as those described for the No Action Alternative, Section 4.10.2.

4.10.5 Swinomish Bypass Alternative

4.10.5.1 Water Quality

The potential agricultural and sediment runoff during a flood event would release into Swinomish Channel and eventually into Skagit and Padilla Bays. This alternative would have the similar impacts to water quality as the JLS Bypass Alternative.

4.10.5.2 Water Rights

This alternative would have the similar impacts to water rights as the CULI and JLS Bypass Alternatives.

4.10.5.3 Cumulative Impacts to Water Quality and Water Rights

Possible effects associated with this alternative due to climate change and cumulative impacts are the same as those described for the No Action Alternative, Section 4.10.2.

4.11 Wetland Habitat

4.11.1 Affected Environment

The National Wetlands Inventory (NWI) was established by USFWS to conduct a nationwide inventory of wetlands. In general, NWI maps are drawn using aerial photo analysis of vegetation patterns, visible hydrology and geographic position to provide an overview of wetlands within an area. Due to the limitations of aerial photo interpretation, NWI mapping can include errors and requires field verification. A field visit on 29 June 2012 identified the presence of wetlands in the vicinity of potential project features and verified that the NWI maps, while not perfect, did provide a good characterization of wetlands in the project area and would be a useful tool for alternative comparison.

Downstream of Sedro Woolley, intensive land modification for agriculture has occurred, including the construction of extensive levees and dike systems. These actions drained former wetlands and disconnected floodplains. Among the individual deltas of Puget Sound, the Skagit River delta has suffered the greatest absolute change in wetland coverage. Losses include approximately 89 percent of tidal freshwater wetlands, 98 percent of oligohaline transition wetlands (low salinity, shrub-dominated wetlands), and 35 percent of estuarine mixing wetlands (marine to brackish wetlands dominated by herbaceous species), for an average loss of around 80% and a total loss of 22.2 square miles (Simenstad et al. 2011). See Section 4.13 (Aquatic Habitat), for more information on brackish and estuarine wetlands and submerged aquatic vegetation.

NWI maps identify pockets of wetlands on both sides of the levees and dikes in the lower river and delta. The largest complexes are waterward of the levees/dikes and associated with sloughs such as Gages

Slough along Skagit and Padilla Bays. Particularly within the Skagit floodplain, the NWI wetlands landward of the levees are often modified through farming. Fresh water wetlands in the lower river basin include emergent, scrub-shrub and forested wetlands. Typical freshwater wetland vegetation includes various willows (*Salix* spp.), black cottonwood (*Populus balsamifera*), red alder (*Alnus rubra*), Pacific ninebark (*Physocarpus capitatus*), red osier dogwood (*Cornus sericea*), hardhack (*Spiraea douglasii*), sedges (*Carex* spp.), and rushes (Juncaceae family). Non native invasives can be problematic, including reed canary grass (*Phalaris arundinacea*) and Himalayan blackberry (*Rubus armeniacus*).

The salt marsh vegetation is typical of that found in the Puget Sound region. Areas regularly inundated with salt water are dominated by salt grass (*Distichlis spicata*), pickleweed (*Salicornia virginica*), gumweed (*Grindelia* spp.), jaumea (*Jaumea carnosa*), and arrowgrass (*Triglochin maritima*). Regions higher up on the beach more brackish in nature are dominated by tufted hair grass (*Deschampsia cespitosa*), sedges (e.g. *Carex lyngbyei*), and various grasses. Large expanses of unvegetated intertidal flats also exist in the Skagit Delta.

Though not identified on the NWI maps, Gages Slough is a series of connected depressional flow-through wetlands that cross Burlington, fed primarily by stormwater runoff (Otak 2007). The upstream connection to the Skagit River (via Hart Slough) is limited by the Sterling Dam, constructed in 1899 as a reaction to numerous floods affecting the railroad tracks (Burlington 2012). The downstream connection to the river is through a pump station. Both connections of Gages Slough to the Skagit River are inaccessible to fish.

Gages Slough wetlands have been substantially altered and degraded as a result of the influence of urbanization and agricultural practices. Burlington is planning several improvement projects to include improvements to public access, restoration activities, increases in the size of culverts, removal of obstructions, improvements in surface water management, and general improvements to the flow characteristics to provide efficient conveyance of water through the city during flooding. Burlington (2012) has identified 15 sites in the Gages Slough corridor for potential restoration and a reconnaissance level plan has been prepared for each. Three projects have been built including the Wetland Restoration Demonstration project in the Jack Doyle Memorial Neighborhood Park, the Goldenrod Bridge restoration project, and the Unit 10 former city dump restoration site.

4.11.2 No Action Alternative

The decline in extent and quality of wetlands is expected to continue due to continued development as well as the continued maintenance and construction of levees that constrain the river and limit inundation of floodplain wetlands.

4.11.2.1 Cumulative Impacts to Wetland Habitat

Increased urbanization in the future would create the need for more infrastructure (including roads, water and electrical supply) and could result in further fill of wetlands and deforestation of surrounding lands. Wetland functions such as flood attenuation and storage, water quality improvements, and wildlife and fish habitat could be lost. Some of these potential losses of wetlands would be offset by existing and future wetland restoration projects. As mentioned in Section 4.11.1 Affected Environment, wetlands restoration projects at Gages Slough have already been constructed or are identified. The Skagit Delta

Tidegates and Fish Initiative would convert up to 2,700 acres of agricultural land into estuarine wetlands. The proposed PSNERP includes several restoration projects under consideration in the Basin that may restore wetlands function.

Climate change, and the associated changes in precipitation and groundwater patterns, may result in large scale changes to wetland complexes and the functions they provide. Increased intensity of flood events may alter the sedimentation deposition and erosion patterns. Changes in precipitation patterns may alter groundwater recharge/discharge rates and locations, and reduced summer river flow may alter the vegetation communities and the habitat functions of these wetlands (Kusler 2005). Wetlands could be affected by declines in freshwater or groundwater supplies as well as declines in water quality (i.e. increased salinity, increased stormwater inputs) driven both by urbanization and climactic shifts (SITC 2009). Negative impacts to wetlands would likely contribute to negative impacts to fish and wildlife.

Habitat viability in tidelands and marine habitat requires specific levels and frequencies of inundation as well as salinity (SITC 2009). The Swinomish Climate Change Initiative (2009) estimated habitat losses by 2100 based on high-estimate sea level rise of 59 inches. They reported 87 percent loss of tidal freshwater marsh, 99 percent loss of estuarine beach and 97 percent loss of brackish marsh. Sea level rise will likely shift the eelgrass beds, mudflats, and salt, brackish, and freshwater marshes landward. Space for this shift is limited due to the development that abuts the marshes, leading to an overall decline in brackish and freshwater habitat. Most of the brackish marsh in Skagit Bay today would be converted to salt marsh and estuarine beach habitats would be converted to open water or tidal flats (Glick et al. 2007, Tohver and Mantua undated).

4.11.3 Comprehensive Urban Levee Improvement Alternative

The footprint of the CULI Alternative has only a few known wetlands in it, which are at the Burlington Hill Cross Levee and Sedro Woolley Waste Water Treatment Plant Floodwall (Figure 4-3). As most of the widening of the levee would occur landward of the existing levee, within this urban corridor the area behind the levee is well developed. The proposed alignment for the Burlington Hill Cross Levee would cut across Gages Slough. A culvert structure would be constructed to accommodate daily flows into Gages Slough but to restrict flood flows from flooding Burlington. Although the culvert would allow daily flows into the slough, the footprint for the new levee would impact up to 3 acres of wetland adjacent to the slough.

By placing a properly sized culvert in the levee, with the ability to close the culvert during larger flood events, the slough should function similar to typical existing conditions. Sterling Dam currently prevents most floods from entering the slough; by closing the Gages Slough culvert the new levee would also prevent Skagit River waters from entering the slough at larger events. Because the slough is largely fed by stormwater runoff from within the City of Burlington, the main water source would be unchanged.

Per NWI map, the adjacent land around Sedro Woolley's waste water treatment plant has 1 forested/shrub wetland (9.22 acres) and 2 freshwater emergent wetland (5.08 acres). The construction of the proposed floodwall at this location would impact approximately 0.30 acres of freshwater forested/shrub wetland.

As discussed in Section 4.5 (Hydrology and Hydraulics) and Section 4.6 (Geomorphology and Sediment Transport), the flood discharges and sediment deposition are expected to similar as the existing condition.

Therefore, the impact of flushing floodwaters along with the suspended sediments into the delta wetlands would be minimal. The velocities from North and South Forks to Skagit Bay during flood events (10% to 1% ACE) would range from approximately 6 to 13.5 ft/s which would be the same as the existing velocities for the same flood events.

The other CULI Alternative features such as nonstructural features or modifications to Baker Dam operations would have minimal effects to wetland habitat because the alternative features would either be located in an urban setting with little to no wetlands in their footprint or not be modify existing wetland habitat with operational changes.

During future design phase, wetland delineation would be conducted to determine the extent and function of wetlands affected by the CULI Alternative. To offset and mitigate for this potential impact, this alternative would minimize the project footprint to maximum extent possible in later design phase and most likely, purchase wetland mitigation credits from a local mitigation bank.

4.11.3.1 Cumulative Impacts to Wetland Habitat

Cumulative impacts would be similar to those described in Section 4.11.2 No Action Alternative. This alternative, mostly likely, would not impact or compromise any of the completed or proposed restoration sites in the Basin. In addition, the amount of possible wetland fill attributed to this alternative would only slightly contribute to overall loss of wetlands in the Basin. Possible effects with this alternative due to climate change are the same as those described for the No Action Alternative, Section 4.11.2.

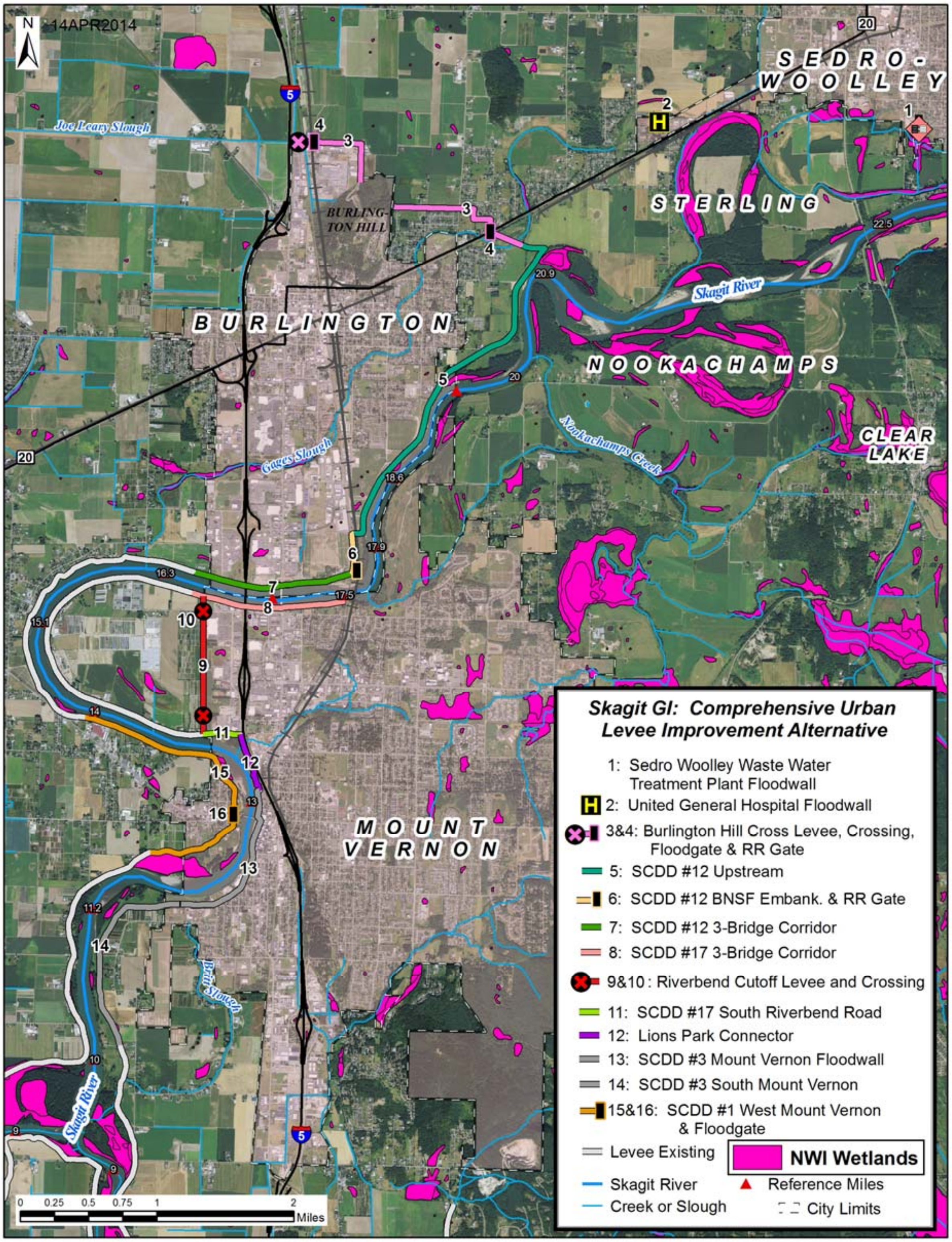

Figure 4-3: NWI Wetlands within the CULI Alternative Footprint

4.11.4 Joe Leary Slough Bypass Alternative

NWI maps show that there are 57 acres of wetland within the JLS Bypass footprint (Figure 4-4). Impacts to these wetlands would vary in intensity from total loss of wetlands due to filling for the construction of the levees to the more complex impacts to wetlands within the bypass channel. For the purposes of alternative comparison, all wetlands within the bypass footprint are considered to be impacted. These wetlands include 1 forested wetland (0.9 acres), 4 freshwater ponds (4.5 acres), 17 freshwater emergent wetlands (26.3 acres), and 7 estuarine wetlands (25.3 acres).

The estuarine wetlands are a wetland complex associated with Joe Leary Slough at the confluence with Padilla Bay. Existing sea dikes disconnect this lower end of Joe Leary Slough from the surrounding floodplain, limiting the extent of wetlands in the area. The proposed bypass alignment includes an outlet structure at the confluence of Joe Leary Slough and Padilla Bay which would remove salt water and tidal influence to these wetlands. Also, the design includes excavation from just east of Farm to Market Road to the outlet structure. This would include excavation of all the estuarine wetlands as well as three freshwater ponds (1.86 acres). The installation of the outlet structure and the excavation effort is likely to expand the freshwater wetlands in this area while eliminating the estuarine wetlands. The 25.3 acres within the project footprint likely underestimates the extent of impact to estuarine wetlands. Activation of the bypass could have impacts on adjacent and nearby wetlands through the influx of freshwater and sediments. Eelgrass (*Zostrea marina and Z. japonica*) and macroalgae beds exist within Padilla Bay at the mouth of Joe Leary Slough. See Section 4.13 on Aquatic Habitat for more details on impacts to eelgrass and other nearshore aquatic habitats.

The freshwater emergent wetlands noted in the NWI maps appear to be matrix of low quality depressional wetlands in farmed fields. As these do not appear to be fed by a surface water connection, their inclusion within the bypass footprint is expected to be less impactful during construction. One larger emergent wetland would be bisected by the construction of the levee. The wetland is approximately 38 acres, with 18.3 acres inside the proposed JLS Bypass footprint. This wetland, similar to the other freshwater emergent wetlands, appears to be farmed. Activation of the channel could minimally impact the wetlands within the proposed bypass channel. At its peak, maximum velocities in the channel could reach 3-4 ft/s which would not be sufficient to cause erosion. Vegetation loss and soil loss would not be expected during the highest flows.

The one forested wetland (0.9 acres) within the footprint lies on the edge of the proposed alignment. If the alignment is not shifted, it is likely that this wetland would be largely filled by the levee construction as the wetland is only about 122 feet wide. As project design is finalized, it would potentially be modified to limit impacts to this wetland. Assuming that the levee alignment remains in its current location, the functions of this wetland would likely be lost, with only a small remnant of the wetland remaining.

Outside of the footprint, 18.4 acres of freshwater forested and shrub wetlands exist in the Sterling area at the confluence of the bypass channel with the Skagit River. These wetlands are outside the main channel footprint and are therefore not included in the impact calculation. This alternative would require the excavation landward of this wetland area for the inlet structure (Figure 4-4). This excavation would avoid the existing wetlands. Activation of the bypass would not affect these wetlands because the Sterling area would naturally fill with floodwaters before flowing into the bypass similar to current conditions.

Similar to the emergent wetlands, the freshwater ponds within the footprint appear to be isolated. Two of the ponds are adjacent to Joe Leary Slough, separated from the slough by the sea dike. Another pond is a shallower, sandy depression near the slough, but slightly farther inland. These would be impacted by the proposed excavation in this area. The last pond is a part of Gages Slough, near the inlet to the bypass.

Increasing agricultural runoff with activation of the bypass would not be expected to cause marsh plant impacts due to herbicide runoff. Several studies (Mayer and Elkins 1990, Bulthius and Shaw 1993, and Bulthius and Scott 1993) have looked at the effects of common pesticides, including various herbicides, on eelgrass, cordgrass (*Spartina alterniflora*), and other marsh plants. Runoff from the agricultural fields adjacent to Padilla Bay has been shown to contain minimal amounts of pesticides (Mayer and Elkins 1990) even during the rainfall immediately following application. Bulthius and Scott (1993) studied the application of glyphosate directly on marshes in Padilla Bay for control of the non-native cordgrass. Bulthius and Shaw (1993) looked at the effects of glyphosate application on eelgrass. These studies showed that glyphosate had no impact on eelgrass, cordgrass, saltgrass (*Distichlis spicata*) and pickleweed (*Salicorna Virginica)*, but did kill 75% of spear saltbush (*Atriplex patula*). Typically pesticide application occurs in mid-June to control weeds, insects, and fungi (Mayer and Elkins 1990). Timing of likely bypass activation in the fall and early winter could wash fertilizers applied to fields downstream into Padilla Bay. Overall, the amounts of any herbicide present in diverted floodwaters would be very dilute and limited effect to estuarine marshes would be expected.

The other JLS Bypass Alternative features such as nonstructural features or modifications to Baker Dam operations would have minimal effects to wetland habitat because the other features would either be located in an urban setting with little to no wetlands in their footprint or not be modify existing wetland habitat with operational changes.

During future design phase, wetland delineation would be conducted to determine the extent and function of wetlands affected by the JLS Bypass Alternative. To mitigate for this potential impact, this alternative would minimize the project footprint to maximum extent possible in later design phase, possibly construct a wetland complex at outlet structure, and most likely, purchase wetland mitigation credits from a local mitigation bank.

4.11.4.1 Cumulative Impacts to Wetland Habitat

Cumulative impacts would be similar to those described in the Section 4.11.2. This alternative, mostly likely, would not impact or compromise any of the completed or proposed restoration sites in the Basin. In addition, the amount of possible wetland fill attributed to this alternative would only slightly contribute to overall loss of wetlands in the Basin. Possible effects with this alternative due to climate change are the same as those described for the No Action Alternative, Section 4.11.2.

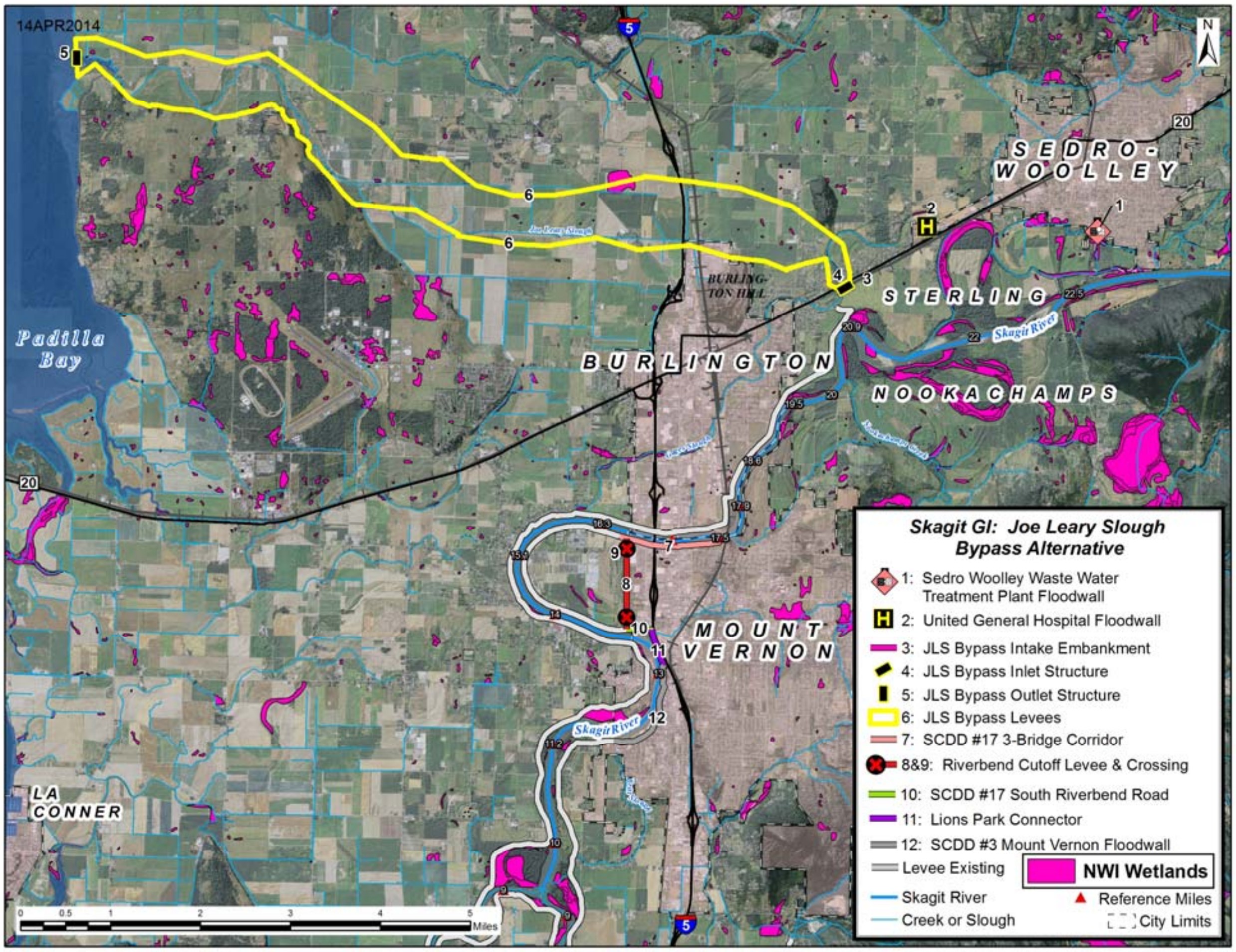

Figure 4-4: NWI Wetlands within the JLS Bypass Alternative Footprint

4.11.5 Swinomish Bypass Alternative

NWI maps show that there are 141.5 acres of wetland within the Swinomish Bypass footprint (Figure 4-5). These wetlands include 11 forested wetland (18.1 acres), 4 freshwater ponds (28.0 acres), 17 freshwater emergent wetlands (94.0 acres), and 1 estuarine wetlands (1.4 acres). The outlet of the Swinomish Bypass Alternative would flow into Telegraph Slough. The Telegraph Slough area is mapped in NWI as freshwater wetlands as it is largely cut off from tidal influence. Impacts including agricultural runoff to wetlands and possible mitigation would be the same as those impacts described in Section 4.7.4 JLS Bypass Alternative. The proposed Burlington Hill Cross Levee would have the same impacts to Gages Slough as described under the CULI Alternative in Section 4.7.3.

4.11.5.1 Cumulative Impacts to Wetland Habitat

Possible effects with this alternative due to cumulative impacts and climate change are the same as those described for the No Action Alternative in Section 4.11.2.

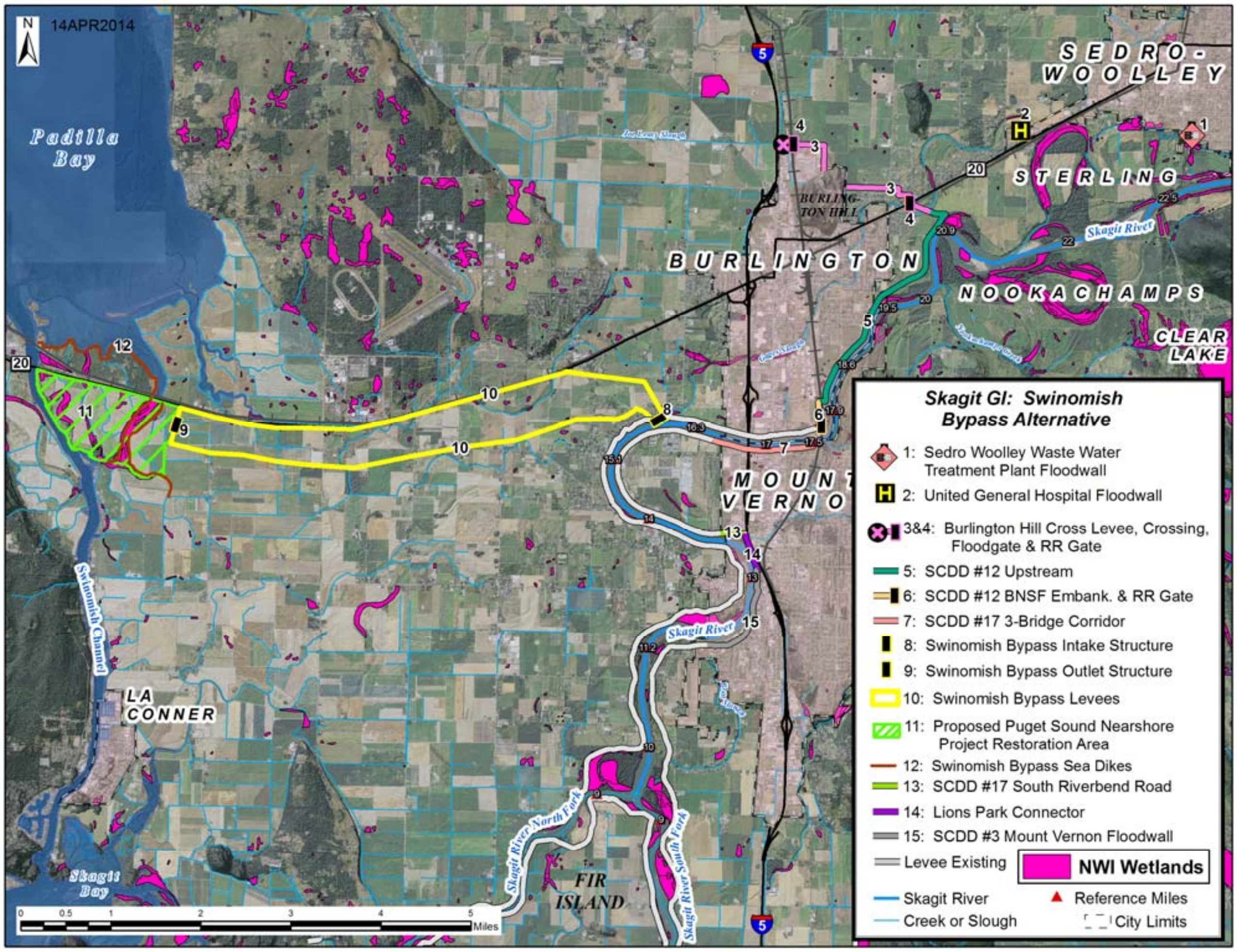

Figure 4-5: NWI Wetlands within Swinomish Bypass Alternative Footprint

4.12 Riparian Habitat

4.12.1 Affected Environment

Riparian habitat is defined by Washington Department of Fish and Wildlife (WDFW) as the area beginning at the ordinary high water line and extending to that portion of the terrestrial landscape that directly influences the aquatic ecosystem by providing shade, fine or large woody material, nutrients, organic and inorganic debris, terrestrial insects, or habitat for riparian-associated wildlife (Knutson and Naef 1997). WDFW includes the full extent of the floodplain as riparian habitat because that area significantly influences and is influenced by the waterway during flood events. Riparian habitat is identified as a WDFW Priority Habitat because it performs many functions that are essential to fish and wildlife and is critical in supporting the recovery of imperiled native salmonids (Knutson and Naef 1997).

Shade provided by forested riparian areas maintains cool water temperatures. Plant roots stabilize stream banks to control erosion and sedimentation. Vegetation contributes leaves, twigs, and insects to streams providing important nutrient inputs to the aquatic system. Large trees from functioning riparian habitats fall into the waterway and provide important refuge habitat for juvenile and adult fish. Riparian vegetation, litter layers, and soils filter incoming sediments and pollutants. Also, approximately 85% of Washington's terrestrial vertebrate species use riparian habitat for essential life activities (Knutson and Naef 1997).

The lower Skagit River Basin lies in the Eastern Puget Riverine Lowlands ecoregion (EPA 1996). This ecoregion is composed of floodplains and terraces, historically dominated by Western red cedar and Western hemlock forest. Riparian and riverine wetland habitats were common prior to European settlement. Pastures, cropland, and urban centers now dominate the landscape.

Today, the riparian zone downstream of Sedro-Woolley is greatly limited by the presence of levees that disconnect the floodplain from the river in the most frequent flood events. A riparian corridor along the existing levee system consists of patchy strips of small to medium sized cottonwood, willow, and alder. Along much of the South Fork of Skagit River, there is a healthy riparian corridor that provides a local supply of LWD. For further information on the land use within the floodplain protected by the levees, see Section 4.18. Approximately 56 miles of levees and 39 miles of sea dikes exist in the Skagit River delta (Halverson 1999), of which approximately 48 miles of levees participate in the USACE levee Rehabilitation and Inspection Program, also known as the PL 84-99 program. This program provides assistance to eligible non-Federal levee owners to repair flood damage. The program requires certain maintenance standards to retain program eligibility, including vegetation maintenance requirements. The required vegetation maintenance, coupled with the placement of levees closely adjacent to the river on both sides, has resulted in the majority of the levees being covered with grasses and invasive species (i.e. blackberry, knotweed, and reed canary grass). However in addition to willows and shrubs planted as mitigation for the 2011 Skagit Levee Rehabilitation Project, shrubs, small sized trees, and other vegetation grow along the majority of revetments. Downstream of Sedro-Woolley, from approximately RM 25, approximately 60% of riverbanks of the mainstem channel are hardened with riprap within about 200 feet of the channel's edge in an almost contiguous system of levees and revetments (Beamer et al. 2000).

A screening of riparian vegetation conditions in floodplain habitats throughout the Skagit basin found significant impairment in most of the reaches surveyed (Figure 4-6) (Beamer et al. 2000). Landscape alteration has resulted in a fragmented riparian zone on the lower mainstem that provides inadequate protection of habitats and refugia for sensitive aquatic species such as salmon. For further discussion on salmon and aquatic habitat, see Section 4.13 on Aquatic Habitat.

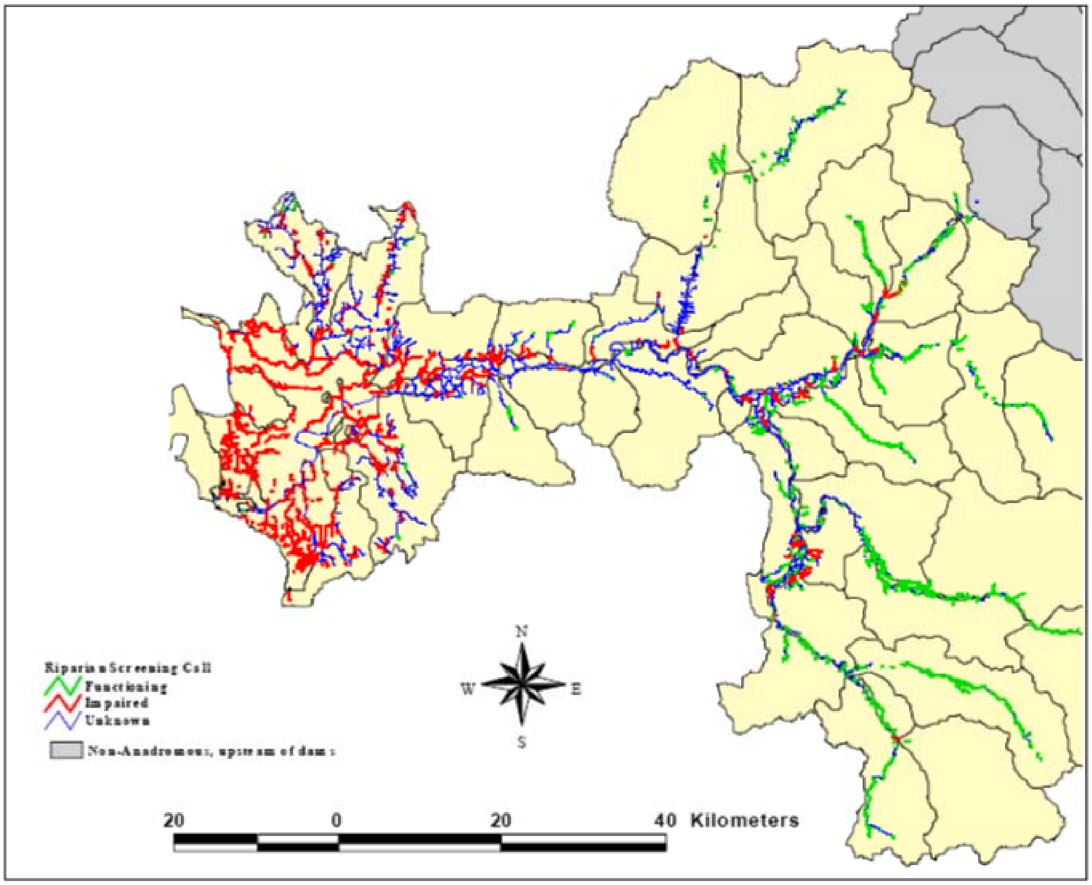

Figure 4-6. Riparian buffer function in the Skagit basin; based on Landsat data (Lunetta et al. 1997 in Beamer et al. 2000).

4.12.2 No Action Alternative

Riparian habitat in the lower basin will continue to be impacted by the presence of levees and bank protection projects adjacent to the river bank.

4.12.2.1 Cumulative Impacts to Riparian Habitat

Ongoing levee maintenance, i.e. vegetation removal and bank hardening, would be expected to continue in order to address deterioration of levees from potential damage and aging. These maintenance efforts will further fragment and limit riparian function. Loss of riparian vegetation in the Skagit basin would result in loss of wildlife and fish habitat, higher water temperatures, less organic and nutrient input to the river, and limited LWD recruitment. There are ongoing and future restoration efforts in the Basin that could offset some of these impacts.

Climate change may greatly alter the vegetation communities in the Skagit basin. Increased winter precipitation and summer drought, longer growing seasons, and warmer temperatures may result in changes in plant species composition and increased pest populations affecting agricultural crops (SCSC 2012). Invasive species may proliferate and fill previously unaffected niches as native species are stressed and displaced by more generalist species. Climate change could also increase the frequency and intensity of flood events (SCSC 2012). This would be expected to require more frequent levee and revetment repairs and more diligent vegetation management; both actions would further reduce riparian function.

4.12.3 Comprehensive Urban Levee Improvement Alternative

As mentioned in the Section 4.12.1 (Riparian Habitat, Affected Environment), the existing riparian corridor is patchy and mostly devoid of large trees along the River due to the existing levees. Effects to riparian habitat would be exacerbated with this alternative. Along the Skagit River, approximately 9 miles (47,520 ft) of levees would be raised and approximately 0.4 miles (2,300 ft) of floodwall would be constructed (Figure 3-12 in Section 3.8.2). The typical levee profile would remain unchanged riverward of the crown wherever practical; levee raise would increase the elevation of the crown and build out the landward slope at the existing grade or gentler, except of the SCDD #12 BNSF Embankment. This segment of the levee raise would build out the levee slope in the riverward direction. At this site, adjacent to the SCDD #12 BNSF Embankment is East Whitmarsh Road and a soccer field towards the River. In addition, there is a riparian buffer, ranging from approximately 140 to 300 ft wide. The levee raise is not expected to disturb the riparian buffer except for small section at the southern end of the buffer. However this section would not be adjacent to the river and roughly a 170 ft wide buffer would remain. Proposed toe protection would place riprap along the existing revetment as described in Section 3.8.2. The existing vegetation along the revetments would be removed where the riprap is placed. Substantial effects to riparian habitat, therefore, would potentially occur; the greater length of toe protection, the greater the impact.

The Lions Park Connector would construct a floodwall riverward of Freeway Drive, resulting in approximately 0.7 acres of vegetation including medium to large trees to be removed. There would still be approximately a 100 ft buffer of vegetation including trees between the river and vegetation free zone of the floodwall.

The other CULI Alternative features such as nonstructural features or modifications to Baker Dam operations would have minimal effects to riparian habitat because the alternative features would either be located away from the River with no riparian habitat in their footprint or not modify existing riparian habitat with operational changes. Ongoing levee maintenance, i.e. vegetation removal, would be expected to continue and would maintain the existing condition of an improperly functioning riparian corridor.

4.12.3.1 Cumulative Impacts to Riparian Habitat

Cumulative impacts would be similar to those described in the No Action Alternative, Section 4.12.2. This alternative, mostly likely, would not impact or compromise any of the completed or proposed restoration sites in the Basin. In addition, the effect to riparian habitat attributed to this alternative would only slightly contribute to overall loss of riparian habitat in the Basin. Possible effects with this alternative due to climate change are the same as those described for the No Action Alternative, Section 4.12.2.

4.12.4 Joe Leary Slough Bypass Alternative

Under the JLS Bypass Alternative, the effects to riparian habitat associated with the levee raise features along the River (SCDD #17 3-Bridge Corridor, SCDD #17 South Riverbend Road, and SCDD #1 West

Mount Vernon), toe protection, floodwalls, nonstructural features, and modification to dam operations would be similar to those described in Section 4.9.3 (CULI Alternative). Adverse effects to riparian habitat in the footprint of the Bypass are expected occur. The levees that form the Bypass could result in the removal of approximately 3 miles of trees along the base of Bay View Ridge. Joe Leary Slough, itself, is largely devoid of riparian habitat. For the majority of the slough, farming occurs up to the edge of the slough which does not allow for riparian habitat. This condition would continue into the future to ensure proper function of the bypass.

At the inlet structure, vegetation including shrubs and small to medium trees would be removed for the installation of the JLS Bypass intake embankment and inlet structure. Currently, this vegetation does provide some riparian habitat function for Gages Slough. The installation of the outlet structure would result in the removal of vegetation, mainly grasses, shrubs, and small trees. In addition, the design includes excavation from just east of Farm to Market Road to the outlet structure which would remove all vegetation within the excavated area.

To lessen these potential impacts to riparian vegetation, this alternative would minimize the project footprint to maximum extent possible in later design phase. As mentioned in Section 4.11 (Wetlands Habitat), a wetland complex at outlet structure could be constructed to offset wetland impacts; this would also offset the loss of riparian vegetation.

4.12.4.1 Cumulative Impacts to Riparian Habitat

Cumulative impacts would be similar to those described in Section 4.11.2, No Action Alternative. Possible effects with this alternative due to climate change are the same as those described for the No Action Alternative, Section 4.7.2.

4.12.5 Swinomish Bypass Alternative

Under the Swinomish Bypass Alternative, the effects to riparian habitat associated with the levee raise features along the River (SCDD #17 3-Bridge Corridor and SCDD #17 South Riverbend Road), toe protection, floodwalls, nonstructural features, and modification to dam operations would be similar to those described in Section 4.12.3, CULI Alternative. Adverse effects to riparian habitat in the footprint of the Bypass are expected occur at the outlet structure. Installation of this structure would result in the removal of vegetation at Telegraph Slough.

4.12.5.1 Cumulative Impacts to Riparian Habitat

This alternative would result in similar impacts associated with climate change and cumulative impacts as discussed in Section 4.12.2 No Action Alternative.

4.13 Aquatic Habitat

This section covers the components of aquatic habitat in the freshwater, estuarine, and marine environment. For the purposes of this report, aquatic habitat is defined as habitat that is submerged most of the time and is used by aquatic organisms such as fish and benthic invertebrates. Therefore, wetlands, both freshwater and estuarine, are covered in a separate section, but components of those wetland such as distributary channels, are classified as aquatic habitat. Below is a discussion of such habitat in the Skagit River Basin.

4.13.1 Affected Environment

4.13.1.1 Large Woody Debris (LWD)

Naiman and Decamps (1997) found that LWD plays a significant role in stream bank stabilization particularly in headwater streams. LWD also creates microhabitat and pool formation, provides natural stream bank protection, dissipates flow, stores sediment, provides a platform for vegetation recruitment, and is a source of organic input. These structures provide refuge from predators and high flows, as well as egg attachment for fish, and foraging platforms for wildlife (Hood 2007a). In the upper reaches of the Skagit River, there is no transport of LWD from above the dams by either natural or human processes. LWD is common in the middle reach (RM 19 – RM 78), both in water and as recruitable trees. Large concentrations of LWD can be found at the upstream end of islands, such as those between the towns of Sedro Woolley and Lyman, or at the entrance to side channels. Assessment of LWD in the lower Skagit River indicates that there is a lack of large wood in the system (Hood 2007a). While LWD is generated in large quantities in the upper basin, there are few areas in the lower reaches (RM 19 – RM 8) where the LWD can become anchored to the bank due to the predominance of smooth banks (riprap) and removal of LWD through flood fight efforts. There are a few localized areas in the lower reach, such as Freshwater Slough, where LWD collects. Numerous installations of log clusters occur along the river banks near Interstate 5 as mitigation for the USACE PL84-99 program (levee repair).

4.13.1.2 Off-Channel Habitat and Tidal and Distributary Channels

Over the last century the Skagit River has lost a large proportion of its off-channel habitat due to the diking of the river and land use practices; most of this loss has been in the lower Skagit Basin in the floodplain and delta area (Beechie 1994 et al., Collins and Sheikh 2002). Many beaver ponds, side channels, and sloughs once used by salmon have been disconnected from the main river channel as a result of diking and other agricultural practices and bank revetments. In the last century, the Skagit basin has lost approximately 80 percent of historic estuarine delta habitat, including a loss of 35 percent of estuarine mixing habitat, 98 percent of oligohaline transitional habitat, and 89 percent of its freshwater tidal habitat (Simenstad et al. 2011). The lower Skagit basin has lost approximately 45 percent of the historic side slough habitat (424,200 m^2) that provided critical rearing and refuge functions in the floodplain (Beechie et al. 1994). The Skagit delta has lost approximately 75 percent of its distributary channel habitat (Beechie et al. 2001). A reduction in the number of side channels and sloughs, changes and reductions in the quality of riparian vegetation, and a reduction in the number of high quality stream channel pools has significantly reduced the amount of available refugia for juvenile salmonids.

In general, off-channel habitat becomes increasingly scarce further up into the watershed due to increases in the slope of the valley walls and gradient of the river. Upstream of the town of Concrete, there is a braided section of river before the river morphology transitions almost solely to primary channel extending up to Diablo, Gorges, and Ross dams. Sections of braided channel and secondary off-channel habitat are present between the towns of Concrete and Sedro Woolley, with increasing occurrence as the river progresses downstream. Agriculture does occur along the banks of the Skagit River above Sedro

Woolley and it is likely that some off-channel habitat has been lost as a result. In the upper portions of the watershed, much of the off-channel habitat has been lost due to augmentation of flows by the dams (Smith 2005).

Distributary channels are the dendritic branching of the river in the estuary. They are driven by a combination of riverine and tidal forces. Tidal channels are largely formed by tidal action and are not necessarily directly connected with a river. The Skagit River delta was once a complex mosaic of distributary and tidal channels that weaved through estuarine wetlands and mudflats, maintaining a sediment source to these areas and providing habitat for a variety of aquatic organisms. Diking in the estuary has lead to a substantial decline in these habitat types, although some remains, particularly on the South Fork (Figure 4-7).

Figure 4-7. Remnant Distributary and Tidal Channels of the South Fork of the Skagit River

Diking of the river has both cut off and/or filled distributary and tidal channels in the Skagit Estuary, and also changed the processes that lead to the formation of such habitat types, including erosion and accretion patterns and sediment transport. Cutting off of distributary channels from the river has also affected the marshes, essentially starving them of sediment. This is particularly evident in the marsh fringe area between the North and South Forks (Hood 2007b).

4.13.1.3 Submerged Marine Vegetation

Eelgrass and kelp dominate the shallow sub-tidal zones of many areas of Puget Sound. They are of high ecological value, providing three dimensional habitat for diverse communities of invertebrates, shelter and refugia for commercial species like Dungeness crab and salmon, and a significant source of primary production in nearshore waters. Eelgrass (*Zostrea marina and Z. japonica*) beds function as valuable nursery habitat for both juvenile salmon and rockfish and as foraging grounds for waterfowl and marine birds (Mumford 2007 and PBNERR 2008). Biodiversity in eelgrass beds increases during high tides. In the Skagit River Basin there are eelgrass beds at intertidal and subtidal elevations between the north and south forks and north of the North Fork in Skagit Bay (McBride et. al 2006), as well as in Padilla Bay. In Skagit Bay eelgrass bed distribution is disturbed and patchy in front of the North and South Forks from the diking of the lower river, resulting from the starving of deltaic wetlands of sediment and displacing it into Skagit Bay (Grossman 2012).

The extensive eelgrass beds in Padilla Bay compose the largest contiguous eelgrass meadow in the State of Washington (approximately 7,500 acres), and one of the largest on the west coast (Bulthuis et al. 2006). Padilla Bay is designated as National Estuarine Research Reserve and, based on this status, has strict guidelines regarding its management and protection. Historically Padilla Bay was connected to the Skagit River via a complex of wetlands and distributary channels. However, diking of the river and the bay for agriculture and development now prevents normal river flows from entering the bay (PBNERR 2008). Sediment cores of the Bay showed that there were not large sediment inputs historically and it was of a composition that supported eelgrass beds (Grossman et al., In Review, McGann et al., 2012, Czuba et al., 2011, and Grossman et al., 2011). Current sources of freshwater input to Padilla Bay come from a series of sloughs that drain agricultural areas, including Telegraph, Indian, and Joe Leary Sloughs, but it is a fraction of the input received from the Skagit River prior to diking. During high flood events water from the Skagit River will still make its way to Padilla Bay and its eelgrass beds. In any given year there is a two percent chance (or once every 50 years) that water will overtop the levees on the north side of the river, eventually making its way to Padilla Bay via Telegraph and Joe Leary Sloughs (Eriksen, pers. comm. 2013). This floodwater also moves towards Swinomish Slough and the north end of Skagit Bay. The majority of this overtopping would occur between river miles 17 and 22. In the event of a downstream breach of a levee on the north bank, this chance can increase or decrease depending on where the breach is and where the pathway of drainage goes (in some cases the pathway is to Skagit Bay and others it is to Padilla Bay). However, a breach of the levee system is rare; occurring only a few times in the past century.

Kelp and other marine algae (seaweeds) is sparse both Skagit and Padilla Bays due to its dependence on larger substrate for attachment, except in a few areas with riprap and other larger substrate. Floating kelp (*Nereocystis luetkeana*) is patchily distributed along portions of the Swinomish Channel (WDNR 2006). Sea lettuce (*Ulva spp.*) is present in roughly 3% of Padilla Bay (Bluthuis 1991).

4.13.2 No Action Alternative

4.13.2.1 Large Woody Debris

LWD recruitment would remain low, assuming USACE implementation of levee vegetation standards and lack of bank diversity for LWD to recruit to. Lack of LWD would result in loss of wildlife and fish habitat, higher water temperatures, less organic river input, which fuels the food chain, and increases in the presence of invasive species like blackberry and knotweed. Reductions in LWD would also contribute to long-term adverse impacts to essential habitat for fish and macro invertebrates and reduced protection of plant propagules from erosion, abrasion, drought and herbivory (Naiman and Decamps, 1997). Presence of LWD may also indirectly affect nitrogen dynamics in conjunction with the LWD dependent, nitrogen fixing shrub Myrica gale (Hood 2007a).

4.13.2.2 Off-Channel Habitat and Distributary and Tidal Channels

The off-channel habitat and distributary and tidal channel loss seen over the last century in the Skagit River due to diking of the river and strong presence of agricultural practices in the lower Skagit Basin floodplain and delta areas is expected to remain as is. Several restoration projects are underway in the lower estuary, which may offset continued losses. Sea level rise coupled with increased storm surge and more intense and frequent flood events could shift the zonation of tidal wetlands landward. However, in much of the delta there is simply no room to migrate due diking and agriculture. This could result in a further long term negative impacts with the loss of these habitat types in the lower portions of the estuary.

4.13.2.3 Submerged Marine Vegetation

It is unclear what the future conditions and distribution of kelp and eelgrass beds will be in the Puget Sound region given variables like increased development from population growth, climate change, sea level rise, and ocean acidification. Factors influencing future eelgrass bed distribution in the Skagit River Delta and Padilla Bay include sediment erosion and accretion, storm surge, sea-level rise, geologic uplift/subsidence, land use practices, flood event frequency, and allowance for these ecotypes to shift landward (Hood 2012). Research has shown that Padilla Bay has an average elevation change of -0.22 cm per year (Rybczyk 2012). Combined with projected sea level rise, depths within the bay may be too deep to sustain eelgrass, particularly in the deeper areas. Padilla Bay is also confined by diking and uplands, making inland migration of eelgrass beds unlikely. Continued negative water quality impact issues associated with agricultural runoff from the surrounding sloughs could exasperate the decline of eelgrass in Padilla Bay. In Skagit Bay there has been a progradation of the delta towards Whidbey Island since diking occurred in the late 1800s, with the channel shifting towards Whidbey Island. This change in morphology of the Bay is a direct result of sediment bypasses the floodplain and wetlands and depositing on Skagit Bay (Grossman 2012). As the sea levels rise in Skagit Bay this progradation may offset impacts to eelgrass beds and they have more room to migrate landward to areas where salt marsh currently exists. However, they would still be limited by the extensive diking system that surrounds much of the delta, as well as water quality issues from agricultural run-off.

Increased flooding events from climate change could also lead to a decline in eelgrass meadows as more freshwater, sediment, and agricultural runoff flows into the bays. Initial projections from models in the Skagit River Basin have indicated that large flood events (50 to 100 year events) could increase given the predictions associated with climate change (see climate change section of Section 4.5, Hydrology and Hydraulics).

4.13.2.4 Cumulative Impacts to Aquatic Habitat

Cumulative impacts including climate change would be similar to those described above.

4.13.3 Comprehensive Urban Levee Improvement Alternative

4.13.3.1 Large Woody Debris

Impacts to large woody debris from this alternative would be minimal, since the majority of the footprint involves improvement to existing levees that have little structure or opportunity for LWD recruitment. There are a few areas where there are sources of LWD, opportunity for recruitment, and a levee improvement or new levee is needed. However work in these areas is designed to shift landward and proper mitigation would occur for any impacts of water ward work and associated impacts to LWD. Mitigation for impacts to LWD could include installation of logjams and planting riparian vegetation, including large trees, in areas where there is sufficient waterward room for such features per USACE policy on levee safety. Preliminary calculations show that these types of structures and or plantings could be installed in 44% of the total project footprint length.

4.13.3.2 Off-Channel Habitat and Distributary and Tidal Channels

Direct negative impacts to off-channel habitat would be minimal since the majority of the footprint involves improving levees through the urban corridor that are already in place. There is one location that has the potential to negatively impact off-channel habitat where a new floodwall would be installed along Freeway Drive at Lion's gate Park. A small tributary enters the mainstem Skagit at this located via a culvert under Freeway Drive and I5. However, this structure would be set back from the river and designed with a culvert crossing the tributary that meets juvenile fish passage criteria for WDFW, so impacts would be minimal. Expansion of the levees' footprint to accommodate a greater level of protection are expected to shift landward, not riverward, so no filling of off-channel habitat is expected nor cutting off of existing connections of such habitat, largely because it lacking in this section of river. There is a potential to impact off-channel habitat both above and below the urban corridor by way of raising water levels within the river and preventing flooding on the flood plain. This alternative is designed to contain the 100 year flood (1% chance in any given year) within the channel in the urban section of the river by improving the condition of the levees, whereas under existing condition there is a 4% chance in any given year of water discharging into the floodplain from a failure in the system (Eriksen pers. comm. 2013). Additional water within the channel during flood events would lead to deeper water inundating shallow water habitat. This additional water during flood events could change at the micro-habitat level by carrying more sediment and increased velocities, although hydraulic models show only minor changes as an average across the river. Microhabitat could scour and/or filling in, and off-channel habitat conditions could worsen. Changes in tidal and distributary channel formation are not expected

4.13.3.3 Submerged Marine Vegetation

Primary impacts from this alternative would be to eelgrass beds in Skagit Bay. There is little kelp in Skagit Bay, so impacts to such habitat would be minimal (McBride 2006). Under this alternative floodwaters would stay contained within the mainstem throughout the urban corridor for up to a 100 year event. Under existing condition water from the urban corridor enters into the floodplains roughly every 25 years. There would still be flooding downstream of the urban corridor, but the additional floodwater would inevitably carry more sediment to the Skagit Bay. Since velocities would not change in the lower river and estuary from existing conditions (due to flooding in the western floodplain outside the urban areas) this alternative would likely not impact eelgrass beds in Skagit Bay.

4.13.3.4 Cumulative Impacts to Aquatic Habitat

There would be no cumulative impacts to LWD, tidal and distributary channels, or marine submerged vegetation from this alternative due to the minimal impacts to these resources. Little LWD occurs in the urban corridor and excess flood waters would still flow across the western floodplain, not towards the delta. Cumulative impacts to off-channel habitat would derive from increases in channel depth and associated inundation combined with the extensive diking of the Skagit River that has already led to the loss of much of this habitat in the system, particularly through the urban corridor. Climate change could exacerbate these impacts by way of more frequent and intense flood events, greater storm surge, and sea level rise, thereby increasing depths and frequencies of inundation of any remaining off-channel habitat. Mitigation associated with this alternative and ongoing restoration efforts in the basin my help to offset these cumulative effects to off-channel habitat.

4.13.4 Joe Leary Slough Bypass Alternative

4.13.4.1 Large Woody Debris

No significant adverse impacts to large woody debris, either as sources or recruitment potential along the banks, are anticipated under this alternative. It is possible that debris could accumulate on the diversion structure during a flood event and would need to be removed manually, thereby reducing recruitment potential in the system. However, given few places remain in the lower river for logs to get hung up on and the relative infrequency of flood events that would activate the bypass channels (higher than 25 year events) woody debris recruitment in the lower Skagit would likely remain similar to the No Action Alternative. Impacts to LWD associated with the levee improvements needed for this alternative are similar to those discussed for the CULI Alternative, but less so since there is significantly less linear feet of needed levee improvement.

4.13.4.2 Off-Channel Habitat and Distributary and Tidal Channels

Since there is little off-channel habitat in the mainstem below Sedro Woolley it is not likely there would be any substantial adverse impacts associated with this alternative. Diverting flood waters into the bypass would decrease water levels downstream and potentially increase shallow water refuge in any remaining off-channel habitat during flooding events, as compared to the No Action Alternative where more flood water is kept in the mainstem resulting in deeper water throughout the system. The floodwall at Lion's Park is also part of this alternative, but as stated for the CULI Alternative, it would be designed for juvenile fish passage. None of the other levee improvements associated with this alternative overlap with off-channel habitat.

There are few distributary channels in Padilla Bay due to lack of freshwater input, therefore primary impacts would be to tidal channels formation. The large pulses of freshwater and its associated sediment from the Skagit River and erosion of exposed soil in the bypass channel could erode or fill in tidal channels depending on their proximity to the bypass outlet. In the hydraulic analysis there is an assumption that all land within the bypass channel would be planted with sufficient cover to withstand erosive forces of the water. However, this is difficult to enforce and it is likely that some areas would be bare soil or have insufficient cover. Some of this sediment may settle within the bypass channels, but some would also be delivered to Padilla Bay. Therefore changes in sediment patterns in Padilla Bay, both as scour at the outlet of the bypass and deposition elsewhere, are expected. The extent of impacts in remains unknown and depends on the ability of the tidal channels to recover from infrequent events (higher than a 25 year event, which translates to a 4% chance in any given year).

4.13.4.3 Submerged Marine Vegetation

Primary impacts of this alternative would be to eelgrass bed in Padilla Bay, of which the bypass enters on the northeast shoreline. There is little kelp in Padilla Bay, other than occasional sea lettuce, which does well under altered conditions. Flows from the Skagit River will enter the bypass above a 4% ACE event, with flows as high as 87,000 cfs for up to 40 hours during a 1% ACE flood event. This is roughly twice as much as what flows towards Padilla Bay for a 100 year event under existing conditions. As water enters the bypass channel it will pool up behind a tide gate structure and then spill into the Bay. There may scour at the outlet, although the extent has not been modeled, but it could disrupt and/or damage the root mass of the eelgrass beds in the adjacent areas. These large volumes of water in the bypass would carry sediment from the Skagit River and has the potential to move sediment within the bypass channel, if there are areas within the bypass channel that have exposed soil or insufficient cover; depositing it into Padilla Bay. Deposition of sediment beyond the scour zone may bury eelgrass beds inhibiting its ability to photosynthesize. The intensity of the impacts of scour and sedimentation and the resiliency of the eelgrass beds is unknown given how infrequent the bypass would be activated (higher than a 4% ACE). Sea level rise may play an important role in the severity of the impact of additional sediment deposition in the Bay. Given that Padilla Bay has been shown to be subsiding (Rybczyk 2012), additional sediment from the bypass could help maintain the Bay’s current elevation, thus preventing water depths that are too deep to sustain eelgrass. However, short, infrequent diversions of tens of thousands of cfs of flood water via a confined channel may cause more damage to the bay due to erosion at the outlet and smothering beyond. A more consistent and controlled source of sediment would better benefit Padilla Bay against rising seas without the aforementioned impacts.

Another potential affect to eelgrass beds would be from concentrated sources agricultural run off: both in the form of fertilizers and pesticides. However, these chemicals are typically applied in the late spring and do not coincide with the flooding season in November and December when the bypass channel would be activated. Under existing conditions minimal amounts of pesticides runoff have been found in Padilla Bay (Mayer and Elkins 1990), even during the rainfall immediately following application. Although detectable amounts of certain pesticides were found in the surrounding sloughs following a rain event, it was still at level well below what has been demonstrated to affect eelgrass growth. Another study found that application of glyphosate had no impact on eelgrass (Bulthius and Shaw 1993). The runoff under existing conditions is significantly less than what the bypass channel would produce, but given the very low likelihood that the bypass channels would be activated during the application season (spring/summer) and the infrequency of flood events impacts from pesticide runoff is expected to be minimal. Runoff from fertilizers in the form of excess nutrients could result in algal blooms, but given the typical flood season is during November and December and the low levels of sunlight during this time, it is unlikely. As these nutrients accumulate in the sediment they could either provide a benefit to native eelgrass beds or give a competitive advantage to more tolerant species like sea lettuce or non-native species such as Japanese eelgrass (*Zostrea japonica*) or *Spartina)*.

Freshwater input, and the eelgrass’ ability to tolerate changes in salinity, could also influence the health of Padilla Bay’s eelgrass beds. This is less of concern then sediment and associated run-off since eelgrass can tolerate salinities as low as 5ppt (Short 2008, Grossman pers. comm. 2013). Literature suggests that extended periods of low salinities during the growing season can likely result in reduced growth and abundance of eelgrass beds (Short 2008). However, given that it is highly unlikely that the bypass channels would be activated during the growing season (spring and summer months) coupled with the infrequency of flood events in general, impacts of low salinities to eelgrass beds in Padilla Bay is expected to be minimal.

4.13.4.4 Cumulative Impacts to Aquatic Habitat

There would be no cumulative impacts to LWD and off-channel habitat on the mainstem associated with this alternative since there are little to no impacts to these resources. For tidal channels and eelgrass beds in Padilla Bay cumulative impacts would result from runoff from ongoing landuse practices via the major sloughs and agricultural ditches combined with increased sedimentation and run-off from the Skagit River via the bypass channel. Sea level rise may lessen these impacts (more sediment delivery to maintain elevations with rising seas), but climate change could exacerbate them. It is predicted that climate change will produce more frequent and intense flood events (Hamlet 2012). This could lead to the bypass activating more often than a 25 year event, potentially earlier in the season, and discharging larger volumes of water in Padilla Bay at all events for a longer duration. The extent of this change is not known since there has been no model runs for this bypass under the various climate change scenarios. These more frequent and intense flood events would place additional pressures on the eelgrass beds in the form of scour, sedimentation, and excess agricultural run-off.

4.13.5 Swinomish Bypass Alternative

4.13.5.1 Large Woody Debris

Like the JLS bypass no significant adverse impacts to large woody debris, either as sources or recruitment potential, are anticipated under this alternative. It is possible that debris could accumulate on the diversion structure during a flood event and would need to be removed manually thereby reducing recruitment potential in the system. However, given few places remain in the lower river for logs to get hung up on and the relative infrequency of flood events that would activate the bypass channels (higher than 25 year events) woody debris recruitment in the lower Skagit would likely remain similar to the No Action Alternative. Impacts associated with the levees improvement needed for this alternative are similar to those discussed for the CULI Alternative, but less so since there is significantly less linear feet of needed levee improvement. Impacts to LWD associated with the levee improvements needed for this alternative are similar to those discussed for the CULI Alternative, but less so since there is significantly less linear feet of needed levee improvement.

4.13.5.2 Off-Channel Habitat and Tidal Channels

Since there is little off-channel habitat in the mainstem below Sedro Woolley it is not likely there would be significant adverse impacts associated with this alternative. The floodwall at Lion's Park is also part of this alternative, but as stated for the CULI Alternative, it would be designed for juvenile fish passage. Diverting flood waters into the bypass would decrease water levels downstream and potentially increase shallow water refuge in any remaining off-channel habitat during flooding events as compared to the No Action Alternative, where more flood water is kept in the mainstem resulting in deeper water throughout. The additional water that is sent to the Swinomish Channel and Telegraph Slough, and associated changes in scour and sedimentation patterns, would likely impact off-channel habitat in the area. Although no sediment modeling has been done, scour at the outlet of the bypass channel and sedimentation in other areas could result in substantial adverse impacts. Like the JLS Bypass Alternative, this alternative also assumes that there could be areas within the bypass that are not planted or have insufficient cover. These areas could erode due to the high volumes of water that are anticipated in the bypasses, and, combined with sediment from the Skagit River, would ultimately result in more sediment being deposited in Telegraph Slough and its surrounding tidal channels..

Impacts to tidal channels in Padilla Bay would be similar to those described for the JLS Bypass Alternative, but less so due to the buffering effect of the wetlands surrounding Telegraph Slough.

4.13.5.3 Submerged Marine Vegetation

Impacts to submerged marine vegetation would be similar to those described for the JLS Bypass but to a lesser extent. The outlet of this bypass enters the area surrounding Telegraph Slough, a proposed USACE restoration project that consists of 832 acres of tidally influenced wetlands. This large wetland would largely "take the brunt" of the bypass channel; absorbing much of the force and scour of the water, along with its sediment and run-off. See Section 4.11 (Wetlands Habitat), for a discussion on impacts to the wetlands of Telegraph Slough. It is possible that some of the flow would enter Padilla Bay directly, via Telegraph Slough, but much of the flow would likely disperse into the surrounding wetlands. Unlike the JLS Bypass, the Swinomish Bypass has potential to impact the Swinomish Channel, which contains patchily distributed kelp beds. These kelp beds could suffer from excess sedimentation and freshwater input when the channel in activated. However, as stated previously, much of the zone of impact would be in the wetlands surrounding Telegraph Slough.

4.13.5.4 Cumulative Impacts to Aquatic Habitat

There would be no cumulative impacts associated with this alternative to LWD or off-channel habitat in the mainstem since there in little to no impacts to these resources. Cumulative impacts to tidal channels and eelgrass beds in Padilla Bay are similar to those described for the JLS Bypass Alternative but less so due to the buffering effects of the wetlands surrounding Telegraph Slough. Cumulative impacts to Telegraph Slough would derive from the increased sedimentation and/or erosion in the slough when the bypass channel is activated combined with the run-off from the surrounding agricultural fields that drain into the slough via Higgins Slough and agricultural ditches. Cumulative impacts to kelp in Swinomish Channel would also derive from sediment and freshwater from the bypass channel combined with other sources run-off into the channel. Impacts of sea level rise and climate change would be similar to those described for JLS.

4.14 Wildlife and Fish

4.14.1 Existing Conditions

4.14.1.1 Wildlife

Large mammals found in the Upper Skagit Basin include elk (*Cervus canadensis*), black-tailed deer (*Odocoileus hemionus columbianus*), black bear (*Ursus americanus*), mountain lion (*Puma concolor*), coyote (*Canis latrans*), mountain goat (*Oreamnos americanus*), and North American wolverine (*Gulo gulo luscus*, a candidate species under ESA). Federally listed grizzly bear (*Urus arctos horribilis*), gray wolf (*Canis lupus*), and Canada lynx (*Lynx canadensis*) could also inhabit the area. Some large upland mammals, such as black tailed deer, can be found on Hart Island and are occasional visitors to the estuary, although they are more common in the upper watershed. Smaller mammals such as raccoon (*Procyon lotor*), American marten (*Martes americana*) and fisher (*Martes pennanti*, a candidate species under ESA) also utilize the Skagit basin. Semi aquatic mammals such as muskrat (*Ondatra zibethicus*), mink (*Neovison vison*), river otter (*Lontra canadensis*) and beaver (*Castor canadensis*) inhabit the river, tributaries and sloughs. Harbor seals (*Phoca vitulina*) are common in both Padilla and Skagit Bay. Common small mammals include Townsend chipmunks (*Neotamias townsendii*), trowbridge shrew (*Sorex trowbridgii*), deer mouse (*Peromyscus* sp.), snowshoe hare (*Lepus americanus*), Douglas squirrel (*Tamiasciurus douglasii*), and a variety of bats (*Chiroptera*). In addition, nutria (*Myocastor coypus*), a destructive, semi-aquatic, non-native rodent, are present in the Skagit Valley. Nutria can burrow into levees and dikes, potentially causing severe damage.

Puget Sound is host to numerous marine mammals, many of which can use the bays and delta of the project area. Common marine mammals include Pacific harbor seals, Northern elephant seals (*Mirounga angustirostris*), California sea lion (*Zalophus californianus*), harbor porpoise (*Phocoena phocoena*), Dall's porpoise (*Phocoenides dalli*), gray whale (*Eschrichtius robustus*), and minke whale (*Balaenoptera acutuorostrata*). One marine mammal commonly found in Puget Sound is listed under the Endangered Species Act: southern resident killer whale (*Orcinus orca*). For further information on killer whale, see Section 4.15 (Threatened and Endangered Species). While the larger whales are restricted to deeper waters, many of the seal and sea lions use the estuarine marsh islands as haul outs in both Skagit and Padilla Bays.

The Skagit River Delta area is an important waterfowl wintering area due to the mild climate and available habitats, including marshes, intertidal flats, and adjacent agricultural fields. It is an important stopping point for migratory birds along the Pacific Flyway. Numerous species of birds use the Skagit Basin as either over-wintering grounds or as permanent residents including raptors, waterfowl, shorebirds, game birds, and songbirds. Federally listed marbled murrelets (*Brachyramphus marmoratus*) and northern spotted owls (*Strix occidentalis caurina*) also utilize the forests of the Upper Skagit (see Section 4.15 (Threatened and Endangered Species) for more details).

Wintering waterfowl common along the area sloughs in Skagit Bay and upland on farms during the peak months of October and November include ducks, geese, and swans. Dabbling ducks, such as mallard (*Anas platyrhynchos*), pintail (*A. acuta*), American widgeon (*A. americana*), and green-winged teal (*A. carolinensis*) are numerous, and utilize estuarine, riparian habitat, and agricultural areas. Snow geese (*Chen caerulescens*) overwinter in very large numbers in the Skagit basin. Trumpeter swans (*Cygnus buccinators*) and tundra swans (*C. columbianus*) also visit the area.

Wading birds, such as great blue heron (*Ardea herodias*), utilize the estuary areas year round. Shorebirds use flooded agricultural fields and estuaries mainly during migration and as over-wintering habitat. Dunlin (*Calidris alpina*) and black bellied plover (*Pluvialis squatarola*) winter in the Skagit delta.

Several species of birds of prey are found in the project area including bald eagle (*Haliaeetus leucocephalus*), red-tailed hawk (*Buteo jamaicensis*), rough-legged hawk (B. *lagopus*; winter only), Northern harrier (*Circus cyaneus*), gyrfalcon (*Falco rusticolus*; winter only), peregrine falcon (*F. peregrinus*), merlin (*F. columbarius*), Coopers hawk (*Accipiter cooperii*), sharp-shinned hawk (*A.* striatus), and osprey (*Pandion haliaetus*).

Many bald eagles migrate into the area to overwinter along the Skagit River. In general, the bald eagle wintering season extends from November through late January, peaking from 25 December through 14 January. The eagles are drawn to the area by the large numbers of spawned out salmon, with eagle numbers peaking about two weeks after spawning completes. Skagit eagle counts in the upper basin conducted by the Skagit River Bald Eagle Awareness Team (2013) showed that numbers peaked in January 2007 at around 859; however, the December 2012 counts showed a more typical peak of 321. Resident bald eagles also occur in the Skagit Basin. Bald eagle nesting typically occurs between early January and mid-August.

Reptile and amphibian species in the Upper Skagit basin include the rubber boa (*Charina bottae*), western terrestrial garter snake (*Thamnophis elegans*), common garter snake (*Thamnophis sirtalis*), northern alligator lizard (*Elgaria coerulea*), Cascade frog (*Amolops* sp.), Oregon spotted frog (*Rana pretiosa*; a candidate species under ESA), northern red legged frog (*R. aurora*), Pacific chorus frog (*Pseudacris regilla*), tailed frog (*Ascaphus sp.*), western toad (*Anaxyrus boreas*), northwestern salamander (*Ambystoma gracile*), and northern rough-skinned newt (*Taricha granulosa*).

4.14.1.2 Fish

Skagit River

The Skagit River is critically important to all five species of Pacific salmon (*Salmonidae*), as well as steelhead (*Oncorhynchus mykiss*) (Table 4-6), and sea-run cutthroat (*O. clarkii*). It hosts 30 percent of all anadromous fish in Puget Sound and the largest populations of pink (*O. gorbuscha*) and chum (*O. keta*) in the contiguous United States (North Cascades Institute 2002, Smith no date). The Skagit River and its tributaries also host the largest populations of ESA listed bull trout (*Salvelinus confluentus*) and wild Chinook (*O. tshawytscha*) in the Puget Sound Basin (USFWS 2004, Smith no date). See Table 4-6 for a list of anadromous salmon runs in the Skagit Basin.

There are numerous runs of each species that exhibit a variety of life history strategies that are a combination of run timing, spawning, incubation and emergence, freshwater rearing, estuarine rearing, and ocean migration. The lower reaches of the Skagit River function primarily as a transportation route for spawning adults and rearing habitat for juveniles during their outmigration to the sea. The lowest spawning occurs near the BNSF railroad bridge at RM 17.5 (Cole, pers. comm. 2013, Wasserman, pers. comm. 2013). See Table 4-7 for presence and timing of salmonid species' life stages in the lower Skagit River. The upper reaches of the Skagit River from Sedro Woolley up to Gorges dam, the Sauk River, the Cascade River, Lake Shannon and Baker Lake, along with other upper tributaries comprise the majority of the spawning habitat for Chinook, steelhead, and coho. Juveniles spend varying amounts of time in freshwater and the estuary depending on species. Pink salmon spend the least amount of time in the river and the estuary, migrating quickly to sea, while Chinook and coho will spend up to a couple of months rearing in the estuary. Coho and certain steelhead life history strategies will spend upwards of a year in freshwater (Sandercock 1991, Wydoski and Whitney 2003). In the less disturbed upper sections of the river, suitable habitat features are still available for spawning and rearing. However hydraulic modifications from the dams on the Baker River, as well as Ross and Diablo dams have altered habitat. The greatest loss of salmonid habitat occurs in the lower river and estuary where only 20% of the historical tidal wetlands and associated channels remain (Simestad et al. 2011). The estuarine loss has been identified as one of the most significant limiting factors in the recovery of Chinook and other salmon in the Skagit Basin (SWC 2005, Beamer et. al 2005, Smith no date).

Table 4-6. Salmon Runs for the Skagit and Samish Basins (WDFW 2002 and Cole, pers. comm. 2013)

Stock	Origin	Production Type	Stock Status	Spawning Location
Chinook (*Oncorhynchus tshawytscha*)				
*Lower Skagit Fall	Not monitored	Not monitored	Not monitored	Not monitored
*Upper Skagit Summer	Not monitored	Not monitored	Not monitored	Not monitored
Lower Sauk Summer	native	wild	Depressed	Sauk River from mouth to Darrington bridge
Upper Sauk Spring	native	wild	Depressed	Sauk River from Darrington to the lower reached of the North and South forks
Suiattle Spring	native	wild	Healthy	Suiattle River and its tributaries
Cascade Spring	native	wild	Depressed	Cascade River and Marble, Found, and Kindy Creeks
Marblemount Hatchery Summer	hatchery	hatchery	n/a	n/a
Samish Hatchery Origin Fall Chinook	hatchery	hatchery	n/a	n/a
Coho (*Oncorhynchus kisutch*)				
Skagit	native	composite	Healthy	Throughout the Skagit River below the Gorge dam
*North Puget Sound Tribs				
Baker	mixed	composite	Healthy	Baker River and some tributaries above the upper Baker dam
*Samish				
Marblemount Hatchery	Hatchery	Hatchery	n/a	
Sockeye (*Oncorhynchus nerka*)				
Baker	native	cultured	healthy	Beaches of Baker Lake and Baker River above the Lake
Pink (*Oncorhynchus gorbuscha*)				
Skagit	Not monitored	Not monitored	Not monitored	Not monitored
Chum (*Oncorhynchus keta*)				
*Mainstem Skagit Fall	Not monitored	Not monitored	Not monitored	Not monitored
*Sauk Fall	Not monitored	Not monitored	Not monitored	Not monitored
*Lower Skagit Tribs	Not	Not	Not	Not monitored

Stock	Origin	Production Type	Stock Status	Spawning Location
Fall	monitored	monitored	monitored	
*Samish/Independents Fall	Not monitored	Not monitored	Not monitored	Not monitored
Steelhead (*Oncorhynchus mykiss*)				
Samish Winter	native	wild	Healthy	Samish River, Friday Creek, and its tributaries
Cascade Summer	unknown	wild	Unknown	Unknown, but thought to take place in upper Cascade River and its forks
Cascade Winter	native	wild	Unknown	Unknown
Finney Creek Summer	native	wild	Unknown	Unknown, likely below RM 11.7
Mainstem Skagit/ Tribs Winter	native	wild	Depressed	Mainstem and all major tribs
Sauk Summer	native	wild	Unknown	In the North and South Forks and slightly below
Sauk Winter	native	wild	Unknown	Sauk, Suiattle, and Whitechuck Rivers
Marblemount Hatchery Origin	hatchery	hatchery	n/a	

* Not monitored in the 2002 WDFW in the SaSI report, therefore no information.

Table 4-7. Life Cycle timing of Salmonids in the Lower Skagit River (WDFW 2007)

SPECIES	LIFE STAGE	MONTH																							
		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
SPRING CHINOOK	Adult Migration				■	■	■	■	■	■	■	■	■	■											
	Spawning																								
	Incubation																								
	Juvenile Outmigration						■	■	■	■	■	■	■	■	■										
SUMMER CHINOOK	Adult Migration														■	■	■	■	■						
	Spawning																								
	Incubation																								
	Juvenile Outmigration					■	■	■	■	■	■	■	■	■	■										
FALL CHINOOK	Adult Migration														■	■	■	■	■	■	■	■			
	Spawning																		■	■	■	■			
	Incubation	■	■	■	■	■	■												■	■	■	■	■	■	■
	Juvenile Outmigration						■	■	■	■	■														
CHUM	Adult Migration																		■	■	■	■	■		
	Spawning	■																		■	■	■	■	■	■
	Incubation	■	■	■	■	■	■	■	■	■												■	■	■	■
	Juvenile Outmigration					■	■	■	■	■	■														
COHO	Adult Migration														■	■	■	■	■	■	■	■	■	■	■
	Spawning	■																				■	■	■	■
	Incubation	■	■	■	■	■	■	■														■	■	■	■
	Juvenile						■	■	■	■	■	■	■	■											

SPECIES	LIFE STAGE	MONTH																							
		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
	Outmigration						■	■	■	■	■	■	■	■											
PINK	Adult Migration														■	■	■	■	■	■	■	■			
PINK	Spawning																■	■	■	■	■	■			
PINK	Incubation	■	■	■	■	■	■	■									■	■	■	■	■	■	■	■	■
PINK	Juvenile Outmigration					■	■	■	■	■	■	■													
SOCKEYE	Adult Migration										■	■	■	■	■	■	■								
SOCKEYE	Spawning																								
SOCKEYE	Incubation																								
SOCKEYE	Juvenile Outmigration						■	■	■	■	■	■	■	■											
SUMMER STEELHEAD	Adult Migration									■	■	■	■	■	■	■	■	■	■						
SUMMER STEELHEAD	Spawning					■	■	■	■	■	■	■													
SUMMER STEELHEAD	Incubation					■	■	■	■	■	■	■	■	■	■	■	■								
SUMMER STEELHEAD	Juvenile Outmigration								■	■	■	■	■	■	■	■	■	■	■						
WINTER STEELHEAD	Adult Migration	■	■	■	■	■	■	■	■	■	■	■	■										■	■	■
WINTER STEELHEAD	Spawning					■	■	■	■	■	■	■	■												
WINTER STEELHEAD	Incubation					■	■	■	■	■	■	■	■	■	■	■									
WINTER STEELHEAD	Juvenile Outmigration					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
CUTTHROAT	Adult Migration									■	■	■	■			■	■	■	■	■	■	■	■	■	■
CUTTHROAT	Spawning		■	■	■	■	■	■	■	■	■														
CUTTHROAT	Incubation			■	■	■	■	■	■	■	■	■	■	■	■										
CUTTHROAT	Juvenile Outmigration																								
SEA-RUN CUTTHROAT	Adult Migration									■	■	■	■			■	■	■	■	■	■	■	■	■	■
SEA-RUN CUTTHROAT	Spawning		■	■	■	■	■	■	■	■	■														
SEA-RUN CUTTHROAT	Incubation			■	■	■	■	■	■	■	■	■	■	■	■										
SEA-RUN CUTTHROAT	Juvenile Outmigration					■	■	■	■	■	■														
BULL TROUT	Adult Migration			■	■	■	■	■	■	■	■	■	■	■	■										
BULL TROUT	Spawning																	■	■	■	■	■			
BULL TROUT	Incubation	■	■	■	■	■	■	■										■	■	■	■	■	■	■	■
BULL TROUT	Juvenile Outmigration						■	■	■	■	■	■	■	■											

Other anadromous fish in the Skagit River include longfin smelt and Pacific and river Lamprey. Resident fish species in the system include rainbow trout (*Oncorhynchus mykiss*), kokanee (*O. nerka*), mountain whitefish (*Prosopium williamsoni*), Salish and largescale suckers (*Catostomus catostomus* and *C. macrocheilus*), three-spine sticklebacks (*Gasterosteus aculeatus*), brook trout (*Salvelinus frontinalis*), lake trout (*S. namaycush*), western brook lamprey (*Lampetra planeri*), and torrent (*Cottus rhotheus*), prickly (*C. asper*), and coastrange sculpin (*C. aleuticus*). A number of non-native species are also found in the Skagit River system including brown trout (*Salmo trutta*), largemouth bass, smallmouth bass, rock bass, crappie, walleye, and perch (Cole, pers. comm. 2013).

ESTUARY AND MARINE NEARSHORE ENVIRONMENT

The marshes and shallow eelgrass beds in Padilla and Skagit Bays provide important nursery habitat for fish. Juvenile salmonids rely on these marshes and associated channels for rearing in the estuary and the eelgrass beds for foraging and refuge during their shoreline migration (Fresh 2006). Historically, Skagit fish could access the Swinomish Slough (now more of channel) and Padilla Bays through a complex of deltaic wetlands and distributary channels. However, due to extensive diking and construction of a jetty, fish have to navigate around the jetty that extends from the North Fork. The only access to Padilla Bay for Skagit fish is via Swinomish Channel. The species composition and abundance in these nearshore areas is seasonal and varies by habitat type, year, and salinity. In 2007 Beamer et. al conducted a study to determine fish assemblages and use of nearshore habitat zones the Skagit River Delta, including Padilla Bay and Swinomish Slough, and compared the results to previous year's data (Beamer et. al 2007). Below is a brief summary of this data for each of the three areas, as well as other sources of information:

Skagit River Delta and Bay

The Skagit River delta has salinities ranging from zero to +25 ppt. The study found sticklebacks, salmonids (mostly Chinook and chum), shiner perch, starry flounder, staghorn sculpins in the Bay and delta and surf smelt in the nearshore areas of the bay and delta. Salmonids were found in all habitats and, depending on the habitat type and salinity range, abundance peaked in the March-June timeframe with the majority of the fish gone by July. Offshore surface waters were dominated by herring. Pink salmon are found in the delta and bay in even years, typically from February to June.

Swinomish Slough

The Swinomish Slough has salinities ranging from five to +20 ppt Species found in the slough include staghorn sculpin, shiner perch, starry flounder, surf smelt, and Chinook and chum salmon. In most habitats salmonids represented a small fraction of total fish caught. The peak abundance of salmonids ranged from February to June depending on habitat type, but were absent in all habitats by mid June. A jetty diverts the majority of the flow from Skagit River away from Swinomish Slough; therefore most of the slough has salinities higher then what is considered suitable for smolting juvenile salmonids (Grossman et. al 2007).

Padilla Bay

In most areas of Padilla Bay the salinity is +20 ppt. The bay and its surrounding waters, including Samish Bay, are used by juvenile salmonids from the Skagit, Nooksack, and Samish Rivers (Rice et. al 2011 and Beamer et. al 2007). Herring (*Clupea harengus pallasi*) and surf smelt (*Hypomesus pretiosus*) spawning has also been documented in Padilla Bay (WDFW 2003 and 2008). Other fish commonly associated in eelgrass beds include juvenile rockfish (*Sebastidae*), shiner perch (*Cymatogaster aggregate*), sculpin species (*Cottidae*), three spine sticklebacks (*Gasterosteus aculeatus*), pipefish (*Syngnathinae*), tubesnouts (*Aulorhynchus flavidus*), juvenile cod species (*Gadidae*), and several species of flatfish (*Plueronectidae and Bothidae*) (Matthews 1990 and Mumford 2007). The Beamer et. al 2007 study found a variety of marine and anadromous fish in Padilla Bay, a number of which showed strong seasonal trends. Starry flounder, staghorn sculpin, surf smelt, sticklebacks, and shiner perch were found in nearshore areas and offshore surface waters were dominated by herring and stickleback. Salmonids in Padilla Bay were mostly Chinook and chum. However, bull trout were caught in low numbers, as would be expected given their population numbers and various life history strategies (Beamer, pers. comm. 2013a). Salmonid presence ranged from March to May, however Chinook were observed in low numbers as late as November.

4.14.1.3 Invertebrate Communities

According to Plotnikoff (1992), communities typical of rivers in the Puget Sound lowlands are dominated by stonefly, caddisfly, and common midge, mosquito, and blackfly larvae. Other taxa present include beetle larvae, amphipods, and aquatic isopods. These lowland invertebrate assemblages are characterized as shredder-gatherer communities.

Invertebrates found in the estuary and salt marsh area include oligocheate and polycheate worms, fly larvae, and crustaceans such as aquatic isopods, amphipods, and copepods (Cordell et al. 1999). Bays and salt marshes of Puget Sound are home to a variety of bivalves (including clams, cockles, and mussels), snails, anemones, and crustaceans such as shrimp, crab, and aquatic isopods. The three dimensional structure of eelgrass beds in Skagit and Padilla Bays host diverse communities of invertebrate taxa (both micro and macroscopic) including hydroids, jellyfish, snails, nudibrachs, sea stars, sea cucumbers, copopods, and isopods (Kozloff 1983 and Mumford 2007). Over 150 different species of mollusks have been identified in Padilla Bay, including many species of bivalves such as macoma spp., cockles, and clams, gastropods such as limpets, snails, and nudibranchs, and one cephalopods (giant pacific octopus). The majority of these mollusks are associated with the bay’s sand/mud bottoms. Non-native species also occur throughout Padilla Bay; either brought here intentionally, as is the case of the Japanese Pacific oyster, or by accident via ballast water or with shipments of Pacific oysters (Dinnel 2000). Commercially and recreationally important dungeness (*Metacarcinus magister*) and red rock crabs use eelgrass beds for settlements of their larvae, refuge from predators as juveniles, and for foraging as adults (Dethier 2006).

4.14.2 No Action Alternative

4.14.2.1 Wildlife

Climate change may lead to a much different microclimate and river system than what is seen today. Alteration in vegetation communities due to changes in precipitation, temperature, pest and forest fire regimes are possible. Not only would this change affect the physical habitat that wildlife in the upper Skagit currently occupy but it could also further decrease populations of already declining anadromous fish, which will in turn impact a variety of marine and freshwater fish, birds, and mammals which are reliant upon them. Sea level rise will likely cause a landward shift of existing eelgrass beds, mudflats, and salt, brackish, and freshwater marshes in the areas bays. Space for this shift is limited due to the development that abuts the marshes, leading to an overall decline in brackish and freshwater habitat. Most of the brackish marsh in Skagit Bay today would be converted to salt marsh, while estuarine beach habitats would be converted to open water or tidal flats (Glick et al. 2007, Tohver and Mantua undated). The loss of marsh habitat has the potential to affect amphibians, small mammals, and reptiles that reside in these areas, as well as impacting migrating and residential birds and waterfowl. Marsh habitat loss would also mean the loss of seal and sea lion haul outs and nursery areas in both Skagit and Padilla Bays.

4.14.2.2 Fish

Skagit River fish have already experienced a variety of pressures caused by the diking of the river and estuary, agricultural activities, construction of dams, insufficient riparian vegetation and large woody debris recruitment, and the development of the floodplain. Off-channel habitat, as detailed in Section 4.13 (Aquatic Habitat), will likely continue to decline in the future as population densities increase in the region and there are greater pressures for agricultural production.

Climate change in the Skagit Basin is likely to exasperate the anthropogenic pressures stressors salmonids and other fish are already experiencing, and the consequences could be severe. With the predicted scenario of warmer wetter winters and hotter dryer summers elevated summer and early fall water temperatures and lower flows are likely due to a lack of buffering from snow and glacial melt (UW Climate Impacts Group 2008). These increased temperatures may be intolerable to many species of salmonids. Bull trout populations in the Skagit River system would be particularly affected by these elevated temperatures since they require water no warmer than 48˚F for spawning and no warmer than 53˚F for rearing (WDOE 2008b). Increased frequency of high flows and floods during the winter and earlier onset of spring freshet could affect fish habitat, behavior, and survival rates (Casola et al. 2005). High flow or inundation events could lead to fish stranding. Loss of habitats such as tidal swamp and brackish marsh could affect survival of juvenile salmonids during rearing and migration.

Predicted sea level rise would cause the freshwater and brackish marshes to retreat landward due to saltwater intrusion, with little room to encroach on already developed land. This additional reduction of brackish habitat, required for acclimation to changes in salinity, is estimated to range from 77-97 percent (Glick et al. 2007); further limiting the production of anadromous fish in the Skagit Basin. Estuarine beaches provide forage fish spawning habitat and food for salmon. In many areas of Puget Sound, estuarine beaches are backed by dikes, bulkheads and armoring such as rip-rap and will inhibit landward migration of habitat.

Ongoing restoration efforts in the Skagit Basin, mostly in the estuary and upper river, may off-set some of these impacts to fish populations but they may not be enough to keep up with human population growth and its associated demands for agriculture and urban development in the region. Future maintenance and repairs of levees and revetments is likely to negatively influence fish populations by elevating water temperature from reduction in shade, altering channel dimensions, and reducing overhead cover..

4.14.2.3 Invertebrates Communities

Invertebrates in the Skagit River, its estuary, and the marine nearshore zone would remain subject to anthropogenic stressors from surrounding development and land use practices, including lack of detrital input, sedimentation, pollution from agricultural runoff, and competition with invasive species. In addition, climate change, sea level rise, and ocean acidification will most certainly affect the distribution and abundance of benthic invertebrates within the basin, particularly in the estuary and the marine portions of Skagit and Padilla Bays due to changes in salinity, temperature, tidal inundation, and reduced availability of carbonate ions for shell building.

4.14.2.4 Cumulative Impacts to Wildlife and Fish

Cumulative impacts including climate change would be similar to those described above.

4.14.3 Comprehensive Urban Levee Improvement

4.14.3.1 Wildlife

Wildlife within the urban corridor are tolerant of human presence, noise, and development. Any mobile wildlife in the vicinity during construction may vacate the area due to the increased activity but would be expected to return to the construction site soon after activity diminished. Any ground dwelling animals within the footprint during construction could be injured or killed.

Removal of vegetation for construction would decrease habitat function of the construction sites. However limited vegetation exists under current conditions as vegetation is highly managed on levees throughout the urban corridor to maintain levee integrity and inspect ability. For the large part, widening of the existing levees will occur on the back side of the levee and will impact developed land that currently provides limited habitat. Similarly, construction of the new levee alignments north of Burlington also occur largely in developed land and grassy lawns. The Burlington Hill Cross Levee does cross a portion of Gages Slough. Impacts to wetlands (detailed in Section 4.11) could reduce habitat function at the construction site. A culvert would be designed to allow typical flows through the levee, but would be closed in large flood events to protect downtown Burlington. The culvert would, most likely, not alter the existing functionality of the instream habitat at the location for amphibians and other wildlife. There is no fish access to Gages Slough.

Following construction, it is expected that the landward side of the raised urban levee will be grass lined and will provide similar low levels of habitat function. Where riverward work at the river bank is required, the banks are assumed to currently provide some habitat function as these armored revetments are often naturally colonized by young alders or willows that can provide perching, roosting, foraging, and refuge habitat for a variety of bird species as well as cover and forage habitat for smaller mammals.

Removal of large trees, such as those possibly used as perching or nesting habitat for eagles is expected to be minor due to the limited number of tall trees adjacent to the levees in this urban corridor. Per WDFW (2008) Priority Habitat and Species mapping, the only nesting sites near the proposed levee raise alignment occur between RMs 10 and 12 approximately 150 feet away. Through this area, the increased footprint width for the levee raise would be expected to occur on the landward side of the levee. The nesting trees are typically riverward of the levee and would not be expected to be impacted, however presence of equipment and noise could potentially disturb nesting behaviors. Surveys for eagle nests would be required prior to commencement of this work and based on the locations of any nests, limitations on work timing to avoid sensitive time periods and a bald and golden eagle permit from USFWS may be needed. There is also a known osprey nest near the proposed levee improvements in Mount Vernon approximately 125 feet from the railroad bridge. Timing of this construction outside of breeding season, typically from March to mid July (Watson and Peirce 1998), would help to minimize impacts.

There are several seal haul outs and nursery areas located in Skagit Bay, particularly near the mouth of the South Fork. These tidal channels and the associated marsh are primarily used by harbor seals (*Phoca vitulina richardsi*) (WDFW 2008) but are used by multiple species, including occasional use by Steller sea lion. The flushing of larger volumes of water and sediment into the bay could result in shifts in these haul out areas. For further detail on how the tidal marshes will be impacted by the CULI Alternative, see

Section 4.13. As these areas are only occasionally used by Steller sea lions, the impact of marsh changes is expected to have only a limited effect on the species.

4.14.3.2 Fish

Urban Levee Improvements

Primary impacts from this alternative would be to fish communities in the Skagit River and those in Skagit Bay. Short-term impacts would be associated with construction of new levees and improvement of existing ones. The only new levee along the river would be a floodwall at Lion's Gate Park, which would be setback parallel to Freeway Drive, but substantial portions of the existing levee system (RM10 to 21) would need improvement. A fair amount of the work required to improve these levees would be on the landward side and atop the levees. However, it is likely that some wet work would be necessary to perform such actions as burying levee toes, adding more armoring rock, and installing wood as mitigation. The in-water work window in the Skagit River is typically from mid-June through August, when water levels are low and the fewest species and numbers of fish are present. However there are still many species that are present in the river at this time, including (WDFW 2007):

- Stream-type Chinook yearlings
- Spring Chinook (adults and juveniles)
- Fall Chinook (adults)
- Coho (adults and juvenile)
- Pink (adults)
- Sockeye (adults and juveniles)
- Sea-run cutthroat (adults and juveniles)
- Resident species like rainbow and cutthroat trout and sculpin

Impacts to these fish from in-water work include elevated turbidity, physical disturbance, and noise that could result in interruption of foraging and migration behavior. It is less likely that physiological damage would result from elevated turbidity and noise levels since fish in the vicinity would likely flee the area. There is uncertainty with construction methods and sequencing, however conditions in the water quality certification from WDOE should help minimize water quality impacts to fish. Installation of an isolation device may be necessary in areas where the levee is directly along the river to minimize turbidity plumes. Noise generated from the installation of an isolation device also has the potential to disrupt fish in the area.

There would be a temporal loss of benefits to fish provided by the riparian vegetation that is removed to improve the levee system. Although the remaining riparian habitat in the urban section of the river is limited to sparse narrow bands, what is left still provides benefits to fish by slowing down water, shading the margins of the river, and providing organic input to fuel the food chain. Impacts from the loss riparian vegetation could be mitigated by actions such as burying the toe to provide a planting bench, setting back levees, where possible, to allow for more substantial riparian plantings, and installation of large woody debris. See Section 5.8 for proposed conceptual mitigation for impacts to aquatic resources.

Long term impacts associated with this alternative would derive from changes in hydrology and habitat, and adding additional armor rock the river banks. Added armoring along the slopes of the levees will perpetuate the poor conditions in the urban corridor, limiting refuge habitat for fish and making them vulnerable to predation. Under existing conditions water spills into the floodplain in the urban corridor every 25 years; equating to a 0.4 chance in any given year (4% ACE). This alternative would keep water within the channel in the urban corridor (RM 16- 21) up to the 1% ACE event. Flood events in the Skagit occur in the fall and winter (see Table 4-8), with the highest likelihood in November and December, prior to peak juvenile salmon outmigration.

Table 4-8. Percent Chance of a Given Flood Event Occurring by Month (Eriksen, pers. comm. 2013)

Month	**Monthly Probability of Annual Peak***	**Annual Chance of Exceedance**					
		50%	**10%**	**4%**	**2%**	**1.30%**	**1%**
Oct	0.20	10.00%	2.00%	0.80%	0.40%	0.26%	0.20%
Nov	0.22	11.00%	2.20%	0.88%	0.44%	0.29%	0.22%
Dec	0.25	12.50%	2.50%	1.00%	0.50%	0.33%	0.25%
Jan	0.21	10.50%	2.10%	0.84%	0.42%	0.27%	0.21%
Feb	0.08	4.00%	0.80%	0.32%	0.16%	0.10%	0.08%
Mar	0.04	2.00%	0.40%	0.16%	0.08%	0.05%	0.04%
*Based on 88 years of data. (April through September not included since there is essentially no chance of flooding occurring during those months)							

However, a number of species are present in the river during the fall and winter (WDFW 2007), including:

- Stream-type Chinook yearling
- Adult Chinook
- Steelhead in all life stages
- Bull trout in all life stages
- Coho adults, yearlings, and juveniles
- Chum adults
- Pink adults
- Resident species like cutthroat and rainbow trout and sculpin

The additional water in the system could lead to hydrologic changes including increased velocities and depth. Off-channel and shallower littoral habitat that is available under existing flood conditions may no longer be available as a result of increased depths. For the 1% ACE flood event, velocities are modeled to increase less than 1 foot per second higher than existing conditions from RM 24 to 10 (see Figure 4-1 in Section 4.6.2 above). Changes in velocities have not been modeled for more frequent flood events, but it is assumed that the changes would be less than the 1% ACE flood event. Velocities elsewhere in the river would not change. These numbers are based on average velocities across a cross section of the river and differences in velocities and inundation at the microhabitat level, including the littoral zone of the mainstem and off-channel habitat where fish tend to occur in flood events, may vary more from existing conditions. These increased depths and velocities could affect different species and/or life stages disproportionately. Juvenile salmon would have the hardest time swimming in areas of increased depths and velocities. This could lead to fish: 1) being forced downstream (due to lack of refuge habitat) where habitat is also limited, and/or before they are physiologically ready, 2) being physically damaged by rip-rap, 3) increasing energy demands to maintain swimming positions, 4) having difficulty foraging, and 5) being more vulnerable to predation from decreased shallow water habitat and decreased energy. Regarding item one, with more fish being pushed further downstream competition will increase in habitat that is already limited. The end result could be lower smolt production. Migrating coho, Chinook, pink, and chum adults would have to work harder to swim upstream, leading to an increased metabolic rate which could affect fecundity and spawning success. Newly spawned bull trout, which typically spawn August to October (Goetz, pers. comm. 2013), may also have difficulty swimming due to depleted energy reserves. Adult steelhead would likely be the least impacted species since they are generally strong swimmers. Resident fish like trout and sculpin would be subject to all the same impacts discussed above, although sculpin are likely to struggle less to maintain positions due to lack of a swim bladder.

Spawning habitat has the potential to be affected as well. The flood season does overlap with spawn timing for Chinook, chum, coho, and pink salmon (WDFW 2007). Although, the majority of spawning occurs just upstream of the BNSF railroad bridge near RM 17.5 (Cole, pers. comm. 2013), above where much of the impacts in hydrology would result from this alternative. However, coho may spawn in the secondary channels of the mainstem below the urban corridor (WDFW 2002 and Beamer, pers. comm. 2013b). Minor changes in velocities from existing conditions for the 1% ACE flood event are expected, and extrapolating from the 1% ACE flood event even less change is expected for the more frequent flood events. However, it is possible that some scour of spawning habitat and redds, reduced fertilization success, and difficulty for adults to maintain their position could result from increased depths. Furthermore, improving levees in the urban corridor would result in a lost opportunity for restorative actions in a section of river that has very poor conditions for fish populations.

Fish communities in Skagit Bay are not likely to be affected by this alternative. The majority of the water displaced from the urban corridor during higher flood events would still spill onto the western floodplain.

Baker Dam Operational Modifications

The action alternatives all involve the adoption of Articles 107a and b of the FERC License for the Baker Hydroelectric Project. Article 107a refers to the operation of the Baker Lake reservoir to provide flood storage by October 15 (with same volume of storage to the existing condition), while Article 107b refers to the operation of the Lower Baker reservoir to provide flood storage from October 1 to March 1. Pursuant to these Articles, both Lake Shannon and Baker Lake would be down ramped and held to provide flood control storage during the active flood season if this alternative were adopted. Assuming the instream flow requirements laid out as part of Article 106 in Aquatics Table 2 are met, the holding of the reservoir pools at a reduced level will affect fish communities in both lakes. Because downstream effects have already been considered in the Baker River Hydroelectric Project Final EIS (FERC 2006), only effects in Lake Shannon and Baker Lake would be considered in this report.

In both reservoirs, flood storage draw downs would by definition reduce the total reservoir area, as water is released through the dams and the water level recedes. However, this point is particularly relevant in Lake Shannon, where there has not historically been any flood storage drawdown requirements. Although euphotic depth may not change, the total volume of the euphotic zone will necessarily decrease, as sunlight penetrates the water column over a smaller total area (R2 Resource Consultants 2008). This reduction in the euphotic volume has the potential to affect fish populations, as this volume is critical to the productivity of aquatic systems via primary and secondary production. Primary producers require energy from the sun for growth, and secondary producers require primary producers for food. A smaller euphotic zone has the potential to impact the entire aquatic food chain in both Lake Shannon and Baker Lake.

The overall impacts to fish species in both reservoirs is difficult to predict, as very little data exists. However, several major changes could occur. As primary and secondary producers are impacted by the reduction in euphotic volume, there could be a strain to the food sources of fish in both reservoirs, especially to sockeye. Sockeye feeding habits may change as a result of this pressure, causing cascading effects on sockeye physiology, such as adult size (Paller 1997). Overall species richness may decrease as well, as the loss of forage fish species could cause additional stress on larger fish populations (Paller 1997).

Despite these specific impacts to food production, the overall impacts to fish in both reservoirs will be minor due to several mitigating factors. According to Mazumder's 2004 estimates, Baker Lake could support 2-3 times more sockeye smolts (Mazumder 2004). Although Lake Shannon is a different system, mean zooplankton density has been greater in Lake Shannon than in Baker Lake over previous years, signifying a similar if not larger excess in sockeye carrying capacity (R2 Resource Consultants 2010). Additionally, the reduction in euphotic volume could actually increase relative zooplankton density, and make it easier for sockeye to find available food in the winter. The importance of changes to euphotic volume to fish productivity matter much less in the winter due to natural variations in zooplankton abundance (R2 Resource Consultants 2008). This coincides with the Lake Shannon drawdown, which will occur during the winter months. The final key aspect of the proposed action is the actual volume of drawdown for flood storage. According to Mazumder, average daily drawdown for both dams is between 39 and 49 feet (Mazumder 2004). The draw downs in the proposed action fall at or below these daily averages (FERC 2006).

The area between reservoir water level before and after pool drawdown, known as the littoral drawdown zone, is critical to the survival of the fish species in the reservoir. Sockeye, in particular, will lose important spawning areas, as the drawdown will reduce the amount of spawning substrate available for these fish to use (FERC 2006). Any redds that have been established in this zone before drawdown may be completely or partially dewatered, significantly reducing their chances of survival (FERC 2006). Additionally, the holding down of the reservoirs at a lower pool level can cause major loss of vegetation and habitat in and adjacent to the littoral drawdown zone, potentially decreasing the amount of external debris input into the reservoir (Paller 1997). This debris input is extremely important as it provides food, structure, and habitat to fish species in the reservoir (Paller 1997). Smaller forage fish that depend on these inputs will be particularly impacted, as these species are forced into deeper water by the lack of shelter near the reservoir margins, creating a potential increase in predation (Paller 1997). While this may be true in both reservoirs, this impact may be particularly pronounced in Lake Shannon, which has not been subject to flood control storage requirements in the past; vegetation in and adjacent to the littoral margins of Lake Shannon is more established than in Baker Lake. Peak spawning would be minimally affected by the adoption of Article 107 a and b, because the start date of October 1st would the same for the proposed early drawdown at Upper Baker Dam and additional flood storage Lake Shannon as the No

Action condition. As the project moves towards feasibility-level design, the project will continue to evaluate the impact of the Baker Dam measures.

4.14.3.3 Invertebrates Communities

Short-term impacts from construction are expected to be minimal as benthic communities typically re-colonize disturbed areas quickly. Long-term impacts to benthic invertebrates in the Skagit River could be affected by this alternative in two ways: 1) changes in hydrology could lead to changes in substrate composition and distribution leading to changes in benthic communities, and 2) the temporal loss of riparian vegetation from levee improvements would decrease the amount of detrital input of which many invertebrates rely on. Changes in hydrology are expected to be minimal from this alternative; however changes at the microhabitat level could occur. Additional scour and or sedimentation could change invertebrate communities to more tolerant taxa like snails and fly larvae and decrease optimal taxa like mayflies, caddis flies, and stoneflies. The extent of the potential impacts is not quantifiable since no sediment models have been run for this alternative. In lieu of modeling, the agencies believes based on current science and expertise that the loss of detrital input would result in a loss off a food source for many invertebrate taxa. However, impacts from vegetation loss could be mitigated in the long-term by planting benches on levees where the toe can be buried or the water ward areas where levees can be set back.

Invertebrate communities in the estuary and Skagit Bay are not likely to be affected by this alternative since no changes in hydrology or sedimentation are expected downstream of the forks.

4.14.3.4 Cumulative Impacts to Wildlife and Fish

This alternative would result in similar impacts to wildlife associated with climate change and cumulative impacts as discussed in Section 4.14.2 No Action Alternative.

There would be no cumulative impacts to invertebrates and fish in the estuary or Skagit Bay since this project has little to no impact on these areas. Cumulative impacts to invertebrates and fish in the Skagit River would derive from the perpetuation of armoring the river banks with rip-rap and strict levee vegetation standards by improving the urban levees combined with the past channelization/modification of the river and future levee repairs and flood fighting. Armor rocks is poor fish habitat, creating harsh conditions that include vulnerability to predators, physical damage, and lack of bank complexity for refuge in higher flows. Sparse vegetation of levees leads elevated temperatures, lack of organic input, and lack of refuge/cover habitat along the margins which has negative effects on invertebrates and fish communities. Levees also cut off valuable off-channel habitat necessary for rearing of juvenile fish and resting adults. Climate changes impacts on this alternative would be similar to those described for the No Action Alternative, although the increased frequency of floods would increase the frequency of deep water in the mainstem since this alternative would keep anything below a 100 year event (1% ACE) within the channel in the urban corridor, whereas existing conditions keeps anything under a 25 year event in the channel. Mitigation and ongoing restoration efforts in the basin could lessen these cumulative effects.

4.14.4 Joe Leary Slough Bypass Alternative

4.14.4.1 Wildlife

Wildlife within this urban and agricultural corridor are tolerant of human presence, noise, and development. Any mobile wildlife in the vicinity during construction may vacate the area due to the increased activity but would be expected to return to the construction site soon after activity diminished. Any ground dwelling animals within the footprint during construction could be injured or killed.

Removal of vegetation for construction would decrease habitat function of the construction sites. However limited natural vegetation exists under current conditions as the bypass area is largely cleared for agriculture. The proposed JLS alignment does cross a portion of Gages Slough. Impacts to wetlands could reduce habitat function at the construction site. Culverts would be designed into the levees to allow typical slough flows through the levee in smaller rain or flood events, but would be closed in large flood events to protect downtown Burlington. The culverts would decrease the functionality of the instream habitat at the location for amphibians and other wildlife. The levee improvements and construction of new levees along or near the river could require vegetation removal in the riparian corridor of the Skagit River. Although much of the riparian corridor function is limited due to the need to maintain vegetation for levee integrity, the river banks are assumed to currently provide some habitat function (see Section 4.12 for more detail on the riparian corridor). The existing armored revetments are often naturally colonized by young alders or willows that can provide perching, roosting, foraging, and refuge habitat for a variety of birds as well as cover and forage habitat for smaller mammals.

Riparian habitat along Joe Leary Slough could also be impacted. The banks of the slough are dominated by herbaceous plants and are largely devoid of forested riparian habitat. Vegetation management within the bypass would maintain this degraded riparian corridor to avoid potential concerns with excess roughness or debris in the bypass during channel activation.

Removal of large trees, such as those possibly used as perching or nesting habitat for eagles is expected to be minor due to the limited number of tall trees within the area. Per WDFW (2008) Priority Habitat and Species mapping, the nearest nesting site to the proposed bypass is approximately 1,000 ft outside of the bypass near the outlet. There are no known eagle nests near the levee improvements that are included with the JLS Bypass Alternative; however there is an osprey nest in Mount Vernon near the railroad bridge. The presence of equipment and noise could potentially disturb nesting behaviors for both species. Surveys for nests would be required prior to commencement of this work and based on the locations of any nests, limitations on work timing to avoid sensitive time periods may be needed. The long-term impact of perpetual tree management within the bypass required to allow the bypass to function properly (reduced roughness and limit debris accumulation at the outlet structure) would continue to limit forested habitats within the area into the future. Much of this land would be expected to continue to be dominated by agriculture in the future, so the impact of the bypass is not expected to be significantly different from the projected future condition without the bypass construction.

Impacts to wetlands (discussed in Section 4.11) within the bypass could impact habitat for amphibians and waterfowl. Excavation near the outlet could lead to creation of a large freshwater wetland complex in that area, which could be designed to offset wetland impacts and benefit local wildlife populations.

Conversion of existing estuarine marsh at mouth of JLS to freshwater, depending on placement of the tide gate, would make the area unsuitable to species reliant on salt marshes.

Several harbor seal haul outs exist approximately 3,300 feet offshore of the outlet structure. Activation of the bypass and flushing of a large volume of water into Padilla Bay could impact these haul outs by moving sediments, and could lead to long-term permanent adverse impacts. Several other haul outs exist in Padilla Bay such that it would be expected that any displaced seals would find other suitable locations in relatively close proximity.

4.14.4.2 Fish

Joe Leary Bypass

Short-term adverse impacts associated with this alternative derive from construction to improve levees on the Skagit River and the construction of the outlet structure in Padilla Bay. The impacts associated with levee improvement are similar to those described for the CULI Alternative, including elevated noise and turbidity, but to a much lesser extent since improvements for this alternative are not required along the right bank through all of Burlington. Construction of the bypass would require substantial excavation at the outlet, modification of sea dikes, and adding of a control structure at the mouth of Joe Leary Slough. These activities could lead to elevated turbidity in Padilla Bay and Joe Leary Slough that could displace fish, interrupt their foraging behavior, disrupt spawning and/or cause physical damage their gills. The impacts of elevated turbidity could be minimized by working only during low tides, avoiding spawning seasons of forage fish, avoiding the migration timing of juvenile salmonids along the shoreline, installing an isolation device, and complying with all conditions issued in the water quality certification from WDOE. The inlet structure to the bypass would not be located on the river; therefore no impacts to fish are expected from its construction. Impacts to fish from the temporal loss of riparian vegetation are similar to those described for the CULI Alternative, but less so since less levee improvements are needed (roughly one third).

Long-term impacts to fish will be discussed separately for the Skagit River and Padilla Bay:

Skagit River

Impacts to fish in the Skagit River include the placement of additional armor rock along the banks of the urban corridor, changes in river velocities upstream of the bypass, and stranding and physical damage due to fish entering the bypass. Impacts of additional armor are the same as those described for the CULI Alternative but less so due to substantially less required levee improvement. Changes in velocities within the river would only change upstream of the bypass inlet during flood events greater than 25 years. Up to 87,000 cfs for a 100 year event and 75,000 for a 75 year event would be diverted into the bypass. Model runs have not been done for amount of water in the bypass channel in a 50 and 25 year event, but based on extrapolation from existing conditions it is estimated to be roughly 55,000 cfs and 30,000 cfs, respectively. An increase in velocity of up to two feet per second is expected between RM 21 and 23 for the 100 year flood event for this alternative versus a 100 year event under existing conditions. Based on extrapolation, it can be assumed that this difference would be less for more frequent flood events. Elsewhere in the river velocities decrease slightly between this alternative and existing conditions for a flood events greater than 25 years because water would be diverted out of the river prior to entering the urban corridor. The section of river where velocities increase overlaps with spawning habitat for steelhead, pink, coho, and chum, and spawn timing of many these species overlaps with the beginning of the flood season (November). Impacts to spawning from increased velocities are similar to those discussed for the CULI Alternative, including difficulty for adults to hold their position, lower reproductive success, and scour of spawning substrate and redds.

A major impact to fish populations in the Skagit River associated this alternative would be from entrainment in the bypass. In order to provide fish exclusion from this bypass channel a screen would need to be designed that is three miles long and it would require substantial debris management. Such a structure is considered to be infeasible. Without fish exclusion, fish would be subject to being swept into the bypass channel. A list of fish that are present in the river during the flood season, when the bypass channel would be activated, can be found in Section 4.14.3 (Wildlife and Fish) of the CULI Alternative. Fish may enter the bypass passively if they are not strong enough to swim against the force pulling towards the inlet. Juveniles will certainly have more difficultly than adults. While others may enter it actively in pursuit of slower moving water. Once in the bypass, the survival rate of fish would be low. They could be injured going through the inlet structure, get flushed out of the bypass channel into Padilla Bay (where they could be injured at outlet structure or juveniles would enter the saltwater before they are physiologically ready), or become stranded in the bypass channel. Adult salmon that get swept into Padilla Bay may not have the energy reserves to navigate back to the mouth of the Skagit River and then back upstream towards their spawning grounds. Once the water recedes any remaining fish would have no path back into the Skagit River or to Padilla Bay, and there would be no habitat within the bypass channel since it is planned for ongoing agriculture uses. The channel would activate at any event higher than a 25 years so the risk of this happening in any given year is low (4%). However, if there is a wet periods in which there are consecutive events higher than 25 years (or many times in a 5 or 10 period) then impacts at population level may be detectable due to exposure of multiple cohorts. Life history diversity from success of multiple cohorts can increase production and buffer population fluctuations (Greene et al 2009), and negative impacts to multiple cohorts in a short time period are likely to do the opposite.

Padilla Bay

Impacts to fish in Padilla Bay would arise from episodes of low salinity and degraded water quality associated with flood events activating the bypass channel, as well as long-term changes in their habitat from these events. Impacts to fish habitat is discussed in Section 4.13 (Aquatic Habitat), but they include changes in the health and distribution of eelgrass beds and tidal channels. In addition, this alternative would cut off fish access to Joe Leary Slough due to construction of an outlet structure at the terminus of the bypass channel. Decreased salinities in Padilla Bay are expected while the bypass channels are active. These salinities could be too low for marine fish like herring, flatfish, cod, and juvenile salmon that have already acclimated to more saline conditions. Elevated turbidity is expected as water carries sediment from any unplanted agricultural fields in the bypass into the Bay. This could cause gill damage, elevated stress levels that cause physiological damage, and disruption of foraging and reproductive behavior. Forage fish spawning may also be impacted when the bypass channels is activated. Adults may be discouraged to spawn, eggs may not be able to tolerate the lower salinities, and/or eggs may be smothered by excess sediment. However, forage fish spawning typically doesn’t occur until February in this region of Puget Sound; the very tail end of the flood season. The chances of a flood event that would activate the bypass channel (higher than a 25 year event) occurring in February is 0.32%.

Baker Dam Operational Modifications

Impacts would be the same as those described for the CULI Alternative, Section 4.14.3.

4.14.4.3 Invertebrates Communities

Primary impacts to invertebrate communities would be to those in Padilla Bay. Since hydrology in much of the Skagit River is not expected to change, with the exception of directly upstream of the bypass channel, minor impacts are expected to benthic invertebrates in the river. Short-term impacts from construction in the Skagit River are expected to be minimal as benthic communities typically recover quickly. Impacts to invertebrate communities in Padilla Bay would derive from two sources: 1) temporary increases in sedimentation and decreased water quality during flood events when the bypass channel is activated, and 2) long-term changes in habitat due to scour in front of the outlet structure and additional sediment deposited elsewhere in the Bay. When the channel is activated it would discharge into the eastern shoreline of Padilla Bay, carrying sediment and agricultural run-off from the bypass channel. This sediment could smother epi-benthic and benthic invertebrate communities like clams, oysters, and borrowing worms, as well as nudibranchs and jellyfish in eelgrass beds, in the zone of impact. More mobile taxa like crab and shrimp may be less affected than sessile ones, but given the magnitude (up to 87,000 cfs) and the duration (up to 2 days) of water that would be diverted into the bypass channel it is unlikely that anything in the path could escape such a force. Excess nutrients and pesticides could affect invertebrate communities by causing harmful algal blooms and toxicity, but application of these chemicals does not typically overlap with the flooding season (when the bypass channel would be activated). In addition, the low salinities caused by the freshwater plume during flood events may beyond the tolerance levels of many invertebrate species. Permanent impacts of this alternative would result from changes in habitat. Section 4.13 details the impacts of this bypass on aquatic habitat in Padilla Bay. The extensive eelgrass meadows in Padilla Bay provide habitat for an abundant invertebrate taxa. If habitat like eelgrass beds and tidal channels in the Bay degrade due to scour at the mouth and sedimentation elsewhere invertebrate communities would suffer from lack of habitat.

4.14.4.4 Cumulative Impacts to Wildlife and Fish

This alternative would result in similar impacts to wildlife associated with climate change and cumulative impacts as discussed in Section 4.14.2, No Action Alternative.

Cumulative effects to fish and invertebrates in the Skagit River are similar to those described for CULI.. They would derive from the perpetuation of armored banks and compliance with levee vegetation standards from improving levees and risk of entrainments in the bypass (for fish) combined with the past channelization/ modification of the river and future levee repairs and flood fighting. . Climate change could exacerbate these impacts with more frequent and intense flooding events causing the bypass channel to activate more often than expected raising the risk of entrainment. As temperatures warm in the Skagit River the onset of juvenile migration may be earlier and could overlap with the flood season. This could lead to greater risk of entrainment of juveniles in the bypass channel and put further pressures on salmon in a system that is already of poor habitat quality.

Cumulative impacts to fish and invertebrate communities in Padilla Bay would derive from the habitat changes that occur in the Padilla Bays eelgrass beds and tidal channels from increased sediment and flow from the bypass channels combined with the runoff it receives from the agricultural fields via the surrounding sloughs. Fish and invertebrates depend on these habitat types for feeding, resting, and rearing of juveniles. As sea levels rise in Skagit Bay eelgrass and tidal channel habitat could become increasingly sparse, unless sediment from the bypass channel counteracts this effect. However, this seems unlikely given the infrequency of the bypass channel activation and the short-term impacts from the magnitude of water that would discharge into the Bay. Mitigation and ongoing restoration efforts in the basin would likely not offset the impacts on fish of such a large-scale alteration of the system. Climate change could exacerbate the impacts of this alternative on invertebrate and fish communities. More frequent and intense storm events would cause the channel to be activated more often for a longer duration, exposing invertebrate and fish communities to increased runoff and lower salinities more often. Additional sediment entering the Bay could offset the effects of sea level rise, maintaining elevations that are suitable for eelgrass beds and the communities that depend on them. However, it is difficult to quantify if the benefit of added sediment in Padilla Bay to counteract sea level rise would outweigh the impacts of the bypass channel when it is activated.

4.14.5 Swinomish Bypass Alternative

4.14.5.1 Wildlife

As discussed above for the JLS Bypass Alternative, wildlife within this urban and agricultural corridor are tolerant of human presence, noise, and development. Any mobile wildlife in the vicinity during construction may vacate the area due to the increased activity but would be expected to return to the construction site soon after activity diminished. Any ground dwelling animals within the footprint during construction could be injured or killed.

Removal of vegetation for construction would decrease habitat function of the construction sites. However limited natural vegetation exists under current conditions as the bypass area is largely cleared for agriculture. The inclusion of the Burlington Hill Cross Levee with the Swinomish Bypass Alternative requires constructing a levee that would cross a portion of Gages Slough. Impacts to wetlands could reduce habitat function at the construction site. A culvert would be designed into the levee to allow typical slough flows through the levee in smaller rain or flood events, but the culvert would be closed in large flood events to protect downtown Burlington. The culvert would decrease the functionality of the instream habitat at the location for amphibians and other wildlife. The levee improvements and construction of new levees along or near the river could require vegetation removal in the riparian corridor of the Skagit River. Although much of the riparian corridor function is limited due to the need to maintain levee vegetation for levee integrity, the river banks are assumed to currently provide some habitat function (see Section 4.12, Riparian Habitat, for more detail on the riparian corridor). The existing armored revetments are often naturally colonized by young alders or willows that can provide perching, roosting, foraging, and refuge habitat for a variety of birds as well as cover and forage habitat for smaller mammals.

Removal of large trees, such as those possibly used as perching or nesting habitat for eagles is expected to be minor due to the limited number of tall trees within the area. Per WDFW (2008) Priority Habitat and Species mapping, there is an eagle nest in a small cluster of trees near the proposed levee alignment for the bypass. Under the current bypass alignment this nesting tree would likely be impacted. This impact could be mitigated by realigning the levee to avoid the nesting tree, though timing of construction of any nearby levee would need to be coordinated with USFWS under the Bald and Golden Eagle Protection Act to determine the appropriate timing of construction to minimize disturbance. Surveys for other nests would be required prior to commencement of construction as work timing limits may extend to other construction locations. The long-term impact of perpetual tree management required to allow the bypass to function properly (reduced roughness and limit debris accumulation at the outlet structure) would continue to limit forested habitats within the area into the future. Much of this land would be expected to continue to be dominated by agriculture in the future, so the impact of the bypass is not expected to be significantly different from the projected future condition without the bypass construction.

Impacts to wetlands within the bypass and at the outlet could impact wetland wildlife. Amphibians in the freshwater marshes could be caught in flood waters and pushed into saltwater areas. Impacts to tidal marsh habitat used by shorebirds, raptors, waterfowl, and wading birds could include scour or shifting sediments that could temporarily diminish food availability.

4.14.5.2 Fish

Swinomish Bypass

Short-term impacts to fish are similar to those discussed for the JLS Bypass Alternative. However, there a few differences: 1) the inlet to this bypass channel is located directly on the Skagit River so there would be impacts to fish during construction of this structure that are similar to those associated with improving the levees, 2) levee improvements are needed along the upstream portions of the right bank adjacent to Burlington, but not as extensive as the CULI Alternative, 3) improvements are not needed along the right bank near Mount Vernon, and 4) the outlet enters the area surrounding Telegraph Slough before discharging into the Swinomish Channel. Overall length of levee improvement is slightly more than the JLS Bypass Alternative (roughly 0.2 miles), but construction impacts from the improvements, as well as the inlet structure, would be similar including elevated turbidity and noise resulting from in-water work. The scale of these short-term construction impacts on fish would be less that the CULI Alternative, but slightly more than the JLS Bypass Alternative. There would be little short-term impacts associated with the construction of the outlet structure since it does not abut any aquatic habitat. Impacts to fish from the temporal loss of riparian vegetation are similar to those described for the previous alternatives but less than the CULI Alternative and more than the JLS Bypass Alternative due to the differences in needed levee improvements.

Long-term impacts will be discussed separately for the Skagit River, Padilla Bay, and Swinomish Slough:

Skagit River

Impacts associated with adding armor rock along the river banks are similar to those described for the previous alternatives, but less so than CULI and more so than JLS (related to linear feet of needed improvements). Fish exclusion is also not technically feasible for the alternative and, like JLS, the channel would activate in flood events greater than a 25 year event. Therefore fish entrainment risk in this bypass channel is the same as described for the JLS Bypass Alternative resulting in impacts including injury, stranding, and flushing into saltwater before they are ready. Flows in this bypass would be less than that of the JLS, with 66,000 cfs for a100 year flood, 59,000 for a 50 year flood, 52,000 for a 50 year flood, and 28,000 cfs for a 25 year flood. However, even with these lower flows there is no path for fish back to the Skagit River once in the bypass channel. Like the JLS Bypass Alternative, velocities should remain the same or lower than that of existing condition throughout much of the river, with the exception of directly upstream of the bypass channel. Under this alternative, velocities would increase up to 3cfs above existing conditions for a 100 year flood event from roughly RM 16 to 17.5, approaching 10 feet per second. This area does not overlap with much spawning habitat, but is located just below spawning for species like steelhead, pink, coho, and chum (the BNSF railroad bridge crosses the river at RM 17.5). Most fish, particularly juveniles, would have extreme difficulty swimming in velocities this high (Bell 1973, Powers and Orsborn 1985).

Padilla Bay and Swinomish Slough

Impacts to fish using Padilla Bay are similar to those described for the JLS Bypass Alternative, but less so since the outlet structure would enter Telegraph Slough and its surrounding wetlands and not discharge directly into the Bay. These wetlands would buffer the impacts of the bypass channel on fish in Padilla Bay by absorbing sediment and other agricultural run-off. It would also buffer effects on fish habitat like eelgrass and tidal channels (see Section 4.13, Aquatic Habitat, for more details). It is unknown if these wetlands would be able to buffer changes in salinity, although the inlet structure is set back further from Padilla Bay then the JLS bypass so the distance alone may attenuate the freshwater effects. In addition, there would be impacts to fish transiting the Swinomish Channel from this alternative. These impacts include exposure to temporary changes in salinity, elevated turbidity, and agricultural run-off. However, as mentioned previously, these impacts would be somewhat buffered by the wetlands surrounding Telegraph Slough.

Baker Dam Operational Modifications

Impacts would be the same as those described for the CULI Alternative, Section 4.14.3.

4.14.5.3 Invertebrates Communities

As with the JLS Bypass Alternative, impacts to invertebrate communities in the Skagit River are not expected to due to little changes in hydrology, with the exception of the area just upstream of the bypass channel. Short-term adverse impacts from construction in the Skagit River are expected to be minimal as benthic communities typically re-colonize disturbed areas quickly. Impacts to invertebrate communities in Padilla Bay are similar to those described for the JLS Bypass Alternative including temporary smothering and low salinities, and long-term changes in habitat. However, these impacts would be less due to the buffering effects of the wetlands surrounding Telegraph Slough (absorbing sediment and other agricultural run-off). There would be additional impacts to estuarine invertebrate communities in Telegraph Slough and its wetlands that are similar to those described for Padilla Bay. Invertebrates in Swinomish Channel would also be impacted by temporary smothering, poor water quality, and low salinities, as well as any additional maintenance dredging resulting from excess sediment that is diverted from the bypass.

Climate change impacts would be similar to the JLS Bypass Alternative but less so due to the buffering effects of the surrounding wetlands.

4.14.5.4 Cumulative Impacts to Wildlife and Fish

This alternative would result in similar impacts to wildlife associated with climate change and cumulative impacts as discussed in Section 4.14.2, No Action Alternative.

Cumulative impacts to fish and invertebrates in the Skagit River and Padilla Bay, including those from climate change and sea level rise, are similar to those described for JLS, but to a lesser extent in Padilla Bay due to the buffering effects of the wetlands surrounding Telegraph Slough. Cumulative impacts to fish and invertebrates in Telegraph Slough would derive from the added sediment and scour associated with flows from the bypass combined with the run-off from agriculture in the surrounding areas and the constriction of the mouth by HWY 20 near Padilla Bay. If the PSNERP restoration project is constructed at Telegraph Slough then these impacts could lessen. Cumulative impacts to fish in the Swinomish channel would also derive from the combination of the added sediment and runoff from the bypass channel, the other agricultural runoff from ditches and sloughs that draining fields adjacent to the channel, and the diking and dredging of the channel for agriculture and navigation. Climate change would also exacerbate the impacts of sediment, turbidity, and freshets on fish and inverts in Telegraph Slough and Swinomish Channel, causing the channel to activate more frequently and for longer durations.

4.15 Threatened and Endangered Species

USACE intends to submit a Biological Assessment (BA) on the preferred alternative and its proposed mitigation to NMFS and USFWS under Section 7 of the Endangered Species Act. This BA will contain an extensive analysis of the project's effects and an associated effects determination of either "*no effect*", "*may affect but not likely to adversely affect*", or "*may affect and likely to adversely affect*" for each ESA listed species in the project area. NMFS and USFWS will decide, based on the BA, if they concur or do not concur with the USACE determinations and may recommend reasonable and prudent measures to minimize impacts to ESA listed species in a Biological Opinion. The analysis presented below is a summary of ESA species occurrence and life history strategies in the basin, as well as potential impacts resulting from the alternatives:

4.15.1 Affected Environment

Numerous species of plant, fish and wildlife species occur in the Skagit Basin, including several threatened and endangered species that occur in the project areas (Table 4-9).

Table 4-9. Listed Species in the Basin

Species	Scientific Name	Status	Critical Habitat
Puget Sound Chinook Salmon	*Oncorhynchus tshawytscha*	Threatened	Designated-Skagit River
Coastal/Puget Sound Bull Trout	*Salvelinus confluentus*	Threatened	Designated-Skagit River
Puget Sound Steelhead	*Oncorhynchus mykiss*	Threatened	Proposed
Boccacio	*Sebastes paucispinis*	Endangered	No Designation
Canary Rockfish	*Sebastes pinniger*	Threatened	No Designation
Yelloweye Rockfish	*Sebastes ruberrimus*	Threatened	No Designation

Species	Scientific Name	Status	Critical Habitat
Southern Resident Killer Whale	*Orincus orca*	Endangered	Designated- marine areas greater than 20 feet
Marbled Murrelet	*Brachyramphus marmoratus*	Threatened	Designated-Upper Skagit Basin
Northern Spotted Owl	*Strix occidentalis*	Threatened	Designated-Upper Skagit Basin
Grizzly Bear	*Ursus arctos*	Threatened	No Designation
Gray Wolf	*Canis lupus*	Endangered	No Designation
Canada Lynx	*Lynx canadensis*	Threatened	Designated-not in Skagit Co.

4.15.1.1 Puget Sound Chinook Salmon

The evolutionarily significant unit of Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*) includes all naturally spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound, including the Strait of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington. Six wild stocks of Puget Sound Chinook salmon occur in the upper Skagit, most of which are ocean type (migrating to the ocean within the first year) and smaller fraction of which are stream type (migrating to the ocean after one year of rearing in fresh water). Only one of these stocks, Suiattle Chinook, is classified as healthy by WDFW (see Table 4-6 in Section 4.14, Wildlife and Fish). Critical habitat has been designated for the entire Lower Skagit and Upper Skagit River and most of its tributaries up to the dams at Newhalem. Critical habitat primary constituent elements (PCEs) include freshwater spawning sites, freshwater rearing sites, and freshwater migration corridors. In estuarine habitats the PCEs include areas with water quality, water quantity, and salinity that support the physiological transition of juveniles and adults. In marine habitats PCEs include areas with water quality and forage opportunities to support growth and maturation (NMFS 2005).

The most downstream spawning occurs in the mainstem Skagit and its tributaries between Sedro-Woolley and the Sauk River confluence. Spawning also occurs throughout the Sauk, Cascade, and Suiattle Rivers and their tributaries. Spawning ranges from late July to late October, depending on the stock. The incubation period varies and for most stocks juvenile outmigration begins in early March (WDFW 2002). The majority of suitable freshwater rearing habitat is limited to the reaches above the Burlington/I-5 corridor in the mainstem, as well as its tributaries, due to the extensive levee system and its associated bank armoring in the lower river. A study by Beamer et al. (2010) showed that the majority of juvenile Chinook in the Skagit prefer pool, glide, and bank habitat. Juvenile Chinook have a strong dependence on the estuary for rearing, in the Skagit River they have been shown to spend one to two months residing there before they head out to the Puget Sound and eventually the North Pacific Ocean. There are life history strategies that do not use the estuary; some migrate quickly to Skagit Bay and others rear in freshwater for a couple of months and then head straight for the bay. However, the majority of juvenile Chinook in the Skagit Basin do use the estuary. Presence of juvenile Chinook in the Skagit estuary ranges from January to July. Once they leave the estuary they use shallow marine nearshore zones, including beaches and eelgrass beds, as well as non-natal estuaries for rearing during their shoreline migration (Fresh 2006 and Beamer et al 2007). In Skagit Bay juvenile Chinook occur from March to as late as October, but in most habitat types they are gone by June. In Padilla Bay presence occurs from February to November, depending on the habitat type (Beamer et al. 2007). Research by the Skagit River

System Cooperative and others has shown that the reduced amount of estuarine habitat is likely limiting the production of Chinook (Beamer et al. 2005, Beamer and Larsen 2004, Congleton et al. 1981). Other limiting factors of Skagit Chinook recovery include degraded riparian zones, hydrological modifications (dams), poaching, high water temperatures, lack of pocket estuaries, and high seas survival (SRSC and WDFW 2005).

4.15.1.2 Coastal/Puget Sound Bull Trout

Coastal-Puget Sound bull trout (*Salvelinus confluentus*)population segment has two management units, Olympic Peninsula and Puget Sound. . The Skagit River supports the largest natural population of bull trout/Dolly Varden in Puget Sound. The Puget Sound unit is bounded by the Cascade crest on the east, the Kitsap Peninsula on the west, and Canadian border to the north, and includes all watersheds within the Puget Sound basin and the marine nearshore areas of Puget Sound. This unit has eight core areas (Chilliwack, Nooksack, Lower Skagit, Upper Skagit, Stillaguamish, Snohomish-Skykomish, Chester Morse Lake, and Puyallup). Of this population, lower Skagit bull trout were identified as a distinct stock based on their geographic location; an area which includes all of the Skagit River and its tributaries located below the Gorge Dam, excluding the Baker River (USFWS 2004). Critical habitat was designated for the entire Lower Skagit and Upper Skagit River to the portions of Ross Lake and its tributaries that lie within the boundaries of the United States. Critical habitat PCEs determined essential to the conservation of bull trout include water temperatures between 36°F and 59°F, complex stream channels, appropriate substrate for spawning and rearing success, a natural hydrograph, sufficient water quality and quantity including subsurface connectivity, migratory corridors, abundant food base, and lack of non-native predatory or competitive species.

Anadromous, fluvial, adfluvial, and resident life history forms are all found in the Skagit River system, at times spawning occur at the same time and place. Spawning usually takes place from August to October, and occurs in upriver areas that are less than 8°C. Bull trout are apex predators that locate where prey is abundant. Bull trout will also follow prey around, such as migrating juvenile salmon. Based on sampling by the Skagit River System Cooperative in the estuary (Beamer and Henderson 2004), bull trout were found to use delta blind tidal channels, but did not directly use smaller and shallower channels or channels more distant from river distributaries. Trends in annual abundance remained constant. The presence of bull trout in the estuary and nearshore zone varies significantly throughout the year, with the primary period from April through August and a peak in June. Bull trout in the Skagit are known to migrate to both Puget Sound and other river systems, including the Stillaguamish and Snohomish, in search of food; although the majority of these migrants return to the Skagit to spawn (Goetz, pers. comm. 2008). Bull trout also use the marine areas of Skagit Bay; however, their presence in shallow intertidal habitat was very low compared to the deeper intertidal-subtidal fringe. They are present in the deeper intertidal-subtidal habitats of Skagit Bay and Swinomish Channel year round. Peak abundance in Skagit Bay occurs in May or June, with recent data showing a second peak in fall (Beamer and Henderson 2004). A study done by Hayes et al. (2011) found that tagged bull trout from the Skagit River entered the Bay in March through May and then reentered the river in May through August. Bull trout have also been caught in Padilla Bay in low numbers, mostly in February; likely in pursuit of juvenile salmon (Beamer et al. 2007).

4.15.1.3 Puget Sound Steelhead

The distinct population segment for Puget Sound steelhead (*Oncorhynchus mykiss*) includes all naturally spawned anadromous winter-run and summer-run populations, in streams in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Wash., bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive), and the Green River. There are six stocks of wild steelhead in the Skagit River (3 summer and 3 winter) and one in the Samish River. All but one of these stocks are native, and considered to be distinct based on geographic separation. Five of the six stocks have an unknown status and one is characterized as depressed. The Samish River stock is considered to be healthy based on the 2002 stock assessment (WDFW 2002). Critical habitat has been designated for the entire Lower Skagit and Upper Skagit River and most of its tributaries up to the dams at Newhalem. Primary constituent elements (PCEs) are the same as those listed for Chinook salmon (NMFS 2013a).

Steelhead exhibit complicated life history strategies and differing combinations of freshwater/saltwater periods that lead to many different possible life cycles (Barnhart 1986). Depending on the life history strategy, they can spend anywhere from one to four years in the freshwater environment. Summer steelhead run through the Skagit system from May to October and hold in freshwater for a few months before spawning. Winter steelhead run from November to June and spawn closer to their run-time. Steelhead spawning takes place throughout the Skagit system starting in the mainstem just above Mount Vernon and Burlington up to Gorges Dam, and in the major tributaries in including the Nookachamps, Sauk, and Cascade Rivers, and Lake Shannon and Baker Lake. Depending on the stock, spawning ranges from mid-January to mid-July. In many cases precise timing and location of steelhead spawning is unknown (WDFW 2002). In the Samish River, spawning occurs throughout the mainstem Samish, and in Friday Creek and its tributaries from mid-February to early June (WDFW 2002). Based on this variability it is reasonable to assume that all life history stages of steelhead can be present in rivers year-round at varying numbers. As is the case for Chinook salmon, the majority of suitable freshwater rearing habitat occurs in the mainstem reaches above Burlington and the tributaries due to the extensive levee system in the lower river. A study by Beamer et al. (2010) found that juvenile rainbow trout/steelhead in the Skagit system used a variety of habitat types for rearing for freshwater rearing including back waters, banks, bars, glides, pools, step pools, and riffle with a shift in habitat preference as they grew older. Relative to the longer nearshore rearing periods of other juvenile salmonids, juvenile steelhead smolts generally out-migrate to offshore areas quickly and the transit time through the estuary is brief (days to weeks). Few references discuss estuarine use by steelhead adults. Once in the marine environment they quickly move off-shore to deeper waters (Goetz, pers. comm. 2013).

4.15.1.4 Bocaccio, Canary Rockfish, and Yelloweye Rockfish

The distinct population segements for bocaccio (*Sebastes paucispinis*), canary rockfish (*Sebastes pinniger*), and yelloweye rockfish (*Sebastes ruberrimus*) is the Puget Sound and Georgia Basin. Juvenile bocaccio and canary rockfish are the most abundant life stage occurring in the shallow waters of Puget Sound, such as those found in Skagit and Padilla Bays. Boccacio juveniles hover over rocky substrate with various understory kelps or sandy bottoms with eelgrass.

Juvenile canary rockfish settle in tide pools and kelp beds. The adults of these two species tend to occupy waters deeper than what is found in Padilla and Skagit Bays.

Yelloweye rockfish adults, sub-adults, and juveniles occupy the shallower areas with rocky substrate. The larval stages of all three of these species are pelagic, drifting with the mercy of the currents, and therefore can be present in low numbers throughout Puget Sound (Love et. al 2002). No critical habitat has been established for these three species of rockfish.

4.15.1.5 Southern Resident Killer Whale (Orca)

Southern Resident killer whales occur in Puget Sound from early spring to late fall when they move south (as far as Monterey, California) and north (as far as the Queen Charlotte Islands, British Columbia) along the coast for the winter. Critical habitat is designated as marine waters more than 20 feet deep in the Puget Sound, San Juan Islands, and Strait of Juan de Fuca (NMFS 2006). Although Southern Resident killer whales do not directly occupy the shallow waters of Skagit and Padilla Bays, they have a strong feeding preference for salmon (first Chinook then chum). The survival of these whales has been shown to positively correlate with Chinook salmon abundance (Ford et al. 2010). 72.2 percent of the 396 salmon taken by killer whales that were sampled from 1974 to 2004 were Chinook, despite the much higher abundance of the other species (Ford and Ellis 2005). Given that the Skagit River hosts the largest populations of Chinook in the Puget Sound it is likely that these whales are eating a substantial amount of fish that originate from the Skagit River. Southern Resident killer whales are often spotted in the waters surrounding the San Juan Islands, Vancouver Island, and to a lesser extent the west side of Whidbey Island (Kriete 2007). In the fall, the whales may expand their range in Puget Sound proper in pursuit of local salmon runs before leaving for their winter habitat outside of Puget Sound (Kriete 2007).

4.15.1.6 Marbled Murrelet

Marbled murrelets (*Brachyramphus marmoratus*) are small marine diving birds that range from southern California to Alaska. Murrelets feed in shallow marine waters and nest in mature old-growth forests. Critical habitat has been designated to include terrestrial nesting habitat and associated forest stands (USFWS 1996). All nest locations in Washington have been located in old-growth trees that were greater than 32 inches in diameter at breast height (USFWS 1996). Marbled murrelet nests have been located in forest stands as small as seven acres, though average stand size is 509 acres (Hamer and Nelson 1995), and are generally within 50 miles of marine waters. Numerous confirmed occurrences of marbled murrelets have occurred in both Whatcom and Skagit counties (WDFW 2008). Critical habitat for the marbled murrelet has been designated throughout the Upper Skagit basin (USFWS 1996). On October 5, 2011, USFWS revised the critical habitat designation for marbled murrelet in northern California and Southern Oregon, however no changes were made to critical habitat in Washington. The recovery plan for marbled murrelet was developed in 1997 and a number of recovery actions, including additional research and creation of conservation zones, have been implemented (USFWS 1997a).

4.15.1.7 Northern Spotted Owl, Grizzly Bear, Canada Lynx, and Gray Wolf

Although these species are known to occur in Skagit and Whatcom Counties, none of them are found in the Puget Sound lowlands where the project occurs. Therefore, USACE anticipates no effects to these species from any of the alternatives.

4.15.2 No Action Alternative

Habitat and species protections for the listed birds and terrestrial species would be expected to continue into the future. Climate change could have potentially significant impacts, particularly on Canada lynx, as snow levels rise and plant species shift with warming temperatures. The loss of delta marsh (see Section 4.11 (Wetlands Habitat) for detail) with sea level rise and climate change could result in changes to or loss of haul out areas used by Steller sea lions in Skagit Bay.

Protections are in place for ESA listed salmonids including recovery plans, limits on harvest, and ongoing restoration actions focused outside of the urban areas. Regardless of these efforts, much of the lower river would potentially remain as poor quality salmonid habitat from the extensive levee system that protects the urban areas and agriculture. Ongoing repairs under the PL84-99 program will perpetuate rock armored banks with little riparian cover and no off-channel habitat that limits the recovery of Chinook, steelhead, and bull trout in the basin. Climate change could make recovery of ESA listed species more difficult, with increased flows in the winter from storms and lower flows in the summer from lack of snow melt, and higher water temperatures overall. The future of Southern resident killer whales is tied to the recovery of Chinook and chum, as well as factors like contaminant exposure that are beyond the scope of this project. Rockfish recovery depends primarily on relief of fishing pressures and not the status of the Skagit River. All listed species may be more sensitive to climate change and its associated habitat changes due to low population numbers, limited habitat availability, and population isolation.

4.15.3 Comprehensive Urban Levee Improvement Alternative

4.15.3.1 Terrestrial Species

Implementation of the CULI Alternative would include construction focused in or near Burlington and Mount Vernon. Due to the urban nature of this alternative, the terrestrial species listed in Table 4-9 above are unlikely to be in the area due to specialized habitat needs that do not exist in the urban corridor or many areas of the Puget Sound lowlands. These include grizzly bear, gray wolf, Canada lynx, and northern spotted owl. Marbled murrelet may transit the area while travelling from foraging grounds to nesting habitat. Construction of the levee raises and the new levee alignments would not be expected to impact marbled murrelet flight routes or timing as the levels of noise and human activity associated with the effort would not be substantially different than typical ambient levels for this urban area.

4.15.3.2 Puget Sound Chinook Salmon

Impacts to Chinook associated with this alternative are similar to those described in the Section 4.14 (Fish and Wildlife). These include the temporary impacts of construction to early spring-run adults and the late out-migrating spring and summer-run juveniles from elevated turbidity and noise disturbance. Improvements in levees would require existing vegetation to be removed and more rock to be added to reinforce the toe. This would result in further degradation of already poor rearing habitat for out-migrating Chinook. These impacts could be mitigated by actions such as burying the toe to provide planting benches, setting back levees where possible, and installing large woody debris. No Chinook spawning habitat would be affected by this alternative since it is all upstream of the project footprint and its area of impact (SRSC 2005). Changes in hydrology, including increased depth and velocities at the microhabitat scale, also have the potential to impact Chinook. Juveniles may get pushed downstream where habitat is also scarce before they are physiologically ready; a result of more water being kept in the urban corridor during flood events.

4.15.3.3 Coastal/Puget Sound Bull Trout

Impacts to bull trout are similar to those described for Chinook including temporary construction impacts and long-term impacts associated with additional armoring and temporal loss of riparian habitat. However, construction has the potential to affect all life stages of bull trout since they have multiple life history strategies and there is no discrete timing when they leave the river (Goetz, pers. comm. 2013). There would be no modification in spawning habitat since it is in the smaller cooler tributaries, well above the zone of influence of the project. Changes in hydrology at the micro-habitat level during flood events could impact juveniles and newly spawned adults that are transiting the lower river since they may have a harder time swimming in swift water.

4.15.3.4 Puget Sound Steelhead

Impacts to steelhead in the Skagit River are the similar to those described for Chinook and bull trout including those associated with construction, additional armoring of the banks, loss of riparian vegetation, and changes in hydrology at the micro-habitat level during flood events. However, as with bull trout, steelhead have many life history strategies with up to four years spent in freshwater and there is no discrete in-water work window that would avoid impacts to a specific life stage.

4.15.3.5 Bocaccio, Canary Rockfish, and Yelloweye Rockfish

Much of these species' lifecycle is in deeper water than that of Skagit Bay. Although eelgrass beds are important nursery habitat of juvenile rockfish, particularly bocaccio, there would be no impacts to the estuary or Skagit Bay so these rockfish should be unaffected by this alternative..

4.15.3.6 Southern Resident Killer Whale (Orca)

Impacts of this alternative would be directly related to the impacts on Chinook, a preferred prey item of orca populations. Quantifying extent of impacts on orcas is complex since they rely on Chinook runs from various rivers in addition to the Skagit, including a substantial proportion from the Fraser River (NMFS 2013b). However, it is important to note that there would be no impacts to orca habitat since they do not use the shallow waters of Skagit Bay.

4.15.3.7 Cumulative Impacts to Threatened and Endangered Species

There would be no cumulative impacts to terrestrial species, murrelet, or rockfish from this alternative since it has little to no impact on these species. Cumulative impacts to Chinook, steelhead, and bull trout, including those from climate change, are similar to those described in this fish section of the CULI Alternative. These impacts include the perpetuation of armored banks combined with the extensive diking of the entire lower river and ongoing levee repairs and flood fighting action, all of which cause poor quality habitat for fish. Implementation of the Chinook recovery plan and ongoing restoration efforts in the basin may lesson these negative cumulative impacts.

Cumulative impacts to orcas would derive from any of the projects' impacts on Chinook salmon coupled with the pressures that Chinook salmon face in the entire Puget Sound basin and Fraser River (mostly tied to lack of freshwater habitat due to diking of rivers and development of floodplains), as well as the continued release of contaminants that build up in orca tissue. The implementation of the Chinook recovery plan and ongoing restoration efforts in Puget Sound for Chinook habitat may lessen these cumulative impacts to orcas.

4.15.4 Joe Leary Slough Bypass Alternative

4.15.4.1 Terrestrial Species

Due to the specialized habitat needs of the terrestrial species in Table 4-9, these species would not be expected to be found in this developed agricultural floodplain, or their presence is so transitory that any temporal effects to these species from construction activities would not be perceived as unusual, cause disruption of behavior or lead to measurable reductions in their prey base. These include grizzly bear, gray wolf, Canada lynx, and northern spotted owl. Marbled murrelet may transit the area while travelling from foraging grounds to nesting habitat. Construction of the bypass channel would not be expected to impact murrelet flight routes or timing as the levels of noise and human activity associated with the effort would not be substantially different than typical ambient levels for this developed area.

4.15.4.2 Puget Sound Chinook Salmon

Impacts from construction, additional armoring on the banks, and temporal loss of vegetation would be similar to those described for the CULI Alternative, but less so since there is fewer linear feet of levee improvements needed (roughly one third). Impacts to Chinook from changes in hydrology would be minimal, since velocities are not expected to change in the majority of the river. The exception is the section of river just upstream of the inlet structure for the bypass where up to two feet per second increases in velocity above existing conditions is predicted for a 100 year event by the hydraulic model. This area does not overlap with Chinook spawning habitat, but does function as rearing habitat during juvenile outmigration. These velocities, as well as the diversion of the water in general, could lead to entrainment of Chinook in the bypass channel resulting in injury, flushing out to Padilla Bay, or stranding in the bypass. The flood season does not coincide with the juvenile Chinook outmigration so overall risk is low for ocean-type fry. However, there is a risk that adults and stream-type juveniles could become entrained in the bypass channel. The juveniles would likely not be physiologically ready for salt water and the adults may not have the energy reserves to make their way back to the Skagit River mouth via the Swinomish Channel. Impacts of elevated turbidity, low salinity, and agricultural run-off from the bypass on Chinook using Padilla Bay would be minor since the flood season typically begins is at the tail end of Chinook presence in the Bay (Beamer et. al 2007). Long-term changes in habitat in Padilla Bay could also impact Chinook salmon by degrading the quality of eelgrass beds and filling in tidal channel that juveniles use during their shoreline migration. The low frequency of the bypass channel being activated weighed against the magnitude of force when it is activated makes it difficult to quantify impacts to Chinook salmon.

4.15.4.3 Coastal/Puget Sound Bull Trout

Impacts from construction, additional armoring, and temporal loss of vegetation would be similar to those described for the CULI Alternative, but less so since there is fewer linear feet of levee improvements needed. Impacts from changes in hydrology would be similar to those described for Chinook, including increased difficulty swimming just above the bypass channel during flood events. All life stages could be exposed to these velocities, but juveniles and newly spawned adults will have the most difficulty. No spawning habitat would be impacted by this alternative because all bull trout spawning occurs well upstream of the project. All life stages of bull trout can become entrained in the bypass channel since they have multiple life history strategies and there is no discrete timing when a particular life stage is in the river. Adult and sub-adults that get swept into Padilla Bay may be able to make their way back to the Skagit River, if they are not injured first, since they regularly move in and out of saltwater. Bull trout using the Padilla Bay would be impacted by elevated turbidity and agricultural runoff when the bypass channel is activated, as well as from long-term changes in habitat like eelgrass beds and tidal channels. They have been caught in low numbers in Padilla Bay, towards the end of the flood season in November (Beamer and Henderson 2004).

4.15.4.4 Puget Sound Steelhead

Impacts from construction, additional armoring, and temporal loss of vegetation would be similar to those described for the CULI Alternative, but less so since there is fewer linear feet of levee improvements needed (roughly one third). Impacts from changes in hydrology would be similar to those described for Chinook, including increased difficulty swimming just above the bypass channel during flood events. Adult steelhead tend to be strong swimmers so they may have less difficulty than other species. This alternative does have the potential to negatively impact effect spawning habitat, because an increase in velocities of up to two feet per second is expected between RMs 21 and 23 for the 100 year flood event versus a 100 year event under existing conditions. This stretch of river overlaps with steelhead spawning habitat (WDFW 2002). If a flood overlaps with spawn timing, which it typically does not since they spawn from March to June (WDFW 2002), this increase in velocity could lead to difficulty for the fish to maintain its position and defend its territory, low fertilization success, and/or scour of redds. Entrainment of steelhead in the bypass channel is possible, for all life stages, since they have complex life history strategies and juveniles and sub-adults can be found in the river year round and adult migration of winter steelhead overlaps with the flood season. Adults that get swept into Padilla Bay may be able to make their way back to the Skagit River, if they are not injured first, as they spawn multiple times and do not have the same energy limitations that salmon do. There would be no impacts to steelhead associated with changes in water quality when the bypass is activated or long-term changes in habitat in Padilla Bay since steelhead tend to quickly migrate off shore upon entering saltwater.

4.15.4.5 Bocaccio, Canary Rockfish, and Yelloweye Rockfish

Eelgrass beds are important nursery habitat of juvenile rockfish, particularly bocaccio. Changes in salinity, increased turbidity, and impacts to eelgrass bed health resulting from scour and sedimentation in Padilla Bay has the potential to negatively affect juvenile rockfish recruitment. Given successful recruitment occurs only every decade or so (Love et. al, 2002), activation of the bypass channel could have long-term adverse impacts to rockfish populations in the project area. Quantifying these impacts would be difficult and speculative since rockfish populations are not as easy to monitor as salmonids.

4.15.4.6 Southern Resident Killer Whale (Orca)

Impacts of this alternative would be directly related to the impacts on Chinook, a preferred prey item of which orca populations are correlated to. Quantifying extent of impacts on orcas is complex since they rely on Chinook runs from other rivers in addition to the Skagit with variations in population amounts by year, including a substantial proportion from the Fraser River (NMFS 2013b). There would be no impacts to orca habitat since they do not use the shallow waters of Skagit Bay.

4.15.4.7 Steller sea lion

There are no Steller sea lion haul outs in Padilla Bay. While Steller sea lions may use the area for foraging, the occasional activation of the bypass channel would not be expected to significantly impact the species or their prey base.

4.15.4.8 Cumulative Impacts to Threatened and Endangered Species

There would be no cumulative impacts to terrestrial species, murrelet, or rockfish from this alternative since it has little to no impact on these species. Cumulative impacts to Chinook, steelhead, and bull trout, including those from climate change, are similar to those described in this fish section of the JLS Bypass Alternative (Section 4.14.4). These impacts from levee improvement and entrainment risk in the bypass combined with the poor habitat quality conditions in the Skagit River from past diking of the river and future levee repairs and maintenance.

Cumulative impacts to orcas would derive from the projects' impacts on Chinook salmon coupled with the pressures that Chinook salmon face in the entire Puget Sound basin and Frasier River (mostly tied to lack of freshwater habitat due to diking of rivers and development of floodplains), as well as the continued release of contaminants that build up in orca tissue. The implementation of the Chinook recovery plan and ongoing restoration efforts in Puget Sound for Chinook habitat may lessen these cumulative impacts to orcas.

4.15.5 Swinomish Bypass Alternative

4.15.5.1 Terrestrial Species

Due to the specialized habitat needs of the terrestrial species in Table 4-9, they would not be expected to be found in this develop agricultural floodplain, or their presence is so transitory that any temporal effects to these species from construction activities would not be perceived as unusual, cause disruption of behavior or lead to measurable reductions in their prey base. These include grizzly bear, gray wolf, Canada lynx, and northern spotted owl. Marbled murrelet may transit the area while travelling from foraging grounds to nesting habitat. Construction of the bypass channel would not be expected to impact murrelet flight routes or timing as the levels of noise and human activity associated with the effort would not be substantially different than typical ambient levels for this developed area.

4.15.5.2 Puget Sound Chinook Salmon

Impacts of construction to Chinook are similar to those described for the CULI and JLS Bypass Alternatives, but less than CULI due to the amounts of levee improvements required (roughly one third of CULI). Impacts to Chinook resulting from changes in hydrology are similar to JLS, but the area upstream of the bypass channel in which velocities would change during flood events is lower in the system (RM 16- 18). This area still does not overlap with Chinook spawning habitat and is of poorer quality (located in heavily armored urban corridor) than the area upstream of the JLS bypass, but the velocities created by this bypass (up to 10 feet per second) may be too swift for juvenile Chinook. Studies by Bell (1973) and Powers and Orsborn (1985) found that adult Chinook could only sustain swimming speeds above 10 fps for 6 seconds, so juvenile would likely be flushed downstream in such high speeds. However, there is a low likelihood that juveniles would be exposed to such velocities since their outmigration does not occur during the flood season. Adults may also have a difficult time swimming in these velocities. Risk of entrainment of Chinook is essentially the same as described for the JLS Bypass Alternative, but the bypass channel six miles further downstream. Impacts to Chinook in Padilla Bay and the eelgrass beds and tidal channel that they use are similar to those of JLS, but less so due to the buffering effects of the wetlands surrounding Telegraph Slough. There are additional impacts to Chinook using the Swinomish Channel associated with this alternative, including elevated turbidity and low salinities when the channel is activated.

4.15.5.3 Coastal/Puget Sound Bull Trout

Impacts of this alternative are the same as those described above for Chinook, with the exception that all life stages of bull trout can become entrained in the bypass channel and that adults and sub-adult bull trout may be able to find their way back to the Skagit River via the Swinomish Channel after being flushed into Padilla Bay from the bypass.

4.15.5.4 Puget Sound Steelhead

Impacts of this alternative are the same as those as those described for the JLS. There are three exceptions: 1) Construction and long-term impacts associated with levee improvements and the inlet to the bypass structure are greater due to more length of levees requiring improvement and the bypass structure being located directly on the river, 2) the area upstream of this bypass channel that is expected to have increased velocities during flood events just barely overlaps with steelhead spawning habitat, and 3) velocities in the area upstream of the bypass would be as much as 10 feet per second (fps), which may be too swift for juvenile steelhead. Studies by Bell (1973) and Powers and Orsborn (1985) found that adult Steelhead could only sustain swimming speeds above 13.7 fps for 6 seconds and they could maintain prolonged speeds of 4.6-13.7 fps. However, juvenile steelhead would likely be flushed downstream in such high speeds.

4.15.5.5 Bocaccio, Canary Rockfish, and Yelloweye Rockfish

Impacts to juvenile rockfish would be similar to those described for the JLS Bypass Alternative but less so due the buffering effects of the wetlands surrounding Telegraph Slough.

4.15.5.6 Southern Resident Killer Whale (Orca)

Impacts of this alternative would be directly related to the impacts on Chinook, a preferred prey item of which orca populations are correlated to. Quantifying extent of impacts on orcas is complex since they rely on Chinook runs from other rivers in addition to the Skagit, including a substantial proportion from the Fraser River (NMFS 2013b). There would be no impacts to orca habitat since they do not use the shallow waters of Skagit Bay. There would be no impacts to orca habitat since they do not use the shallow waters of Skagit Bay.

4.15.5.7 Cumulative Impacts to Threatened and Endangered Species

There would be no cumulative impacts to terrestrial species, murrelet, or rockfish from this alternative since it has little to no impact on these species. Cumulative impacts to Chinook, steelhead, and bull trout, including those from climate change, are similar to those described in this fish section of the Swinomish Bypass Alternative (Section 4.14.5). These impacts from levee improvement and entrainment risk in the bypass, combined with the poor habitat quality conditions in the Skagit River from past diking of the river and future levee repairs and maintenance.

Cumulative impacts to orcas would derive from the projects' impacts on Chinook salmon coupled with the pressures that Chinook salmon face in the entire Puget Sound basin and Frasier River (mostly tied to lack of freshwater habitat due to diking of rivers and development of floodplains), as well as the continued release of contaminants that build up in orca tissue. The implementation of the Chinook recovery plan and ongoing restoration efforts in Puget Sound for Chinook habitat may lessen these cumulative impacts to orcas.

4.16 Cultural Resources

Cultural resources are locations of past human activity, occupation or use on the landscape. The term was coined by the National Park Service in the early 1970s to encompass a wide range of heritage assets including, but not limited to: archaeological sites such as lithic scatters, villages, procurement areas, resource extraction sites, rock shelters, rock art, shell middens; and historic era sites such as trash scatters, homesteads, railroads, ranches, logging camps, and any buildings or structures that are over 50 years old. Cultural resources also include aspects of the physical environment that are associated with cultural practices or beliefs of a living community that are both rooted in that community's history and are important in maintaining its cultural identity (Parker and King 1998). Commonly referred to as Traditional Cultural Properties (TCP), these areas are afforded the same consideration as other cultural resources.

The term cultural resource is not defined in the NEPA and has no statutory definition, but the related term "historic property" is defined at law (16 U.S.C. 470w) and regulation (see 36 CFR Part 800.16 - Definitions). A historic property is defined as a type of cultural resource that has met certain standards of age, integrity, and significance (Figure 4-8) in order to be eligible for listing on the National Register of Historic Places. The National Historic Preservation Act (NHPA) is the major piece of legislation that mandates that Federal agencies take into account the effects of their undertakings on historic properties.

There are three main standards that a resource must meet to qualify for listing on the National Register (36 CFR 60): age, integrity, and significance. To meet the age criteria, a resource generally must be at least 50 years old. Properties under 50 years of age can be found eligible when the resource is of exceptional significance (36CFR60.4). To meet the integrity criteria, a resource must possess integrity of location, design, setting, materials, workmanship, feeling, and association. Finally, a resource must be significant according to one or more of the following criteria:

(A) be associated with events that have made a significant contribution to the broad patterns of our history; or

(B) be associated with the lives of persons significant in our past; or

(C) embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(D) have yielded, or may be likely to yield, information important in prehistory or history

Figure 4-8 Standards Resource Must Meet to Qualify for Listing on National Register of Historic Places

Impacts to cultural resources are typically examined in terms of how the project would affect the characteristics that make the property eligible for the National Register. For instance archaeological sites that are eligible under Criterion D may be impacted by ground disturbance. Meanwhile, a property that is eligible under Criterion A, such as a farmhouse or TCP, may be impacted by the introduction of audible or visual intrusions because these intrusions would affect its integrity of location, setting, and feeling. Such impacts are referred to as adverse effects in the NHPA's implementing regulations (36CFR800.5). The phrase "adverse effect" (used in the NHPA) and "significant impact" (used in NEPA) are not equivalent terms but are similar in concept. For the purposes of this analysis, adverse effects to properties that are eligible for the National Register will be viewed as significant impacts.

Regulations at 36 CFR 800 outline the process through which Section 106 of the NHPA is administered. In general, the regulatory process can be broken into four steps. These are 1) defining the undertaking and assessing if it has the potential to affect historic properties included on, or eligible for inclusion on the National Register; 2) making a good faith effort to identify those properties within the area of potential effect; 3) assessing the undertaking's effects on those resources; and 4) taking steps to avoid or mitigate adverse effects if present.

By the nature of feasibility studies, identification efforts would need to be delayed until a future phase of the study. Consequently, USACE, in consultation with the State Historic Preservation Officer (SHPO), Skagit County, Affected Tribes, and other interested parties, would develop a Programmatic Agreement (PA) in accordance with 36CFR800.14, in order to fulfill their obligations under Section 106 of the NHPA. The PA would define how the consulting parties will meet their responsibilities under Section 106 including: defining the area of potential effect, procedures for identifying and evaluating the resources, and listing preferred strategies to avoid, minimize or mitigate adverse effects to historic properties. The draft PA is being prepared and is available for review upon request. The final PA will be included with the final feasibility report/EIS. As the projects are further developed, cultural resource surveys would occur and any actions where an adverse effect finding cannot be avoided, the parties would work toward the development of mitigation or treatment options which would be implemented through a Memorandum of Agreement.

Section 304 of the NHPA prohibits Federal agencies from publicly disclosing specific information about cultural resources that could lead to their harm through vandalism or looting regardless of their eligibility. Therefore, specific site locations are not discussed in this analysis.

4.16.1 Affected Environment

In order to compare the alternatives and identify potential impacts to cultural resources, a search was made of the Washington Department of Archaeology and Historic Preservation's (DAHP) online database WISAARD (last query October 2013). The database lists all archaeological sites that have been officially recorded and sent to DAHP. The database also shows areas that have been inventoried since 1995, but does not provide a comprehensive list of inventories conducted prior to 1995 (Figure 4-9). Other sources consulted include ethnographies, General Land Office records, property records, and historic maps.

In general, surveys efforts have focused on developed areas and along the river and coastline. This bias is based in the fact that most inventories are completed as a requirement of Section 106 of the NHPA and consequently only occur where project development is proposed.

Owing to cultural resources work associated with a prior USACE study and other work along the river, more sites have been recorded along the river downstream of Mt. Vernon on the North and South Forks than in other reaches or in proposed bypass areas. Currently, two properties within the Skagit Delta are listed in the National Register: the town of La Conner and the Skagit City School. In addition, the Fishtown Archeological District, a constellation of three prehistoric sites along the North Fork, was nominated to the register. The Washington State Register of Historic Places includes the Old Skagit County Courthouse in Mount Vernon and the Methodist Church in Fir. The Washington State Inventory of Historic Places includes the town sites of Fir, Sterling, and Skagit City. During the summer and fall of 1978, USACE contracted with Seattle Central Community College to conduct a cultural resources reconnaissance for the proposed Skagit River Levee and Channel Improvement Project (Onat et al 1979) which overlaps with some of the currently proposed alternatives (The reconnaissance identified 54 cultural resource sites: 20 prehistoric sites and 34 historic sites. The prehistoric sites are largely habitation shell middens; the historic sites include elements of towns, farms, refuse areas, a cemetery, granary, and logging establishments.

Delta formation processes of meandering and progradation and other land forming processes have been active since human occupation of the region first began after the glaciers departed from the lowlands. Shifting of the river channel and deposition of sediment mean that sites on older buried landforms and surfaces can be expected nearly anywhere within the floodplain. Given the incomplete coverage of the Skagit Valley, there is a high likelihood that additional sites will be discovered. Due to the counterclockwise migration of the main channel from north to south, the northern portion of the delta potentially contains a greater age range of sites (e.g., older lithic sites on ridges and terraces and older buried sites near the Samish River) than the relatively younger deposits associated with the current North and South Fork. In addition, there is the potential for well preserved sites capped by lahars from Glacier Peak.

Regarding historic structures, some inventory work has been undertaken in the County, and some investigations have been conducted by Certified Local Governments. While historic property inventories and register listings have occurred mostly within urban areas and commercial historic districts, less attention has been focused on the rural agricultural properties of the Delta. Information about known or suspected resources within the alternative footprints is included below.

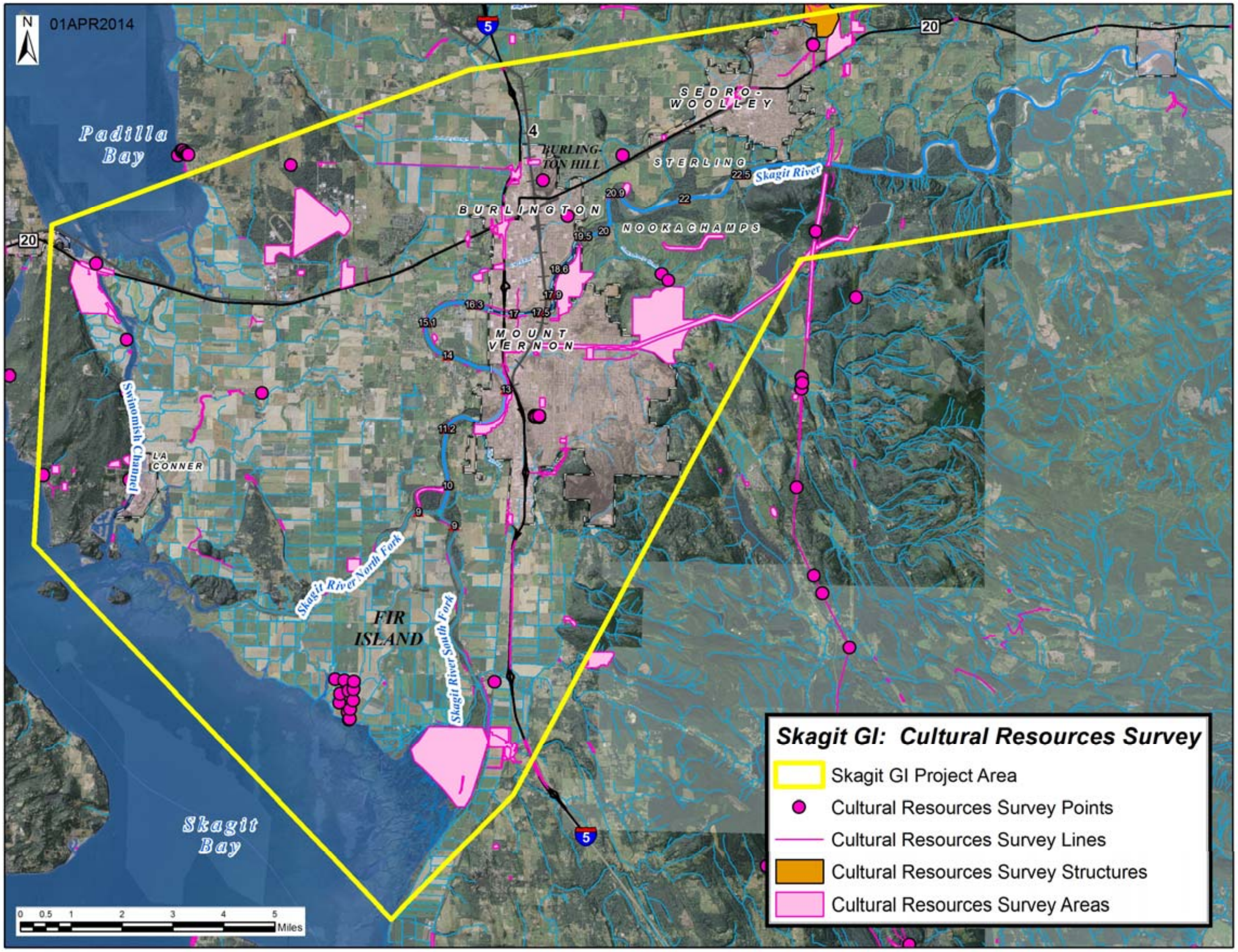

Figure 4-9: Inventory Coverage

4.16.2 No Action Alternative

To date, a small percentage of likely archaeological sites have been identified and recorded, and there is the additional potential that traditional cultural properties with religious significance to native peoples exist. Flood events pose a threat to archaeological sites by way of erosion and sloughing actions which carry away significant cultural materials and features and thereby compromise their integrity, or bury them entirely in layers of sediment. Continued flooding cycles in the Skagit Watershed may damage or destroy archaeological sites which have the potential to yield valuable information about the history and life ways of those who lived in the region before and after white contact.

Continued flooding may also undermine the material and structural integrity of significant historic buildings and structures, especially those of wood frame construction, or those that have been minimally maintained. Repeated flooding of vulnerable structures increases the likelihood of damage, and can result in neglect and abandonment when owners lack sufficient income to perform needed repairs, as well as a loss of potential tourism opportunities associated with heritage.

4.16.2.1 Cumulative Effects to Cultural Resources

Cumulative impacts would be similar to those described above.

4.16.3 Comprehensive Urban Levee Improvement Alternative

As stated in the introduction, impacts to cultural resources are typically assessed in terms of how the project would affect the qualities that make a property eligible for the National Register or, in other words, the qualities that make the property significant. Because this is a programmatic level analysis based on conceptual project designs, a quantitative analysis is not possible. Archival data were collected to determine the location and nature of prehistoric, historic, and architectural resources present within each of the preliminary project areas as well as resources that are likely to be present. Impacts are discussed in terms of property types that are known to exist or are likely to exist within the project footprints and how those properties would most likely be affected by project implementation. Project construction and operation activities would have a significant impact on cultural resources if they diminish the characteristics that qualify the property for inclusion on the National Register. Under NEPA and the NHPA, effects to cultural resources can be direct or indirect.

In general, cultural resources are geospatial resources that are most likely to be directly impacted by ground disturbing activities. The CULI Alternative would include raising 5 sections of existing levee (9.2 miles) and constructing two new levees (2.9 miles). In order to raise the height of the levees the base would need to expand landward anywhere from 10' to 60.' The footprint of the two new levees at riverbend and north Burlington would have an average footprint of 70.' Other potential ground disturbing activities associated with raising the height of the levees would be the creation of staging areas and access roads needed for construction.

In May of 1978, USACE contracted with Seattle Community college to complete a reconnaissance survey along the Skagit River for the Skagit River Levee and Channel Improvement Project (see Prior Reports and Existing Projects 1.7.1 for more information). While this survey focused on the North and South

Forks of the Skagit River, interviews with local residents and a search through the ethnographic literature revealed three locations that fall within or adjacent to the current levee alignment that have a strong likelihood of containing archaeological remains. These include a house and burial site for the Nookachamp Indians, a village and smokehouse, and a prominent fishing location. All of these locations were reported by Snyder (1952-54). No prehistoric materials were located during the reconnaissance, but the high rates of alluvial deposition indicate that evidence of these locations may still be present.

In addition, four archaeological sites have been documented within the currently proposed levee expansion footprint. These sites include: 45SK117 and 45SK304 (both are remnants associated with the historic community of Avon), 45SK125 (remains of one of the earliest settlements north of Mount Vernon), and 45SK415 (a prehistoric hearth feature containing charred faunal remains). These four resources have not been formally evaluated for inclusion in the National Register; however, they would most likely be eligible under Criterion D.

The levees themselves are also historic resources. The first levees appeared along the Skagit River in 1895 and were mostly in place by 1920. These original levees have been modified several times over the last century. Timber pilings were driven in front of the levees in the 1930s in order to slow the water down and prevent undercutting on the banks. Throughout the 1970s and again in the 1990s most of the levees were completely rebuilt into the uniform structures that exist now. Keyways (subterranean impermeable clay walls) were added in several spots in the 1990s. While the levees are a ubiquitous type, undistinguished for their engineering value, the levee system played a critical role in the development of the Skagit Valley and consequently they may be eligible for the National Register under Criterion A. If determined eligible, the construction of the CULI Alternative would result in an adverse effect to the levees.

Skagit County also presented USACE with a GIS layer of all of the structures located within the County. For this analysis, USACE queried the parcel data set to limit the layer to structures built prior to and including the year 1970. The year 1970 was selected because it gives a better analysis of structures that will have attained the 50 year mark by the time any of the alternatives would go to construction. Based on the GIS exercise, five pre-1970 structures would need to be removed within the Burlington Hill Cross Levee footprint. There are also three structures located right along the edge of the landward extension of the toe on the SCDD#17 levee raise footprint. The impacts to these structures cannot be determined at this time. These eight structures have not been recorded or evaluated for eligibility.

Fourteen pre-1970 structures are located between the existing levee and the proposed Riverbend Cutoff levee..This area currently does not get flooded until there is a greater than a 100 year event, future flooding in this area is not expected to be significantly worse than the No Action Alternative

The worst case scenario is assumed for this analysis; however, final designs will include measures to avoid eligible properties whenever possible. In the event that a resource cannot be entirely avoided, steps will be taken to minimize and/or mitigate the project effects. Typically, these steps would entail some form of treatment that is tailored to the property's eligibility criteria. Treatment efforts often include archaeological data recovery, historic research, relocating structures, photodocumentation, engineered drawings, or interpretation

4.16.3.1 Cumulative Effects to Cultural Resources

The CULI Alternative would add to the continuing transformation of the Skagit Riverfront. Previous projects such as the construction of the levees and riverfront development have impacted both archaeological sites and led to the demolition of early historic features. The CULI Alternative is mostly limited to previously disturbed areas with less potential for containing significant archaeological sites. The improvement of the levees could incrementally aid in the protection of historic structures in urban and semi urban areas.

This alternative will also lead to a change to the levee system which has been in a state of transition almost since it was first constructed.

It is expected that the CULI Alternative in conjunction with ongoing and future actions will not contribute significantly to the loss of cultural resources or data within the basin especially if the resources are effectively mitigated.

4.16.4 Joe Leary Slough Bypass Alternative

Only two small archaeological surveys covering approximately 8 acres have occurred within the JLS footprint (Randolph 2010; Randolph 2012). No archaeological sites were recorded as part of these survey efforts. General Land Office maps (1871) show that large tracts of the area were marshy and consequently have a low potential for prehistoric long term habitation sites but short term resource extraction sites could be present. A 1925 Metsker map shows that small farms covered the project area by that time. Early twentieth century farming related sites are expected to be present. Maximum velocities within the channel are expected to be three to four feet per second, which would not cause significant erosion if there is vegetation cover in the channel. A vegetated channel is a design assumption.

If archaeological sites are present, direct impacts are anticipated to occur as a result of the construction of the 17.6 miles of levee. Ground Impacting activities include: clearing and grubbing vegetation, leveling of the 70’ levee base footprint, and the construction of staging areas and access routes. There would also be some excavation within the channel at the inlet and outlet locations.

A review of the parcel data revealed that a total of 64 structures that have a construction date of 1970 or earlier are located within the bypass footprint. None of these sites have been evaluated for the National Register. Twenty-one of these structures are located near the inlet. The extent of the excavation that needs to occur at the inlet structure is not known at this time, but direct effects to the structures such as demolition are likely.

The only one of the 64 structures that has been recorded is a wood gambrel barn, known as the Heath Barn, constructed in the 1920s. It is listed in the Washington State Heritage Barn Register but has not been evaluated for National Register eligibility. The barn is located in the middle of the 2,000 foot wide channel. While the JLS area already has a 4% chance of receiving flood waters every year, the JLS Bypass Alternative would increase the depth of this flood water to an average of seven to ten feet of water. In other words, the structures would be flooded at the same frequency as they currently are but the extent of the flooding would be much greater. For structures such as the Heath barn, which is already in poor condition, flood damage often leads to a loss of material and structural integrity and eventual demolition as the costs of rehabilitation become prohibitive to most owners.

Resources within the footprint and surrounding area that are eligible under Criteria A, B and C could also be indirectly affected by the introduction of visual or audible intrusions such as temporary construction efforts or the new levees. The levees along JLS would be ten to 17 feet high on average.

The bypass would cross the BNSF Railroad. The route was originally the Great Northern Railroad, which operated a line from Seattle to Vancouver, BC from 1857 until 1970. Other historic era transportation sites whose routes bisected the footprint include the Seattle, Lake Shore and Eastern Railroad (1885), later reorganized as the Seattle and International Railway and eventually purchased and abandoned by BNSF in 1971, and the Interurban electrified railroad that ran between Mt Vernon and Bellingham from 1912 to 1929. If this alternative was selected additional design work would occur to determine modifications for the BNSF Railroad. How these modifications would impact the cultural values of the railroad is not known at this time. Significant adverse impacts to the other rail lines or other historic roads are not anticipated since they are currently completely under water during flood events. No additional erosion of these sites would occur as a result of this alternative.

The other JLS Bypass Alternative features such as the modifications to the SCDD# 1 and # 17 levees, the construction of the new Riverbend Cutoff and the Lions Park Connector levees would have the same impacts as discussed for the CULI Alternative above.

As with the CULI Alternative, final designs will include measures to avoid eligible properties whenever possible. If avoidance is not possible, mitigation measures as outlined in Section 5.8 would be applied.

4.16.4.1 Cumulative Effects to Cultural Resources

The JLS Bypass Alternative would be constructed in a mostly rural area. The bypass when combined with other development across the valley floor could contribute to a general loss of the areas' historical character through the continued loss of historic rural structures and alteration of the valley's landscape. These effects are not expected to be significant.

As far as archaeological resources and TCPs are concerned, it is expected that the JLS Bypass Alternative in conjunction with ongoing and future actions would not contribute significantly to the loss of cultural values or data within the basin especially if the resources are effectively mitigated.

4.16.5 Swinomish Bypass Alternative

The types of impacts to cultural resources would be similar to the JLS Bypass Alternative. Both feature levee construction, a 2,000' wide channel with lower water velocities, and excavation at the inlet and outlet. The Swinomish Alternative terminates over a mile inland from Swinomish Slough. This analysis assumes that a restoration project (wetland) being considered under a separate study will be completed prior to the Swinomish Bypass.

One cultural resource survey of approximately 5 acres has occurred within the project footprint (Randolph 2010b), and two investigations have occurred within the restoration area. The two investigations are the monitoring of the City of Anacortes' Waterline Replacement (Wilson 2002) and a small survey adjacent to the piers of the Swinomish Slough Bridge (Regan 2000). No cultural resources were identified during any of these surveys. One small prehistoric site was recorded in the project footprint in 1969. Prehistoric sites are expected to occur in the same or slightly greater density than the JLS Bypass footprint, owing to the fact that the area was not as marshy.

Thirty-five pre-1970 structures are located within the project footprint. None of these are located within the restoration area and none of them have been recorded or evaluated for National Register eligibility. As with the JLS Bypass, the structures would be flooded at the same frequency, but with peak flood depths reaching the 16 to 20 foot range, the extent of the flooding would be much greater and impacts to historic structures would be the same. Similarly, visual intrusion from the ten to 18 foot levees could indirectly adversely affect surrounding resources.

The inlet for the bypass is positioned within the historic community of Avon. Avon was one of the earliest settlements along the Skagit River and while most of the original waterfront buildings were moved to surrounding communities when the levees were constructed, the area has a high potential for containing historical archaeological sites that could yield information about this early period. Only one pre 1970 structure has been identified near the inlet. Excavation at the inlet would have a medium to high chance of adversely impacting significant cultural resources at this location.

Beyond the impacts within the bypass channel, this alternative would direct flood waters into the Swinomish Channel and could lead to increased erosion of sites located on its banks. Twelve archaeological sites have been recorded within 500 feet of the channel edge. It is the densest concentration of prehistoric archaeological sites within the basin. Beginning in the 1990s, USACE has been monitoring erosion rates at one of these sites (45KI156) and has documented that over a meter is lost yearly due to minor actions such as boat wakes and natural processes. Sudden influxes of water into the channel could result in an adverse effect to these sites. It is anticipated that the 832 acre wetland restoration project would ameliorate some of these effects but not all.

The other Swinomish Bypass Alternative features such as the modifications to the SCDD # 12 upstream, and SCDD# 12 BNSF Embankment levees, the SCDD #17 levees, and the construction of the new Burlington Hill Cross Levee and Lions Park Connector levee would have the same impacts as discussed for the CULI Alternative above.

As with the CULI Alternative, final designs will include measures to avoid eligible properties whenever possible. If avoidance is not possible mitigation measures as outlined in Chapter 5 would be applied.

4.16.5.1 Cumulative Effects to Cultural Resources

Cumulative effects for this alternative is expected to be the same as the JLS Bypass Alternative

4.17 Hazardous, Toxic, and Radioactive Waste (HTRW)

4.17.1 Affected Environment

Per ER 1165-2-132, Hazardous, Toxic and Radioactive Waste (HTRW) Guidance for Civil Works Projects, HTRW includes any material listed as a "hazardous substance" under the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. 9601 et seq (CERCLA). A database search of EPA Enviro Facts and WDOE's Integrated Site Information System (Web Reporting) was performed in June 2012 to identify potential HTRW concerns in the immediate study area of Skagit County. At the time of the search, 21 facilities were identified with reported toxic releases. 306 facilities were identified with reported hazardous waste activities. It should be noted that four of the facilities with hazardous waste activities are part of the EPA's Superfund program. None of the sites are listed on the National Priorities List nor do they have published Records of Decision. All four sites are Located in the City of Anacortes. All other facilities identified with known releases or hazardous waste activities are located throughout Skagit County, but primarily concentrated along major roadways and within the urban areas of Mount Vernon, Burlington, and Sedro Woolley.

4.17.2 No Action Alternative

The existing without-project condition is not expected to change significantly in the future under the No Action Alternative. WDOE will likely continue to monitor and identify facilities with hazardous waste activities and, as necessary, remediate facilities with reported toxic releases.

4.17.2.1 Cumulative Impacts to Hazardous, Toxic, and Radioactive Waste

There are no suspected cumulative impacts for the No Action Alternative. Any known or suspected sources of contamination would likely be considered singular and isolated, thus resulting in no cumulative effect.

4.17.3 Comprehensive Urban Levee Improvement Alternative

The construction footprint of the CULI Alternative primarily runs through urban and residential development. In a search of the WDOE's Integrated Site Information System there are several Confirmed and Suspected Contaminated Sites within close proximity of the alternative's construction footprint. However, none of the sites are directly impacted and therefore do not present a concern for HTRW. During advanced design it will be necessary to continue coordination regarding HTRW sites to ensure levee alignments do not encounter sites with confirmed and suspected contamination. In particular, the Riverbend Cutoff Levee has the most likely chance of encountering HTRW issues because of three nearby sites identified with confirmed and suspected contamination.

The SCDD #1 West Mount Vernon Levee runs directly adjacent to Edgewater Park in the City of Mount Vernon. A portion of the area is a former landfill that was eventually acquired by the City of Mount Vernon and converted into a public park. In a 1986 environmental assessment produced by Earth Consultants Inc. no HTRW issues were identified. Primary items found were residential refuse including metal debris, bricks, appliances, and wood debris. Soil and groundwater chemical analyses did not detect any contaminants regulated under CERLCA. There are no HTRW issues expected in association with construction of the SCDD #1 West Mount Vernon Levee.

4.17.3.1 Cumulative Impacts to Hazardous, Toxic, and Radioactive Waste

There are no suspected cumulative impacts for the alternative. Any known or suspected sources of contamination would likely be considered singular and isolated, thus resulting in no cumulative effect.

4.17.4 Joe Leary Slough Bypass Alternative

The construction footprint and associated floodway for the Joe Leary Slough Bypass Alternative primarily runs through lightly developed urban and rural communities with several sites identified by the WDOE as Confirmed and Suspected Contaminated Sites. These sites are either actively being remediated or are awaiting remediation. While approximately five of these sites are in the general vicinity of the alternative, it is unknown if there would be a direct impact to these sites based off the conceptual level of design for the alternative. The most likely impact would be from the Inman Landfill located in the town of Bow, Washington. This site is currently awaiting cleanup by the WDOE. The site has confirmed groundwater contamination above state cleanup levels and suspected contaminated soil.

Construction activities adjacent to SR20 would likely encounter groundwater during excavation required for this alternative. Because of several cleanup sites identified by the WDOE along SR20 southwest of the excavation area, contaminated groundwater plumes could extend up into the area of excavation. The full extent of those groundwater plumes is unknown and it is uncertain if excavation activities would directly encounter this contamination. Further information about actions to be taken in this alternative will be affected by the known groundwater contamination.

4.17.4.1 Cumulative Impacts to Hazardous, Toxic, and Radioactive Waste

There are no suspected cumulative impacts for the alternative. Any known or suspected sources of contamination would likely be considered singular and isolated, thus resulting in no cumulative effect.

4.17.5 Swinomish Bypass Alternative

The construction footprint and associated floodway for the Swinomish Bypass Alternative primarily runs adjacent to SR20 on the south side. There are several sites along SR20 that the WDOE has identified as Confirmed and Suspected Contaminated Sites Further information about actions to be taken in this alternative will be affected by the known groundwater contamination.

4.17.5.1 Cumulative Impacts to Hazardous, Toxic, and Radioactive Waste

There are no suspected cumulative impacts for the alternative. Any known or suspected sources of contamination would likely be considered singular and isolated, thus resulting in no cumulative effect.

4.18 Land Use, Planning and Zoning

4.18.1 Affected Environment

The County's eastern boundary falls on the Cascade Mountain crest. Three-fourths of the County is mountainous with a number of peaks that rise above 8,000 feet in elevation; the County's highest peak is Mount Buckner, which stands at around 9,100 feet in elevation. The terrain in the mountainous areas of eastern Skagit County is one of extreme topography and rugged scenic beauty, with numerous glaciers and perpetual snow fields. The peaks are sharply defined and the plentiful streams of the region cascade swiftly down to the lowlands (WSWP 1973).

One-fourth of the County's area consists of lowlands and flat valley floors. Broad alluvial flat areas cover a major part of the southwestern portion of the county where the Skagit River delta extends into Skagit Bay. The northwestern part of the county, drained largely by the Samish River, is topographically similar (WSWP 1973).

Approximately 48% of Skagit County is in public ownership, mostly in the mountainous regions. The major public landowner is the Federal government, including the Mt. Baker-Snoqualmie National Forest and the North Cascades National Park (Skagit County GIS 2011).

A land cover analysis of the County revealed that approximately 71.3% of lands are classified as forest, 6.7% as agriculture, 6.6% as water, 4.8% as ice and rock, 3.2% as developed, 3.2% as grassland, 2.8% as wetland, and 1.4% as unconsolidated shore (Skagit County GIS 2011).

Skagit County land use is primarily regulated through Skagit County Code (SCC) Title 14, Unified Development Code. City of Mount Vernon land use is primarily regulated through Title 14, Land Use and Development, Title 15, Buildings and Construction, Title 16, Subdivisions, and Title 17, Zoning. City of Burlington land use is primarily regulated through Title 15 Buildings and Construction, Title 16, Subdivisions, and Title 17 Zoning.

Skagit County's comprehensive planning process helps identify objectives and priorities of long-term issues, including land use. The purpose of the Comprehensive Plan is to address principles of the County within the framework mandated by the state Growth Management Act and to provide goals, policies, and strategies for managing growth over 20 years. The Comprehensive Plan was completed in 2007 in tandem with the Skagit County's Countywide Planning Policies. The Comprehensive Plan can be amended annually to ensure consistency with other plans, address changes in local circumstances, and rebalance land use designations.

Land Uses recognized in the Comprehensive Plan fall into four general categories: Urban, Rural, Natural Resources Lands, and Open Space. Chapter 2 (Urban, Open Space & Land Use Element), Chapter 3 (Rural Element), and Chapter 4 (Natural Recourse Land Element) together comprise the Lane Use Element of the Comprehensive Plan.

Land use patterns are guided by the following plans and regulations, including Comprehensive Plan policies (sub-area plans, special function plans); land use related regulations and ordinances (state land use law, land use development regulations, individual and public drinking water systems, septic systems); intergovernmental agreements; plans and studies of land use (economic development, housing, population statistics and forecasts, parks and recreation, wetlands, shorelines, and water resources, solid waste, water supply, transportation, natural hazards, resources lands and critical areas, and environmental review).

Urban Growth Areas (UGAs) include incorporated cities and towns, combined with whatever surrounding unincorporated area is necessary to accommodate urban growth projected to occur over 20 years. Skagit County and its cities and towns assess the respective UGA boundaries and densities on a seven year cycle, and revise their comprehensive plans and development regulations as necessary to accommodate the urban growth projected to occur for the succeeding 20-year period. Appropriate UGA sizing is the major mechanism under the current countywide planning policies for achieving the County's current goal for 80% of new population growth to locate in urban areas. There are approximately 1,200 total development rights in the 100-year floodplain. Approximately 438 are on lands designated Ag-NRL, and another 762 in other land use designations.

UGAs may change to ensure they are sufficient size to accommodate the County's 20-year urban population and employment allocations. Skagit County has a policy to consider the following Growth Management Act (GMA) requirements for designating UGAs: provide for recreational lands, critical areas, open space corridors, greenbelts, and view sheds, and to avoid natural hazard areas prone to flooding or other risks to public safety. The following UGAs are designated within Skagit County: Bayview Ridge, Swinomish, Anacortes, Burlington, Concrete, Hamilton, La Conner, Lyman, Mount Vernon, Sedro-Woolley. The following UGAs (or portions thereof) are located within the floodplain: Burlington, Mount Vernon, Sedro-Woolley, and La Conner.

Although Skagit County has experienced significant pressures of growth, the agriculturally based economy remains strong. Skagit Valley farmers harvest the finest red potatoes in the world, produce hundreds of acres of stunning world famous tulips, provide a significant portion of cabbage and other kohlrabi crop seeds for the entire world, as well as being on the cutting edge of production for blueberries, strawberries, and raspberries. In 2009, Skagit County farmers produced approximately $300 million in products (WSU 2011). According to the 2007 Skagit County Comprehensive Plan, there are 89,277 acres of land in Skagit County zoned as Agriculture-Natural Resource Lands, or "Ag-NRL." The County has protected more than 8,000 acres of farmland from future development through the Farmland Legacy Program. This program allows the County to purchase conservation easements, which protects open space and productive farmland in perpetuity.

The following table from the 2007 Skagit County Comprehensive Plan summarizes all land use designations by acreage in Skagit County.

Table 4-10 Land Use Designations by Acreage

LAND USE DESIGNATIONS	ACREAGE
Water Bodies	[176,696]
PUBLIC OPEN SPACE OF REGIONAL/STATEWIDE IMPORTANCE (OSRSI)	
National Forest	282,812
National Park & Recreation Areas	130,848
Wilderness	83,530
State Parks & Recreation Areas	5,425
Other	16,727
Subtotal	519,342
NATURAL RESOURCE LANDS (NRL)	
Secondary Forest (SF-NRL)	38,008
Industrial Forest (IF-NRL)	319,623
Rural Resource (RRc-NRL)	26,871
Agriculture (Ag-NRL)	89,277
Subtotal	473,779
Mineral Resource Overlay (MRO)	[61,492]
RURAL LANDS	
Rural Village Residential (RV)	2,791
Rural Intermediate (RI)	8,035
Rural Reserve (RRv)	70,378
Subtotal	81,204
COMMERCIAL/INDUSTRIAL LANDS	
Rural Business (RB)	186
Rural Freeway Service (RFS)	29
Rural Village Commercial (RVC)	20
Natural Resource Industrial (NRI)	239
Small-Scale Recreation & Tourism (SRT)	16
Rural Center (RC)	19
Rural Marine Industrial (RMI)	50
Small-Scale Business (SSB)	31
Master Planned Resort	113
Subtotal	703
URBAN GROWTH AREAS (UGA)	
Incorporated UGA Areas (not including incorporated water areas)	22,675
Unincorporated UGA Areas	11.,409
Subtotal	34,084
TOTAL	**1,109,112**

*Acreage figures are based on the best information and technology available. Accuracy may vary depending on the source of the information, changes in political boundaries or hydrological features, or the methodology used to map and calculate a particular land use. Bracketed figures represent an overlay to other land uses and do not contribute to the total acreage.

4.18.2 No Action Alterative

This alternative would have no effect to existing land uses in the project area. Land use patterns will continue to be defined by local zoning, land use ordinances, and building codes. Land uses in the floodplain such as residential and commercial development and agricultural production would not be expected to change as a result.

4.18.2.1 Cumulative Impacts to Land Use, Planning, and Zoning

Cumulative effects would be similar to those described above. Land use patterns could be affected by potential alterations to hydrology and hydraulics affecting future flood risks (see Section 4.5, Hydrology and Hydraulics) as a result of climate change.

4.18.3 Comprehensive Urban Levee Improvement Alternative

This alternative includes levee improvements as described in Section 3.8 (Final Array of Alternatives). The land uses adjacent to these levee improvements include (approximately): 32,814 feet of Agriculture-Natural Resource Lands; 38,011 feet City; 128 feet Urban Reserve Commercial-Industrial; and 3,515 feet of Urban Reserve Residential.

Similar the No Action Alternative, land use patterns would continue by governed by local zoning, land use ordinances, and building codes. This alternative would provide an increase in the level of protection for land in the urban areas and small amount of rural land within the UGA for Burlington and Mount Vernon. In these rural areas, there could more pressure to intensively develop these areas, including agricultural land. However, local planning policies and regulations would regulate any development and thereby potentially minimizing develop of agricultural land. This alternative footprint overlaps with the least amount of agricultural land.

Portions of UGAs for Burlington and Mount Vernon would benefit from a higher level of protection in the CULI Alternative. Portions of UGAs for Burlington, Mount Vernon, and Sedro-Woolley that are outside the targeted area of protection would be adversely affected by this alternative. In addition, there would be a slight increase in flood risk to the Samish, Nookachamps, and Sterling areas, please refer to Section 4.5 for a more detail description.

4.18.3.1 Cumulative Impacts to Land Use, Planning, and Zoning

With the CULI Alternative, cumulative effects would be slightly greater to those described in the No Action Alternative. Under the CULI Alternative, increasing the level of protection in rural areas could result in more pressure for development. Possible effects associated with alternative due to climate change are the same as those described for the No Action Alternative, Section 4.18.2.

4.18.4 Joe Leary Slough Bypass Alternative

The land uses affected by this alternative include (approximately): 3,366 acres of Agriculture-Natural Resource Lands; 34 acres of City; 0.73 acres of Rural Business; 76 acres of Rural Intermediate; 31 acres of Rural Reserve; and 0.05 acres of Urban Reserve Residential.

Similar the No Action Alternative, land use patterns would continue by governed by local zoning, land use ordinances, and building codes. However, there could be an increase in pressure to more intensively develop agricultural and other lands that would be provided 1% ACE level of protection. This alternative footprint overlaps with the greatest amount of agricultural land. Continued agricultural use within the bypass footprint is feasible, but with significant restrictions. The land within the bypass footprint would either need to be purchased fee simple or overlaid with flowage easements. In either case, there would be restrictions requiring a winter cover crop to be grown, which could restrict the other types of crops grown during the other times of the year. This would adversely affect agricultural production in the valley and have secondary impacts to the agricultural industry.

There is potential for land outside of bypass to be removed from 1% ACE floodplain which could affect land use patterns through future amendments to the Comprehensive Plan, UGAs, and Zoning.

4.18.4.1 Cumulative Impacts to Land Use, Planning, and Zoning

With the JLS Bypass Alternative, cumulative effects would be greater to those described in the No Action Alternative and CULI Alternative. Possible effects from climate change with this alternative are the same as those described for the No Action Alternative, Section 4.18.2.

4.18.5 Swinomish Bypass Alternative

The land uses affected by this alternative include (approximately): 2,150 acres of Agriculture-Natural Resource Lands; 11 acres of Rural Business; 15 acres of Rural Intermediate; and 3 acres of Rural Reserve.

This alternative would have similar impacts as the JLS Bypass Alternative. This alternative footprint overlaps with more agricultural land than the CULI Alternative, but less than the JLS Bypass Alternative. This alternative would have similar agricultural restriction as the JLS Bypass Alternative.

There is potential for land outside of bypass to be removed from 1% ACE floodplain which could affect land use patterns through future amendments to the Comprehensive Plan, UGAs, and Zoning.

4.18.5.1 Cumulative Impacts to Land Use, Planning, and Zoning

With the Swinomish Bypass Alternative, cumulative effects would be greater to those described in the No Action Alternative and CULI Alternative. Possible effects from climate change with this alternative are the same as those described for the No Action Alternative, Section 4.18.2.

4.19 Agricultural Resources

4.19.1 Affected Environment

The Skagit floodplain and delta include alluvial soils that create highly productive farmland. Skagit County contains approximately 108,000 acres of farm lands (USDA 2007). As described previously in Section 3.1, Skagit County is one of the richest agricultural areas in the world.

The Farmland Protection Policy Act of 1981 was enacted to minimize the extent that Federal programs contribute to the unnecessary and irreversible conversion of prime or unique farmland to non-agricultural uses. US Department of Agriculture's National Resources Conservation Service (NRCS) is responsible for designating prime or unique farmland protected by the Act (2013). Prime farmland, as defined by the act, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forestland, or other land, but it is not urban or built-up land or water areas. Unique farmland is defined by the act as land other than prime farmland that is used for the production of specific high value food and fiber crops, such as citrus, tree nuts, olives, and vegetables.

Based on data accessed from the NRCS, approximately 260,000 acres, or 23%, of the total acreage in the County meet the soil requirements for prime farmland. Unique farmland is not located in the study area. Prime farmland is land that meet NRCS' soil requirements to be designated as prime farmland; however the land may or may not actually be used for crop production.

4.19.2 No Action Alternative

Agriculture is the large industry in the County and will most likely remain the primary industry in the future. The amount of farm land has been decreasing as development has been increasing. As of 2007, approximately 108,000 acres of farm land are in Skagit County which is an approximately 5% decrease in farm land from 2002 (USDA 2007).

4.19.2.1 Cumulative Impacts to Agricultural Resources

Increases in population and development may result in losses of agricultural land and a reduction in the total harvested acres. In addition to development, programs such as the Skagit Delta Tide Gates and Fish Initiative may convert agricultural lands into natural habitat, thus resulting in additional loss of agricultural lands. As mentioned in previous sections of Section 4, climate change could cause more frequent and intense flood events in the Basin. Climate change projections indicate the possibility of increased agricultural pests, invasive plants, and diseases driven by warmer temperatures (Lee and Hamlet 2011). Increases in temperatures in the PNW could impact the agricultural base in the County by increasing the number of insect life cycles per year, expanding pest ranges, altered pathogen development rates and modified crop resistance to pathogens (Casola et al. 2005). In addition, degraded quality and/or decreased productivity of some crops could occur due to warmer temperatures alone; however elevated CO_2 levels could increase the net productivity in some crops (Lee and Hamlet 2011).

4.19.3 Comprehensive Urban Levee Improvement Alternative

The CULI Alternative would raise five sections of existing urban levees with an increase in footprint of approximately 35 acres and construct two new levees with a footprint of approximately 75 acres; totally approximately 110 acres of additional land needed. Of the total additional acres, approximately 85 acres is land designated as prime farmland. All of the 85 acres of prime farmland could be affected (Figure 4-10). Not all of that land is currently being farmed, approximately 8 acres are roads and is located in an urban setting. Out of the 85 acres, approximately 45 acres are zoned as Agriculture, and therefore it is anticipated that these acres are or would used for agricultural production.

This alternative would result in an increase overbank flows at Sterling (61,300 cfs for the 1% ACE event) with all the floodwaters flowing north towards Padilla Bay, in comparison to the existing conditions (40,500 cfs). Even though the discharge would increase, the velocities associated with the flood flow are expected to be similar to the existing condition because both scenarios allow the floodwaters to disperse across the large swath of land, resulting in lower velocities than the two bypass alternatives.

The other CULI Alternative features such as modifications to Baker Dam operations or nonstructural features would have minimal effects to agricultural resources because the alternative features would either be located in an urban setting with little or no farmland in their footprint or not modify agricultural lands or production.

4.19.3.1 Cumulative Impacts to Agricultural Resources

With the CULI Alternative, cumulative effects would be slightly greater to those described in the No Action Alternative. Under the CULI Alternative, approximately 45 acres of agricultural land would permanently lose or modified which would contribute to the overall loss of agricultural land. Possible effects from climate change with this alternative are the same as those described for the No Action Alternative, Section 4.19.2.

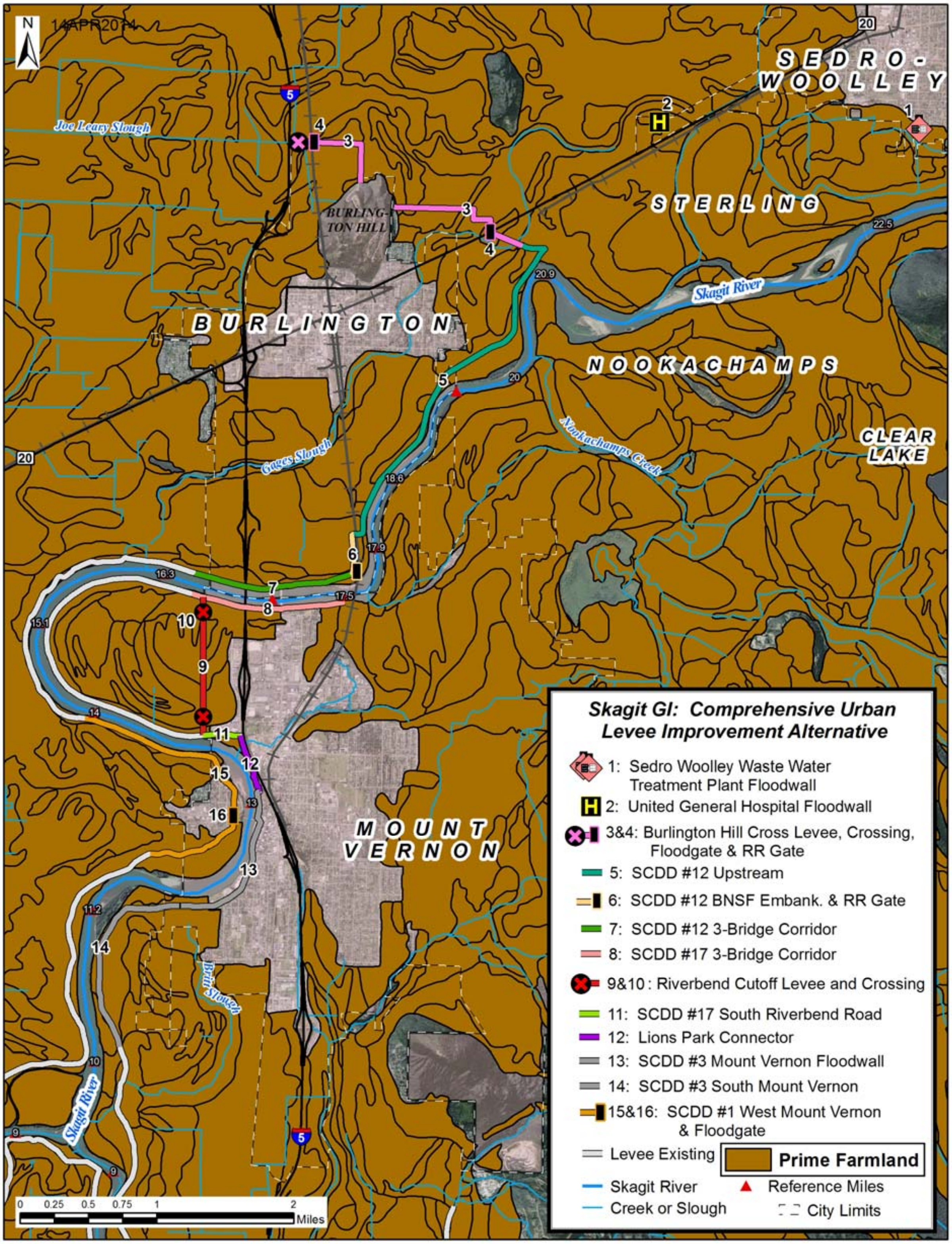

Figure 4-10: Designated Prime Farmland and the CULI Alternative

4.19.4 Joe Leary Slough Bypass Alternative

The JLS Bypass Alternative would be a 2,000 ft wide channel extending from the river near RM 20.9 to Padilla Bay. Approximately 3,500 acres of prime farmland would be within the overall Bypass' footprint (Figure 4-11). Out of those 3,500 acres, there are an estimated 35 acres of existing roads. Of the total acres, approximately 314 acres would be in the new levee footprint which forms the edges of the Bypass. All of the 314 acres of farmland would be permanently taken out of production. Crops production and agricultural practices in the remaining 3,230 acres of farmland of the Bypass footprint, most likely, would be restricted due to the Bypass must be able to handle the design discharges beginning at the 4% ACE. The JLS bypass, therefore, would have major impacts to prime farmland and agricultural resources.

When flood occurs, velocities in the Bypass are not expected to erode the top soil within bypass with the assumption that all land within the bypass channel would be planted with overwinter cover crop to withstand erosive forces of the water. According to NRCS, to prevent soil erosion, a channel/bypass lined with a grass mixture should not exceed maximum velocities ranging between 4-5 ft/s (Chow 1959, NRCS 2007). The JLS Bypass would have maximum velocities of 3-4 ft/s at the peak of the 1% ACE flood, as discussed in Section 4.5 (Hydrology and Hydraulics) and would not exceed the NRCS recommended velocities for erosion assuming there is a cover crop. However, if the cover crop did not completely grow in and/or for some other reason, the bypass channel had areas of exposed soil, then top soil could be eroded from the areas with bare soil, at a minimum. Potentially, the erosive force of the water as it passes over the exposed soil could cause further erosion of top soil in areas with a cover crop. For lower flood events, the velocities would be less than the 1% ACE flood and therefore would have less probability of soil eroding from the Bypass.

The other JLS Bypass Alternative features such as modifications to existing levees and Baker Dam operations would have minimal effects to agricultural resources because the alternative features would either be located in an urban setting with little or no farmland in their footprint or not modify agricultural lands or production.

4.19.4.1 Cumulative Impacts to Agricultural Resources

With the JLS Bypass Alternative, cumulative effects would be greater to those described in the No Action Alternative. Under the JLS Bypass Alternative, approximately 3,500 acres of agricultural land would permanently lose or modified which would greatly contribute to the overall loss of agricultural land. Possible effects from climate change with this alternative are the same as those described for the No Action Alternative, Section 4.19.2.

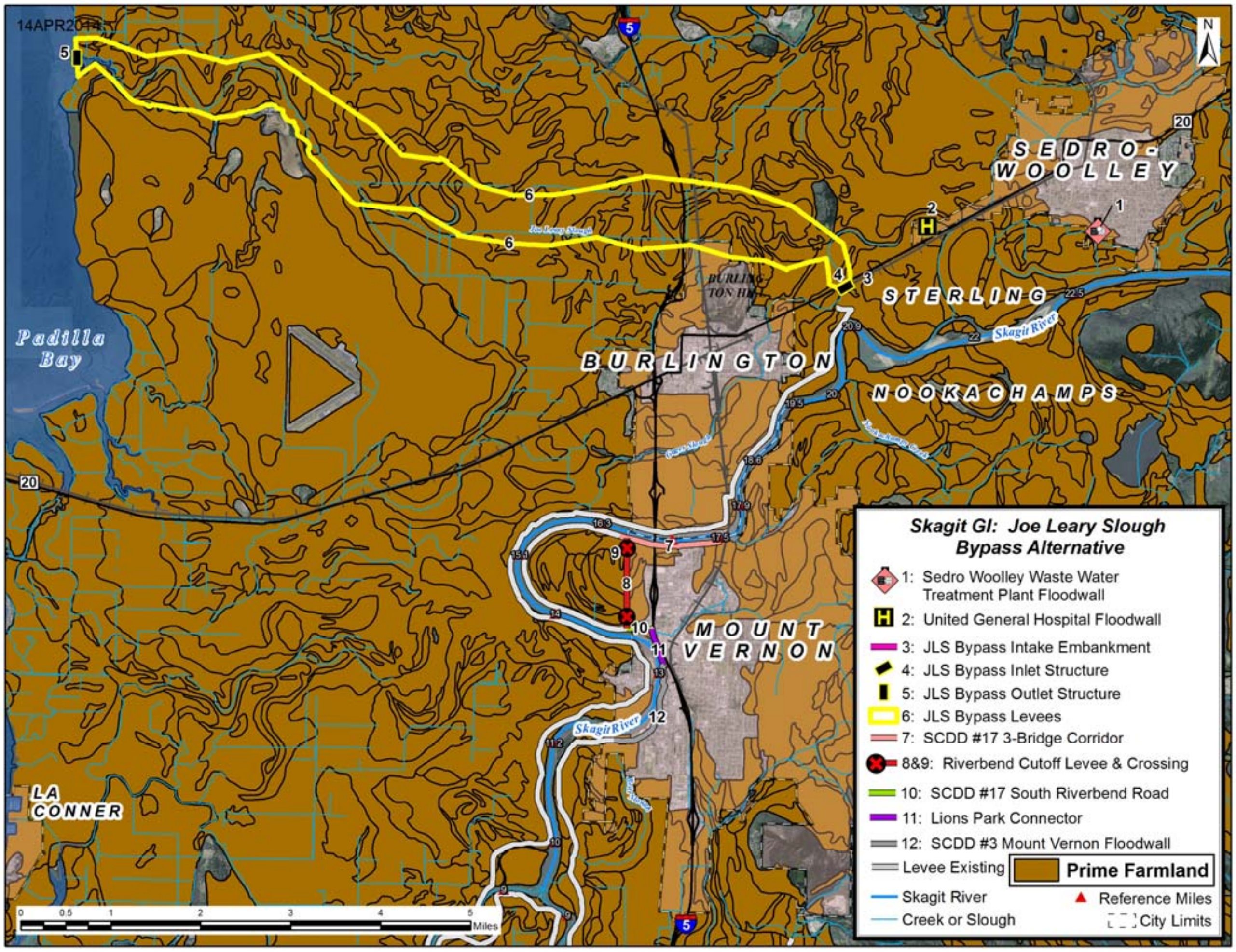

Figure 4-11: Designated Prime Farmland and the JLS Bypass Alternative

4.19.5 Swinomish Bypass Alternative

The Swinomish Bypass Alternative would have similar effects on agricultural resources as the JLS Bypass Alternative. The Swinomish Bypass would be a 2,000 ft wide channel extending from the river near RM 15.7 to Swinomish Channel. Approximately 3,300 acres of prime farmland would be within the overall Bypass' footprint (Figure 4-12). Out of those acres, there are an estimated 22 acres of roads. Of the total acres, approximately 260 acres would be in the new levee footprint which forms the edges of the Bypass. All of the 260 acres of farmland would be permanently taken out of production. Crops production and agricultural practices in the remaining 3,060 acres of farmland of the Bypass footprint, most likely, would be restricted due to the Bypass must be able to handle the design discharges beginning at the 4% ACE. Even though the Swinomish Bypass would affect less acreage of agricultural lands than the JLS Bypass Alternative, this alternative would result in a substantial permanent loss or change to farmland within the footprint.

Potential impacts to loss of top soil would be similar to the JLS Bypass Alternative.

The other Swinomish Bypass Alternative features would have minimal effects to agricultural resources because the alternative features would either be located in an urban setting with little or no farmland in their footprint or not modify agricultural lands or production.

4.19.5.1 Cumulative Impacts to Agricultural Resources

Similar to the JLS Bypass Alternative, the Swinomish Bypass Alternative would greatly affect agricultural resources, cumulatively. Under the Swinomish Bypass Alternative, approximately 3,300 acres of agricultural land would permanently lose or modified which would greatly contribute to the overall loss of agricultural land. Possible effects from climate change with this alternative are the same as those described for the No Action Alternative, Section 4.19.2.

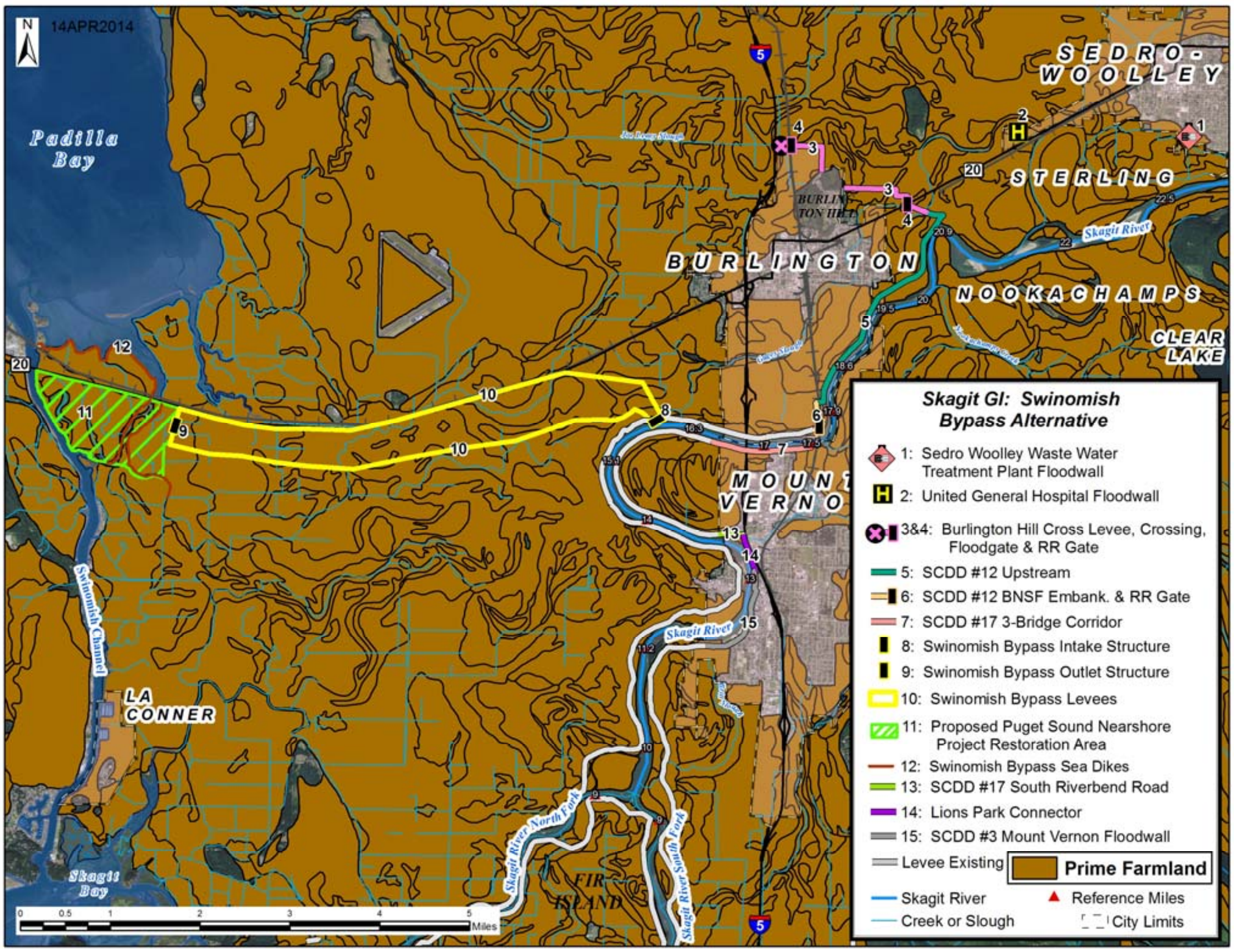

Figure 4-12: Designated Prime Farmland and the Swinomish Bypass Alternative

4.20 Socioeconomics and Environmental Justice

4.20.1 Affected Environment

4.20.1.1 Socioeconomics

Data from 2006 identified that 84.4 percent of the Skagit County population is white. The remainder of the population identified themselves as black, American Indian, Alaska Native, Native Hawaiian, Pacific Islander, Asian, Hispanic or a combination. Based on census data, the largest population centers in the study area were Mount Vernon (30,745), Burlington (6,757) and Sedro-Woolley (8,658) (U.S. Census Bureau 2010a and b). Total county population was estimated to be 113,859 (U.S. Census Bureau 2010b).

For Skagit County, the median household income (in 2008 inflation-adjusted dollars) is $52,554; approximately 7.7 percent of family and approximately 12.3 percent of individuals are below the poverty level. Approximately 84.5 percent of Skagit County's population (25 years old and older) have completed high school and approximately 23.1 percent have completed a Bachelor's degree or higher. (U.S. Census Bureau 2010b).

Population in the upper basin is sparse and centered around the small towns which line Highway 20, including Lyman, Hamilton, Concrete, Marblemount and Newhalem. Agriculture and logging are the primary activities around these small towns, with the exception of Newhalem which is composed of Seattle City Light employees who maintain the dams. The vast majority of land above Marblemount is heavily forested and used primarily for recreation. Most of this land is protected as either National Forest or National Park. The largest population centers are in the middle and lower reaches with county government offices mainly located in Mount Vernon. Agriculture is an important activity in the lower basin.

A 2005 study identified 12,544 residential and 1,639 non-residential (i.e., agricultural, commercial, public, and industrial) properties with a total floor space of 11,210,860 square feet in the floodplain of the study area (USACE 2005). The study area contains over 71,000 acres of agricultural lands that are subject to flooding. The average proportion of agricultural land harvested is approximately 68.8 percent, based on the most recent 2002 U.S. Department of Agriculture Census of Agriculture and 2003 Extension Office reports. During the initial analysis, eleven crops were listed as the principal types for Skagit County (based on the 1996 report from the Washington Agricultural Statistics Service) comprising a total 45,360 harvested acres. Since that report, the harvested acreage and crop type have changed. Harvested acreage is down to 45,200 acres and both carrots and sweet corn have gone out of production. Production of green peas has been reduced by over 50 percent, while production of crops such as potatoes, cucumbers and raspberries has increased in total acreage. Approximately 50 percent of the acreage is in potatoes and hay.

Skagit County has an active aquaculture industry with heavy investments in Samish Bay. There are over 3 million dollars in annual sales from oysters and clams. 4,000 acres of shellfish beds were downgraded by the Washington State Department of Health in May 2011 due to fecal coliform pollution. The County and many partners are actively seeking to reverse the downgrade through an effort known as the Clean Samish Initiative, which involves identifying and correcting pollution sources.

Skagit County is home to diverse commercial enterprise. The largest private employers, including such companies as Draper Valley Farms, Shell Puget Sound Refinery, Janicki Industries, Tesoro Northwest, the Skagit Valley Casino Resort, Regence BlueShield, Dakota Creek Industries, Trident Seafoods Corporation, and Sierra Pacific Industries, employ over 5,000 of the total county population. Large Public employers, including three hospitals, five school districts, the five largest cities, and the county employ an additional 6,000. Most of these employers are located in the lower Skagit River Basin.

Table 4-11 displays employment by major industry sector, with the largest industry sectors in education services, health care, and social assistance; retail trade; and manufacturing. The unemployment rate in Skagit County is estimated at 5 percent.

Table 4-11 Total and Part-Time Employment by Major Industry Sector

Employment	Skagit County	Washington State	United States
Total Employment	**51,185**	**3,135,962**	**141,832,499**
Percent Employment by Industry			
Agriculture, forestry, fishing, hunting, mining	4.4%	2.5%	1.9%
Construction	8.2%	7.0%	6.8%
Manufacturing	11.6%	10.5%	10.8%
Wholesale trade	2.8%	3.1%	2.9%
Retail trade	12.8%	11.6%	11.5%
Transportation and warehousing, utilities	4.7%	5.1%	5.1%
Information	1.5%	2.5%	2.3%
Finance, insurance, real estate, rental and leasing	5.6%	6.0%	6.9%
Professional, scientific, management, administrative and waste management services	7.8%	11.8%	10.5%
Educational services, health care and social assistance	21.1%	21.0%	22.5%
Arts, entertainment, recreation, accommodation and food services	9.5%	8.8%	9.0%
Other services, except public administration	4.6%	4.6%	4.9%
Public administration	5.4%	5.4%	4.9%
Data Source: U.S. Census Bureau, 2007-2011 American Community Survey 5-year Estimates			

4.20.1.2 Environmental Justice

EO 12898, Environmental Justice, was issued by President Clinton on February 11, 1994. Objectives of the EO, as it pertains to this assessment, include development of Federal agency implementation strategies, identification of minority and low-income populations where proposed Federal actions have disproportionately high and adverse human health and environmental effects, and participation of minority and low-income populations.

Accompanying EO 12898 was a Presidential Transmittal Memorandum that referenced existing Federal statutes and regulations to be used in conjunction with EO 12898. The memorandum addressed the use of the policies and procedures of NEPA. Specifically, the memorandum indicates that, “Each Federal agency shall analyze the environmental effects, including human health, economic and social effects, of

Federal actions, including effects on minority communities and low-income communities, when such analysis is required by the NEPA 42 U.S.C. section 4321, et.seq."

Minority populations are those persons who identify themselves as Black, Hispanic, Asian American, American Indian/Alaskan Native, or Pacific Islander. A minority population exists where the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population. Low-income populations as of 2010 are those whose income are $22,050 for a family of four and are identified using the U.S. Census Bureau's (USCB) statistical poverty threshold. USCB defines a "poverty area" as a Census tract with 20 percent or more of its residents below the poverty threshold and an "extreme poverty area" as one with 40 percent or more below the poverty level. This is significant because the social and economic welfare of minority and low-income populations may be positively or disproportionately impacted by the proposed action alternatives and because of public concerns about the fair and equitable treatment (fair treatment and meaningful involvement) of all people with respect to environmental and human health consequences of Federal laws, regulations, policies, and actions. A potential disproportionate impact may occur when the percent minority in the study area exceeds 50 percent and/or the percent low-income exceeds 20 percent of the population. Additionally, a disproportionate impact may occur when the percent minority and/or low-income in the study area are meaningfully greater than those in the reference community.

The USCB reports that the State of Washington had 12.5% of the population living below the poverty line; Skagit County has 12.0% persons living below poverty level (from 2007-2011). USCB reports that approximately 15.6% of the County population is minority. Skagit County is home to four tribes: the Upper Skagit Tribe, the Swinomish Tribe, the Samish Indian Nation, and the Sauk-Suiattle Tribe.

4.20.2 No Action Alternative

The No Action Alternative would have no direct impacts related to socioeconomics or environmental justice concerns. Indirect impacts could include a higher potential for permanent displacement of population compared to an alternative that provides the at risk population increased levels of protection. Population and housing are expected to follow economic trends in the local, regional, and Nation economies. In the absence of a flood damage risk reduction project, certain portions of the low-income and minority populations and housing could be adversely affected. There would likely be disproportionate impacts on low-income residents in a mandatory evaluation due to the lack of financial resources. Federal, state, and local programs are available to assist all residents in the rebuilding process after a flood.

Growth in employment, business, and industrial activity is expected to follow economic trends in the local, regional, and national economies. Without a flood risk management alternative, the stability of employment, business, and industrial activity could be adversely affected. One or more catastrophic floods could result in server negative impacts to employment and business activity and cause significant damage to non-residential structures. An indirect impact of the No Action Alternative could include a higher potential for temporary interruption or permanent displacement of employment, business, and industrial activity as businesses temporarily or permanently relocate to areas with less damage risk.

Future socioeconomic conditions in Skagit County are affected by a number of external variables that are difficult to predict. The county population will continue to increase. Currently the population of Skagit County is 116,397, most of which is located within the lower basin (Sedro Woolley and downstream). By 2030 the population is projected to range from 140,000-220,000 (Washington Office of Financial Management 2007). The Skagit County Comprehensive Plan (2007) is projecting a 45 percent increase in population for 2025 based on the 2000 population.

The growth projections for 2025 indicate that highest growth rates will be seen in Mount Vernon, Sedro Woolley and the smaller East County towns of Hamilton and Concrete. This increase will likely take place in the lower basin due to the presence of North Cascades National Park and Mount Baker-Snoqualmie National Forest in the upper basin. However, due to the location of Mount Vernon and Burlington, and the lack of an endless supply of developable land in the lower basin it is expected urbanization pressure will continue to be felt in the floodplain, as the urban growth boundary pushes out from the cities. Ultimately growth rates will be determined by availability of natural resources (i.e. water) and infrastructure.

The economic base for the County is based largely on natural resource industries including agriculture, forestry and commercial fishing. Agriculture is the largest industry and will most likely remain the primary industry in the future. Currently, the study area contains over 71,000 acres of agricultural lands that are subject to flooding and roughly 45,200 harvested acres. Increases in population and development may result in losses of agricultural land and a reduction in the total harvested acres. Climate change projections indicate the possibility of increased agricultural pests and diseases driven by warmer temperatures. Increases in temperatures in the PNW could impact the agricultural base in the County by increasing the number of insect life cycles per year, expanding pest ranges, altered pathogen development rates and modified crop resistance to pathogens (Casola et al. 2005).

Forests dominate the County land base (approximately 53% in 2007); however, since the timber harvest peak in 1986 both jobs and harvest yields have been decreasing (Skagit County 2007). Climate shifts could have major impacts to forests in the Skagit basin. Disease outbreaks, fire and shifting geographic ranges area all factors that could impact the long-term viability of timber harvesting.

The commercial fishing industry has remained an important industry to the County but in recent years economic viability has significantly decreased in recent years to over fishing, low market prices and catch restrictions (Skagit County 2007). These trends are expected to continue for the future, however as stated above, socioeconomic conditions are driven by a number of external variables that could influence these trends. The future viability for the commercial fishing industry is directly linked to local, State, and Federal policies for managing fisheries.

The shellfish industry would remain an economically important industry to the County. Actions are being taken through the Clean Samish Initiative to identify and correct pollution sources which adversely affect shellfish beds; these will continue under the No Action Alternative.

4.20.2.1 Cumulative Impacts to Socioeconomics and Environmental Justice

Cumulative impacts would be similar to those described above.

4.20.3 Comprehensive Urban Levee Improvement Alternative

The CULI Alternative focuses on improvements to urban areas. This alternative has less of an impact to agricultural resources as compared to Joe Leary Slough Bypass and Swinomish Bypass Alternatives. This alternative would increase the level of protection to urban areas which increases the stability of employment, business, and industrial activity.

This alternative would improve flood risk protection for low-income and minority populations, especially in the population centers of Burlington and West Mount Vernon. Non-structural measures would be implemented for those impacted by the transfer of risk. All alternatives were designed to provide the same level of protection for the major population centers. Non-structural acquisition of residential structures (buy-out) could lead to a permanent loss of population and housing in areas targeted for non-structural measures to be implemented. Elevating affected residential structures would affect access to elevated residences. Non-structural acquisition could lead to changes in population demographics, localized or on a larger scale.

4.20.3.1 Cumulative Impacts to Socioeconomics and Environmental Justice

Possible effects associated with this alternative due to climate change and cumulative impacts are expected to be similar to as those described for the No Action Alternative, Section 4.20.2.

4.20.4 Joe Leary Slough Bypass Alternative

This alternative has the most impact to agricultural resources as compared to the CULI Alternative and the Swinomish Bypass Alternative as it overlaps with 3,366 acres of land designated as Agriculture-Natural Resource Lands. This alternative would increase the level of protection to urban areas which increases the stability of employment, business, and industrial activity.

Impacts associated with environmental justice would be the same as described above in the CULI Alternative.

4.20.4.1 Cumulative Impacts to Socioeconomics and Environmental Justice

With the JLS Bypass Alternative, cumulative effects would be greater to those described in the No Action Alternative. Under the JLS Bypass Alternative, potential changes in land use could occur. In addition, changes in agricultural production, affecting the local economy could occur because of possible agricultural restrictions within the Bypass. Possible effects from climate change with this alternative are the same as those described for the No Action Alternative, Section 4.20.2.

4.20.5 Swinomish Bypass Alternative

This alternative has the less of an impact to agricultural resources as compared to JLS Bypass Alternative as it overlaps with 2,150 acres of land designated as Agriculture-Natural Resource Lands. This alternative would increase the level of protection to urban areas which increases the stability of employment, business, and industrial activity.

Impacts associated with environmental justice would be the same as described above in the CULI Alternative.

4.20.5.1 Cumulative Impacts to Socioeconomics and Environmental Justice

Similar to the JLS Bypass Alternative, the Swinomish Bypass Alternative could affect land use and agricultural-related economy, cumulatively. Possible effects from climate change with this alternative are the same as those described for the No Action Alternative, Section 4.20.2.

4.21 Transportation and Traffic

4.21.1 Affected Environment

Interstate 5 (I-5), the primary highway corridor and the Burlington Northern Santa Fe (BNSF) railroad run through Burlington and Mount Vernon in a north-south direction. State Routes 9, 20, and 536 are critical local transportation corridors that run along through the project area. The three bridge corridor, where the bridges for I-5, BNSF, and Old Highway 99 cross the Skagit River, is located between Burlington and Mount Vernon (RM 17). In May 2013, the I-5 Bridge collapsed and the bridge has been replaced with a permanent bridge, construction was completed in September 2013.

The average annual daily traffic (AADT) count along I-5 near the three bridge corridor is 71,000, of which 12% are trucks transporting commerce to and from Canada (WSDOT 2012). At SR9, the AADT where it crosses Cascade Highway is 9,300. For SR20 in Burlington, the AADT is approximately 17,000. The AADT for SR536 between SR 20 and Mount Vernon ranges from 7,400 to 20,000. (WSDOT 2012).

BNSF and Amtrak operate a primary railroad that crosses the Skagit River. The BNSF railroad bridge over the Skagit River has national significance - it is the only north-south railroad line on the west side of the Cascade Mountains and has international trade importance. Planning estimates indicate that approximately 13 freight trains per day across the Skagit River carrying over 56 million tons of freight (WSDOT 2007). In addition, local refineries make heavy use of the rail line. Amtrak's route from Portland, Oregon to Vancouver, British Columbia passes over the bridge twice per day.

Currently, state routes like SR20, SR9, and local road start shutting down during 4% or greater ACE events. The railroad tracks and I-5, north of Burlington, begin to be affected by flood water at approximately 4% or greater ACE events and could be shut down until the flood waters recede.

4.21.2 No Action Alternative

Vehicle traffic would increase as the population increases, as mentioned in Section 4.20 (Socioeconomics and Environmental Justice). During a 4% or greater ACE event, major highways and state routes would be closed similar to the existing condition, thereby adversely affecting traffic flow. The railroad tracks and I-5 would be affected as described in the existing condition.

4.21.2.1 Cumulative Impacts to Transportation and Traffic

With plans underway for a bulk commodities port in nearby Whatcom County, train traffic could double with coal and other bulk commodities exports. With the climate change, higher flood flows potentially could occur as discussed in Section 4.5. The increased amount of flood water could result in possibly longer duration of highways and state routes closures.

4.21.3 Comprehensive Urban Levee Improvement Alternative

With this alternative, there would be short term construction related impacts to transportation, specifically vehicular traffic. During construction activities, vehicles and equipment associated with the project would disrupt local traffic due to merging, turning, and traveling together. Traffic controls would be used as needed to ensure public safety. Approximately 75,000 construction-related vehicles, mainly dump trucks would be on the road in addition to the existing traffic over approximately a 2 year construction period. The numbers of vehicles would vary depending on the construction activities occurring during the different phases of the project. There could be lane closures along a few local roads as work is being completed such as Freeway Drive where the Lions Park Connector floodwall would be. These lane closures would be short term. Once construction of the alternative would be complete, impacts from additional traffic would not occur.

As described in the No Action Alternative, I-5, SR20, SR9, and local roads would be affected and shut down during a 4% or greater ACE events. In addition, the proposed flood gate across SR20 and railroad track would be closed for the 2% or greater ACE events. Because of the proposed floodgates are closed at a lower ACE than the existing condition and No Action Alternative, effects to transportation and traffic including railroad would be slightly improved up to a 2% ACE event. Once the proposed floodgates are closed at the 2% ACE and greater, the effects to transportation and traffic would be the same as the No Action Alternative.

4.21.3.1 Cumulative Impacts to Transportation and Traffic

No cumulative effects are anticipated with the CULI Alternative. The alternative would increase traffic in the immediate project area during the construction period. Effects from climate change are expected to be the same as the No Action Alternative.

4.21.4 Joe Leary Slough Bypass Alternative

The JLS Bypass Alternative would have greater short term impacts to traffic as the CULI Alternative but less than the Swinomish Bypass Alternative. Approximately 180,000 construction-related vehicles would used during construction and similar lane closure could be required. Effects from road and railroad closure due to 4% or greater ACE events would be the same as the No Action Alternative and local roads could be closed once the bypass has been activated.

4.21.4.1 Cumulative Impacts to Transportation and Traffic

Cumulative effects from JLS Bypass Alternative would be the same as the CULI Alternative, Section 4.21.3. Effects from climate change are expected to be the same as the No Action Alternative, Section 4.21.2.

4.21.5 Swinomish Bypass Alternative

The Swinomish Bypass Alternative would have the greater short term impacts to traffic as the JLS Bypass Alternative. Approximately 190,000 construction-related vehicles would used during construction and similar lane closure could be required. There would, most likely, be closures of local roads within the bypass once the bypass has been activated. I-5, SR 20 floodgate, and railroad floodgate could be closed during a 2% or greater ACE event; however less flow at the Sterling area is expected then the existing condition. Effects to transportation and traffic including railroad in the Sterling Area would be the same as the CULI Alternative.

4.21.5.1 Cumulative Impacts to Transportation and Traffic

Cumulative effects from Swinomish Bypass Alternative would be the same as the CULI Alternative, Section 4.21.3. Effects from climate change are expected to be the same as the No Action Alternative, Section 4.21.2.

4.22 Public Services and Utilities

4.22.1 Affected Environment

The existing public services and utilities is described in Section 3.1.3, Existing Economic Overview, Infrastructure.

4.22.2 No Action Alternative

The public services and utilities are expected to continue provide services to the Basin and those located in the floodplain would remain at risk of damage from flood events greater than 4% ACE.

4.22.2.1 Cumulative Impacts to Public Services and Utilities

As the population continue to increase as expected as described in Section 4.18 (Land Use, Planning and Zoning), public utilities and service would be expected to provide increased services. In addition, potential increase in flood discharges as a result from climate change could put public utilities and services in the floodplain at a greater risk from flooding.

4.22.3 CULI Alternative

This alternative would reduce to risk of flooding up to a 1% ACE event to the public services and utilities located with the cities of Burlington, Mount Vernon, and Sedro-Woolley and therefore would have a beneficial effect for those services and utilities. For any services and utilities such as the oil and gas pipelines within the floodplain and are not located with the above mentioned cities, this alternative is not anticipated to substantially increase their risk of damage from a flood event more than the No Action Alternative.

4.22.3.1 Cumulative Impacts to Public Services and Utilities

Possible effects associated with this alternative due to climate change and cumulative impacts are the same as those described for the No Action Alternative, Section 4.22.2.

4.22.4 JLS Bypass Alternative

Impacts to public services and utilities located in the cities of Burlington, Mount Vernon, and Sedro-Woolley would be the same as the CULI Alternative. Those public services and utilities such as natural gas lines and pipelines located within the bypass channel could be affected by this alternative. For underground utility lines and pipelines, impacts would, most likely, be minimal because as mentioned in Section 4.2.4 Hydrology and Hydraulics, JLS Bypass Alternative, significant erosion is not expected which could expose the various underground utilities assuming there would be a cover crop. During future design phases, appropriate measures would be designed to reduce effects to aboveground utilities and thereby offsetting any adverse impacts. Utilities located in the floodplain but not in the bypass channel would have the same impacts described in the No Action Alternative.

4.22.4.1 Cumulative Impacts to Public Services and Utilities

Possible effects associated with this alternative due to climate change and cumulative impacts are the same as those described for the No Action Alternative, Section 4.22.2.

4.22.5 Swinomish Bypass Alternative

Impacts to public services and utilities located in the cities of Burlington, Mount Vernon, and Sedro-Woolley would be the same as the CULI Alternative. This alternative would have similar impacts and reduction measures as the JLS Bypass Alternative with regard to public services and utilities located within the bypass channel and outside the channel.

4.22.5.1 Cumulative Impacts to Public Services and Utilities

Possible effects associated with this alternative due to climate change and cumulative impacts are the same as those described for the No Action Alternative, Section 4.22.2.

4.23 Public Health and Safety

4.23.1 Affected Environment

Existing conditions for public health and safety are described in Sections 3.1.2 (Existing flood risk management in the Basin) and 3.1.3 (Existing Economic Overview, Infrastructure).

4.23.2 No Action Alternative

The public health and safety are expected to continue provide health and safety services such as fire departments and flood risk management to the Basin and those health and safety services located in the floodplain would remain at risk of damage from flood events greater than 4% ACE.

4.23.2.1 Cumulative Impacts to Public Health and Safety

As the population continue to increase as expected as described in Section 4.18 (Land Use, Planning and Zoning), provide health and safety services would be expected to provide increased services. In addition, potential increase in flood discharges as a result from climate change could put more stress on health and safety services assisting during potential larger flood events.

4.23.3 CULI Alternative

This alternative would reduce to risk of flooding up to a 1% ACE event within the cities of Burlington, Mount Vernon, and Sedro-Woolley more than the No Action Alternative and therefore would have an overall beneficial effect to public health and safety. The floodplain west of the cities of Burlington and Mount Vernon would experience similar effects as the No Action Alternative because the flooding in this area would be similar to the No Action Alternative, refer to Section 4.5.2 (Hydrology and Hydraulics, No Action Alternative).

The northern floodplain may experience an increase in floodwaters spreading across the Samish River near Edison; thus this area could have an adverse impact to public health and safety. Floodwalls are proposed around the United General Hospital to minimize potential increase in risk from the increased overbank flows at Sterling as mentioned in Section 4.5. This facility could become isolated during a 1% ACE event cutting off access to the public. In addition, the closed floodgate across SR20 would restrict access into Burlington for people east of the floodgate; however under the No Action Alternative, SR20 could be affected and possibly shut down at a 4% ACE flood event or greater. The public east of the floodgate would be impacted by this alternative. Evacuation preparation could alleviate some of these risks to public health and safety.

4.23.3.1 Cumulative Impacts to Public Health and Safety

Possible effects associated with this alternative due to climate change and cumulative impacts are the same as those described for the No Action Alternative, Section 4.21.2 (Transportation and Traffic, No Action Alternative).

4.23.4 JLS Bypass Alternative

Impacts to public health and safety in the cities of Burlington, Mount Vernon, and Sedro-Woolley would be the same as the CULI Alternative. Any public located within the bypass channel could have an increased risk to health and safety during a flood event; however with implementation of nonstructural measures such as relocations, elevating homes, developing evacuation routes and plans, these risks to the public would be reduced. Impacts of public health and safety in the floodplain but not in the bypass channel would have the same impacts described in the No Action Alternatives.

4.23.4.1 Cumulative Impacts to Public Health and Safety

Possible effects associated with this alternative due to climate change and cumulative impacts are the same as those described for the No Action Alternative, Section 4.23.2.

4.23.5 Swinomish Bypass Alternative

Impacts to public health and safety in the cities of Burlington, Mount Vernon, and Sedro-Woolley would be the same as the CULI Alternative. This alternative would have similar impacts and nonstructural measures as the JLS Bypass Alternative with regard to public health and safety within the bypass channel and outside the channel.

4.23.5.1 Cumulative Impacts to Public Health and Safety

Possible effects associated with this alternative due to climate change and cumulative impacts are the same as those described for the No Action Alternative, Section 4.23.2.

5. Tentatively Selected Plan (TSP)

The national or Federal objective of water and related land resources planning is to contribute to national economic development (NED). Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and to the rest of the nation. Ordinarily the plan that reasonably maximizes net benefits, known as the NED plan, is recommended. This section documents the optimization of the tentatively selected plan (TSP) to reasonably maximize net benefits for NED. Further documentation of the economic analysis of the TSP is located in Appendix C.

5.1 Optimization of TSP Plan for NED

The 1% ACE (100-year) event was used to evaluate and compare alternatives, and identify the TSP. The Comprehensive Urban Levee Improvement (CULI) Alternative was identified based on a number of criteria discussed in Section 3 and the environmental impacts assessment in Section 4. Based on evaluation and comparison of the final array of alternatives, the CULI Alternative was the only alternative in the final array of alternatives thought to provide positive net benefits. Three scales of the CULI Alternative were evaluated for benefits and costs to determine an appropriate scale to maximize net benefits, including protection from the 1% ACE, 1.3% ACE and 0.4% ACE event. These alternative scales were chosen to evaluate protection greater than existing protection and incremental changes in benefits and costs with increasing protection. Scaling of the features were based on the computed ACE and conditional non-exceedance probability (CNP), or the likelihood a reach would remain dry from a given ACE, with CNP greater than 90% for the target ACE in the Burlington-Mount Vernon urban areas. Hydraulic analyses of the Baker Dam operational measures were also conducted and carried forward into the hydraulic analysis of the CULI Alternative, and the results of the hydraulic analysis and the estimated operational expenses are summarized in the following section.

5.1.1 Baker Dam Optimization

The Upper and Lower Baker Dam Operational Modification Measure are included in the optimization of the TSP, CULI Alternative. The analysis examined early seasonal storage at Upper Baker Dam and flood storage at Lower Baker Dam, consistent with Article 107 in the Settlement Agreement for the Baker River Project. Upper Baker Dam is currently operated for flood control with full flood storage capacity of 74,000 acre feet available on November 15. The Upper Baker Dam operational measure includes flood storage capacity of 74,000 acre feet on October 15. Approximately 30 percent of floods occur between October 1 and November 15. Lower Baker Dam is operated with Upper Baker Dam for hydropower generation and currently is not operated for flood control. An analysis conducted by Puget Sound Energy (PSE) determined 20,000 acre feet of assured flood control space could be available during the flood season. The TSP also includes 20,000 acre feet of storage at Lower Baker Dam from October 15 to March 1. Both dams were evaluated on their own and in combination. The flood discharge reductions from regulation at each dam were calculated for the Skagit River at Concrete. Those regulated flood hydrographs were then routed downstream through the study area and used to compute flood water surface elevations. The combination of both the Upper and Lower Baker Dam operational modification measure resulted in the greatest downstream benefit, with a 17,000 cfs flow reduction for the 1% ACE flood at Concrete and up to approximate a 1 foot stage reduction in the Nookachamps area. These measures are consistent with language in the Federal Energy Regulatory Commission (FERC) No. 2150 relicense dated October 17, 2008 which allows for additional flood control operations if a number of conditions are met, including compensation to PSE for forgone hydropower generation and dependable capacity. PSE estimates generation and dependable capacity losses to be approximately $861,000 on average each year using April 2012 energy prices. At this time, it is assumed that PSE would be compensated for these losses and is included as an annual economic expense.

5.1.2 Cost Estimates, Construction Schedules and Risks

A baseline cost estimate, developed using the 1% ACE hydraulic model, was developed to calculate to cost of the TSP. In order to determine the NED plan, two additional iterations were developed based on this baseline (1.3% ACE and 0.4% ACE). Table 5-1 summarizes project costs for three alternative scales, escalated to the year of anticipated authorization (first costs), which range from $196 million for 1.3% ACE protection to $220 million for 0.4% ACE protection. The range in costs is largely due to changes in levee elevations from one scale to another, and thus differences in necessary materials and quantities. Table 5-1 summarizes all project costs (excluding O&M) that the Federal Government and Skagit County are expected to incur following Project Authorization. Costs are accounted for along a standardized work breakdown structure (WBS).

Conceptual level designs and parametric costs were used to develop the construction estimates, and at the same time identifying risk and uncertainties, using the risk-informed decision process. A primary intention at this stage is to provide a basis for identifying an appropriate NED plan for further development. Additionally, determining future costs is a goal. Conceptual level designs and parametric costs are appropriate for comparison purposes, and contributes to the higher contingency values. A detailed cost estimate based on feasibility-level design will be prepared later in the feasibility phase, and would be the basis of both the authorized cost, and the framework of cost sharing between the Federal Government and Skagit County.

Table 5-1 CULI Alternative Scale Project First Cost Estimates

WBS Feature & Sub-Feature Description (Oct 2015 prices)	CULI 1.3% ACE Estimated Cost	CULI 1% ACE Estimated Cost	CULI 0.4% ACE Estimated Cost
06 - Fish & Wildlife Facilities	$6,207,000	$6,230,000	$6,285,000
11 - Levees & Floodwalls	129,095,000	139,963,000	151,348,000
02 - Relocations	12,915,000	13,198,000	13,621,000
Construction Estimate Totals	***$148,516,000***	***$159,391,000***	***$171,254,000***
01 - Lands & Damages	$11,845,000	$11,845,000	$11,845,000
30 - Planning, Engineering & Design (PED)	30,548,000	30,548,000	30,548,000
31 - Construction Management	10,504,000	11,235,000	11,943,000
Project First Cost Totals	**$201,413,000**	**$213,020,000**	**$225,590,000**
Schedule Durations (months)	**25**	**25**	**27**
Construction Contingency	**63%**	**64%**	**65%**

The Cost Engineering Appendix (Appendix G) contains more detailed information on how values in Table 5-1 were calculated. However, the figures above can be broken into three broad categories: construction costs (WBS 06, 11), real estate and relocation costs (01, 02), and design and administrative costs (30, 31).

Construction Cost Estimates

Construction cost estimates were based on conceptual designs and quantities prepared for each alternative scale. The largest single cost component is raising levees in urban areas. This is due to the volume of material required for construction. Other major cost drivers are the floodwalls and floodgates that protect critical infrastructure, as well as the new levees that would be constructed in North Burlington and at the Riverbend Cut-Off.

Real Estate and Relocation Costs

Land costs were developed by NWS Real Estate Division. They are meant to incorporate easements, lands, and all other minimum real estate acquisition costs required to support the proposed project. Additionally, both Federal and non-Federal Administrative cost projections were included to cover labor and other activities associated with acquiring the required real estate interests. (See Appendix F (Real Estate) for more details.)

A variety of relocations would be necessary in order to allow for new and improved levees and the protective floodwall features. The majority of these costs are due to road modifications. However, there are a number of utilities that may require relocation.. Exact utility locations and the necessity of relocating subject utilities will be further explored during the feasibility-level design phase. Initial utilities relocation cost estimates were developed by NWS Cost Engineering.

Design and Administrative Costs

These costs are meant to capture the cost of design and project management following authorization of the project. They do not include costs of General Investigation (feasibility phase) process. These numbers are based on estimates of similar large scale projects that the Seattle District has designed and implemented, and further refinement will take place later in the Feasibility Phase.

Construction Schedules

Following authorization of the project, completion of design, acquiring necessary real estate, and awarding the construction contract, actual construction would begin. Construction times vary between the three alternative scales, ranging between 25 and 27 months. Due to the project footprint, it is currently assumed that many project elements could be constructed in parallel, rather than sequentially. This allows for shorter construction duration, but this assumption is likely to change as project development proceeds. Currently, tasks other than construction activities are not incorporated into the schedule; however, during the Feasibility Phase a comprehensive schedule dealing with all tasks following project authorization will be prepared.

Construction Risks & Contingency

Construction risks play a role in determining overall costs as these risks are used in determining contingency. The largest risk to this project is related to changes in raising levees in urban areas and the acquisition strategy. For ease of estimating, a single large contractor was assumed to do all work and that this work would not be phased. This injects a large amount of risk that will need to be revised at a later phase. Levees represent the single largest piece of project cost, and minor variations to this feature could have large implications for the project cost. While the PDT is largely confident in the overall prism, there is the potential that portions of levee will be converted to flood wall, height increases in localized segments of the levee, increases in protective armoring based on hydraulic conditions, or that interferences with existing structures and property will require changes to the footprint. Other components of risk that drive contingency include uncertainty regarding site conditions and staging areas, the need for floodwalls to include piling to prevent overturning, and the use of conceptual designs that may change to incorporate more information as the project develops. Contingency is developed scientifically and methodically using the risks as documented by the PDT, along with the team's understanding of the likelihood of an eventuality occurring and the overall impact to the project. Further detail is available in the Cost Engineering Appendix.

Operations and Maintenance

A comprehensive operations and maintenance (O&M) cost estimate will be prepared during the Feasibility Phase. Currently items incorporated this include: new floodwalls, and USACE water management operations of the Baker Dam project during the flood season. Annual O&M of the CULI Alternative are assumed to be the same across scales. Operations and maintenance is discussed in greater detail in Section 5.6.6.

5.1.3 Economic Costs

Economic costs were based on present value cost estimates at the September 2013 price level. Expenditures or financial outlays made during the construction of alternatives are made with no immediate return on investment. Those financial outlays could have otherwise been invested elsewhere and begin returns on investment immediately. The forgone return on investment is an opportunity cost of the alternative and is computed as interest during construction. Interest during construction (IDC) was estimated using the estimated construction duration and current Federal discount rate. IDC was added to the estimated project costs to determine the total investment cost of each CULI Alternative scale, as shown in Table 5-2. Annual O&M costs of the CULI Alternative are assumed to be the same across scales. New O&M with the CULI Alternative includes new levees, new floodwalls, and USACE water management operations of the Baker Dam project during the flood season as described in Section 5.1.2. Operations and maintenance is discussed in greater detail in Section 5.6.6.

Table 5-2 CULI Alternative Scale Cost Summaries

	CULI 1.3% ACE	CULI 1% ACE	CULI 0.4% ACE
Present Value Cost (September 2013 prices)	$196,312,000	$207,954,000	$219,940,000
Interest During Construction	$6,914,000	$7,324,000	$7,747,000
Total Investment Cost	$203,226,000	$215,278,000	$227,687,000
Period of Analysis (Years)	50	50	50
Discount Rate (FY14)	3.50%	3.50%	3.50%
Annual Cost of Initial Investment	$8,664,000	$9,178,000	$9,707,000
Annual Cost of Baker Storage Compensation	$861,000	$861,000	$861,000
Annual O&M of New FRM Features and Additional Flood Regulation	$40,000	$40,000	$40,000
Total Annual Cost	$9,565,000	$10,079,000	$10,608,000

5.1.4 Benefits

Expected annual damages (EAD) of each of the CULI Alternative scales were compared to the without-project condition EAD estimate of $40 million as shown in Table 5-3 EAD Reductions by Alternative Scale. Damages were reduced to urban development in Burlington (1A), Mount Vernon (2A, 4A, and 5A) and La Conner (7) with the CULI Alternative, with potentially minor induced flood damages to Sedro-Woolley (Reach 8), Nookachamps (6), Clear Lake (6A), and the broad northern Skagit floodplain (1). The 0.4% ACE CULI Alternative scale provides the greatest damage reduction of $19.8 million annually, or approximately a 50% reduction in expected annual flood damages. Table 5-3 shows the residual risk, or the flood damage that remains if the proposed flood damage reduction project is implemented.

Table 5-3 EAD Reductions by Alternative Scale ($1,000s)

Damage Reach(es)	Without-project EAD	CULI 1.3% ACE		CULI 1% ACE		CULI 0.4% ACE	
		EAD (Residual Risk)	Benefits (EAD Reduced)	EAD (Residual Risk)	Benefits (EAD Reduced)	EAD (Residual Risk)	Benefits (EAD Reduced)
Burlington (Reach 1A)	$14,737	$2,925	$11,812	$1,770	$12,967	$955	$13,782
Mount Vernon (Reaches 2A, 4A, and 5A)	3,740	837	2904	338	3,401	99	3,640
La Conner (Reach 7)	872	283	589	134	738	86	786
Rural Floodplain (all other reaches)	20,550	19453	1096	19,099	1,452	18,974	1,577

Damage Reach(es)	Without-project EAD	CULI 1.3% ACE		CULI 1% ACE		CULI 0.4% ACE	
		EAD (Residual Risk)	Benefits (EAD Reduced)	EAD (Residual Risk)	Benefits (EAD Reduced)	EAD (Residual Risk)	Benefits (EAD Reduced)
Total	$39,899	$23,498	$16,401	$21,341	$18,558	$20,114	$19,785

5.1.5 Engineering Performance

This section includes a summary of the project performance and long-term risk associated with the project. Table 5-4 displays the expected annual exceedance probability (AEP) for the without project condition and the three CULI scales. The expected annual exceedance probability is the probability of having a flood of a given stage or greater in any given year. According to Engineering Manual (EM) 1110-2-1619, the stage probability function can be used to determine this value. EM 1110-2-1619 states that analysts should "refer first to the rating function to determine the discharge corresponding to the top-of-levee stage. Given this discharge, the probability of exceedance would be found then by referring to the discharge-probability function: This probability is the desired annual exceedance probability".

Table 5-4 Expected Annual Exceedance Probability by Plan

Damage Reach(es)	Expected Annual Exceedance Probability (AEP)			
	Without Project	CULI 1.3% ACE	CULI 1% ACE	CULI 0.4% ACE
Burlington (Reach 1A)	5%	1%	0.3%	0.1%
Mount Vernon (Reaches 2A, 4A, and 5A)	4%	1%	1%	0%
La Conner (Reach 7)	4%	1%	1%	0%
Rural Floodplain (all other reaches)	4-61%	0.2-61%	0.1-61%	0-61%

It should be noted that the performance of the Mount Vernon floodwall in Reach 4A is dependent on both upstream and downstream measures. It was designed to provide at least 1% ACE protection and in combination with the CULI measures provides at least 1% ACE protection (and at least 0.4% ACE protection for the CULI 0.4% ACE plan) as is reflected in the annual exceedance probabilities for Mount Vernon as shown in Table 5-4.

Once the expected annual exceedance probability (P) is known, the following equation is used to determine long-term risk for a specified period of time (n):

$\textit{Long-term Risk} = 1 - [1 - P]^n$

The long-term risk of having one or more floods in a 30 year period, for example, would be equal to $1 - [1 - P]^{30}$. Table 5-5 displays the long-term risk in a 30 year period (a typical mortgage duration) for the without project condition and the three CULI scales.

Table 5-5 Long-Term Risk (30 years) by Plan

Damage Reach(es)	Long-Term Risk (30 years)			
	Without Project	CULI 1.3% ACE	CULI 1% ACE	CULI 0.4% ACE
Burlington (Reach 1A)	72%	13%	7%	3%
Mount Vernon (Reaches 2A, 4A, and 5A)	64%	14%	2%	0.2%
La Conner (Reach 7)	68%	15%	3%	0.4%
Rural Floodplain (all other reaches)	67-100%	4-100%	3-100%	0.8-100%

The probability that a specific event will not exceed the top of protection (top of levee or river bank), or given that a specific event occurs, what is the probability that event will be contained by a given level of protection. This value is called the conditional annual non-exceedance probability (CNP). Table 5-6 below shows the CNP's for the without project condition and three CULI scales assuming the 1% ACE event occurs. These values are good indicators of a project's performance because it takes into consideration the uncertainty in the discharge-probability and stage-discharge estimates.

Table 5-6 Conditional Non-Exceedance Probability (CNP) for the 1% ACE Event by Plan

Damage Reach(es)	Conditional Non-Exceedance Probability (CNP) for the 1% ACE Event			
	Without Project	CULI 1.3% ACE	CULI 1% ACE	CULI 0.4% ACE
Burlington (Reach 1A)	8%	84%	92%	97%
Mount Vernon (Reaches 2A, 4A, and 5A)	21%	81%	97%	99.7%
La Conner (Reach 7)	22%	77%	95%	99.4%
Rural Floodplain (all other reaches)	0-35%	0-94%	0-96%	0-99%

Additional estimates of long-term risk and CNP is included in Appendix C (Economics), including 10 year and 50 year long-term risk, and CNP estimates for the 10%, 4%, 2%, 4%, and 0.2% ACE events.

5.1.6 Benefit-Cost Analysis

Total annual benefits, or expected annual damage reductions, were analyzed with total annual costs to determine net benefits and benefit-cost ratios as summarized below in Table 5-7. Net benefits are equal to the total annual benefits minus total annual costs. Benefit-cost ratios (BCRs) are equal to total annual benefits divided by total annual costs. All CULI Alternative scales resulted in positive net benefits and benefit-cost ratios greater than 1. The 1% ACE CULI Alternative scale removes 3,736 properties from the 1% floodplain and the 0.4% CULI Alternative scale removes 3,942 properties from the 1% floodplain. The 0.4% ACE CULI Alternative scale provided the greatest contributions to National Economic Development (NED) as it maximizes net benefits (annual benefits less annual costs) at $8.7 million and results in the greatest benefit-cost ratio of 1.8.

Table 5-7 Benefit-Cost Ratio and Net Benefit Evaluations for CULI Alternative

	CULI 1.3% ACE	CULI 1% ACE	CULI 0.4% ACE
Total Investment Cost (Sep 2013 price level)	$203,226,000	$215,278,000	$227,687,000
Total Annual Cost	$9,565,000	$10,079,000	$10,608,000
Total Annual Benefits	$16,401,000	$18,558,000	$19,785,000
Net Benefits	$6,836,000	$8,479,000	$9,177,000
Benefit-Cost Ratio (at 3.5% discount rate)	1.7	1.8	1.9
Benefit-Cost Ratio (at 7% discount rate)	1.02	1.09	1.10

Alternative scales greater than the 0.4% ACE scale were not considered for analysis of net benefits. Larger levees and further confinement of flood waters would likely induce impacts, and transform and transfer risk to both the levee protected areas as well as levees on the North and South Forks of the Skagit River. Containing more flow in the river at Burlington and Mount Vernon would increase flows downstream, which would increase overtopping and could necessitate further levee improvements (raises or setbacks) to accommodate this transfer of risk.

5.1.7 NED Plan Selection

While the floodplain is the same for either the 1% or 0.4% ACE scale, the 0.4% ACE scale further reduces flood frequency to critical infrastructure and the long-term risk to protected areas based on existing flood hydrology. The 1% ACE scale provided greater incremental net benefits at $1.6 million when going from the 1.3% ACE scale to the 1% ACE scale. The incremental net benefits for the 0.4% ACE scale at $617,000. This suggests that benefits are increasing at a lower rate than the increase in cost after the 1% scale. However, the 0.4% ACE scale provides greater protection and long-term risk reduction. Over thirty years, the probability of inundation decreases by approximately half when going from the 1% ACE to 0.4% ACE scale project for the most heavily populated areas. Additionally, going from the 1% ACE to 0.4% ACE scale provides the project greater resilience against predicted future climate change impacts that will increase flood frequencies. The 0.4% ACE CULI alternative scale provided the greatest contributions to National Economic Development (NED) as is thought to maximize net benefits (annual benefits less annual costs) at $8.7 million and results in the greatest benefit-cost ratio of 1.8, and provide increased life safety improvements. The NED plan would protect approximately 16,000 people and critical infrastructure in the cities of Burlington andMount Vernon, as well as United General Hospital and the Sedro-Woolley Wastewater Treatment Plant located outside of city limits.

The NED alternative will continue to be refined and undergo further analysis during feasibility-level design. It would be possible to revise the recommended NED plan from the more conservative 0.4% ACE scale to the 1% ACE scale as a result of these refinements, but differences are expected to be minor.

An additional consideration of the NED selection is climate change impacts. Climate change has been identified as a concern by local stakeholders and the tribes in the Skagit River Basin. The hydrologic impacts of climate change are uncertain and the science is still evolving. USACE has not established a procedure for addressing potential hydrologic changes caused by future climate change; however, a sensitivity analysis was completed to consider the effects of climate change. The results show that an important climate change related factor is that if we design for the 1% ACE flood and flood discharges do increase as predicted by Skagit River Basin Climate Science Report (SRBCSR 2011), the CULI Alternative will not provide 1% ACE protection over the 50-year project life. If we design for the 0.4% ACE scale, the urban areas would most likely still benefit from a 1% ACE protection over the 50-year project life and the benefits associated with the proposed Federal action would still be largely realized. Impacts of sea-level rise do not extend upstream to the urban areas protected by the CULI Alternative. The maximum sea-level rise is expected to be 2.15 feet, with a dampening of sea level rise of zero feet near the confluence of the North Fork and South Fork Skagit River distributaries downstream of the urban areas.

Table 5-8 summarizes the project first costs (constant dollar basis at the October 2015 price level) and the cost sharing for the NED Plan. The project first cost is estimated at $225,590,000 and the fully funded cost estimate is estimated at $243,922,000. The fully funded cost estimate accounts for cost inflation through the mid-point of construction. Assuming the project is authorized in the first quarter of FY 2016, the mid-point of construction is expected in the first quarter of 2019. Lands, easements, right-of-ways, relocations, and disposals (LERRDs or Lands & Damages, and Relocations) are credited towards the non-Federal sponsor's 35 percent cost share responsibility. The Federal and non-Federal shares are estimated $146,634,000 and $78,957,000, respectively.

Table 5-8 NED Plan: CULI 0.4% ACE Cost Estimate

First Costs (1 Oct 2015 price level)	Federal	Non-Federal	Total
Flood Risk Management			
Lands & Damages		$11,845,000	$11,845,000
Fish & Wildlife Facilities	$6,285,000		6,285,000
Levees & Floodwalls	151,348,000		151,348,000
Relocations		13,621,000	13,621,000
Planning, Engineering & Design	30,548,000		30,548,000
Construction Management	11,943,000		11,943,000
Minimum 5% Cash Contribution		12,196,000	
Cash Contribution	-53,491,000	42,211,000	
Total Project Cost Share	**$146,634,000**	**$78,957,000**	**$225,590,000**
Total Project Cost Share (%)	65%	35%	100%

5.2 NED Plan Residual Risk and Performance

Residual risk is the risk remaining after implementation of the plan. Each of the CULI Alternative scales, including the NED, leave some amount of residual risk in the floodplain. Much of the floodplain not concentrated in the urban areas remain at risk of flooding, including properties, agricultural lands, and critical infrastructure. Although risk is reduced to urban areas with improved levees, the risk levee failure poses to these same areas could be catastrophic if people remain in harm's way and are not able to receive ample warning to evacuate. Under the CULI Alternative, the 1% ACE flood elevations may increase by about 1 foot in the Nookachamps Basin. The floodplain overflow at Sterling would increase by 10,000-15,000 cfs, with all the floodwaters flowing north towards Padilla Bay. This increase in Sterling overflow could cause a 1/2 – 3/4 foot rise in 1% ACE flood elevations the northern floodplain.

Risk mitigation measures were included in this alternative, such as floodwalls for the United General Hospital and Sedro-Woolley Sewer Treatment Plant in Sedro-Woolley, which are not otherwise protected by levees or other flood infrastructure, or nonstructural measures. The United General Hospital serves eastern Skagit County. Another hospital is located in Mount Vernon outside of the floodplain. In the event of a flood, these facilities could become isolated until flood waters recede. Additionally, emergency access to the hospital, as well as emergency evacuation routes from communities upstream of Burlington to areas of safety, would continue to flood.

Other infrastructure that remains at risk with this alternative includes the major transportation routes I-5, SR 20, and SR 9 which could be closed during flood events. I-5 has not historically flooded from the Skagit River, but has flooded near Centralia from the Chehalis in 2007 and 2009 approximately 150 miles south of Mount Vernon, resulting in closure of a 20 mile stretch of I-5 for up to four days. The BNSF Railroad risks overtopping and pipeline operations may be impacted from floods of 1% ACE or a lesser chance of occurrence. However, BNSF operations would be halted during operations of the Mount Vernon Floodwall which includes a stop log across the railroad to tie in to high ground. The northern Skagit and Samish floodplain would still flood from both the Skagit River near Sterling and the Samish River, as indicated above.

Evacuation preparation can be made 2-3 days in advance of predictable flood events. As river stages rise and are predicted to reach flood stages, warnings could be reiterated and evacuation efforts increased. This would allow for evacuation of immobile residents and other people with special evacuation needs (hospital patients, assisted living facility residents, and elderly individuals) by way of emergency evacuation routes.

Flood fighting may affect the performance of the CULI Alternative if activities confine flood flows and allow for more water to reach downstream areas where levees could be at risk of overtopping and failure which include the urban centers protected by this alternative.

5.3 Risk and Uncertainty

Risk and uncertainty is fundamental to all water resource planning and communication. This study incorporated risk management framework principles and risk-informed planning into its plan formulation process.

- The hydrologic impacts of Climate Change are uncertain. If the changes discussed in Section 4.5 were to occur, the level of protection provided by the CULI Alternative could fall from 0.4% ACE to 1% ACE over the 50 year period of analysis.
- Risk analysis and communication was used following ER 1105-2-101, Risk Analysis for Flood Damage Reduction Studies, and EM 1110-2-1619, Risk-Based Analysis for Flood Risk Management.

- Uncertainty was captured through cost engineering's mandatory center of expertise (MCX) risk assessment project to establish cost contingencies. Risks to project cost and schedule were documented in an abbreviated cost and schedule risk assessment.
- Risks were assessed and managed throughout the study process, in coordination with the USACE Vertical Team.

Specific risk and uncertainty remaining includes the extent of potential induced and transferred flood risk resulting from confined flood flows with larger and more robust levees to areas in the northern Skagit River floodplain, including the Nookachamps-Clear Lake area and Sedro-Woolley, and downstream below Mount Vernon. To minimize and mitigate these uncertainties, more detailed hydraulic modeling of the CULI Alternative will be needed to better understand the flood risks associated with larger and more robust levees to other areas in the floodplain. Nonstructural measures such as elevating homes, relocations, developing evacuation routes and plans, as well as structural measures such as low elevation berms and improvements to interior drainage and sea dikes, can be evaluated on an incremental basis to reduce induced and/or residual flood risks once the risk is better understood.

5.4 System of Accounts

A method of displaying the positive and negative effects of various plans was to use the System of Accounts as established by the U.S. Water Resources Council. The accounts are categories of long-term impacts, defined in such a manner that each proposed plan can be easily compared to one another. The four accounts used to compare proposed water resource development plans are the national economic development (NED), environmental quality (EQ), regional economic development (RED) and other social effects (OSE) accounts.

5.4.1 National Economic Development (NED)

The intent of comparing alternative flood control plans in terms of NED is to identify the beneficial and adverse effects that the plans may have on the national economy. Beneficial effects are considered to be increases in the economic value of the national output of goods and services attributable to a plan. Increases in NED were expressed as the plans' economic benefits, and the adverse NED effects were the investment opportunities lost by committing funds to the implementation of a plan. The CULI Alternative scale that provided the greatest net benefits is the 0.4% ACE scale.

5.4.2 Environmental Quality (EQ)

The environmental quality account was another means of evaluating the plans to assist in making recommendation. The EQ account displays long-term effects that the alternative plans may have on significant environmental resources. The Water Resources Council defines significant environmental resources as those components of the ecological, cultural and aesthetic environments that, if affected by the alternative plans, could have a material bearing on the decision-making process. The EQ account is described in Sections 4 and 5.4.2. The CULI Alternative is the most environmentally preferred alternative.

5.4.3 Regional Economic Development (RED)

The RED account was intended to illustrate the effects that the proposed plans would have on regional economic activity, specifically regional income and regional employment. RED benefits have not been estimated for the project. However, short-term RED benefits are expected with construction of the project, as well as long-term RED impacts associated with reductions in business disruptions attributable to the reduction in flood damage and frequency to commercial and industrial structures and to populations which live and work in Skagit County.

5.4.4 Other Social Effects (OSE)

The other social effects (OSE) account typically includes long-term community impacts in the areas of public facilities and services, recreational opportunities, transportation and traffic and man-made and natural resources. The CULI 0.4% ACE Alternative provides greater life safety improvements to urban areas, with a reduction in population at risk of 16,000. However, residual risk is still of concern for much of the rural floodplain, including cropland. Many critical structures remain in the floodplain or would become isolated during floods. Nonstructural measures such as updating evacuation plans and routes will be considered during feasibility-level design.

5.5 Future Design Phase Requirements

5.5.1 Design and Construction Considerations

During the PED phase (following completion of the feasibility study and project authorization) additional information will be required to confirm assumptions, refine quantity estimates, address property and regulatory concerns, and fill in data gaps. Additional information that is anticipated at this time includes bathymetry survey, material source investigation, and additional hydraulic analysis. Survey data will be used to refine feasibility-level design, specifically to inform alignments and features (culverts, roads, and confirm locations for levees versus floodwalls, for example). Information will also be obtained for consideration of cultural resources and HTRW.

In the construction phase, applicable Best Management Practices minimizing run-off, turbidity and, prevention and containment of spills shall be utilized.

Levee construction would generally be constructed during the drier months and during non-flood season.

Levee raise construction would generally include: placement of embankment fill material along the crown, landward slope, and landward toe; replacement of asphalt or gravel driving surface on the levee crown; reseeding grass on the landward slope.

New levee construction would generally include: placement of levee embankment fill for entire structure; placement of gravel driving surface on the levee crown; seeding grass on landward slope; seeding grass or placement of riprap on riverward slope.

Depending on foundation materials, some areas of the site may benefit from pre-loading. This can be accomplished using embankment fill material or other available material and could be completed during any time of year.

Levee seepage berm construction would generally include placement of spall rocks at the landward toe. Seepage cutoff trenches would generally include an excavation to 10-20 feet deep, backfilled and compacted with an impermeable material. Location of the cutoff trench could be in the riverward bench (where sufficient space is available), in the levee crown, or at the landward toe. Excavation should occur during a low river stage to ensure the excavated trench is dry when placing impermeable material.

Where various fill materials are used, or where large variations in a particular material type are present, multiple compaction curves will be required to ensure proper compaction throughout construction.

All aspects of construction need to be carefully phased to avoid elevated flood risks and comply with any in-water work windows.

5.5.2 Real Estate Requirements

Real Estate tasks to be completed in feasibility-level design phase include:

- Legal opinions of compensable interest for owners of utilities and public facilities affected by the proposed project alternative. The Opinions of Compensable interest require a final relocation plan for affected utilities and/or public facilities.
- Takings analyses will be accomplished for parcels where the proposed project design appears to result in a taking of property interests. Takings could result from induced inundation, cutting off reasonable access to a parcel, or designing a levee structure that requires the demolition of homes or other structures on affected parcels of land.
- A land cost estimate will be accomplished by the Real Estate Division Appraiser for lands affected by the project, including lands required for the proposed levee improvements and for lands identified in the takings analysis as “takings” for which just compensation would be required. Estimated Real Estate costs utilized in the PPA and Final Total Construction Cost estimate will be based on the land cost estimate appraisal product accomplished in the Final Design Phase of the project.

5.6 Implementation Requirements and Permits

The following sections outline the requirements for implementation of the NED.

5.6.1 Non-Federal Sponsor

Skagit County is the cost-sharing non-Federal sponsor of the study and has provided a letter reaffirming the County’s support of the TSP and further study phases including development of feasibility-level designs and cost estimates. USACE will request a letter of intent prior to the completion of the feasibility phase as well as non-Federal sponsor self-certifications of financial capability prior to execution of a project partnership agreement (PPA).

5.6.2 Institutional Requirements

The schedule for project implementation assumes authorization in a Water Resources Development Act following project approval. After project authorization, the project would be eligible for design and construction funding. The project would be considered for inclusion in the President’s budget based on national priorities, magnitude of the Federal commitment, economic and environmental feasibility, level of local support, willingness of the non-Federal sponsor to fund its share of the project cost, and the budget constraints at the time of funding. Once Congress appropriates Federal design and construction funds, USACE and the non-Federal sponsor would enter into a PPA that would define the Federal and non-Federal responsibilities for implementing, operating, and maintaining the project.

5.6.3 Schedule

USACE would officially request the non-Federal partner to acquire the necessary real estate immediately after signing the PPA. The estimated duration of the preconstruction engineering and design (PED) phase, which would follow completion of the feasibility study, is two years. That estimate, however, assumes PED work is fully funded. The duration would be longer if not fully funded from the start, and may cost more due to inefficiencies with a longer PED phase. The construction phase duration is also estimated to be two years, assuming full funding. The advertisement of the construction contract would follow the certification of the real estate. The final acceptance and transfer of the project to the non-Federal partner would occur following completion of construction, and after delivery of an operations and maintenance manual and as-built drawings.

5.6.4 Monitoring and Adaptive Management

Please see Section 5.8 (Mitigation for Adverse Effects).

5.6.5 Local Betterments

No local betterments have been identified for this project.

5.6.6 Operations, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R)

After completion of construction, the non-Federal sponsor would assume O&M responsibility for the entire project footprint. The non-Federal sponsor would be responsible for all long-term project operations, maintenance, repairs, replacements, and rehabilitations following completion of construction. O&M costs have been estimated for the TSP. At this time it is assumed that the TSP would require minimal maintenance only (approximately $40,000 per year or less with O&M activities focusing on minor inspection and periodic levee maintenance activities). Activities include operations and maintenance new levees, new floodwalls, and USACE water management operations of the Baker Dam project during the flood season. Baker Dam compensation for forgone hydropower and dependable capacity will also be examined in greater detail during detailed design. A detailed O&M manual will be developed during the Project Engineering and Design phase.

5.7 Summary of Environmental Consequences

NEPA requires disclosure of environmental consequences that would be involved with the proposed Federal action should it be implemented. The following sections summarize analysis of anticipated effects of the TSP.

5.7.1 Summary of Differences between 1% and 0.4% CULI Alternative

In Section 3 (Plan Formulation), the CULI Alternative is described and selected as the TSP based on comparison and evaluation of the 1% ACE conceptual designs. In addition, environmental consequences were evaluated in Section 4 (Affected Environment and Environmental Consequences for the Alternatives), on these designs. As mentioned above, the NED plan has been optimized as the 0.4% ACE CULI Alternative based on a conceptual level design. It should be noted that the NED plan will continue to be refined during the feasibility-level design phase. The 0.4% ACE CULI Alternative would have slightly larger levee dimensions and footprint than the 1% ACE CULI Alternative as described in Section 3.8.2. Based on 0.4% ACE conceptual level of design, the average levee raise, final levee height, and width would increase by approximately ½ foot, ½ foot, and 3 1/3 foot, respectively as compared to the 1% ACE conceptual design. In addition, with the 0.4% ACE CULI Alternative, overflow at Sterling could potentially increase by approximately 5,000 to 10,000 cfs. This increase in Sterling overflow may result in an increase in flood elevations by approximate ¼ - ¾ foot from the 1% ACE CULI Alternative. There may also be a slight increase in flood elevations (~1/3 foot) in the Nookachamps Basin. These potential increases in overflow and flood elevations would only occur for floods larger than the 1% ACE event, and thus representing the incremental impacts of the 0.4% CULI. Flood frequency is expected to decline for the Burlington and Mount Vernon areas, and is not expected to change for other areas within the study area with implementation of the project. Areas outside of the study area upstream of Sedro-Woolley may see an incremental benefit associated with Baker Dam operational modifications.

At this conceptual level of design, the 0.4% CULI Alternative would have the same direct, indirect, and cumulative impacts as the 1% ACE alternative for all resources analyzed in Section 4 (Affected Environment and Environmental Consequences for the Alternatives).

5.7.2 Unavoidable Adverse Environmental Effects

To facilitate the construction of all of the proposed restoration measures of the TSP, some adverse environmental effects, while only temporary, could occur within the project area. The following list summarizes adverse environmental effects that are more fully described in Section 4:

- Temporary, minor, and localized degradation of water quality from increases in turbidity during in-water work
- Greenhouse gas emissions from construction equipment would combine with the global accumulation of greenhouse gases
- Temporary disturbance to fish and aquatic insects through increased turbidity and construction activity in the water
- Temporary clearing of upland and riparian vegetation for access and staging areas
- Temporary and localized disruptions to traffic cause by construction vehicle access to worksites
- Continued simplification of the riparian and aquatic habitats in the urban corridor
- Permanent reduction of refuge habitat for fish including ESA-listed species

5.7.3 Irreversible and Irretrievable Commitment of Resources

NEPA requires that environmental analysis include identification of "any irreversible and irretrievable commitments of resources which would be involved in the preferred alternative should it be implemented." This clause refers to the use of nonrenewable resources and the effects that the use of these resources have on future generations. Irreversible effects primarily result from use or destruction of a specific resource (e.g., energy and minerals) that cannot be replaced within a reasonable period. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored because of the action (e.g., extinction of a species or the disturbance of a cultural site).

The TSP would result in an irreversible use of fossil fuels to execute the construction of the habitat restoration. Machinery types were estimated during the cost estimate work for the alternatives analysis. The proposed Federal action is designed to have minimal irreversible and irretrievable commitment of resources. All construction effects are assumed to be short-term reductions in fish, aquatic insect, and plant resources, which would recover their abundances in a relatively short period.

5.7.4 Relationship Between Short-Term Uses and Long-Term Productivity

NEPA requires that an EIS consider the relationship between short-term uses of the environment and the impacts that such uses may have on the maintenance and enhancement of long-term productivity of the affected environment (40 CFR Section 1501.16). This section compares the short- and long-term environmental effects of the proposed project. For the TSP, "short-term" refers to the temporary phase of construction of the proposed project, while "long-term" refers to the 50-year period of analysis of the proposed project and beyond. Section 4 of this document evaluates the direct, indirect, and cumulative effects that could result from the alternatives.

Short-term impacts caused by the project would be similar for any of the construction alternatives. These impacts would occur during and immediately after construction and would generally result in adverse effects. However, the long-term impacts that would occur over the life of the project would result in overall beneficial effects.

Implementation of the TSP would result in beneficial long-term impacts. The alternative would address levee deficiencies that currently threaten property and public safety. Flooding in the event of a levee failure would result in extensive flooding and potential loss of life.

5.7.5 Areas of Controversy and Unresolved Issues

NEPA requires disclosure of controversial issues to the decision-maker. The following issues were identified during public scoping and outreach efforts for this project.

5.7.5.1 Conversion of Agricultural Lands

The conversion of agricultural lands to other land uses is a controversial issue in the Basin. The agricultural community has voiced concerns regarding the project affecting agricultural land and related productivity with the implementation of the project. These effects have been discussed in Section 4 (Affected Environment and Environmental Consequences).

5.7.5.2 Property Acquisition

A specific subset of construction-related effects involves potential conflicts with private property underlying or near proposed improvements. In some cases there may be temporary property use in the form of construction easements to build the project and permanent acquisition for operations and maintenance of the project. These effects are described in Section 4 (Affected Environment and Environmental Consequences).

5.7.5.3 USACE Vegetation Engineering Technical Letter (ETL) Levee Safety Policy

USACE national policy (ETL 1110-2-583) concerns restrictions for vegetation on and near flood control structures; however, Seattle District inspects levees for eligibility in the program using the Seattle District Variance, rather than the ETL. Much of the remaining natural riparian habitats along Skagit River are located along flood control levees. During levee inspections by USACE, vegetation may be identified for removal, if necessary, to maintain eligibility; otherwise a variance may be needed to be obtained for compliance with this policy. If, in the future, the Seattle District Variance were to be rescinded, a vegetation variance may be necessary. Effects on riparian habitat, aquatic habitat, fish and wildlife, and threatened and endangered species from project implementation are addressed in Section 4 (Affected Environment and Environmental Consequences).

5.7.5.4 Climate Change and Sea-Level Rise

Global climate change and resultant sea-level rise are phenomena receiving international attention. These issues are further analyzed in the effects discussions in Section 4 under each alternative with regards to climate change and specifically in Hydrology and Hydraulics for sea-level rise.

5.7.5.5 Endangered Species Act and Fisheries

In the Pacific Northwest, salmonid fisheries including ESA listed salmonids are an important resource to the local tribes and communities. Effects on threatened and endangered species from project implementation are addressed in Section 4 (Affected Environment and Environmental Consequences).

5.7.6 Implementation Requirements and Permits

This study will need responses from other agencies for compliance with ESA, NHPA, CWA Section 401, NPDES, and Coastal Zone Management Act. Implementation requirements and permits will be requested in the next phase of the study.

5.8 Mitigation for Adverse Environmental Effects

NEPA requires that agencies identify and include in the action all relevant and reasonable mitigation measures that could reduce negative effects of the Federal action.

Implementation of the TSP would involve raising and constructing levees, constructing a floodwall and floodgates, and nonstructural measures with construction activities in the aquatic environment and in close proximity to other ecological resources. Through the analysis of effects, certain adverse effects were identified as summarized in Table 4-2 Summary of Environmental Consequences in Section 4.

Throughout the planning process, conceptual alternative designs incorporate avoidance and minimization measures to reduce impacts. Construction designs would include practices that avoid and minimize effects to affected significant resources. This section describes methods to avoid and minimize adverse effects of the proposed alternative. For the DFR/EIS, proposed mitigation measures are conceptual at this point and will be further developed during feasibility design phase using an approved model.

5.8.1 Standard Practices to Mitigate Negative Effects of Construction

Specific measurable and enforceable mitigation measures would be developed for the project based on the specific impacts of the project. The TSP's designs and construction timing would include the following standard measures:

- USACE would schedule work to occur during designated periods often referred to as 'fish windows' as established by WDFW per Washington Administrative Code (WAC) 220-110-271.
- USACE would conduct survey for eagle nests and limit construction activities during breeding season.
- Construction contractor would be required to prepare an Environmental Protection Plan for approval by a USACE staff biologist.
- Traffic alterations would be designed to minimize impediments, with the shortest and least disruptive detours possible, and in coordination with the relevant transportation agency.

5.8.2 Conceptual Mitigation Measures for Effects to Wetlands Habitat

- Wetland delineation would be conducted to determine the extent and function of wetlands affected by the TSP during future design phase; then
- To minimize this potential impact, the project footprint would be reduced to maximum extent possible; and either
- To rectify any remaining effects, onsite wetland habitat would be restored or;
- To compensate for any remaining impacts, wetland mitigation credits would be purchased from a local mitigation bank.

5.8.3 Conceptual Mitigation Measures for Effects to Threatened and Endangered Species, Fish, and Aquatic and Riparian Habitats

- To minimize impacts, the project footprint would be reduced to maximum extent possible; and
- To compensate for any remaining impacts, a combination of some or all of the following options could be implemented:
  - Planting along a levee bench per ETL 1110-2-583,
  - Planting of riparian vegetation per ETL 1110-2-583,
  - Installing a buried levee toe along a levee already set back from the river and abandoning the rock revetment,

- Setting back a levee,
- Constructing a side channel,
- Installing habitat weirs,
- Anchoring root wads, and/or
- Purchasing credits at local mitigation banks.

5.8.4 Conceptual Mitigation Measures for Effects to Cultural Resources and Best Management Practices

Prior to project implementation, lands within the area of potential effect (APE) for the project would be inventoried in accordance with Washington State standards**.** Any sites encountered would be recorded and evaluated for National Register eligibility. The preferred strategy is to redesign projects to avoid any impacts to significant resources. If avoidance is not possible then USACE will implement site specific steps to reduce or mitigate those impacts. USACE would consult with the SHPO and any affected Tribes on the proposed mitigation measures. Typical mitigation measures are listed below.

<u>For Properties Eligible under Criteria A or B</u>

- Historic Research
- Oral Histories
- Museum Displays, Interpretive Panels, or Historic Markers
- Building Relocations

<u>For Properties Eligible under Criterion C</u>

- HABS/HAER documentation
- Photo-documentation
- Building Relocation

<u>For Properties Eligible under D</u>

- Data Recovery (Archaeological Excavation)
- Interpretive Panels

5.8.5 Best Management Practices to Protect Water Quality

The proposed construction activities would involve, by necessity, some in-water work and areas of ground clearing. Protecting water quality from storm water runoff would require implementation of best management practices (BMPs) to avoid excessive runoff and elevated turbidity in the receiving water body. It is important to avoid excessive pulses of sediment during the construction phase that are more than what the surrounding aquatic life can easily tolerate. The proposed alternative would have a Stormwater Pollution Prevention Plan, which includes a Temporary Erosion and Sedimentation Control Plan, approved by a USACE staff biologist. Construction contractors would be required to obtain a

Construction Stormwater Permit under Section 402 of the Clean Water Act. Standard construction stormwater BMPs can be incorporated into site designs, operational procedures, and physical measures on site. The following are some examples of frequently used BMPs:

- Minimize area of ground disturbance and vegetation clearing.
- Use the site's natural contours to minimize run-off and erosion.
- Do not expose the entire site at one time; avoid bare soils during rainy months.
- Stabilize erodible surfaces with mulch, compost, seeding, or sod.
- Use features such as silt fences, gravel filter berms, silt diking, check dams, and gravel bags for interception and dissipation of turbid runoff water.

5.8.6 Best Management Practices to Minimize Effects of Greenhouse Gas Emissions

There are no legal requirements to mitigate for GHG emissions; however, BMPs are available for fuel and material conservation during construction. Such BMPs include the following:

- Maximizing use of construction materials that are reused or that have a high percentage of recycled material content, such as recycled asphalt pavement, concrete, and steel.
- Obtaining construction materials and equipment from local producers or vendors to minimize energy use for shipping.
- Encouraging construction personnel to carpool or use a crew shuttle van.
- Turning off equipment when not in use to reduce idling.
- Maintaining equipment in good working order to maximize fuel efficiency.
- Routing truck traffic through areas where the number of stops and delays would be minimized, and using off-peak travel times to maximize fuel efficiency.
- Scheduling construction activities during daytime hours or during summer months when daylight hours are the longest to minimize the need for artificial light.
- Implementing emission-control technologies for construction equipment.
- Using ultra low sulfur (for air quality) and biodiesel fuels in construction equipment.
- Using warm mix asphalt or cool pavement rather than hot mix asphalt.
- Using renewable energy produced onsite or offsite. For example, using solar-powered generators to supply electricity for field offices and construction lighting.

6. Compliance with Environmental Statutes

This section provides documentation of how the preferred alternative (Tentatively Selected Plan) complies with all applicable Federal environmental laws, statutes, and executive orders.

6.1 National Environmental Policy Act

The National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. §4321 et seq.) provides a commitment that Federal agencies will consider, document, and publicly disclose the environmental effects of their actions. These NEPA-required documents must provide detailed information regarding the proposed action and alternatives, the environmental impacts of the alternatives, appropriate mitigation measures, and any adverse environmental impacts that cannot be avoided if the proposal is implemented. Agencies are required to demonstrate that decision makers have considered these factors prior to undertaking actions, which is exhibited in signing a Record of Decision for Environmental Impact Statements such as this one. This Draft Feasibility Report/Environmental Impact Statement (FR/EIS) is the primary vehicle to achieve NEPA compliance for the proposed project. Before preparing this document, USACE published a Notice of Intent to prepare an EIS in the Federal Register on 20 November 1997 and again on 29 July 2011, and held a public scoping meeting 10 August 2011. Following approval of the Final FR/EIS, the Chief of Engineers would sign a Record of Decision as well as USACE-required Chief's Report.

6.2 Endangered Species Act

The Endangered Species Act (ESA) of 1973 (16 U.S.C. §1531-1544), amended in 1988, establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and plants and the habitat upon which they depend. Section 7(a) of the ESA requires that Federal agencies consult with the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS), as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their critical habitats. USACE is coordinating with NMFS and USFWS to ensure the protection of those threatened and endangered species under their respective jurisdictions and to anticipate potential negative effects that may result from the project. If USACE elects to implement the preferred alternative, the study team will prepare a Biological Evaluation based on the 35% level of design. USACE will submit this document to NMFS and USFWS for their concurrence.

6.3 Clean Water Act

The Federal Water Pollution Control Act of 1972 (33 U.S.C. §1251 et seq.) is more commonly referred to as the Clean Water Act (CWA). This act is the primary legislative vehicle for Federal pollution control programs and the basic structure for regulating discharges of pollutants into waters of the United States. The CWA was established to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." The CWA sets goals to eliminate discharges of pollutants into navigable waters, protect fish and wildlife, and prohibit the discharge of toxic pollutants in quantities that could adversely affect the environment. The sections of the CWA that directly apply to the Skagit River GI are 401 regarding discharges to waterways, 402 regarding discharges of stormwater, and 404 regarding fill material in waters and wetlands.

6.3.1 Section 401

Under provisions of the Clean Water Act (33 U.S.C. §1251), any project that involves placing dredged or fill material in waters of the United States or wetlands, or mechanized clearing of wetlands requires a water quality certification from the state agency as delegated by the U.S. Environmental Protection Agency (EPA). For the Skagit River GI, the delegated authority is the Washington State Department of Ecology (WDOE). When the site-specific construction drawings and contract are prepared, USACE will provide these and all other necessary documentation for WDOE to certify that the action will not violate established water quality standards

6.3.2 Section 402

Section 402 of the Clean Water Act (33 U.S.C. §1251), the National Pollutant Discharge Elimination System (NPDES), controls discharges into waters of the United States. NPDES permits, issued by either the EPA or an authorized state/tribe, contain industry-specific, technology-based, and/or water-quality-based limits, and establish pollutant monitoring and reporting requirements. In 1987, the Clean Water Act was amended to require the EPA to establish a program to address stormwater discharges. In response, the EPA promulgated the NPDES stormwater permit application regulations. These regulations require that facilities or construction sites with stormwater discharges from a site that is one acre or larger apply for an NPDES permit.

USACE will ensure that preferred alternative is covered by a Section 402 Construction Stormwater General Permit. The application process will occur during the engineering and design phase for proposed action authorized for construction. Best management practices for erosion and sedimentation control will be included in the project design.

6.3.3 Section 404

USACE administers regulations under Section 404(b)(1) of the CWA, which establishes a program to regulate the discharge of dredged and fill material into waters of the U.S., including wetlands.

A draft 404(b)(1) consistency evaluation has been prepare which analyzed the alternatives and has demonstrated the avoidance of wetland impacts to the maximum extent practicable, the minimization of potential impacts, and if determined necessary, compensatory mitigation as appropriate for any unavoidable impacts. The draft 404(b)(1) evaluation can be found in Appendix D (Environmental Appendix).

6.4 Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) of 1972 as amended (16 U.S.C. §1451-1464) requires Federal agencies to carry out their activities in a manner that is consistent to the maximum extent practicable with the enforceable policies of the approved State Coastal Zone Management Program. The aim of the act is to "preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone." The delegated authority for review of consistency with the Coastal Zone Management Program is WDOE. In compliance with State law, each of the 15 coastal counties in Washington has developed its own Shoreline Master Program in compliance with the State Shoreline Management Act.

USACE expects to be fully consistent with the enforceable polices of Skagit County's Shoreline Master Program. USACE will prepare a CZMA Consistency Determination for the preferred alternative during the engineering and design phase according to the county code and will submit the consistency determination to WDOE for their review and concurrence.

6.5 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA) of 1934 as amended (16 U.S.C. §661-667e) provides authority for the USFWS involvement in evaluating impacts to fish and wildlife from proposed water resource development projects. It requires that fish and wildlife resources receive equal consideration to other project features. It requires Federal agencies that construct, license, or permit water resource development projects to consult with the USFWS, NMFS, and State resource agencies regarding the impacts on fish and wildlife resources and measures to mitigate these impacts. Section 2(b) requires the USFWS to produce a Coordination Act Report (CAR) that describes fish and wildlife resources in a project area, potential impacts of a proposed project, and recommendations for a project. The draft CAR includes the USFWS positions and recommendations.

USACE received a planning aid report dated 12 August 1997, and several subsequent planning aid letters dated 10 October 2000, 7 May 2001, 30 October 2001, and 15 June 2012 that are included in Appendix D (Environmental Appendix). Further coordination with USFWS is necessary; the final Coordination Act Reports will be completed for the final FR/EIS to fully comply with the FWCA.

6.6 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 U.S.C. §668-668c), enacted in 1940 and amended several times since then, prohibits anyone without a permit issued by the Secretary of the Interior from "taking" eagles including their parts, nests, or eggs. The Act applies criminal penalties for persons who "take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any [bald or golden] eagle alive or dead, or any part, nest, or egg thereof." The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb."

Construction activities associated with the proposed actions have the potential to disturb bald and golden eagles due to elevated noise levels and the presence of heavy machinery. These impacts would be minimized by surveying for nests and roosts prior to and during construction, and, if nests and/or roosts are nearby, monitor and coordinate with USFWS.

6.7 Clean Air Act

The Clean Air Act (CAA) as Amended (42 U.S.C. §7401, et seq.) prohibits Federal agencies from approving any action that does not conform to an approved State or Federal implementation plan. Three agencies have jurisdiction over air quality in the project area: EPA, WDOE, and the Northwest Clean Air Agency. The EPA sets standards for concentrations of pollutants in outdoor air and the State establishes regulations that govern contaminant emissions from air pollution sources. Construction activities associated with the proposal will create air emissions, but the emissions are not expected to affect implementation of Washington's CAA implementation plan.

6.8 Magnuson-Stevens Sustainable Fisheries and Conservation Act

The Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. §1801 et. seq.) requires Federal agencies to consult with NMFS on activities that may adversely affect Essential Fish Habitat (EFH). The objective of an EFH assessment is to determine whether the proposed action(s) "may adversely affect" designated EFH for relevant commercial, federally managed fisheries species within the proposed action area. EFH includes those waters and substrate necessary for fish spawning, breeding, feeding, or growth to maturity. The assessment describes conservation measures proposed to avoid, minimize, or otherwise offset potential adverse effects to designated EFH resulting from the proposed action. During feasibility-level design phase, USACE would prepare an effects analysis addressing EFH, which would be provided to USFWS and NMFS within the Biological Evaluation required under ESA Section 7. Although habitat disturbance may have temporary adverse effects to designated EFH, the conservation measures that USACE will include as part of the proposed site design to address ESA concerns should be adequate to avoid, minimize, or otherwise offset potential adverse impacts to the EFH.

6.9 Marine Mammal Protection Act

The Marine Mammal Protection Act of 1972 (16 U.S.C. §1361-1407) restricts harassment of marine mammals and requires interagency consultation in conjunction with the ESA consultation for Federal activities. The preferred alternative would have limited effect to stellar sea lions and potentially adverse effects to Southern Resident killer whales. USACE would consult with NMFS on effects to marine mammals in conjunction with the ESA Section 7 consultation. USACE would implement all practicable conservation measures and adhere to a marine mammal monitoring plan.

6.10 Migratory Bird Treaty Act and Executive Order 13186 Migratory Bird Habitat Protection

The Migratory Bird Treaty Act (16 U.S.C. §703-712) of 1918 as amended protects over 800 bird species and their habitat, and commits that the U.S. will take measures to protect identified ecosystems of special importance to migratory birds against pollution, detrimental alterations, and other environmental degradations. Executive Order 13186 directs Federal agencies to evaluate the effects of their actions on migratory birds, with emphasis on species of concern, and inform the USFWS of potential negative effects to migratory birds. If USACE elects to implement the preferred alternative, migratory bird habitat will be investigated during feasibility-level design phase to determine whether any negative effects will occur and will coordinate appropriate mitigation with USFWS.

6.11 Farmland Protection Policy Act

The Farmland Protection Policy Act (7 U.S.C. § 4201 et seq., 7 CFR 658) was authorized to minimize the unnecessary and irreversible conversion of farmland to nonagricultural use due to Federal projects. This Act protects Prime and Unique farmland, and land of statewide or local importance. The Farmland Protection Policy Act protects forestland, pastureland, cropland, or other land that is not water or urban developed land. The Farmland Protection Policy Act requires a Federal agency to consider the effects of its action and programs on the Nation's farmlands. This Act is regulated by the NRCS. The NRCS is authorized to review Federal projects to see if the project is regulated by the Farmland Protection Policy Act and establish what the farmland conversion impact rating is for a Federal project. The tentatively selected plan would affect prime farmland along the increased footprint of levee. During feasibility-level design phase, USACE will provide the NRCS with project maps and descriptions to assess impacts on Prime and Unique farmlands.

6.12 National Historic Preservation Act

The National Historic Preservation Act (NHPA) and its implementing regulations 36 CFR §800 provides a regulatory framework for the identification, documentation, and evaluation of cultural resources that may be affected by Federal undertakings. Under the Act, Federal agencies must take into account the effects of their undertakings on historic properties (cultural resources that have been found to be eligible for listing in the National Register of Historic Places) and afford the Advisory Council a reasonable opportunity to comment on such undertaking. Additionally, a Federal agency shall consult with any tribe that attaches religious and cultural significance to such properties.

To meet the Agency's responsibilities under NHPA, USACE is in the process of executing a Programmatic Agreement with the Advisory Council, SHPO, and all five tribal nations, which will set forth the means by which USACE will comply with the Act. Programmatic Agreements are prepared when effects on historic properties cannot be fully determined prior to approval of an undertaking (36CFR800.14).

6.13 Native American Graves and Repatriation Act

The Native American Graves Protection and Repatriation Act (NAGPRA) (Public Law 101-601; 25 U.S.C. §3001-3013) describes the rights of Native American lineal descendants, Indian tribes, and Native Hawaiian organizations with respect to the treatment, repatriation, and disposition of Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony, referred to collectively in the statute as cultural items, with which they can show a relationship of lineal descent or cultural affiliation. If cultural items protected under NAGPRA are discovered during pre construction cultural resource investigations or during construction, USACE will halt work and follow the procedures outlined in the Act.

6.14 Archaeological Resources Protection Act

The Archaeological Resources Protection Act of 1979 (ARPA) (16 U.S.C. §470aa-470mm; Public Law 96-95 as amended) establishes the requirements to protect archaeological resources and sites on public and Indian lands and to foster increased cooperation and exchange of information between governmental authorities, the professional archaeological community, and private individuals. The Act established civil and criminal penalties for the destruction or alteration of cultural resources. Prior to conducting archaeological investigations on tribal lands, USACE will attain a permit or its regulatory equivalency from the applicable tribe.

6.15 Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) is designed to clean up sites contaminated with hazardous substances; remediating abandoned hazardous waste sites, by establishing legal liability, as well as a trust fund for cleanup activities. CERCLA, called "Superfund," provides broad Federal authority to clean up releases or threatened releases of hazardous substances that may endanger public health or the environment. The law authorized the EPA to identify parties responsible for contamination of sites and compel the parties to clean up the sites. Where responsible parties cannot be found, EPA is authorized to clean up sites itself, using a special trust fund. In 1986, the Superfund Amendments and Reauthorization Act addressed cleanup of leaking underground storage tanks (USTs) and other leaking waste storage facilities. The amendments established a trust fund to pay for cleanup of leaking UST sites where responsible parties cannot be identified.

No Confirmed and Suspected Contaminated Sites directly impact the preferred alternative and therefore do not present a concern for HTRW. During advanced design it will be necessary to continue coordination regarding HTRW sites to ensure levee alignments do not encounter sites with confirmed and suspected contamination.

6.16 Federal Treaty Obligation

The Federal Trust Responsibility involves recognizing trust obligations and trust resources. In order to exercise trust responsibility it is important to obtain American Indian Tribal views of trust and treaty responsibilities related to Corps actions. These responsibilities are exercised in accordance with provisions of treaties, laws, executive orders, and the Constitution of the U.S. when USACE implements or takes an action that may affect a Tribal interest. In order to effectively develop a relationship with the Tribes, we provide for coordination and consultation with each Tribe as a sovereign nation on matters related to trust and treaty responsibilities.

The Federal government has a fiduciary relationship for the assets and resources held in trust for American Indian governments and their members. It is a general obligation to protect Tribal self-government, in addition to providing services. Trust responsibility can be divided into three broad areas: (1) protection of trust property; (2) protection of self-government; and (3) provision of services. Examples include natural and cultural resources important to the Tribes, whether on project lands or impacted by projects.

The Treaty of Point Elliott of 1855 was signed by all four Skagit Basin tribal nations as well as the Lummi, Suquamish, Snoqualmie, Snohomish, and Duwamish Tribes, and is one of the five treaties in western Washington known the Stevens Treaties. In accordance with the Point Elliott Treaty, the tribes agreed to cede their lands and settle onto reservations. In return, the tribes reserved their Usual and Accustomed (U&A) fishing and hunting rights. The Lummi, Samish, Sauk-Suiattle, and Upper Skagit Tribes, and Swinomish Indian Tribal Community have U&A fishing and hunting rights in the Skagit Basin including Skagit and Padilla Bays.

One of the primary court cases in Washington state that interprets the Stevens Treaties is United States v. State of Washington, 384 F. Supp. 312 (W.D. WA. 1974), affirmed, 520 F.2d 676 (9th Cir. 1975), certiorari denied 423 U.S. 1086, 96 S.Ct. 877,47 L.Ed.2d 97 (1976). This case, often referred to as Boldt I, is named after the judge who decided the case, Judge George Boldt. The case provided a list of which tribes were signatories to which treaties and also designated usual and accustomed treaty fishing rights. In subsequent proceedings, additional tribes joined in the litigation and had their U&A areas either delineated or clarified. The Boldt I case also defined the allocation of fish in the treaty area as 50 percent. In 1979, the 50-percent issue reached the United States Supreme Court where it was upheld in Washington v. Washington State Commercial Passenger Fishing Vessel Association, 443 U.S. 658 (1979). The Ninth Circuit Court has also held that the reserved treaty rights includes the right to take shellfish (U.S. v. Washington, 135 F. 3d 618 (9th Cir 1998). A second case, known as Boldt II (United States v. Washington, 506 F. Supp. 187 (W.D. WA. 1980), affirmed in part, reversed in part, 694 F.2d 1374 (9th Cir. 1983)) was actually written by Judge William Orrick. This case "included the issue of whether the right of taking fish incorporates the right to have treaty fish protected from environmental degradation." In that case Judge Orrick implied that the tribes have the right to a habitat that sustains fish. The 9th Circuit in Boldt II held that the issue of degradation of fish habitat will be determined on a case by case basis.

Federal agencies have a trust responsibility to preserve, protect, and enhance fisheries in Washington State within tribes' usual and accustomed fishing areas and to do so in consultation and coordination with the federally recognized tribes. The tribes in the Skagit Basin have been involved throughout the scoping process for this FR/EIS via participants in a variety of project meetings including government-to-government, NEPA public scoping.

6.17 Wild and Scenic Rivers Act of 1968

The Wild and Scenic Rivers Act (Public Law 90-542; 16 U.S.C. 1271 et seq.) establishes a National Wild and Scenic Rivers System to preserve, protect, and enhance the wilderness qualities, scenic beauties, and ecological regimes of rivers and streams. Any construction within 100 feet of a scenic stream requires a scenic streams permit. The Sauk, Suiattle, and Cascade Rivers, tributaries to the Skagit River, are in the Wild and Scenic River system, as is the Skagit River from Ross Lake to Sedro-Woolley. The proposed construction work would occur downstream of Sedro-Woolley and would not affect the protected reaches.

6.18 Executive Order 11988 Floodplain Management

Executive Order (EO) 11988, Floodplain Management, requires Federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of the base floodplain and the avoidance of direct and indirect support of development in the base floodplain whenever there is a practicable alternative. The Corps is required to provide leadership and take action to: avoid development in the base floodplain unless it is the only practicable alternative; reduce the hazard and risk associated with floods; minimize the impact of floods on human safety, health and welfare; and restore and preserve the natural and beneficial values of the base floodplain.

The proposed action is located solely in the base floodplain. A number of critical infrastructure and evacuation routes are located in the base floodplain as described in Section 3. An estimated 37,000 people are at risk from flooding without an action. Cost effective and practicable alternatives to locating in the base floodplain where not identified through plan formulation.

The proposed action would protect a number of critical infrastructure, including a jail, fire station, police station, County offices, several schools, the United General Hospital, and the Sedro-Woolley Wastewater Treatment Plant. The proposed action provides protection to 16,000 people from a 1% ACE flood event. The proposed action would also allow the opportunity to reevaluate the evacuation plan and local institutional controls, such as land use and building codes. The proposed action minimizes impacts to natural floodplain values, and preserves agricultural values in the floodplain by minimizing and avoiding conversion of agricultural land use for development of flood risk reduction measures. The proposed action is not anticipated to induce development of the floodplain or to otherwise adversely affect any floodplain, since the County plans to direct development to existing urban areas, which includes areas outside of the floodplain, to accommodate population growth and preserve farmland, the local ecosystem, and access to that natural world as the County grows. No land use changes are expected to result from the project that would enhance development conditions in the floodplain.

6.19 Executive Order 12898 Environmental Justice

Executive Order 12898 directs Federal agencies to take the appropriate steps to identify and address any disproportionately high and adverse human health or environmental effects of Federal programs, policies, and activities on minority and low-income populations. USACE has analyzed the potential effects of the alternatives on communities in the Skagit Basin and found that no adverse effects would occur to protected communities.

6.20 Executive Order 13175 Consultation and Coordination with Indian Tribal Governments

Executive Order 13175 reaffirmed the Federal government’s commitment to a government-to-government relationship with Indian Tribes, and directed Federal agencies to establish procedures to consult and collaborate with tribal governments when new agency regulations would have tribal implications. USACE has a government-to-government consultation policy to facilitate the interchange between decision makers to obtain mutually acceptable decisions. In accordance with this Executive Order, USACE has engaged in regular and meaningful consultation and collaboration with the tribes in the Basin throughout the course of the study.

6.21 Executive Order 11990 Protection of Wetlands

Executive Order 11990 entitled Protection of Wetlands, dated May 24, 1977, requires Federal agencies to take action to avoid adversely impacting wetlands wherever possible, to minimize wetlands destruction and to preserve the values of wetlands, and to prescribe procedures to implement the policies and procedures of this Executive Order. In addition, Federal agencies shall incorporate floodplain management goals and wetlands protection considerations into its planning, regulatory, and decision making processes. The preferred alternative would have adverse effects to wetlands. During future design phase, wetland delineation would be conducted to determine the extent and function of wetlands affected. To offset those impacts, the project footprint would be minimized to the greatest extent possible and possibly wetland mitigation credits would be purchased.

6.22 Agency and Tribal Government Consultation and Coordination Process

Preparation of this Draft FR/EIS is being coordinated with appropriate Federal, State, local, and tribal interests as well as environmental groups and other interested parties.

6.22.1 Federal Agencies

Several Federal agencies participated in early study activities, particularly in the process of identifying problems and opportunities in the basin. Additionally, USACE is coordinating with USFWS in compliance with the Fish and Wildlife Coordination Act. The Council for Environmental Quality regulations for implementing NEPA encourage agencies to formally agree to “cooperating agency” status, thus ensuring their expertise will be applied when formulating feasible alternative plans. FEMA, NRCS, and USCG are all cooperating agencies to the Skagit River GI.

6.22.2 State Agencies

USACE will continue to coordinate with the Washington Department of Fish and Wildlife (WDFW), Ecology, and SHPO to seek input on this project.

6.22.3 Indian Tribes

USACE has engaged in formal and informal consultation with all tribal nations in the Basin throughout the feasibility phase. Tribal coordination will continue throughout the feasibility phase, preconstruction engineering and design, and construction in accordance with Executive Order 13175 Consultation and Coordination with Indian Tribal Governments. In addition, USACE will continue to consult with the Tribes with regards to Section 106.

As mentioned earlier in this report, there are five tribal nations with reservations or U&A fishing rights in the Basin. They are the Swinomish Indian Tribal Community (population 800) and Upper Skagit Tribe (population 230), the Samish Tribe (population 1200), the Sauk-Suiattle (population 230) and the Lummi Tribe (population 5000). Like numerous Northwestern tribes, all five tribal nations in Skagit Basin were known for fishing, and canoes and longhouses crafted of cedar. In addition to current salmon fishing and shellfish harvesting practices, these tribal nations own and operate a variety of business ranging from casinos to seafood processing company. All five tribal nations are active influential participants in management of the River and have strong cultural and economic interests in the Basin.

7. Public Involvement Process

Both USACE Planning policy and the NEPA require public involvement in government actions. The goal of public involvement and coordination is to open and maintain channels of communication with the public in order to give full consideration to public views and information in the planning process. This section of the draft FR/EIS describes the public involvement process for this study. Consistent with these policies, the benefits and risks associated with the proposed actions are assessed and publicly disclosed. Opportunities were presented for the public to provide oral or written comments on potentially affected resources, environmental and other issues to be considered, and the agency's approach to the analyses conducted for this study. Efforts to involve the public in included a public scoping meeting, soliciting relevant information from the public, and explaining procedures of how interested parties can get information on the study process.

7.1 Public Scoping Meeting

Scoping is a critical component of the overall public involvement program to solicit input from affected Federal, State, and local agencies; tribes; and interested stakeholders. The scoping process provides early and open means of determining the scope of issues (problems, needs, and opportunities) to be identified and addressed in the EIS. The Skagit River GI scoping process was conducted jointly with Skagit County.

As required under the NEPA, an initial notice of intent (NOI) for this project was originally published in the Federal Register on November 20, 1997, for a Skagit River Flood Damage Reduction Study (62 FR 62019). Since the original NOI was issued in 1997, the study has evolved to meet new challenges and include ecosystem considerations associated with Puget Sound Chinook salmon and bull trout species listed as threatened under the Endangered Species Act (ESA). On July 29, 2011, an additional NOI was published, recommencing the scoping process (76 FR 45543). The scoping comment period originally was scheduled to end on August 29, 2011, but was extended to September 9, 2011. Notice of the comment period extension was published on September 1, 2011 (76 FR 54453). The purpose of this most recent NOI was to provide opportunity for additional public input and ensure that the study still accurately reflects stakeholder resource issues and concerns. A public meeting notice in the Skagit Valley Herald and postcards announced a public scoping meeting, which was held at the Skagit Station at 105 E. Kincaid Street in Mount Vernon, Washington, on August 10, 2011. The meeting was held from 5:00 to 8:00 p.m. and included a presentation of the project history, a formal public hearing with comments captured by a court recorder, and an open house where members of the public could ask questions in a one-on-one setting. USACE and Skagit County personnel shared information, received comments, and addressed questions from meeting attendees. The meeting was attended by 40 people with 11 individuals providing oral comment during the public hearing. Three individuals provided written comments at the meeting.

During the comment period, 30 comments were received, of which three comment forms were submitted during the scoping meeting, eleven verbal comments were given during the scoping meeting, nine letters were mailed, and seven email messages were submitted, all totally 124 individual comments. Comments included several themes, primarily flood management measures, environmental analyses and effects, and study process. A complete list of public comments from the scoping period is contained in Appendix I (Public Involvement).

7.2 Public Outreach Effort Overview

The centerpiece of the study team's outreach efforts was a series of presentations of the preliminary alternatives to the public and local stakeholders during the months of April 2012-June 2012. The presentations included a general overview of the study and study area, an overview of the plan formulation process, an overview of the preliminary alternatives, and an overview of the study process and path forward.

The goal of this outreach effort was to:

- Identify issues that appear to be major concerns
- Gather data or identify data sources that would assist with refinement of the without-project condition, formulation of the alternatives and evaluation of project impacts
- Obtain public input and determine acceptability of the preliminary alternatives.

Documentation of the public scoping meetings and comments received are provided in Appendix I (Public Involvement). A comment card was provided at every meeting and posted on the Skagit County website. The public and stakeholders were asked to state their comment, issues and concerns regarding the alternatives and the study process. The public and stakeholders were also asked to provide alternatives to the alternatives presented and local knowledge of the area that would be helpful for further refinement of the alternatives.

7.3 Draft Feasibility Report / EIS Public Review

The public comment period, during which any person or organization may comment on the draft EIS, is mandated by Federal laws. For the Skagit GI study, the draft FR/EIS public comment period will formally run for 45 days beginning in June 2014 and ending in July 2014. The purpose of this review is to seek input on the TSP in order to refine the TSP in the feasibility-level design phase of the study. USACE will consider all comments received during the comment period. The complete list of comments regarding the draft FR/EIS and USACE's responses will be included as an appendix to the Final FR/EIS.

The PDT will host one public meeting in the study area; the meeting will be held during the public comment period. In addition to accepting comments during the public meeting, comments will be accepted via mail, fax, or email.

7.4 Additional Coordination and Consultation

The following Federal, State and local agencies, tribal partners, and non-governmental organizations have been involved during the feasibility study:

- National Marine Fisheries Service

- U.S. Fish and Wildlife Service
- Federal Emergency Management Agency
- Natural Resources Conservation Service
- Washington Department of Fish and Wildlife
- Washington Department of Transportation
- Skagit County
- City of Mount Vernon
- City of Burlington
- City of Sedro-Woolley
- City of La Conner
- Seattle City Light
- Puget Sound Energy
- Diking Districts
- Lummi Tribe
- Samish Tribe
- Sauk-Suiattle Tribe
- Upper Skagit Tribe
- Swinomish Indian Tribal Community

7.5 Peer Review Process

Northwestern Division approved the Review Plan for this feasibility study in January 2012 and Seattle District updated the Review Plan in March 2014. Seattle District coordinated development of the Review Plan with USACE Flood Risk Management Planning Center of Expertise (FRM-PCX). Peer review was designed to meet all pertinent Corps policies (e.g. Engineering Circulars [EC] including EC 1165-2-214; USACE 2012). This plan requires independent external review by an outside external organization (OEO) of the project's technical reports as well as the draft FR/EIS. The Skagit River GI has adhered to this guidance and completed multiple rounds of District Quality Control (DQC) and Agency Technical Review (ATR) on feasibility phase deliverables. This Draft FR/EIS has undergone District Quality Control (DQC) review, and will undergo Agency Technical Review (ATR), and Independent External Peer Review (IEPR) concurrent with the public review. Completed, DQC, ATR, and IEPR reports will be submitted with the Final FR/EIS.

8. Recommendations

The following text is draft, and will be included in the final FR/EIS report, pending public review, policy review, technical reviews, and subsequent comments and revisions:

I have considered all significant aspects of this project, including environmental, social and economic effects; and engineering feasibility. I recommend that the tentatively selected plan for flood risk management for the Skagit River Basin project area as generally described in this report be authorized for implementation as a Federal project, with such modifications thereof as in the discretion of the Commander, USACE may be advisable. The estimated first cost of the recommended plan is $225,590,000. Operations, maintenance, repair, rehabilitation, and replacement (OMRR&R) expenses are estimated at $40,000 per year at this time. The Federal portion of the estimated first cost is $146,634,000. The non-Federal sponsors' portion of the required 35% cost share of total project first costs is $78,957,000. The non-Federal partner shall, prior to implementation, agree to perform the following items of local cooperation:

a. Provide the non-federal share of total project costs, including a minimum of 35 percent but not to exceed 50 percent of total costs of the NED Plan, as further specified below:

1. Provide 35 percent of design costs in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

2. Provide, during construction, a contribution of funds equal to 5 percent of total costs of the NED Plan;

3. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the government to be required or to be necessary for the construction, operation, and maintenance of the project;

4. Provide, during construction, any additional funds necessary to make its total contribution equal to at least 35 percent of total costs of the NED Plan;

b. Shall not use funds from other federal programs, including any non-federal contribution required as a matching share therefore, to meet any of the non-federal obligations for the project unless the federal agency providing the federal portion of such funds verifies in writing that expenditure of such funds for such purpose is authorized;

c. Not less than once each year, inform affected interests of the extent of protection afforded by the flood risk management features;

d. Agree to participate in and comply with applicable federal flood plain management and flood insurance programs;

e. Comply with Section 402 of WRDA 1986, as amended (33 U.S.C. 701b-12), which requires a non-federal interest to prepare a flood plain management plan within one year after the date of signing a project partnership agreement, and to implement such plan not later than one year after completion of construction of the project;

f. Publicize flood plain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the flood risk management features;

g. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the level of protection the project affords, hinder operation and maintenance of the project, or interfere with the project's proper function;

h. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

i. For so long as the project remains authorized, OMRR&R of the project, or functional portions of the project, including any mitigation features, at no cost to the federal government, in a manner compatible with the project's authorized purposes and in accordance with applicable federal and state laws and regulations and any specific directions prescribed by the federal government;

j. Give the federal government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

k. Hold and save the United States free from all damages arising from the construction, OMRR&R of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;

l. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

m. Comply with all applicable federal and state laws and regulations, including, but not limited to Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled

"Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c et seq.);

n. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the federal government determines to be required for construction, operation, and maintenance of the project. However, for lands that the federal government determines to be subject to the navigation servitude, only the federal government shall perform such investigations unless the federal government provides the non-federal sponsor with prior specific written direction, in which case the non-federal sponsor shall perform such investigations in accordance with such written direction;

o. Assume, as between the federal government and the non-federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the federal government determines to be required for construction, operation, and maintenance of the project;

p. Agree, as between the federal government and the non-federal sponsor, that the non-federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, OMRR&R of the project in a manner that will not cause liability to arise under CERCLA; and

q. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-Sb), and Section l03G) of the WRDA 1986, Public Law 99-662, as amended (33 U.S.C. 2213G)), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until each non-federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element.

The recommendations contained herein reflect the information available at this time and current departmental policies governing the formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of the national civil works construction program or the perspective of higher levels within the executive branch. Consequently, the recommendations may be modified before they are transmitted to Congress for authorization and/or implementation funding. However, prior to transmittal to Congress, the State of Washington, interested Federal agencies, and other parties will be advised of any significant modifications in the recommendations and will be afforded an opportunity to comment further.

BRUCE A. ESTOK
Colonel, Corps of Engineers
District Commander

9. List of Preparers*

Table 9-1 below lists the individuals who prepared this Draft FR/EIS.

Table 9-1. List of Preparers

Name	Education/Experience	Responsibility
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Lynn Wetzler	B.A. Sociology, Master of Public Administration; 5 years experience	Project Manager
Hannah Hadley	B.A. Anthropology; 9 years experience	Environmental Coordinator
Margaret Chang	Master of Landscape Architecture; 3 years experience	Plan Formulation
Don Kramer	Master of Public Administration, Master of Urban Planner; 5 years experience	Plan Formulation
Charyl Barrow	B.S. Economics; 6 years experience	Economics
Kristen Kerns	B.S. Environmental Science; 5 years experience	Hazardous Waste
Danielle Storey	M.A. Anthropology; 13 years experience	Cultural Resources
Chemine Jackels	M.S. Biological Science (emphasis on aquatic); 13 years experience	Fish and Invertebrates, Aquatic Habitat, Endangered Species
Bobbi Jo McClain	B.S. Biology, M.S. Environmental Forest Biology; 12 years experience	Wildlife, Wetland Habitat, Endangered Species
Glenn Kato	B.S. Civil Engineering; 10 years experience	Civil Design
Karl Eriksen	B.S. Environmental Resource Engineering, M.S. Water Resource Engineering, M.S. Hydraulic and Coastal Engineering; 36 years experience	Hydrology & Hydraulics
Dan Lowry	B.S. Civil Engineering; 5 years experience	Cost Engineering
Travis Macpherson	B.S. Civil Engineering; 4 years experience	Geotechnical Engineering
Kevin Kane	B.A. Ecological Studies; 15 years Realty Specialist	Real Estate
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Lisa Hansen	B.A. Sales & Marketing Education; 15 years experience	Technical Editor
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