U.S. Army Corps
of Engineers
Seattle District

DRAFT ENVIRONMENTAL IMPACT STATEMENT

Centralia Flood Damage Reduction Project
Chehalis River, Washington
General Reevaluation Study

July 2002

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for

CENTRALIA FLOOD DAMAGE REDUCTION PROJECT

Proposed Action: Seven alternatives were proposed to provide 100-year flood protection to the cities of Centralia and Chehalis, Washington, while providing potential restoration opportunities within the project area.

Responsible Agencies: U.S. Army Corps of Engineers

Lead Agency: U.S. Army Corps of Engineers

Abstract

The cities of Centralia and Chehalis, Washington have been subject to flooding for many years. This flooding has caused extensive damage to private and public property and caused periodic closure of critical transportation routes resulting in significant economic losses. The closure of critical transportation routes also disrupts emergency response teams and adversely impacts public safety. In addition, stream habitat functions of the Chehalis River and its tributaries have been damaged in the past due to development throughout much of the Chehalis Basin. This has resulted in the diminishment of the remaining habitat to adequately support sustainable fish and wildlife resources. The loss of wetlands, riparian areas, and back channels has also contributed to increased flooding in the area. The proposed preferred alternative will provide the cities 100-year flood protection and provide habitat enhancement opportunities for fish and wildlife. With set back levees, there will be opportunities for the river to overflow its banks and potentially restore riparian habitat along its banks while providing flood reduction. The Skookumchuck dam modifications will allow flood water storage up to 492 feet or 20,000 acre feet of water behind the dam for a period not to exceed five days. This will provide some flood reduction along the Skookumchuck River. After modifications are completed to the dam, a re-operation plan will call for a maximum flow at Pear Street not to exceed 5,000 cubic feet per second. This can only occur on events under the normal two-year event because, with events two years and over, the tributaries will augment the river flow resulting in a loss of flow controls at Pearl Street. The greatest protection from dam modifications will occur between the 50- and 100-year events. There is expected to be an adverse impact on 40 acres of wetlands resulting from levee construction and no major wetland impacts from dam modifications. The Corps has committed to further studies to investigate stream bed-load and sediment movement on the Skookumchuck River.

Note: Official closing date for the receipt of comments is September 19, 2002. This report is also available on the web site at: http//www.nws.usace.army.mil

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EXECUTIVE SUMMARY

The Seattle District, U.S. Army Corps of Engineers (Corps) and Lewis County, Washington have collaborated to re-evaluate a previously authorized flood reduction project in the Chehalis River Basin and prepare an Environmental Impact Statement. The previously authorized project was not found to be economically justified under its narrow scope, and flooding continues to be a problem in the basin, especially in the Cities of Centralia and Chehalis. The purpose of this Draft Environmental Impact Statement (DEIS) is to provide the public and all parties concerned, a list of all reasonable alternatives considered and an in depth discussion of the benefits and adverse impacts of the alternatives including the environmentally preferred and national economic development preferred alternatives. This project is authorized under Section 401(a) of 1986 Flood Control Act (PL 99-662), which authorized construction of "works of improvement" substantially in accordance with the Report of the Chief of Engineers, dated 20 June 1984. On 9 October 1998, the U.S. House of Representatives Committee on Transportation and Infrastructure adopted Resolution 2581, requesting a review of past Corps report recommendations with a view to determining if the recommendations should be modified "with particular reference to flood control and environmental restoration and protection, including non-structural floodplain modification." This resolution provided the authority and directive for the Corps to conduct a Flood Hazard Reduction and Ecosystem Restoration Study for the Chehalis River Basin.

Habitat conditions for fish and wildlife in the Chehalis basin are limited by several factors, including altered hydrologic regime, loss of floodplain connectivity, changes to sediment supply and transport, loss of riparian zone, presence of fish barriers and poor water quality. This DEIS describes seven different alternatives that were investigated to address those limiting factors while reducing flood damage to the basin.

Alternative #1 - No Action

Under this alternative, no project features are implemented. The studies conducted in the General Reevaluation Report (GRR) indicate this alternative would result in continued flooding in the project area.

Alternative #2 - Skookumchuck Dam Modifications

This alternative is intended to provide reductions in flooding along the Skookumchuck River. This is needed to address flooding problems in the town of Bucoda and the City of Centralia.

This alternative may also provide some reduction in discharge in the Chehalis River downstream of the confluence with the Skookumchuck River.

Alternative #3 - Overbank Excavation and Flowway Bypass
This alternative was developed in an effort to reduce flooding in the City of Chehalis, to prevent State Route 6 (SR6) from overtopping in large floods through floodplain modification, and to reduce flooding of Interstate Highway 5 (I-5). By overbank excavation, it would increase channel capacity in the vicinity of Centralia. It was anticipated that a combination of these two features would provide significant flood damage reduction in these areas.

Alternative #4 - Levee System
This project design was to reduce flood damages associated with the Chehalis and Skookumchuck Rivers. It also addresses flooding along Salzer Creek, Dillenbaugh Creek, and the Newaukum River. This alternative reduces damages to structures and allows I-5 to stay open for transportation.

Alternative #5 - Upstream Flow Restriction Structures, and Upstream Storage
Flow restrictors are intended to increase water surface elevation upstream of the flow restrictor at low flows providing potential benefits to wetlands and fisheries. Currently there is lack of off-channel habitat for salmon along the main stem of the Chehalis River. If spring and summer flows could be backed up into adjoining low areas or disconnected oxbows, without also resulting in a stage increase during the 100-year flood event, then additional off-channel habitat could be created. The increased upstream inundation could also have a potential benefit in regards to increasing groundwater recharge.

Alternative #6 - Non-Structural Alternative
The intent of the non-structural alternative was to formulate a viable non-structural solution to reduce flood damages throughout the study area. This would be accomplished by watershed management, flood-proofing structures, evacuation plans, and removal of structures from the flood plain.

Alternative #7 - Interagency Committee Alternative
The purpose of this alternative is to provide short and long-term actions that will reduce flooding hazards to the Centralia and Chehalis area residents, while at the same time, restore and enhance river hydrology and floodplain functions to support the basin’s salmonoid habitat base. This would be accomplished by focusing first on regulatory and voluntary measures. The

connectivity of the Chehalis River to its floodplain would be maintained and enhanced by using land use and development regulations before implementation of any costly structural solutions. This included the uses of flood plain easements, acquisition of frequently flooded areas and structures, relocation or elevation of structures, and improved upland water storage.

The Levee Alternative and the Skookumchuck dam modifications (low dam) combined are the National Economic Development Plan, and are economically feasible to construct. The Levee Alternative and the Skookumchuck dam modifications (high dam) are the environmentally preferred and locally preferred alternative based on the following restrictions: The Skookumchuck dam can only be used for flood reduction events. Water can be stored no longer than a 5-day period for the 50- to 100-year flood event. During the 2- to 50-year period of frequency, retention greater than elevation 477 feet (NGVD 1929) should not occur more than every other year; storage should be no longer than 5 days for these events. The environmental impacts between the low and high dam are basically the same. Differences occur mainly with the frequency of events and the time of retention of floodwaters above 477 feet, with no known environmental impacts if water is stored no longer than 5 days. The levee alignment and Skookumchuck dam operations were combined based on the 100-year flood event.

For levee alignments, the peak flood stage would be decreased below River Mile (RM) 70 along the Chehalis River. The peak flood stage would be increased between RM 70 and RM 78 with the maximum increase of 0.65 feet at RM 72.8. At the Galvin Road Bridge, peak flood stage would decrease 0.15 feet, and at Grand Mound the peak flood stage would decrease 0.2 feet. Between Grand Mound and Porter, the peak flood stage decrease would vary from as much as 0.39 feet to as little as 0.06 feet.

Along the Skookumchuck River, peak flood stages would decrease in a range of 2.22 feet to 0.38 feet from RM 10 to the mouth for the dam modifications and levee alignment. Chapter Two of the DEIS gives a full description of all the alternatives and the preferred alternative. The preferred alternative was chosen after a series of studies were conducted in many technical areas including:

- Survey and mapping
- Hydrology and hydraulics
- Engineering design
- Geotechnical Studies
- Economic Studies

- Cultural Resource Studies
- Environmental Studies

The scopes of these studies and findings are discussed in detail in Chapter Two “Alternatives”, but the overall purpose of these studies was to assist in identification and selection of the preferred alternative.

The purpose of the chosen preferred alternative is to provide flood protection during a 100-year event. With and indirect result in damage reduction caused by the flooding. Another benefit of the preferred alternative is to provide the opportunity to establish restoration areas to enhance fish and wildlife habitat. In setting the levees back from the Chehalis River this will give the river an opportunity to overbank during certain flood events and possibly re-establish riparian zones along the rivers banks while protecting the main infrastructure of the cities of Centralia and Chehalis.

Major Conclusions

The levee system will provide 100-year flood protection for the cities of Centralia and Chehalis that are within the boundaries of the levees while minimizing environmental impacts. Modification to the Skookumchuck dam and levees along a portion of the Skookumchuck River will also provide 100-year flood protection to Centralia.

With an impact of approximately 34 acres of wetlands for construction of the levee system, all mitigation efforts will be concentrated along the Schubert Ditch, SR-6 oxbow, and associated potential wetland sites. Total wetland loss is estimated to be 34 acres of wetlands over approximately 15 miles of levees and floodwalls. Approximately 14 miles of the preferred alternative consists of levees and 1 mile of floodwall.

Skookumchuck Dam modification will not have a major impact on wetlands or stream geomorphology down stream of the dam as earlier expected. The Skookumchuck dam only controls approximately ¼ of the total water shed in the study area. A number of tributaries along the Skookumchuck have an extremely large influence on the environment associated with, in and along the mainstem of the Skookumchuck River. The re-operation plan for the modified dam will ensure that a fishery and/or fishery habitat flow will be maintain during all events. Since this is a flood control dam, all flows will be allowed to flow through the dam as they do now unless we approach major flooding. At that time the flow from the dam will be reduced to off-set the input of the tributaries (but not below the required fish and/or fishery habitat flow) until the tributaries recede and the dam can resume a higher flow of water down stream. Therefore, there are no expected impacts to wetlands or the mainstem channel of the Skookumchuck from the dam modification.

Issues to be Resolved

The winter steelhead population is depressed. Information about how well the existing dam functions with respect to fish passage is lacking. There is uncertainty as to whether the trap and haul operation has been successful in producing smolts, or that any smolts produced actually reach the dam, given the assumed level of predation in the reservoir.

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1. INTRODUCTION

1.1 Need for the Proposed Action

The Cities of Centralia, Chehalis and surrounding communities in Lewis and Thurston Counties, Washington, have a long history of flooding and flood damage. Episodic flooding has caused extensive damage to private and public property and intermittent closure of critical transportation routes resulting in significant economic losses. The January 1990 flood, the second highest flood of record observed since 1929, alone caused an estimated $19,189,000 in damages (PIE 1996). In closing transportation routes, the flooding also significantly disrupts emergency response by local governments, adversely affecting public safety. Without implementation of flood hazard reduction measures, actions, or projects, the area will continue to suffer from damaging floods. The local economy will continue to experience depressing economic effects due to the damages and uncertainty associated with future floods. Figure 1.1 (page 2) shows the extent of inundation within the project area during a 100-year flood.

In addition, stream habitat functions of the Chehalis River and its tributaries have been damaged in the past due to development throughout much of the Chehalis Basin. This has resulted in the diminishment of the ability of the remaining habitat resources to adequately support sustainable fish and wildlife resources. Loss of wetlands, riparian areas, and back channels has also contributed to increased flooding in the area. The improvement of degraded areas along the Chehalis River or its tributaries can be a significant factor in sustaining and improving existing fish and wildlife resources in the Chehalis Basin.

1.2 Project Purpose

The purpose of the actions proposed by this study are to reduce flood hazards to the study area, which includes Centralia and Chehalis, as well as surrounding areas in Lewis and Thurston Counties, and to incorporate appropriate fish and wildlife habitat improvements. Flood hazards are defined as significant damage to existing structures, including private and public property, high risk to life, and extended closures of transportation corridors.

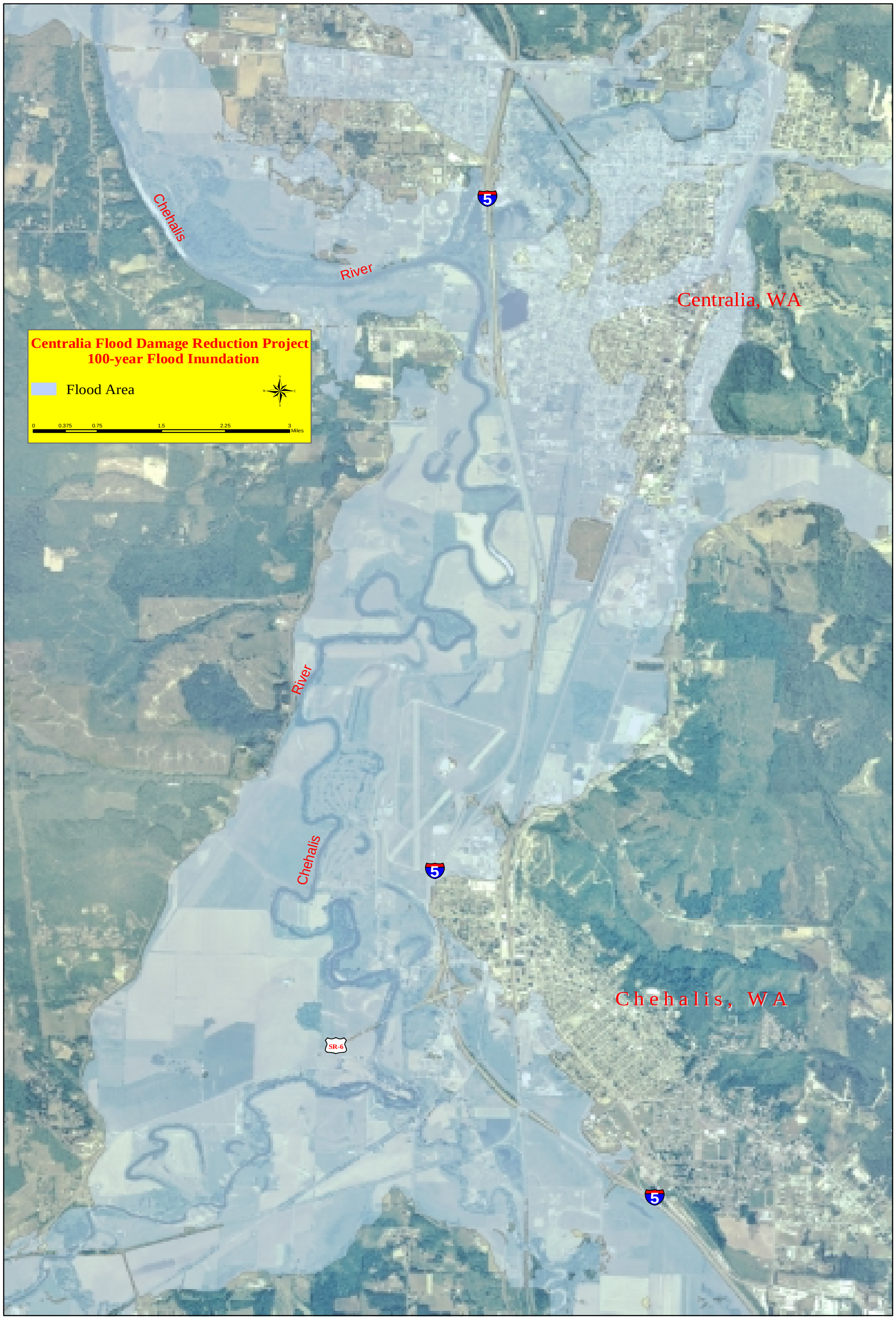


Figure 1.1. Extent of inundation, 100-year flood.

The proposed project would provide reductions in flooding along the Chehalis, Skookumchuck, and Newaukum Rivers, and smaller tributaries, protecting the flood-prone areas near the cities of Chehalis, Centralia and the town of Bucoda. The project aims to reduce damage costs in the project area and decrease the transportation closures during flooding on Interstate Highway 5 and other critical transportation corridors. Additional objectives include avoiding increasing flood risks downstream of the project area and adverse impacts to the environment.

1.3 Background

1.3.1 Authorizations

Authority for the Centralia Flood Hazard Reduction General Reevaluation Study and any subsequent construction is provided by the following Congressional actions:

1.3.1.1 Skookumchuck Dam Modification Project

Section 401(a) of 1986 Flood Control Act (PL 99-662) authorized construction of "works of improvement" substantially in accordance with the Report of the Chief of Engineers, dated 20 June 1984. The report was an interim report submitted (third in a series) under the Chehalis River and Tributaries Feasibility Study authority, originally authorized by a 19 April 1946 House of Representatives Flood Control Committee Resolution. The project recommended in that report envisioned modification of the existing private water supply dam on the Skookumchuck River to provide a maximum of 28,500 acre-feet of flood storage, reducing flood damages in the Skookumchuck valley, the Town of Bucoda, and the City of Centralia.

The recommended project was authorized in 1986 with an estimated cost of $30.2 million (converted to 2001 price level). It proposed to add a 12-foot-diameter, 1,200-foot-long, low-level, gated discharge tunnel through the dam's north abutment and a bascule gate, 15 feet high by 136 feet wide, on the existing spillway crest. That project would provide up to 28,500 acre-feet (ac-ft) of flood storage and reduce the Skookumchuck River 200-year flood flow (1985 analysis) from 13,300 cubic feet per second (cfs) to 6,700 cfs (a flood depth reduction of 2-5 feet along the Skookumchuck River in Centralia). With average annual benefits estimated at $4.3 million (2001 price level), the project had a benefit-to-cost ratio of 1.4 to 1.0.

1.3.1.2 Chehalis River and Tributaries General Reevaluation Study

On 9 October 1998, the U.S. House of Representatives Committee on Transportation and Infrastructure adopted Resolution 2581, requesting a review of past Corps report recommendations with a view to determining if the recommendations should be modified "with particular reference to flood control and environmental restoration and protection, including non-structural floodplain modification." This resolution provided the authority and directive for the Corps to conduct a Flood Hazard Reduction and Ecosystem Restoration Study for the Chehalis River Basin.

1.3.2 Status of Authorized Project

Prior to this study, the Corps had conducted Preconstruction Engineering and Design (PED) work on the 1984 Authorized Project (Skookumchuck Dam) from February 1988 through August 1990. Negotiations were undertaken with the dam operator, PacifiCorp, to identify the maximum amount of flood storage they would agree to provide at Skookumchuck Dam; about 12,000 ac-ft. The Corps prepared basic hydrologic, hydraulic, and economic studies that were updated from the previous reports and preliminary spillway design layouts and cost estimates. The Corps suspended design work after studies indicated that the recommended plan lacked economic justification. The most promising design at that time involved replacing the gated tunnel and spillway gate with gated sluices in the existing spillway (or a short gated tunnel) to control reservoir elevations and provide 11,900 ac-ft of flood storage.

Following the disastrous 1996 flood event, a group of interested citizens formed the Flood Action Council (FAC) to work on options to reduce or eliminate severe flooding of the Centralia-Chehalis area. The FAC developed a preliminary plan that combined modifying Skookumchuck Dam and providing additional upstream flood storage with overbank excavation of the Chehalis River near the City of Centralia. The proposal to form a Chehalis Basin (Lewis County) Flood Control District to implement that plan was rejected by the Lewis County Commissioners because it did not meet legal criteria for creation. However, the Commissioners decided that Lewis County would take the lead in identifying flood reduction measures and set up by ordinance a countywide Flood Control Zone District (FCZD).

Subsequently, Lewis County used local and state funding to conduct studies that identified possible modifications to the 1984 Authorized Project (Skookumchuck Dam) that could result in a potentially economically justified project. These studies were developed to provide a community-based alternative to the Washington Department of Transportation's (WSDOT) plan to upgrade and possibly raise Interstate Highway 5 (I-5) grade near Centralia and Chehalis. The local governments wanted a plan for a comprehensive flood hazard management project that would provide flood relief as well as avoid raising I-5.

On 7 July 1998, Lewis County requested that the Corps resume PED work with the idea of combining additional measures with the authorized dam modification element to form a more complete flood hazard reduction plan for the Centralia-Chehalis urban area. Although the City of Centralia had been the project sponsor through the feasibility phase and initial work, Lewis County has agreed to serve as local sponsor for project construction and to provide the appropriate cost sharing when necessary. Using available funds, Corps resumed work in July 1998. Initial effort involved reviewing the documents and technical reports produced by Lewis County.

1.3.3 Chehalis River Basin Study

In a separate, but complimentary effort, the Corps has partnered with Grays Harbor County on the Ecosystem Restoration General Investigation (GI) study for the entire Chehalis River basin. The study will assess historic and existing conditions of the Chehalis River basin in order to identify project alternatives, which both recover the degraded ecosystem, primarily for salmonoid recovery, and provide ancillary flood damage reduction benefits to the basin. The study encompasses the study area for the authorized project (described below).

1.4 Study Area

The study area for the authorized project includes the mainstem Chehalis River, its floodplain and tributaries from the South Fork Chehalis River confluence to Grand Mound, and includes the Cities of Centralia and Chehalis, and surrounding areas in Lewis and Thurston Counties in southwest Washington (map 2.1).

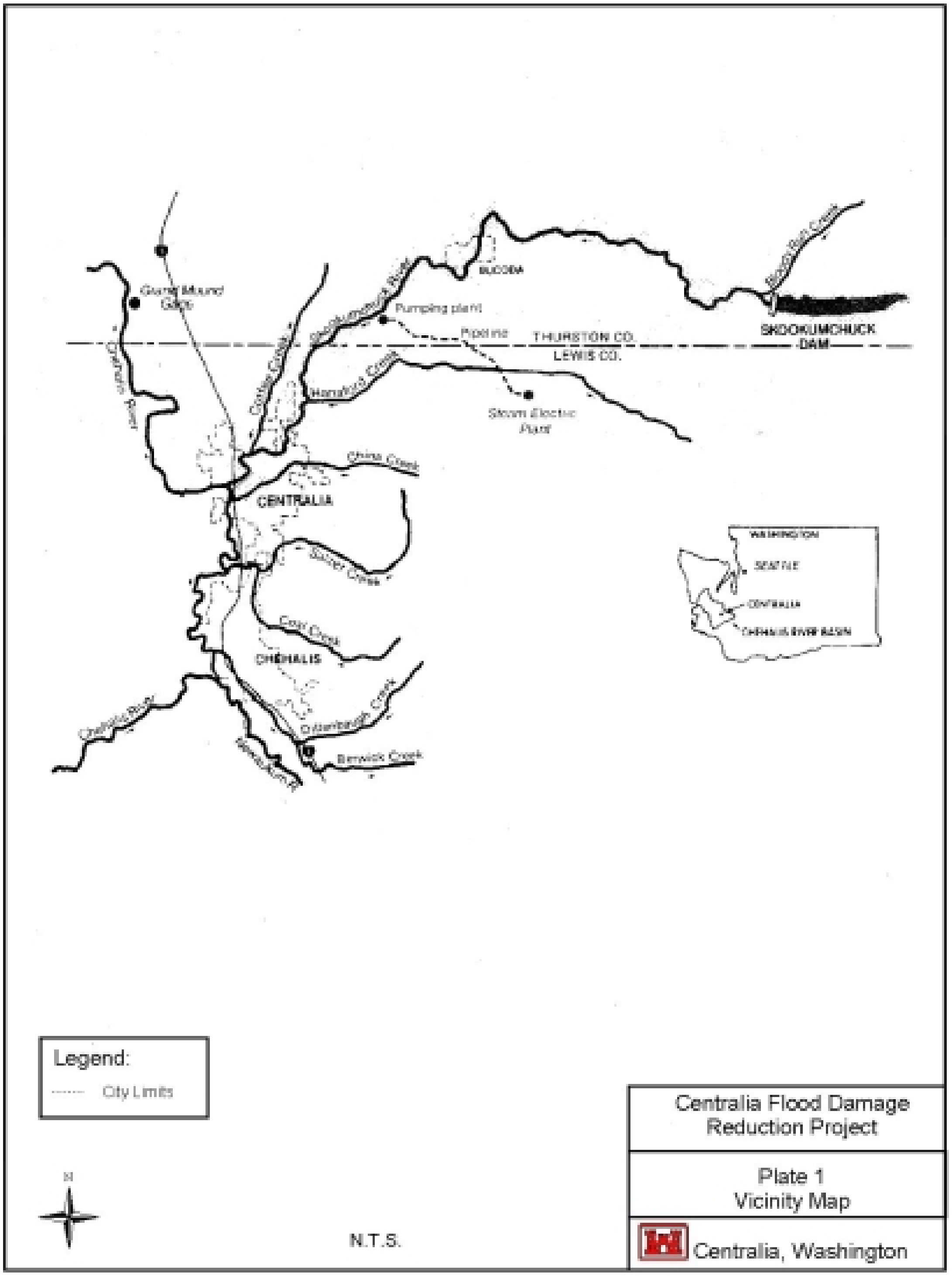


Figure 1.2. Vicinity Map

Tributaries entering the study area include the Skookumchuck and Newaukum Rivers and numerous smaller creeks. The study area extends along the Skookumchuck River to a point upriver of Skookumchuck Dam and includes the Town of Bucoda in Thurston County. Figure 1.2 shows the location of the study area within the Chehalis River Basin.

1.5 National Environmental Policy Act

The primary purpose of this Draft Environmental Impact Statement (DEIS) is to serve as a public disclosure document to ensure that the policies and goals of the National Environmental Policy Act (NEPA) are incorporated into and duly considered during the development of the recommended project.

This DEIS must provide a full and fair discussion of significant environmental impacts and must inform decision makers and the public of reasonable alternatives that would avoid or minimize adverse impacts.

The analysis includes identifying the concerns and needs of the public, developing a reasonable range of alternatives to meet the project purpose, assessing environmental and social impacts, including impacts on biological resources, socioeconomic resources, cultural resources, and recreation, and determining suitable mitigation measures for any unavoidable adverse impacts.

1.5.1 Public Scoping Process

A public scoping process is required as part of the EIS preparation [49 CFR 1501.7]. Scoping, as defined by the Council on Environmental Quality (CEQ) is "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to the proposed action."

The scoping process for this EIS began officially on 9 September 1999 when the Federal Register notice of intent to prepare an EIS was published. The Corps and Lewis County held two public meetings in September 1999 in Chehalis (28 September) and Rochester (29 September), Washington. Even before the notice of intent, Lewis County held numerous public meetings and hearings and provided the local newspapers with regular information.

The Corps notified potentially interested parties about the flood hazard reduction study EIS scoping process and provided opportunities to comment. The Corps also provided a press release about the scoping meetings to area media and placed notices in the local newspapers.

The key issues identified during public scoping are discussed below. The Corps and Lewis County had also identified many of these issues as potential areas of concern during internal scoping evaluations.

1.5.1.1. Alternatives

Public comment's urged the Corps and Lewis County to evaluate a full range of alternatives that include non-structural alternatives such as flood proofing, buy-outs, and land use planning.

1.5.1.2. Skookumchuck Dam

Public comment’s expressed concern regarding the stability of Skookumchuck Dam. In addition, commenter provided information regarding potential benefits and detriments of the future operation of the dam for flood storage purposes.

1.5.1.3. Increased Downstream Flooding

Public comment’s expressed concern regarding the potential of any project to increase flooding downstream during high water events.

1.5.1.4. Increased Low Flow Impacts

Public comment’s expressed concern regarding the potential of any project to diminish summer flows, which are identified as an existing limiting factor to fishery health.

1.5.1.5. Water Quality

Public comment’s expressed concern regarding the potential of any project to degrade existing water quality conditions, some of which are already severely degraded (high summer water temperatures, bacterial contamination, high dissolved oxygen).

1.5.1.6. Tribal Coordination

The Consolidated Tribes of the Chehalis requested full coordination on this project because of potential impacts to Tribal resources. The Chehalis Reservation is also located downstream of the study area.

1.5.1.7. Cultural Resource Impact

The Chehalis Basin is rich in both historical and archeological resources. Public comment's expressed concern regarding potential impacts to these resources.

1.5.1.8. Hazardous Wastes

The study area has multiple sites of known hazardous waste contamination, including sites listed on the National Priorities List under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA also known as "Superfund"). Public comment's expressed concern regarding the interface between any proposed project and these sites.

1.5.1.9. Sediment Transport

Public comment's expressed concern regarding the potential of any proposed project to change the sediment transport characteristics of both the Chehalis River and the Skookumchuck River. Concerns include increased erosion or sedimentation within of the study area and downstream, decreased inundation of riparian forests and wetlands through channel incision, and increased scouring or sedimentation of critical fish habitat.

1.5.1.10. Habitat Impacts

Public comment's expressed concern regarding the potential of any proposed project to result in the loss and/or degradation of critical habitat types within the study area. These include wetlands and riparian areas.

1.5.1.11. Fisheries Impacts

Public comment's expressed concern regarding the potential of any proposed project to result in the loss and/or degradation of critical fisheries within the Chehalis River Basin.

1.5.2 Supplemental Studies

Seattle District, Lewis, and Thurston Counties completed the following supplemental studies to address concerns raised during the scoping process and the project development process. The scopes of these technical studies are summarized in the following sections. The results of these studies are presented in detail in the respective technical appendices of this DEIS and the GRR, as appropriate. Those results that were key to the formulation and selection of the recommended plan are summarized throughout the following chapters in this document.

The Chehalis River General Reevaluation Study is a Post Authorization Study being conducted by the Corps of Engineers Seattle District and Lewis County, WA. A general reevaluation study is a reanalysis of a previously completed and authorized study, using current planning criteria and policies, which is required due to changed conditions and/or assumptions. The results may affirm the previous plan; reformulate and modify it, as appropriate; or find that no plan is currently justified. The results of the study are documented in this General Reevaluation Report (GRR).

1.5.2.1. Hydrologic and Hydraulic Studies

Hydrologic and hydraulic study tasks were completed to update, calibrate, and operate a hydraulic model of the Chehalis River Valley. Previous Corps archived databases and models were activated and updated as appropriate. The deregulated natural and existing condition flows on mainstem Skookumchuck and Chehalis Rivers and tributaries associated with winter and spring floods of record were updated for use in hypothetical flood and dam regulation analyses. The Chehalis Basin frequency curves were reviewed and, particularly the low flow curves, revised, and hypothetical floods developed for the 2-, 10-, 25-, 50-, 100-, 200-, 500-year, and larger events. Work developed the magnitude of flow versus timing relationships and updated observed and hypothetical flood routings for use in hydraulic model.

Information was developed on the expected interior runoff for any areas protected by the potential alternatives. Risk and uncertainty associated with hydrologic data was also identified.

Reservoir release options were investigated regarding fishery impacts, river sedimentation, and water supply. The former reservoir temperature analyses were updated. The former “Probable Maximum Flood” and “Standard Project Flood” analyses were reviewed and updated for site-specific dam safety analysis and spillway discharge adequacy. Reservoir storage rule curves and gate operating schedules were revised and updated. A preliminary data-collection plan and preliminary reservoir-operating plan was developed.

An existing hydraulic model (UNET1D) was updated to reflect revised hydrologic and topographic data. The model covers the river floodplain from the mouth at Aberdeen through Pe Ell (RM 107) with particular emphasis in the upper basin above Grand Mound (RM 60). The model includes 10 miles on the Black River, 22 miles on the Skookumchuck River, 9 miles on the Newaukum River, about five river miles in the Lincoln Creek valley, nine river miles in the Hanaford Valley, and eight river miles in the South Fork Chehalis River valley. An assessment of sediment transport in the river was prepared. After the models were calibrated to replicate past flood conditions accurately, the existing "without-project" flooding conditions were determined for the selected range of floods. In addition, an analysis was conducted to update the flood insurance floodplain and floodway maps for the Federal Emergency Management Agency (FEMA) to publish on an interim basis until a project(s) is/are constructed. If there were a construction project that affects the floodplain, a revised version of the maps would be prepared before actual construction.

The model was used to develop the "with-project" conditions for reviewing potential alternatives. Sediment sampling and analysis was performed to evaluate the impact of alternatives on the sediment regime and to develop potential project operation and maintenance costs. A probabilistic risk and uncertainty analysis was performed for the selected project to help determine the levels of damage reduction.

1.5.2.2. Geotechnical Studies

Geotechnical studies for this study include the investigation, exploration, and analysis of foundations and materials conditions related to the selection and design of the alternative flood damage reduction measures. Geotechnical effort was divided into two distinct elements: Skookumchuck Dam investigations and analyses and floodplain investigations and analyses.

Skookumchuck Dam**:** The geotechnical studies for Skookumchuck Dam included a site-specific ground motion study due to increased estimations of the seismic risk in the Pacific Northwest. Past seismic studies were evaluated using present state-of-the-art practice and existing literature. A seismic analysis of the dam embankment stability based on dynamic loading methods followed the ground motion study. A soil exploration program was conducted beneath portions of the downstream dam embankment berm to determine liquefaction susceptibility of dam foundation silt and alluvium. An exploratory core-drilling program was conducted to support rock cut slope stability and dewatering.

Floodplain Investigations: The geotechnical studies included review of available geotechnical information from previous studies and intrusive field investigations to physically characterize the subsurface materials. The exploration program involved auger drill borings, backhoe test pits, and the installation of piezometers.

1.5.2.3. Environmental Studies

Environmental studies included environmental data collection and the determination of environmental impacts of alternative plans. Activities included literature searches and review of existing reports and field surveys to establish environmental baseline conditions; identification of future "without-project" conditions; determination of impacts of the alternatives; coordination with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS); analysis of mitigation needs; and the development of potential habitat restoration opportunities.

A literature search and compilation of existing data was accomplished to collect all pertinent information for use in assessing project impacts. Some of the information is in the Geographical Information System (GIS) format and was entered on the Seattle District GIS for overlaying on study and/or report maps. Resource specific studies are described in the following:

Riparian Habitat Survey and Inventory: Existing information was reviewed on riparian habitat, vegetation type and structure, and floodplains. A field survey was completed to evaluate the quality and extent of riparian areas along the Chehalis River and tributaries in the study area. Riparian areas were also inventories and mapped, using a classification system developed by the U.S. Fish and Wildlife Service (USFWS).

Wetland Inventory*:* Existing information on wetlands in the study area was reviewed and evaluated. Wetlands were inventoried and mapped, using a classification system developed by the USFWS.

Fishery Survey: Existing information on fish distribution and use of the Chehalis River and tributaries was reviewed. Additional field investigations were conducted, including field surveys of instream habitats and fish use on the Skookumchuck River and fish use of portions of the Chehalis River during spawning. Specific information included the following:

- Spawner surveys (Skookumchuck River and the mainstem Chehalis River)
- Habitat survey (above Skookumchuck dam)
- Off-channel habitat surveys (Skookumchuck River and the mainstem Chehalis River) that assess functional connections with streams, access, temperature, and changes in off-channel habitat resulting from potential water level changes
- Fish passage at dam
- Instream habitat effects of water level changes
- Investigation of potential habitat restoration opportunities

1.5.2.4 Hazardous Waste Studies

Guidance for the consideration of issues associated with hazardous materials or waste which may be located within project boundaries or may affect or be affected by Corps Civil Works projects is found in the Army Corps of Engineers Regulation 1165-2-132, Hazardous, Toxic and Radioactive Waste (HTRW) Guidance for Civil Works Projects. This regulation outlines procedures to facilitate early identification and appropriate consideration of HTRW concerns in the various phases of a project. Specific goals include:

- Identification of level of detail for HTRW investigations and reporting for each phase of project
- Promotion of early detection and response by the appropriate responsible parties
- Determination of viable options to avoid HTRW problems
- The establishment of a procedure for resolution of HTRW concerns, issues or problems

HTRW studies were conducted to determine the presence and character of contamination, if any, on lands within the study area. Lands potentially needed for alternatives were reviewed, and sites with possible contamination identified in an initial screening. Further review of available information concerning those sites was conducted to estimate the volume and level of any contamination.

A preliminary assessment was conducted for occurrence of HTRW on lands in the study area. The assessment included a project review, review of site literature and project features, database search, review of available records, site inspections and interviews. The assessment included a review of historical documentation; a review of regulatory listings and, when required, review of site files; site visits; and interviews with regulators, site owners and tenants where available or necessary. The assessment covered the general vicinity of the proposed project or existing features proposed for significant modifications. The project conditions assume that any HTRW found during any phase of the project would be remediated in accordance with local, state, and Federal laws or avoided.

1.5.2.5 Cultural Resource Studies

Cultural Resource Studies were conducted to locate, identify, and evaluate historic and prehistoric cultural resources (CR) possibly impacted by alternative measures. Previous CR studies identified numerous sites within the study area. A preliminary evaluation of the effects of flood damage reduction alternatives upon historic properties was conducted. These tasks were accomplished in consultation with the Washington State Historic Preservation Office (SHPO). If required, site data recovery would occur during the project construction phase. The CR data recovery strategy will be developed in accordance with a Memorandum of Agreement between the Seattle District, the SHPO, the Advisory Council on Historic Preservation, and the Confederated Tribes of the Chehalis.

1.5.2.6. Economic Studies

Economic studies involved studies pertinent to an economic cost/benefit analysis of the alternatives. Expected annual flood damages were estimated under the existing (without-project) and the alternative with-project conditions.

The economic analysis was conducted in several phases. First project mapping was reviewed and all structures within the 500-year floodplain were provided a unique identifier number and entered into a database. This was followed by a field survey to obtain relevant data on the structures for entry into the database. A risk based economic analysis was performed to develop the stage-damage function for each category of structures. The stage-damage functions and structures database were combined with water surface profiles from hydraulic analysis into a model (HEC-FDA) to calculate expected annual damages under existing conditions. The damages reduced by each alternative were then computed and compared to the cost of each alternative to identify the plan that maximizes net benefits.

2. ALTERNATIVES AND THEIR DESCRIPTION

2.0 National Environmental Policy Act (NEPA)

The NEPA process is intended "…to help public officials make decisions that are based on (an) understanding of environmental consequences and (to) take actions that protect, restore and enhance the environment" (40 CFR 1500.1). NEPA applies to Federal agencies and any public or private project that either requires a Federal permit or is funded from Federal Sources. In this case, the Centralia Flood Damage Reduction General Reevaluation Study is federally funded and therefore subject to the requirements of NEPA.

2.1 Alternatives Analysis

Pursuant to NEPA, an Environmental Impact Statement (EIS) is required to analyze alternatives to ensure that they meet the purpose of the project, evaluate the potential for environmental impacts, and examine ways to avoid and minimize impacts. In the Corps' Procedures for Implementing NEPA; Final Rule, "reasonable alternatives" are those that are feasible and such feasibility must focus on the underlying purpose and need of the project (33CFR 325, Appendix B).

Potential alternatives were developed from several sources, including substantial public input and involvement. The alternatives analyzed in this DEIS include those the Corps determined to represent a range of reasonable alternatives. The determination of whether an alternative was reasonable and feasible was based on project-defining criteria that are discussed in Section 2.2. The project criteria were developed in conjunction with Lewis County, Tribal representatives, and Federal, State, and local agencies. In addition, the Corps requested comment on the project criteria within the public scoping process.

The alternatives analyzed here include those developed during the General Reevaluation process that examined previously studied alternatives, an alternative developed by Lewis County and others, an alternative proposed by the Chehalis Tribe, and an alternative developed by Federal, State, and local agency representatives. Consistent with NEPA requirements, a No Action Alternative was also analyzed. Alternatives are presented in detail in Section 2.2.3.

For all potential alternatives that were eliminated from detailed study, the reason or reasons for eliminating the alternative are discussed in this chapter. The alternative analysis resulted in the identification of a preferred alternative, which is described in Section 2.5. Potential mitigation measures were also identified and are described in Chapter 4.

2.1.2 Alternatives Development

Previously Studied Alternatives. These alternatives were derived from previous studies conducted in the Lewis County area and consist of (1) modifications to Skookumchuck Dam (part of the original Authorized Project); (2) setback levees (from a 1970 study that did not receive local funding); and (3) non-structural measures such as flood proofing, relocation out of the floodplain and watershed planning (on-going studies sponsored by the Federal Emergency Management Agency [FEMA]).

Alternative Proposed by Lewis County. The alternative developed by Lewis County in conjunction with the WSDOT and other interested parties consists of overbank excavations and a flowway bypass.

Alternative Proposed by the Confederated Tribes of the Chehalis. The alternative proposed by the Confederated Tribes of the Chehalis and developed in conjunction with other Federal, State, and local resource agencies consists of a series of check dams and flow restrictors.

Alternative Proposed by Interagency Committee. The alternative developed by an interagency committee consists of several structural and non-structural measures.

2.1.3 Range of Alternatives

The Corps considered the alternatives above, in addition to a No-Action alternative, to represent a reasonable range of alternatives under NEPA. These include both structural and non-structural alternatives and reflect information gathered and compiled during the public scoping process. The Corps considered each alternative to have the potential to evolve or be modified during the evaluation process. For example, features of various alternatives could be combined to form an additional alternative, if applicable. Table 2.1.3-1 summarizes the alternatives evaluated.

Table 2.1.3- 1 Summary of Alternatives Evaluated

Alternative Number	Name of Alternative in DEIS	Also Known As
Alternative 1	No Action	NA
Alternative 2	Skookumchuck Dam Modifications	Authorized Project
Alternative 3	Overbank Excavation and Flowway Bypass	Lewis County Alternative
Alternative 4	Setback Levees	Levee Alternative, Levees, Levee System
Alternative 5	Flow Restrictors	Confederated Tribes of the Chehalis Alternative
Alternative 6	Non-Structural Alternative	NA
Alternative 7	Interagency Committee Alternative	NA

2.1.4 Actions Common to All Alternatives with the Exception of the No-Action Alternative

The Corps requires a local sponsor to develop a new floodplain management plan in order to be compliant with Executive Order 11988 (Flood Plains Management)[1], prior to the implementation of any alternative that includes construction for flood damage reduction. Therefore, development of a new floodplain management plan was considered a part of each action alternative. The action alternatives also included potential environmental restoration measures that could be incorporated into the project. Environmental restoration is an integral part of the project purpose and will be included to the maximum extent practicable for any alternative that includes construction for flood damage reduction. Potential restoration measures are presented in Section 2.5.

2.2. Major Project Criteria

The following are project criteria that were established by the Corps and Lewis County and included in the scoping and early study phase. The purpose of the criteria was to provide a

[1] The intent of EO 11988 is to avoid floodplain development, reduce hazards and risk associated with floods, and restore and preserve natural floodplain values.

rationale for equitably assessing each alternative relative to the alternative's ability to achieve the project purpose. For the purposes of the evaluation, an alternative must meet all the criteria in order to achieve the project purpose. The criteria are in no order of priority; each was considered equally important for meeting the project purpose.

The purpose of the actions proposed as a result of this study are to reduce flood hazards to the study area, which includes Centralia and Chehalis, as well as surrounding areas in Lewis and Thurston Counties, and to incorporate appropriate fish and wildlife habitat improvements. Flood hazards are defined as significant damage to existing structures, including private and public property, high risk to life, and extended closures of transportation corridors. Figure 2.1 shows the location of the study area within the Chehalis River Basin.

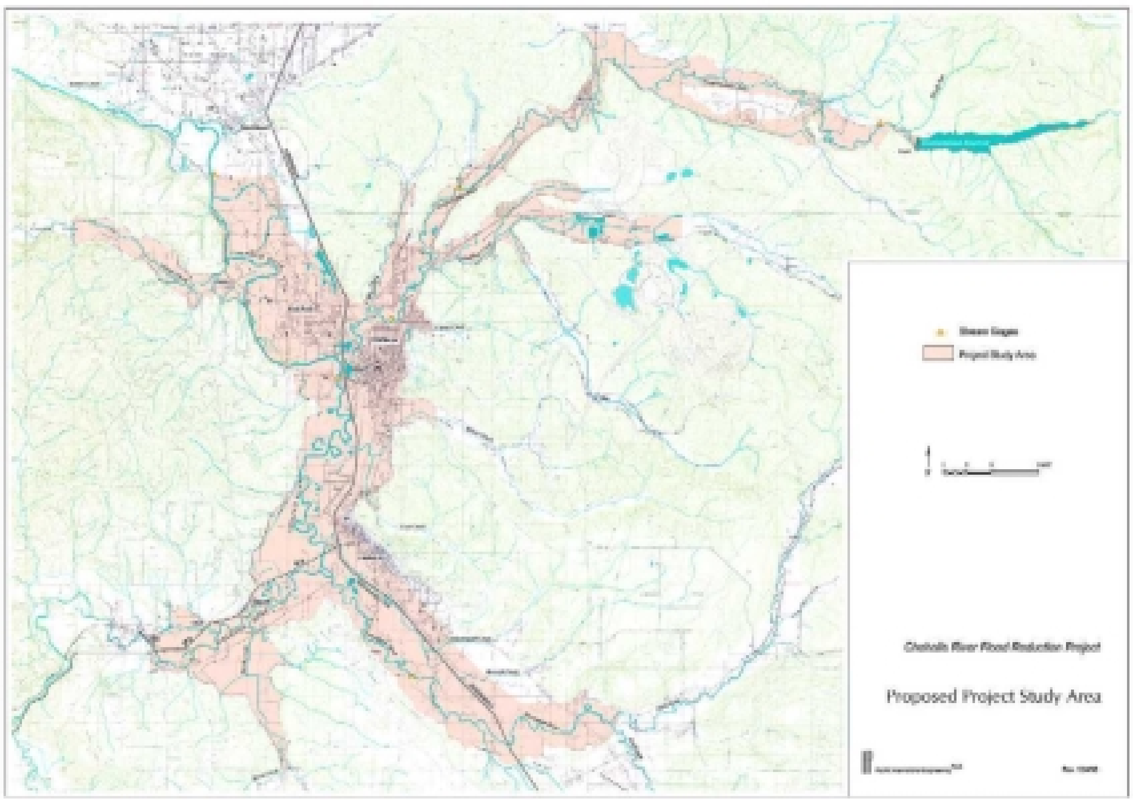


Figure 2.1. Study Area location

The following is a summary of each criterion.

1. Reduce flood hazards in the project area to the maximum extent practicable.

This criterion was included because flood hazard reduction is the subject of the General Reevaluation Report (GRR and the area of Federal interest. No particular flood (i.e., 50-year event or 100-year event) was selected early in the study process because the relationship between flood damage and flood magnitudes needed to be determined. Initially, however, a qualitative analysis of alternatives was done to determine whether they could reduce flood stages significantly in a 100-year event. Subsequent quantitative analysis of the 1-year to 500-year events demonstrated that the damage reduction for the 100-year event provided the most benefit for costs expended. Accordingly, reducing damages caused by the 100-year event became the quantitative measurement for this criterion.

2. ***Decrease the transportation closures during flooding on I-5 and other critical transportation corridors to the maximum extent practicable.***

The reduction of flooding on the major transportation corridors is another major interest of this project. The recent severe floods in the area have closed I-5 for several days. This resulted in diverting traffic approximately 100 miles, costing millions of dollars. In addition, the stretch of I-5 between Chehalis and Centralia also requires widening to increase safety, efficiency, and convenience. Widening of the highway cannot be undertaken unless WSDOT and Federal Highway Administration (FHA) flood clearance requirements are met. Because major floods disrupt transportation to the regional hospital and other essential facilities, a project must provide, to the extent practicable, improved access on local critical transportation corridors during floods.

3. Avoid increasing flood risks downstream from the project area.

To meet the project purpose, a proposed project must not increase downstream flood risks. This includes increases in flood stage, timing, and/or duration of flooding. Each alternative was first analyzed to determine whether it could increase downstream flood risks. If an alternative did not appear to increase downstream risks, additional analysis of downstream effects (e.g., hydraulic and geomorphologic effects) was conducted.

4. Avoid decreasing any existing low flow benefits provided by Skookumchuck Dam.

The current operation of the dam provides a maximum flow of 95 cfs (or natural flow plus 50 cfs) between April and August, and minimum flows of 140 cfs between September 1 and October 31 and 95 cfs between November 1 and March 31 for fisheries benefits. A selected alternative must ensure that this low flow benefit continues to be met, and if practicable, be enhanced. Any project that includes modification of the Skookumchuck Dam to provide flood storage would need to meet this criterion.

5. Reduce flood damage costs in the project area to the maximum extent practicable.

This criterion covers the same damage reduction requirements as Criterion 1; however, it is a measurement of cost rather than function. Criterion 1 originally contained both statements. Through the evaluation, it became apparent that there is an engineering feasibility element (Criterion 1) and an economic feasibility element (Criterion 5). Criterion 5 evaluates the benefits of a project feature relative to the costs of including the feature in a project. In order for an alternative to meet this criterion, the costs of constructing the project cannot exceed the costs of the benefits derived from the project. This assessment is based on the guidance and procedures discussed below:

The quantitative analysis included economic studies pertinent to a cost/benefit analysis of alternatives. Expected annual flood damages were estimated under the existing (without-project) conditions and under alternative with-project conditions. A narrative economic report is included as an appendix to the GRR and summary information is included in the main GRR.

The economic analysis was conducted in several phases. First, maps of the project area were reviewed and all structures within the 500-year floodplain were provided a unique identifier number and entered into a database. A field survey was then done to obtain information on the structures (e.g., first floor elevation and type of structure) for entry into the database. A risk-based economic analysis was performed to develop the stage-damage functions for each category of structures. The stage-damage functions and structures database were combined with water surface profiles from hydraulic analysis into the HEC-FDA (Hydrologic Engineering Center – Flood Damage Analysis) model to calculate expected annual damages under each alternative. The damages reduced by each alternative were then compared to the cost of each alternative to identify the alternative that maximized net benefits. In the final phase of analysis, the alternative identified as the preferred alternative was evaluated again at various sizes and with various combinations of features to identify the optimal scale of the preferred alternative.

The principal controlling guidance of the economic analysis comes from the Corps' "Planning Guidance Notebook", ER 1105-2-100, with specific guidance from Appendix D – Economic and Social Considerations. Additional guidance on the risk-based analysis was obtained from the "Engineering and Design - Risk-based Analysis for Flood Damage Reduction Studies" (U.S. Army Corps of Engineers (USACOE) EM 1110-2-1619, dated 1 August 1996). Guidance on assessing agricultural damages was derived from the Corps Water Resources Support Center's

"National Economic Development Procedures Manual – Agricultural Flood Damage," IWR Report 87-R-10, dated October 1987.

In summary, for an alternative to meet this criterion, it must provide benefits that exceed the costs of the project.

6. Reduce transportation delay costs in the study area to the maximum extent practicable.

This criterion covers the same transportation features as Criterion 2; however, it is a measurement of cost rather than function. Criterion 2 originally contained both statements. Through the evaluation, it became apparent that there is an engineering feasibility element (Criterion 2) and an economic feasibility element (Criterion 6). Criterion 6 evaluates the benefits of a project feature relative to the costs of including the feature in a project. This economic analysis is similar to what was done under Criterion 5.

7. Be cost-effective for both construction and maintenance.

Using procedures similar to those used to determine if an alternative met the purpose of reducing flood hazards and flood damage costs, each alternative was evaluated on maximizing flood damage reduction relative to the costs of constructing, operating, and maintaining the project. For example, if an alternative would provide only minimal reduction in flooding, yet the costs for constructing operating, and maintaining it were high, then that alternative would not be carried forward in the evaluation process.

8. Avoid adverse impacts to the aquatic environment to the maximum extent practicable. Minimize and compensate for unavoidable adverse impacts to the aquatic environment.

Any project that is constructed must avoid and minimize impacts to the aquatic environment to the maximum extent practicable. The Chehalis River basin has been affected by a variety of development activities and a project to reduce flooding should not adversely impact the basin's environment. Once the impacts of an alternative are minimized, mitigation must be sufficient to offset the remaining impacts.

9. Incorporate appropriate fish and wildlife habitat creation, enhancement, and restoration measures to the extent practicable.

Each alternative was evaluated on the feasibility of incorporating appropriate fish and wildlife habitat measures. As mentioned earlier, this is a requirement of each alternative.

10. Comply with all Federal, State, and local regulations, including environmental regulations.

Alternatives were evaluated for compliance with applicable regulations; any alternative that could not meet a regulatory requirement would not be carried further in the evaluation.

2.3 Evaluation of Alternatives

Each of the alternatives listed in Section 2.2.1 were evaluated based on the ten criteria described above.

The initial evaluation of the seven alternatives screened out four of the alternatives from further evaluation. Those screened out were Alternatives 1, 2, 5 and 6. The evaluation indicated that these four alternatives would not meet one or more of the project criteria. The three alternatives that were carried on for further evaluation were Alternative 3 (overbank excavations and flowway bypass), Alternative 4 (levees) and Alternative 7 (Interagency Committee alternative).

For all alternatives, design, cost, and modeling information was used in the initial evaluation, and a screening-level environmental analysis of the impacts of the various alternatives was conducted. The environmental analysis included identification of the known hazardous and toxic waste sites in the area. It also included working with the Tribal governments and a panel of State and Federal agencies to identify the potential impacts of each alternative. For some of the structural alternatives, a limited investigation of the effect on the geomorphology of the Chehalis River was conducted.

Alternative 1 - No Action

Alternative Description. Under the No Action Alternative, no project would be implemented. Technical studies conducted as part of the GRR indicate that this alternative would result in continued flooding in the study area.

Discussion and Summary. The No Action Alternative would not reduce flood hazards in the project area, and would not meet Criterion 1; it would also do nothing to reduce flood-related transportation closures (Criterion 2). It would not reduce flood damage costs (Criterion 5), or transportation delay costs (Criterion 6). Under the No Action Alternative, flood damage would continue to cost the local economy an estimated $10,204,780 annually, and flood damage costs would increase as the cost of living increases. The No Action Alternative clearly could not reasonably meet the project criteria; however, it was carried forward for comparative purposes per NEPA guidelines.

Alternative 2 – Skookumchuck Dam Modifications

Alternative Description. This alternative is intended to provide reductions in flooding problems in the town of Bucoda and the City of Centralia along the Skookumchuck River. This alternative may also provide some reduction in discharge in the Chehalis River downstream of the confluence with the Skookumchuck River.

In 1986, Congress authorized a project modifying Skookumchuck Dam. The project recommended in the 1984 feasibility report envisioned modification of the existing, private, water supply dam on the Skookumchuck River to provide a maximum of 28,500 acre-feet of flood storage, reducing flood damages in the Skookumchuck valley, the town of Bucoda, and the City of Centralia. Most of the alternative configurations of dam modifications evaluated in the current study (and described below) are improvements on the originally authorized project.

Skookumchuck Dam is located on the Skookumchuck River at approximately RM 22. The dam was constructed in 1970 to supply water for the Centralia steam generating plant. The dam is an earth fill structure approximately 190 feet high with the top of the dam at elevation 497 feet. The dam has a 130-foot wide uncontrolled spillway, on the left abutment, with a crest at elevation 477 feet. The dam has a limited capacity to release water from the reservoir when the pool is lower than elevation 477 feet. Outlet works consist of two 24-inch Howell-Bunger valves with a combined discharge capacity of 220 cfs.

Alternative 2 consists of modifications to the existing Skookumchuck Dam for providing flood control. Modifications to the dam for flood control purposes could include modification of the outlet works to allow a flood storage pool at an elevation of either 477 or 492 feet. Modifications would also likely include additional low-level outlet works to allow the rapid evacuation of stored water above an elevation of approximately 455 feet. Storage of water to a pool elevation of 477 feet would provide flood storage from 455 to 477 feet, such that the total storage would be about 11,000 acre-feet. A maximum pool elevation of 492 feet would add an additional 9,000 ac-ft of flood storage to the reservoir such that the total storage between elevations 455 and 492 feet would be approximately 20,000 ac-ft. Although originally authorized to provide 28,500 ac-ft of storage, the previous study of the dam found that no additional flood protection would be provided above 20,000 ac-ft of storage, or a pool elevation of 492 feet.

The Skookumchuck Dam modifications would change the function of the dam from primarily a water supply facility to a facility with flood control features. The Corps evaluated four different designs to achieve the desired flood control results. Each design would create an outlet structure, modify the spillway, and provide a maximum pool elevation of 492 feet. Flood storage to the 477-foot elevation was also evaluated to optimize the benefits of the dam modifications. Each design dealt only with modification of the dam and had a similar potential for environmental effects.

The four designs were as follows:

- Alternative 2B1 – Spillway Sluices with Gates and Rubber Crest Weir
- Alternative 2B2 – Short Tunnel with Gates and Rubber Crest Weir
- Alternative 2B3 – Tainter Gates in Rock Cut with Rubber Crest Weir
- Alternative 2B4 – Tainter Gates in Rock Cut with Emergency Spillway

Specific engineering design details on these designs can be found in the GRR.

Discussion and Summary. This alternative was subjected to detailed economic and feasibility review, although it was evident early in the study process that it could not reasonably meet the project criteria as a “stand-alone” alternative. Modifications to Skookumchuck Dam would provide some flood damage reduction to Bucoda and parts of Centralia, but not to other parts of the study area (specifically, the City of Chehalis) and therefore could not fully meet Criteria 1 and 5 (maximum reduction of damage and damage costs). This alternative would have no effect on flooding of I-5 and other transportation routes and therefore could not meet Criteria 2 and 6 (maximum reduction of transportation delay and delay costs). However, the Skookumchuck Dam modifications could provide flood damage reduction for portions of the study area. This alternative could also provide protection from some potential downstream flooding impacts by delaying flood flows on the Skookumchuck River until Chehalis River peak flows have passed. Therefore, the Corps rejected Alternative 2 as a stand-alone alternative, but evaluated the benefit of incorporating it into Alternatives 4 and 7. Lewis County also included Skookumchuck Dam modifications as a feature of its proposed alternative (Alternative 3). Skookumchuck Dam modifications were carried further into the evaluation as a component of those three alternatives. As part of this process, the four design variations were evaluated. The short tunnel with gates and rubber crest weir was further modified by replacing the rubber crest weir with slide gates and was the only design that proved to be feasible from an engineering standpoint.

Alternative 3 – Overbank Excavation and Flowway Bypass

Alternative Description. The flowway bypass and overbank excavation alternative was developed by Lewis County to 1) reduce flooding in the City of Chehalis and to prevent State Route 6 (SR-6) from overtopping in large floods through floodplain modification and 2) to reduce flooding of I-5 and the City of Centralia by overbank excavation in the Chehalis River to increase channel capacity in the vicinity of Centralia. These two features would provide significant flood damage reduction in these areas. In order to provide flood damage reduction along the Skookumchuck River and reduce downstream effects, modifications to Skookumchuck Dam (described in Alternative 2 above) would be combined with these features.

Components of the Alternative. This alternative would have three primary components. The first component, common to all variations of Alternative 3, is modification of Skookumchuck Dam to provide flood control storage. The second component is floodway modifications near Mellen St. Bridge between RM 65.90 and RM 68.25. A variation of this component would include modifications to the existing Mellen Street Bridge abutment. The third component is floodplain modifications near Chehalis/SR-6 to provide flood flow bypass and storage. The components and final design of Alternative 3 are discussed below; a more detailed description can be found in the GRR.

Centralia Overbank Excavation. This would involve excavation of approximately 2.4 million cubic yards of material from the banks of the Chehalis River to create a floodway bench. The floodway bench elevation would be set to an elevation above the summer normal flow stage so that construction activities would occur in the dry, above the water level. At the upper end of the excavation near RM 68.05, the bench elevation would be approximately at elevation 158 feet. At the lower end of the excavation near RM 65.90, the bench elevation would be approximately at elevation 148 feet. The floodway would have an average excavation width of about 600 feet. Floodway side slopes were assumed to be two horizontal to one vertical (2:1). Flow velocities in the excavation reach would be reduced from a high of almost 8 feet per second to less than 4 feet per second (fps).

The Mellen Street Bridge section of the Chehalis River is one of the most restrictive for flood flows. In order to alleviate this bottleneck, modifications to the bridge would be necessary. The modifications to the bridge would include excavation of the right (east) bank and extending the bridge on piers to elevate it above the excavated floodway.

Several variations of this were modeled to achieve a cost-effective and efficient design. The most cost-effective and efficient design included floodway excavation between RM 65.90 and RM 68.05.

Skookumchuck Bypass. This component would involve diverting a portion of the flow in the Skookumchuck River during flood events to a secondary overflow channel. This secondary overflow channel would start at approximately RM 1.5 on the Skookumchuck River. The channel would be a routed channel under I-5 at Blakeslee Junction, connect with some existing small lakes, and ultimately connect with a remnant channel of the Chehalis River. The channel would empty back into the Chehalis River at approximately RM 60.5, 6.5 miles downstream of the Skookumchuck confluence with the Chehalis River. It was assumed that the channel would be designed to divert up to 5,000 cfs of flood flow.

Construction of a secondary channel in this location would negatively affect fish habitat in the lower river, including potential spawning habitat for fall and spring Chinook salmon. Because of the length of the bypass, scoured areas would form and stranding of fish following floods would be a concern. The hydrologic regime of wetlands and riparian areas in the lower 1.5 miles of the Skookumchuck River would likely be affected by the reduction or elimination of overland flows. In the absence of periodic recharge, wetland and riparian plant communities would change to upland vegetation types, and impacts to wildlife dependent on wetland and riparian habitat would occur.

Construction of the secondary channel would have a significant impact on the built environment, including dislocation of residents as well as industrial, commercial, and agricultural operations. Roads and other public facilities within the bypass footprint would also need to be relocated, which would likely make the component not cost effective and not meet Criterion 7. This component was not carried forward for further evaluation.

Centralia Hospital Bypass. This bypass channel would start at about RM 68.0 and would end at the mouth of Scammon Creek at RM 65.9. The alignment would run roughly northwest following localized low ground and would pass immediately south of the hospital. This channel alignment would require the construction of three bridges and would require excavating out lower Scammon Creek. The entrance to the bypass channel would be set at approximately elevation 165 feet. This is approximately the water surface elevation for the annual flood event. The channel would likely be grass-lined and have a rock-armored entrance to prevent scour.

Construction of this bypass would involve excavation through wetlands, and adjacent wetland areas could be affected by reductions in recharge from overbank flows. Channel and substrate conditions near RM 65.9 would be altered, and could affect potential fish spawning habitat at this location.

Like the Skookumchuck bypass, construction of the Centralia Hospital bypass would cause significant impacts to the built environment, and would require relocation of regional medical facilities. It would also require construction of three bridges. These requirements would make the component cost-prohibitive, and it would not meet Criterion 7. This component was not carried forward for further evaluation.

Hump Excavation. The “hump” is located in the Chehalis River at approximately RM 67.1 to RM 65.9. The channel bottom at this location is approximately at elevation 148 feet. This is approximately 10 feet higher than much of the channel bottom further upstream. This high bottom elevation appears to restrict flow during the 100-year flood. There have been numerous suggestions from the public and some agencies that excavation of this “hump” would significantly increase hydraulic capacity of the channel during flood flows, and thus reduce upstream flooding.

To evaluate the effects of the “hump” on hydraulic capacity during flood flows, two excavation variations were analyzed. The maximum velocity reductions resulting from either variation would be insignificant in the excavation reach. This is because during a flood, a significant portion of the flow is in the overbank area. Thus, the slight increase in channel capacity would have only a marginal effect on the total flow area. As a component of an alternative, hump excavation would not contribute to meeting Criteria 1, 2, 5, or 6. Therefore, this component was not carried forward for further examination.

SR-6 Bypass. This component would include a 400-foot wide excavation under SR-6. The portion of SR-6 between the Scheuber Road intersection and the bridge crossing at RM 74.6 acts as a weir to limit overbank flows from the Chehalis River between RM 75.8 and RM 77.4, but the roadway is frequently overtopped by flood flows. The invert elevation of the excavation would be 179 feet. This would involve excavating and grading approximately 65,000 cubic yards of material, and elevating the roadway. The bypass would reconnect a portion of the historic Chehalis River floodplain north of SR-6 with the river by providing clearance for overbank flows to the floodplain. This component would include a bridge or culvert crossing at SR-6 and a year-round connection for flows from the Chehalis River to the oxbow south of SR-6. The floodplain along Scheuber Road would store floodwater when flows on the Chehalis River at RM 77 exceed the annual flood magnitude. Flows bypassing through the SR-6 excavation to the floodplain would return to the river at the north end of the floodplain bypass and storage area. Returning flows would discharge first through the existing Scheuber drainage ditch and then over the low-lying overbank area between RM 71.6 and RM 72.4 on the Chehalis River. Modifications to the banks in the area where the bypass flows re-enter the river channel may be required. These modifications could include armoring of the banks on both sides of the river to protect from possible head cutting or erosion. Reshaping of the Scheuber ditch side of the river to allow for smooth transition flow back into the river is another possible modification.

Discussion and Summary. As a result of the initial analysis, the Skookumchuck bypass, the Centralia Hospital bypass, and hump excavation components were dropped from this alternative. The Centralia overbank excavation and the SR-6 bypass were retained as components of Alternative 3. As noted earlier, modifications to Skookumchuck Dam (described in Alternative 2 above) would be included to provide flood damage reduction along the Skookumchuck River and reduce downstream effects.

Alternative 3 was then further evaluated based on the project criteria. The first stages of analysis indicated that this alternative met all of the project criteria. Hydraulic modeling demonstrated that Alternative 3 would reduce flood stages significantly within the study area; therefore, it met Criterion 1. Alternative 3 would provide 100-year flood protection for I-5 and significantly decrease the flooding of other transportation corridors (Criterion 2). With the inclusion of Skookumchuck Dam modifications, Alternative 3 would not result in any additional downstream flood risks (Criterion 3). Low flow benefits at Skookumchuck Dam would be maintained (Criterion 4). The screening indicated that the flood stage reductions would significantly reduce the flood damage costs (Criterion 5). Because flooding would be decreased on transportation corridors, transportation delay costs would be reduced (Criterion 6). Construction, operation, and maintenance appeared to be cost effective (Criterion 7).

With regard to Criterion 8, a number of environmental concerns and issues were raised about Alternative 3. For example, concerns raised by resource agencies included potential changes in sediment transport on the Chehalis River, changes in river geomorphology, effects on groundwater recharge, potential reduction in summer low flows, impacts on water quality, and loss of wetlands and riparian areas. This alternative appeared to have the potential for more than minimal environmental impacts. Additional studies would be needed to evaluate the alternative’s impact on environmental resources. The SR-6 bypass would reconnect a portion of the historic floodplain to the Chehalis River and could be designed to maximize the environmental benefits of this reconnection (Criterion 9). Additional review would be necessary to determine compliance with all applicable rules and regulations (Criterion 10).

The screening indicated that this alternative was consistent with the project criteria, although there were issues that needed further investigation. Specifically, the economic benefits and environmental impacts warranted further review. This alternative was carried forward for further evaluation.

Alternative 4 – Setback Levees

Alternative Description. This alternative was designed to reduce damages associated with flooding on the Chehalis and Skookumchuck Rivers. It would also address flooding along Salzer Creek, Dillenbaugh Creek, and the Newaukum River. This alternative would reduce damages to structures and allows I-5 to remain open for transportation during flood events up to and including the 100-year flood.

This alternative would consist of a system of setback levees and floodwalls to protect flood-prone areas near Chehalis and Centralia. Levees and floodwalls would be constructed at selected locations along the Chehalis and Skookumchuck Rivers as well as along several tributaries (i.e., Salzer Creek, Coffee Creek). The alternative was considered both with and without the benefit of flood control operations at Skookumchuck Dam. Options for 11,000 and 20,000 acre-feet of flood control storage in the Skookumchuck reservoir were evaluated as part of the alternative.

This alternative was initially based on the levee alignment developed in the 1970s. Refinements were made based on flood observations made in 1990 and 1996. The levee alignment was tied into existing levees where possible and adjusted to protect existing infrastructure while allowing inundation of the floodplain. The alignment was further adjusted to minimize impacts to residential areas, community infrastructure including roadways, and the natural environment.

The alignment was reevaluated following initial hydraulic modeling. Some levee segments were deleted either because flood protection was not required, or improved alignments were identified. Modifications were also incorporated based upon coordination with WSDOT to ensure consistency with the proposed widening of I-5. The levees were designed using the standard Corps levee design with 12-foot top width and 2:1 horizontal: vertical slopes as the primary levee design. Vertical floodwalls were incorporated in areas where it was important to minimize the impact footprint (i.e., areas close to the Chehalis River or areas with limited space available for a levee).

The levee system would protect residential and commercial structures, local roadways, state highways, and other infrastructure from flooding. Flood protection would extend along the Chehalis River from approximately RM 75 to RM 64, along the Skookumchuck River from approximately RM 5 to near the mouth, as well as along most of the lower two miles of both Dillenbaugh Creek and Salzer Creek. Figure 2.2 shows the currently planned levee alignment and 100-year flood inundation area with the levee system and dam modifications in place.

Discussion and Summary. The initial screening indicated that Alternative 4 would reduce flooding from the Chehalis River, Salzer Creek, Skookumchuck River and Dillenbaugh Creek and would significantly reduce the flood hazards in Chehalis and Centralia (Criterion 1). Alternative 4 would meet Criterion 2 by protecting I-5 from flooding and providing protection to other critical transportation corridors in and around Chehalis and Centralia. This alternative would slightly increase flood stages downstream of the project area, potentially not meeting Criterion 3. However, further evaluation determined that these downstream risks would not be significant. By incorporating modifications to Skookumchuck Dam into the alternative, the risk would be alleviated and no increase in downstream flood impacts would be experienced. Low-flow benefits of the Skookumchuck Dam would be maintained (Criterion 4). Alternative 4 would protect a significant portion of the existing residential and commercial infrastructure in Centralia and Chehalis area from flooding and protect I-5, thereby reducing flood damage costs and transportation delay costs (Criteria 5 and 6, respectively). The initial analysis indicated that Alternative 4 was cost-effective (Criterion 7).

With regard to Criterion 8, Alternative 4 could result in impacts to wetlands and riparian areas. The Skookumchuck Dam modifications could also result in adverse impacts to fish habitat and riparian areas along the Skookumchuck River, mainly between the dam and the first tributary downstream of the dam. The resource agencies raised questions about reductions in groundwater recharge, changes in sediment transport, channel self-maintenance, and channel stability. Additional evaluation of the alternative’s impact on environmental resources would be needed. Although the levee alignment incorporated avoidance of environmental impacts within the design, additional adjustments to the levee alignment may further reduce adverse impacts to wetlands and riparian areas. Setting the alignment away from the river’s edge may also allow opportunities for environmental restoration (Criterion 9). Finally, additional review would be necessary to determine compliance with all applicable rules and regulations (Criterion 10).

This alternative appeared to be consistent with the criteria, although there were issues that needed further investigation. Specifically, the economic benefits and environmental impacts warranted further review. This alternative was carried forward for further evaluation.

Alternative 5 – Flow Restrictors

Alternative Description. Flow restrictors are any kind of structure that intentionally restricts and holds back flow in order to help reduce downstream flooding or to increase upstream inundation. Flow restrictors are much simpler structures and smaller in scale than flood control dams.

Flow restrictors would increase the water surface elevation upstream of the flow restrictor at low flows. Increased upstream inundation can help to create or enhance wetlands and riparian areas upstream of the restrictor and can benefit fisheries by providing off-channel habitat. This would help to offset the lack of off-channel habitat for salmonids along the main stem Chehalis River. If flow restrictors could be located to back up spring and summer flows into adjoining low areas or disconnected oxbows, then additional off-channel habitat could be created. The increased upstream inundation could also have a potential benefit by increasing groundwater recharge. However, in order to meet project criteria, the flow restrictors could not cause an upstream stage increase during the 100-year flood.

Therefore, for all flow restrictors, it was assumed that upstream inundation levels would not be allowed to exceed the current 100-year flood level. Known high water marks from the February 1996 flood were used as the measure during hydraulic modeling. Three different structure types were analyzed: a slot structure, a fixed weir structure, and a control type structure. The control type was found to be most effective of the three. Restrictor sites evaluated included:

- Main stem Chehalis River at RM 87.56
- Main stem Chehalis River at RM 89.61
- Main stem Chehalis River at RM 104.09
- South Fork Chehalis River at RM 0.3
- Lincoln Creek
- Stearns Creek
- Salzer Creek

Hydraulic modeling indicated that the flow restrictors discussed above would cause no significant water surface reduction for the 100-year flood in the Centralia-Chehalis area due to the limited volume of flood storage they would provide. In order to create the volume of flood control storage necessary to effect significant water surface level reductions downstream, other design options for this alternative were considered early in the evaluation process. The other design options were: upstream flood control dams, multiple smaller headwater dams, and flood storage dikes on the floodplain.

Upstream Flood Control Dams. The Corps investigated five potential locations for large multi-purpose storage dams in the upper Chehalis River Basin in the course of its earlier flood control studies (USACE 1982). The five locations consisted of two sites on the Newaukum River, one site on the South Fork Chehalis River, and two sites on the main stem of the Chehalis River, upstream of the Newaukum River. Dams at all five locations were determined to be economically infeasible at the time of the earlier investigations. The flood stage reduction provided by the Newaukum River or South Fork Chehalis dams would be small, and construction costs would be high. For these two dams, 100-year flood stage reductions on the Chehalis River near the Mellen Street Bridge were estimated to range from 0.3 to 0.7 feet, at a cost of $90 million to $125 million (1998 dollars). The main stem Chehalis dams would provide greater stage reduction (2.3 to 3.4 feet at the Mellen Street Bridge). However, costs would be very high ($230 million and $433 million in 1998 dollars), and would equate to $100 million to $127 million per foot of stage reduction. Review for this study indicated that these dam options remain economically infeasible. In addition, there would be significant environmental issues associated with their construction and operation, including blockage of fish passage, inundation and loss of fish and wildlife habitat, and inundation of structures, agricultural lands, roads, and other public and private facilities. The miles of instream habitat lost would vary, depending on the reservoir location. Spawning habitat for spring and fall Chinook salmon, Coho salmon, and winter steelhead could be particularly affected. Potential downstream effects could include changes in the quality of water flowing out of the reservoir behind a dam and changes in downstream water temperatures. Downstream wetland and riparian areas that are dependent on overbank flows for recharge would probably experience reductions in size.

This design option of Alternative 5 could not reasonably meet Criterion 7 and was therefore dropped from further investigation.

Small Headwater Dams. In earlier studies, the Corps also investigated the feasibility of building several small headwater dams (USACE 1982). The Corps evaluated twelve sites in the drainage above Centralia and Chehalis. The combined flood storage capacity of all twelve dams would be only 14,500 acre-feet, with an estimated reduction in flow on the Chehalis River at Grand Mound of 3,000 cfs for a 100-year flood. The 3,000 cfs flow reduction would result in a flood stage reduction of approximately 3 inches. In 2001 dollars, the Corps estimated cost to construct the twelve dams would be approximately $118 million, which would equate to approximately $472 million dollars per foot of flood stage reduction. Because of the poor benefit-to-cost ratio, this design option of Alternative 5 could not reasonably meet Criterion 7 and was dropped from further investigation.

Flood Storage Dikes. The Corps also investigated the feasibility of creating flood storage areas in the floodplain. This would be accomplished by enclosing a large area with a dike. During floods, the floodwaters would overflow into the dike-enclosed storage area. Stored floodwaters would then be released slowly through a downstream outlet. The investigation determined that placing flood control storage areas in the floodplain would require a much larger storage volume for equivalent stage reduction compared to other alternatives. An estimated 40,000 acre-feet of storage volume would be needed in the floodplain to achieve a 1-foot stage reduction at the Mellen Street Bridge. Assuming a 10-foot storage depth, this would require approximately 4,000 acres of land. Because of the large land area required, environmental impacts of this option could be substantial. The specific impacts could not be defined until potential storage locations were identified. This design option of Alternative 5 could not reasonably meet Criteria 1, 2, 5, 6 and 7. Therefore, it was dropped from further investigation.

Discussion and Summary. Preliminary hydraulic modeling of flow restrictors showed that they would not significantly reduce flooding in the project area and that they could cause a relatively significant increase in the areal extent and depth of flooding upstream of the structures. Therefore, Alternative 5 could not reasonably meet Criterion 1. Because flow restrictors would not decrease the flooding to I-5 or other critical transportation corridors in or around Chehalis or Centralia, the alternative would not meet Criterion 2. Any of the design options of Alternative 5 would avoid increased flooding downstream as the purpose would be to store water during a flood (Criterion 3). Alternative 5 does not include any modifications to Skookumchuck Dam, so low flow benefits would not be affected (Criterion 4). The flow restrictors would not reduce flood stages and flood damages in the study area and would not meet Criterion 5. Alternative 5 would not decrease flooding to I-5 and the costs of transportation delay and would not meet Criterion 6. All design options of Alternative 5 had very high operational and maintenance costs because of the multiple structures and extensive area of coverage, and Criterion 7 would not be met. Although there may be short-term changes in sediment transport associated with installation of flow restrictors, this alternative would likely not have significant environmental impacts (Criterion 8). The flow restrictors have potential to create or enhance wetlands and create off-channel fish habitat, and would meet Criterion 9. Further investigation would be necessary to determine if this alternative would comply with all Federal, State, and local regulations (Criterion 10).

Although Alternative 5 met some of the project criteria, none of the design options could reasonably meet all of the criteria. Alternative 5 was therefore dropped from further evaluation.

Alternative 6 – Non-Structural Alternative

Alternative Description. The intent of Alternative 6 was to formulate a viable non-structural solution to reduce flood damages throughout the study area. Non-structural measures include watershed management, flood-proofing structures, evacuation plans, and removal of structures from the floodplain. Watershed management includes such actions as reforestation, timber harvest control, and restrictions on floodplain development. These measures do not directly address flood stage elevations, but reduce economic damages and safety hazards. Flood-proofing structures would require elevation of residential buildings to the 100-year flood level, and making the first floor of commercial buildings watertight. In addition, no new construction would be allowed in the floodplain. Evacuation plans would be developed to assist floodplain dwellers in avoiding flooding impacts. A selected number of structures, or even all of the structures in the floodplain, may have to be removed.

Discussion and Summary. Alternative 6 would reduce some of the flood hazards in the study area by removing structures from the floodplain (Criterion 1) although it would not have any effect on closures of the existing transportation corridors (Criterion 2). Alternative 6 would not result in flooding impacts downstream of the study area (Criterion 3) or affect the low flow benefits of Skookumchuck Dam (Criterion 4). Alternative 6 would reduce flood damages (Criterion 5) but would not have any effect on reducing the costs of transportation delays (Criterion 6). The cost effectiveness of Alternative 6 was not fully evaluated because the initial screening showed that large-scale and relocation of residents and businesses would be cost prohibitive. For example, based on information provided by the City of Centralia (City of Centralia 1998) it has been estimated that as many as 3,000 structures could need to be removed from Centralia alone. Therefore, this alternative would not meet Criterion 7. With regard to Criterion 8, there would be at least temporary air quality, soil disturbance, hazardous waste, and water quality issues associated with the demolition and removal of structures, and substantial adverse impacts on the social fabric and economy of the area if large numbers of residents and businesses were required to relocate. These impacts would need further evaluation if the alternative were carried forward. Alternative 6 would have high potential for environmental restoration, including reforestation and reestablishment of wildlife corridor connectivity, and would meet Criterion 9. Further investigation would be necessary to determine if this alternative would comply with all Federal, State, and local regulations (Criterion 10).

Because Alternative 6 could not reasonably meet Criteria 2, 6, and 7, it was dropped from further investigation. However, many of the non-structural measures contained in this alternative would be incorporated into any recommended plan. Section 2.5.3 provides additional detail on non-structural measures that would be a part of the preferred alternative.

Alternative 7 – Interagency Committee Alternative

Alternative Description. In the fall of 1996, the Washington State Department of Ecology Chehalis Basin Local Action Team began work with local governments to build partnerships to solve water problems in the Chehalis basin. In 1998, the Action Team formed a technical committee, which included representatives of Tribal, Federal, State, and local agencies. The technical committee formed an alternatives subcommittee to identify and evaluate potential flood hazard reduction measures and to develop alternatives for meeting specific flood hazard reduction goals. Alternative 7 is the product of the subcommittee’s work.

The purpose of Alternative 7 was to provide short-term and long-term actions that would reduce flooding hazards to Centralia and Chehalis area residents, while restoring and enhancing river hydrology and floodplain functions to support the basin’s salmonid habitat base.

Alternative 7 focused first on reducing flood hazards and increasing floodwater storage through regulatory and voluntary measures. The connectivity of the Chehalis River to its floodplain would be maintained and enhanced using land use and development regulations before implementation of any costly structural solutions. In addition, Alternative 7 sought to maintain vital I-5 and SR-6 access by constructing a traffic by-pass and by reducing flood frequency and duration. Alternative 7 also included the uses of floodplain easements, acquisition of frequently flooded areas and structures, relocation or elevation of structures, and improved upland water storage. Finally, Alternative 7 included a sequence of actions that required analysis before additional actions would be proposed.

The alternatives subcommittee reviewed a variety of different flood hazard reduction measures and used a format of facilitated workshops to analyze potential combinations of measures by describing the major elements (these could be individual measures or measures in combination) that makes up the combination alternative. These measures included:

- *Measure 1 – Moratorium on Floodplain Development.* In the interim, a moratorium on floodplain development would be implemented until the new flood insurance rate maps are adopted. Lewis County, and possibly Grays Harbor and Thurston counties and area cities would enact interim regulations that restrict new fills until the new FEMA floodplain and floodway maps are prepared and adopted.

- *Measure 2 - Adopt New FEMA Floodplain and Floodway Maps.* This included defining a new floodway based on a 0.2-foot rise in the water surface profile and using the new topographic information for this analysis. The 0.2 rise and the new 100-year floodplain would be used to develop or update floodplain management plans and regulations governing future floodplain development.

- *Measure 3 – Develop Flood Warning System.* Measure 3 would include the development and implementation of a basin-wide flood warning system. This would require that the system be well coordinated and interconnected among the various jurisdictions and agencies that provide emergency services.

- *Measure 4 - Restrict Floodway Development.* Measure 4 would restrict development (residential, commercial, industrial) in the newly defined floodway and require currently approved filling/floodplain development activities to provide a hydraulic analysis to show a 0.2-foot rise or less in the floodwater surface elevation. Jurisdictions would review pending permits to ensure that the proposed development does not increase flood damage risk to adjacent, upstream, and downstream properties. Jurisdictions should also consider establishing a time limit on development permits.

- *Measure 5 – Restrict Development in Flow Path.* In addition to defining the 0.2 foot floodway as described in Measure 2 above, development would also be restricted within additional critical portions of the floodplain, specifically in areas considered to be significant flow paths. Flow paths are naturally occurring swales, which are normally dry, but which have historically conveyed significant amounts of flowing water during flood stage. These flow paths would be established by identifying split flow conditions as part of the flood analysis, or by identifying flow paths from photos and observations. If blockage of a flow path produced more than 0.2-foot backwater, then it would be considered a flow path and would be protected from future development.

- *Measure 6 – Restrict Floodplain Filling.* This measure would restrict new filling in the floodplain by requiring that fill be mitigated through the removal of an equal volume of fill elsewhere in the floodplain or floodway. Cut and fill balances should be retained within the project site whenever possible.

- *Measure 7 – Preserve/Enhance Floodplain Flood Storage.* This measure would implement an analysis to quantify the potential amount of floodplain storage provided by existing, expanded, and enhanced floodwater storage areas. Potential areas are south of SR-6 in the Newaukum basin, South Fork of the Chehalis River, and the area bordered by Ceres Hill and White Road, a site near Stan Hedwall Park, existing wetlands, connections to oxbows and historic flow paths, SR-6 floodplain storage, and upland storage. The analysis would provide an assessment of the storage capacity that could be gained by removing barriers that are no longer used or can be redesigned, such as railroad grades, roadways, and bridges. The analysis would generate hydrographs demonstrating the role of storage, and could be used to implement measures such as voluntary buy-outs, purchase of flow easements, etc.

- *Measure 8 – Restrict Upland Land Uses.* This measure would utilize other land use measures that lower and slow the hydrologic response of the basin. For example, this measure would preserve upland vegetation coverage, reduce development densities, and reduce the area of impervious surfaces. This measure would also require avoidance of impacts to wetlands, and preserve and maintain wetlands, critical areas, and farmlands that supply floodplain storage capacity.

- *Measure 9 – Flood Audits.* This measure would conduct a flood audit for the cities of Chehalis and Centralia and surrounding communities in order to determine which structures would benefit from raising, flood proofing, or acquisition.

- *Measure 10 – Upgrade Stormwater Management Systems.* This measure would require an analysis to determine the detention effects of a 25-year design storm versus a 100-year design storm throughout the basin. Stormwater management is an integral element of the National Flood Insurance Program (NFIP). It regulates new development throughout the watershed to ensure that post-development runoff is no worse than pre-development runoff, and it regulates new construction to minimize soil erosion and protect water quality. Stormwater management is also mitigation for development. This measure is based on judicious planned development to reduce flood reduction risks. However, mitigation for development is inadequate when communities do not have a local stormwater management program or use less than the 100-year design storm for their local programs. With this in mind, it is imperative that stormwater management programs be implemented consistently throughout the basin to mitigate for development. It is also equally vital that the design criteria used for these programs are high enough to be effective. Detention for design storms would be based on the 100-year event. Use of a 100-year, 24-hour design storm is a standard national and State design criteria for stormwater management. This design storm should not be confused with a 100-year flood, which is based on physical characteristics, geology, climatologic antecedent conditions, land use, river morphology, size, and development density of the watershed.

- *Measure 11 – Improve Alternative Transportation and Emergency Access Routes.* This measure would identify alternative transportation and emergency access routes. The proposed priority would be to lower flood levels so that I-5 and the State Routes are not closed during a 50-year event and to maintain emergency access routes on local roads up to a 25-year event. The local medical facility is on Cooks Hill in Centralia, and the two routes via Scheuber Road and Mellen Street are linked to SR-6 and I-5. Improvements would be needed on portions of Scheuber Road along with modifications on the SR-6 Bridge, Mellen Street Bridge, and I-5. This local access road could be used as an I-5 alternate route. Depending on the severity of the flood, the local route may be closed during severe flooding conditions. Depending on the need to keep local roads open, there may be additional modifications to SR-6.

- *Measure 12 – Expand Capacity of Centralia-Chehalis Airport Dike Culverts.* This measure proposes modifications to culverts and levees affecting the duration of flooding on northbound lanes of I-5 (modifications would reduce duration only - not the incidence or frequency of flooding). The recommended measures are to install flap gates and expand culverts to direct water to drain northerly. Flap gated culverts would be necessary on the west side of the highway to drain the airport and the southbound lanes of I-5. An additional flap gate would be needed on the east side in order to drain the northbound lanes of I-5.

- *Measure 13 – Off Channel Storage and Upstream Flow Restriction Structures.* This measure would investigate the flood reduction achieved by installing flow restrictors (such as artificial log jams or agricultural storm water ponds) at strategic locations that would allow for water to be temporarily stored during normal and large flood events. In all areas above flow restrictors and where buy-outs or flood easements take place, the following restoration activities are recommended: 1) restore floodplain and riparian areas via revegetation and livestock exclusion, 2) maximize stormwater mitigation opportunities from urban areas, 3) mitigate agricultural ditch runoff (agricultural storm water ponds), 4) restore wetland complexes (enhancement of summertime flows), and 5) re-establish oxbow/side channel habitat functions as they relate to over winter/summer habitat for salmon.

- *Measure 14 – Chehalis Flowway Bypass.* This measure would include the floodwater bypass measure at SR-6 (included in Alternative 3) in combination with voluntary buy-outs and flood easements to attain enhanced floodwater storage capacities in areas identified in Measure 7. This measure would then be re-assessed, and if still necessary to reach flood hazard reduction goals, include Measure 15.

- *Measure 15 – Excavate Overbank Downstream of "Hump."* This measure would add a carefully designed overbank excavation downstream of the "hump" on the Chehalis River. Any excavation should be strategically designed to align with old side channels, and to remove invasive species such as reed canary grass and restore native vegetation. Excavation should not be located where the banks are functioning well and mature riparian forest is established.

- *Measure 16 – Elevate Segments of I-5.* This measure would add elevation to specific segments of I-5 to avoid flood closures.

- *Measure 17 – Modify Skookumchuck Dam.* This measure would add modifications of Skookumchuck Dam to improve flow control, but would not increase the storage.

- *Other Measures if Required.* Following a detailed analysis of the flood hazard reduction achieved by the above listed measures, this alternative will consider a sequence of structural measures.

Discussion and Summary. Alternative 7 combines several aspects of Alternatives 2 through 6 and therefore is a multiple-action alternative. Through discussion with the alternatives subcommittee, the subcommittee concurred with the Corps' findings regarding the use of flow restrictors (see discussion of Alternative 5) and excavation of the hump (see discussion of

Alternative 3) and therefore dropped those measures from Alternative 7. However, the other actions remained as part of Alternative 7.

When structural measures are included, Alternative 7 would reduce flood hazards (Criterion 1) and decrease transportation closures (Criterion 2). Again, when structural measures are included, Alternative 7 would not result in downstream impacts (Criterion 3) or changes in the low-flow operation of Skookumchuck Dam (Criterion 4). Because flood hazards would be reduced, costs of flood damages would also be reduced (Criterion 5) as would the costs of transportation delay (Criterion 6). Costs of operation and maintenance would need to be further evaluated to determine if Criterion 7 could be met. With regard to Criterion 8, adverse environmental impacts such as loss of existing wetlands and riparian areas, corridor connectivity, and impacts to potential fish habitat would likely be similar to Alternatives 4 and 6 if all measures were implemented. Additional analysis would need to be done to evaluate the socioeconomic effects of development restrictions. Restoration opportunities would be similar to Alternatives 4 and 6 and inclusion of the SR-6 bypass would provide restoration opportunities described earlier for that component of Alternative 3 (Criterion 9). Further investigation would be necessary to determine if this alternative would comply with all Federal, State, and local regulations (Criterion 10).

This alternative appeared to be consistent with the criteria, although there were issues that needed further investigation. Specifically, the operation and maintenance costs and environmental impacts warranted further review. This alternative was carried forward for further evaluation.

The table below summarizes the results of the screening-level evaluation:

Table 2.3-1 Summary of Screening-level Alternatives Evaluation

Alternative	Screening Results	Carry Forward for Further Evaluation?
Alternative 1 – No Action	Could not reasonably meet Criteria 1, 2, 5, and 6.	YES, per NEPA requirements
Alternative 2 – Skookumchuck Dan Modifications	Could not reasonably meet Criteria 1, 2, 5, and 6 as a stand-alone alternative.	YES, as a component of other action alternatives
Alternative 3 – Overbank Excavations and Flowway Bypass	Meets all criteria; additional analysis of economic benefits, environmental impacts, and compliance with laws and regulations needed.	YES
Alternative 4 – Setback Levees	Meets all criteria; additional study of economic benefits, environmental impacts, and compliance with laws and regulations needed.	YES
Alternative 5 – Flow Restrictors	Could not reasonably meet Criteria 1, 2, 5, 6, and 7.	NO
Alternative 6 – Non-structural Alternative	Could not reasonably meet Criteria 2, 6, and 7.	NO, but non-structural measures would be included in all action alternatives
Alternative 7 – Interagency Committee Alternative	Meets all criteria; additional study of operation and maintenance costs, environmental impacts, and compliance with laws and regulations needed.	YES

2.4 Evaluation of Remaining Alternatives

The initial screening process identified three alternatives that tentatively met the project criteria (Alternatives 3, 4, and 7). It also identified one alternative (Alternative 2) that merited incorporation into the other three alternatives. As described earlier, any of the action alternatives identified as the preferred alternative would include non-structural flood damage reduction measures. Consistent with NEPA requirements, the No Action Alternative (Alternative 1) was also carried forward for further evaluation.

A risk-based analysis was performed for each of these alternatives to further evaluate the ability of the alternatives to meet the criteria of reducing of flood hazards and damage costs to the maximum extent possible (Criteria 1, 2, 5, and 6). This included an analysis of engineering performance, costs, damage reduction, residual damages after project implementation, and net benefits. This analysis is fully described in the GRR and is summarized here.

The analysis of alternatives was based on a common water surface profile from the hydraulic model. All alternatives used the 100-year frequency flow and the associated water surface profile to define project components such as levee heights and bypass size. The 100-year flood frequency was selected as the common event for economic screening and allowed an alternative-by-alternative comparison of engineering performance.

To ensure that the analysis was complete, a number of modifications or variations of the alternatives were evaluated. Table 2.4-1 summarizes the results of the evaluation. The alternatives and modifications or variations that were evaluated are indicated on Table 2.4-1 as follows:

- ***No Action:*** This is the No Action Alternative.

- ***CheLev2-Ex SkDam:*** This configuration of Alternative 4 includes the levees on the Chehalis River elevated to the FEMA 100-year performance height and the Skookumchuck Dam with no flood-controlled reservoir.

- ***CheLev2-SkDam1:*** This configuration of Alternative 4 includes levees on the Chehalis River elevated to the FEMA 100-year performance height combined with the Skookumchuck Dam modifications with 11,000 acre-feet of flood storage.

- ***CheLev2-SkDam2:*** This configuration of Alternative 4 includes levees on the Chehalis River elevated to the FEMA 100-year performance height combined with the Skookumchuck Dam modifications with 20,000 acre-feet of flood storage.

- ***CheLev2-Ex SkDam/SkLev:*** This configuration includes levees on the Chehalis River elevated to the FEMA 100-year performance height combined with Skookumchuck River levees and the Skookumchuck Dam with no flood controlled reservoir.

- ***CheLev2-SkDam 1/SkLev:*** This configuration of Alternative 4 includes levees on the Chehalis River elevated to the FEMA 100-year performance height combined with Skookumchuck River levees and the Skookumchuck Dam modifications with 11,000 acre-feet of flood storage.

- ***CheLev2-SkDam 2/SkLev:*** This configuration of Alternative 4 includes levees on the Chehalis River elevated to the FEMA 100-year performance height combined with Skookumchuck River levees and the Skookumchuck Dam modifications with 20,000 acre-feet of flood storage.

- ***Bypass/SkDam1:*** This configuration of Alternative 3 includes the overbank excavation and flowway bypass plus the Skookumchuck Dam modifications with 11,000 acre-feet of flood storage.

- ***Bypass/SkDam2:*** This configuration of Alternative 3 includes the overbank excavation and flowway bypass plus the Skookumchuck Dam modifications with 20,000 acre-feet of flood storage.

- ***Hybrid Plan – Existing Dam:*** This configuration of Alternative 3 includes a modification to the bypass at Mellen Street and the SR6 bypass. Both overbank excavations would be reduced in size from the original Alternative 3 configuration, and the berm in the floodplain would be removed. The Chehalis levee system was added to this configuration. The levee heights were adjusted for the decrease in flood stages due to the influence of the overbank excavation areas. This also includes the Skookumchuck Dam with no flood-controlled reservoir.

- ***Hybrid Plan - SkDam1:*** This configuration of Alternative 3 includes the hybrid plan plus the Skookumchuck Dam modifications with 11,000 acre-feet of flood storage.

- ***Hybrid Plan - SkDam2:*** This configuration of Alternative 3 includes the hybrid plan plus the Skookumchuck Dam modifications with 20,000 acre-feet of storage.

- ***Alternative 7- Existing Dam:*** This configuration includes all of the structural features described in Alternative 7, but elevation of I-5 is not included, since it was clear early in the evaluation that this element would make the alternative not cost effective. For this configuration, elevation of I-5 is replaced by construction of levees along I-5. This configuration includes the existing Skookumchuck Dam with no flood-controlled reservoir. The non-structural features of Alternative 7 could not be modeled or assigned costs for the study.

- ***Alternative 7- SkDam1:*** This configuration is the same as Alternative 7 above, but includes Skookumchuck Dam modifications with 11,000 acre-feet of flood storage.

- ***Alternative 7- SkDam2:*** This configuration is the same as Alternative 7 above, but includes Skookumchuck Dam modifications with 20,000 acre-feet of flood storage.

Table 2.4-1 With-project Economic Analysis

Alternative	Expected Annual Damages					Flood Damages Reduced	Other Damages	Other Damages Reduced	Total Damages Reduced	Cost*	Net Benefit	B/C
	Chehalis		Skookumchuck		Total							
	Res/Comm	Public	Res/Comm	Public								
No Action	6147.81	442.93	2211.84	42.36	8844.94	0.00	2969.10	0.00	0.00	0.00	0.00	0.00
CheLev2 - Ex SkDam	2186.09	58.63	2290.11	42.72	4577.55	4267.39	2969.10	2969.10	7236.49	4863.89	2372.60	1.49
CheLev2 - SkDam 1	1893.35	45.85	694.59	14.09	2647.88	6197.06	2969.10	2969.10	9166.16	5949.58	3216.58	1.54
CheLev2 - SkDam 2	1876.98	43.86	498.56	10.30	2429.70	6415.24	2969.10	2969.10	9384.34	6166.72	3217.62	1.52
Hybrid Plan - Existing Dam	2231.15	61.06	1363.55	38.16	3693.92	5151.02	2969.10	2969.10	8120.12	5306.60	2813.52	1.53
Hybrid Plan - SkDam 1	1901.64	47.66	562.03	14.14	2525.47	6319.47	2969.10	2969.10	9288.57	6746.51	2542.06	1.38
Hybrid Plan - SkDam 2	1900.60	45.02	464.71	8.85	2419.18	6425.76	2969.10	2969.10	9394.86	7449.02	1945.84	1.26
CheLev2 - Ex SkDam/SKLev	2217.91	60.56	1677.61	42.06	3998.14	4846.80	2969.10	2969.10	7815.90	4865.90	2950.00	1.61
CheLev2 - SkDam 1/SkLev	1932.99	50.86	453.78	11.19	2448.82	6396.12	2969.10	2969.10	9365.22	5951.60	3413.62	1.57
CheLev2 - SkDam 2/SkLev	1924.27	48.05	337.42	9.32	2319.06	6525.88	2969.10	2969.10	9494.98	6168.73	3326.25	1.54
Bypass - Existing Dam	3404.44	30.56	2225.90	38.25	5699.15	3145.79	2969.10	0.00	3145.79	6070.04	-2924.25	0.52
Bypass - SkDam 1	2996.60	98.17	542.00	9.28	3646.05	5198.89	2969.10	0.00	5198.89	6882.46	-1683.57	0.76
Bypass - SkDam 2	2977.01	94.28	458.70	6.60	3536.59	5308.35	2969.10	0.00	5308.35	7526.87	-2218.52	0.71
Alternative 7 - Existing Dam	3382.07	97.10	2288.89	41.94	5810.00	3034.94	2969.10	0.00	3034.94	5081.55	-2046.61	0.60
Alternative 7 - SkDam 1	2899.76	74.89	601.44	18.63	3594.72	5250.22	2969.10	0.00	5250.22	5718.95	-468.73	0.92
Alternative 7 - SkDam 2	2869.41	70.80	526.26	7.69	3474.16	5370.78	2969.10	0.00	5370.78	5869.87	-499.09	0.91

** Cost includes mitigation, real estate, interest during construction, and o&m. CheLev2 includes backwater levess up Skookumchuck River.*

The evaluation indicated that the benefit-to-cost (B/C) ratio for Alternative 3 with various dam configurations (shown as the “bypass” alternative on Table 2.4-1) was less than 1; that is, the costs would exceed the damage reduction benefits. The Corps cannot undertake a project unless the benefits can be shown to exceed the project costs. Therefore, this alternative was eliminated from further evaluation. The modified version of this alternative that included a portion of the levee system and altered bypass configurations (the “hybrid plan”) was also evaluated. The analysis showed that the modified Alternative 3 reduced flood damages and achieved a B/C ratio greater than 1. However, flood damage reduction was not maximized; in other words, the modified Alternative 3 was not the most efficient alternative for meeting Criteria 1, 5, and 7. This alternative did not have the highest net benefit or B/C ratio. In addition, there were environmental concerns that would still need to be addressed. These concerns include changes in sediment transport and the potential upstream and downstream effects of these changes.

Early hydraulic model runs showed that all of the structural measures of Alternative 7 would need to be implemented in order to meet project criteria related to engineering effectiveness. This resulted in excessive costs that were not economically justified. In order to determine if this alternative could still be viable, it was modified to include levees. The flow restrictors and raising I-5 were eliminated because they were too costly and did not provide substantial flood reduction benefits. Other modifications included construction of levees along I-5 and various Skookumchuck Dam configurations. The non-structural features of the alternative could not be modeled or assigned costs for the study, and so were not analyzed quantitatively.

The evaluation showed that the B/C ratio for the various configurations of the modified Alternative 7 was less than 1; that is, the costs would exceed the flood reduction benefits. However, many of the non-structural features of Alternative 7 would be incorporated in any alternative identified as the preferred alternative. Non-structural measures that would not be specifically included in the preferred alternative but which could be undertaken by local jurisdictions include placing a moratorium on floodplain development until new FEMA maps are adopted (Measure 1) and restricting upland land uses (Measure 8). The local jurisdictions would adopt the new FEMA 100-year floodplain maps. Restricting upland uses would likely have a minimal effect on reducing flood stages. However, Federal, State, and local regulatory programs already require the protection of wetlands and critical areas included as part of Measure 8. Based on the analysis of floodplain, storage conducted for Alternative 5, removing barriers such as railroad grades, roadways, and bridges to increase floodplain storage (Measure 7) likely would not have a significant effect on flood stages. Improving alternate transportation routes (Measure 11) would not be necessary if a flood reduction project were implemented. The non-structural measures that would be specifically included in the preferred alternative are discussed in Section 2.5.3.

Alternative 4 was identified as the most effective alternative for reducing flood damages. In the final phase of the evaluation, analyzing combinations of several different sizes of the structural features optimized the alternative. This included combinations of various levee heights and the 11,000-acre foot or 20,000-acre foot flood storage pool behind Skookumchuck Dam. Table 2.4-2 summarizes the costs and benefits of these combinations. This included combinations of various levee heights and the 11,000-acre foot or 20,000-acre foot flood storage pool behind Skookumchuck Dam. Table 2.4-2 summarizes the costs and benefits of these combinations. The table is broken out into dam size such as 11 equals 11,000 acre-feet, the protection size of the levees (100 equals approx. 100-year flood protection (this is 3’ above 100 year water surface), BW equals backwater from the Chehalis river into the Skookumchuck River, 0 equals the levee profile at the 100 year water surface and –1 equals one foot below 100 year water surface). The table also shows the residual damages, which are annual flood damages that will remain after the project is constructed, the construction costs, the total flood reduction benefits, and the net benefits of the project.

Table 2.4.2 Total Annual Cost and Net Benefits

Dam Size	Chehalis Levee	Skookumchuck Levee	Residual Damages	Damage Reduction	I-5 Avoided Costs	I-5 Delay Benefits	Total Benefits	Dam Cost	Chehalis Cost	Skook Cost	Total Cost	Net Benefits
11	100	-1	$2,533.37	$6,311.55	$2,840.38	$129.10	$9,281.03	$1,085.70	$4,272.00	$663.14	$6,020.83	$3,260.19
11	100	0	$2,513.16	$6,331.76	$2,840.38	$129.10	$9,301.24	$1,085.70	$4,272.00	$711.09	$6,068.79	$3,232.45
11	100	BW	$2,647.88	$6,197.04	$2,840.38	$129.10	$9,166.52	$1,085.70	$4,272.00	$591.89	$5,949.58	$3,216.93
11	100	75	$2,498.06	$6,346.86	$2,840.38	$129.10	$9,316.34	$1,085.70	$4,272.00	$769.32	$6,127.02	$3,189.32
11	200	-1	$2,337.05	$6,507.87	$2,840.38	$129.10	$9,477.35	$1,085.70	$4,550.83	$663.14	$6,299.66	$3,177.69
20	100	-1	$2,409.98	$6,434.94	$2,840.38	$129.10	$9,404.42	$1,302.83	$4,272.00	$663.14	$6,237.97	$3,166.45
11	200	0	$2,316.83	$6,528.09	$2,840.38	$129.10	$9,497.57	$1,085.70	$4,550.83	$711.09	$6,347.62	$3,149.95
20	100	0	$2,388.65	$6,456.27	$2,840.38	$129.10	$9,425.75	$1,302.83	$4,272.00	$711.09	$6,285.92	$3,139.82
11	200	75	$2,301.74	$6,543.18	$2,840.38	$129.10	$9,512.66	$1,085.70	$4,550.83	$769.32	$6,405.85	$3,106.81
20	100	75	$2,373.82	$6,471.10	$2,840.38	$129.10	$9,440.58	$1,302.83	$4,272.00	$769.32	$6,344.16	$3,096.42
11	100	100	$2,448.83	$6,396.09	$2,840.38	$129.10	$9,365.57	$1,085.70	$4,272.00	$920.73	$6,278.42	$3,087.14
20	200	-1	$2,223.00	$6,621.92	$2,840.38	$129.10	$9,591.40	$1,302.83	$4,550.83	$663.14	$6,516.80	$3,074.60
20	200	0	$2,200.67	$6,644.25	$2,840.38	$129.10	$9,613.73	$1,302.83	$4,550.83	$711.09	$6,564.75	$3,048.97
11	100	200	$2,406.04	$6,438.88	$2,840.38	$129.10	$9,408.36	$1,085.70	$4,272.00	$1,011.16	$6,368.85	$3,039.50
20	200	75	$2,185.85	$6,659.07	$2,840.38	$129.10	$9,628.55	$1,302.83	$4,550.83	$769.32	$6,622.98	$3,005.56
11	200	100	$2,252.50	$6,592.42	$2,840.38	$129.10	$9,561.90	$1,085.70	$4,550.83	$920.73	$6,557.25	$3,004.65
20	100	100	$2,319.05	$6,525.87	$2,840.38	$129.10	$9,495.35	$1,302.83	$4,272.00	$920.73	$6,495.56	$2,999.79
11	200	200	$2,209.71	$6,635.21	$2,840.38	$129.10	$9,604.69	$1,085.70	$4,550.83	$1,011.16	$6,647.68	$2,957.01
20	100	200	$2,291.50	$6,553.42	$2,840.38	$129.10	$9,522.90	$1,302.83	$4,272.00	$1,011.16	$6,585.99	$2,936.91
20	200	100	$2,131.07	$6,713.85	$2,840.38	$129.10	$9,683.33	$1,302.83	$4,550.83	$920.73	$6,774.38	$2,908.94
20	200	200	$2,103.52	$6,741.40	$2,840.38	$129.10	$9,710.88	$1,302.83	$4,550.83	$1,011.16	$6,864.82	$2,846.06
Ext	100	BW	$4,577.55	$4,267.37	$2,840.38	$129.10	$7,236.85	$0.00	$4,272.00	$591.89	$4,863.89	$2,372.96
11	75	-1	$2,983.30	$5,861.62	$0.00	$0.00	$5,861.62	$1,085.70	$3,776.69	$663.14	$5,525.52	$336.10
11	75	0	$2,963.10	$5,881.82	$0.00	$0.00	$5,881.82	$1,085.70	$3,776.69	$711.09	$5,573.48	$308.34
11	75	75	$2,948.00	$5,896.92	$0.00	$0.00	$5,896.92	$1,085.70	$3,776.69	$769.32	$5,631.71	$265.21
20	75	-1	$2,846.42	$5,998.50	$0.00	$0.00	$5,998.50	$1,302.83	$3,776.69	$663.14	$5,742.66	$255.84

Dam Size	Chehalis Levee	Skookumchuck Levee	Residual Damages	Damage Reduction	I-5 Avoided Costs	I-5 Delay Benefits	Total Benefits	Dam Cost	Chehalis Cost	Skook Cost	Total Cost	Net Benefits
20	75	0	$2,824.10	$6,020.82	$0.00	$0.00	$6,020.82	$1,302.83	$3,776.69	$711.09	$5,790.61	$230.21
20	75	75	$2,809.27	$6,035.65	$0.00	$0.00	$6,035.65	$1,302.83	$3,776.69	$769.32	$5,848.84	$186.81
11	75	100	$2,898.76	$5,946.16	$0.00	$0.00	$5,946.16	$1,085.70	$3,776.69	$920.73	$5,783.11	$163.05
11	75	200	$2,855.97	$5,988.95	$0.00	$0.00	$5,988.95	$1,085.70	$3,776.69	$1,011.16	$5,873.54	$115.41
20	75	100	$2,754.50	$6,090.42	$0.00	$0.00	$6,090.42	$1,302.83	$3,776.69	$920.73	$6,000.25	$90.17
20	75	200	$2,726.94	$6,117.98	$0.00	$0.00	$6,117.98	$1,302.83	$3,776.69	$1,011.16	$6,090.68	$27.30
11	0	-1	$3,695.48	$5,149.44	$0.00	$0.00	$5,149.44	$1,085.70	$3,573.22	$663.14	$5,322.05	-$172.61
11	0	0	$3,675.26	$5,169.66	$0.00	$0.00	$5,169.66	$1,085.70	$3,573.22	$711.09	$5,370.01	-$200.35
20	0	-1	$3,540.11	$5,304.81	$0.00	$0.00	$5,304.81	$1,302.83	$3,573.22	$663.14	$5,539.19	-$234.38
11	0	75	$3,660.17	$5,184.75	$0.00	$0.00	$5,184.75	$1,085.70	$3,573.22	$769.32	$5,428.24	-$243.49
20	0	0	$3,517.77	$5,327.15	$0.00	$0.00	$5,327.15	$1,302.83	$3,573.22	$711.09	$5,587.14	-$259.99
20	0	75	$3,502.94	$5,341.98	$0.00	$0.00	$5,341.98	$1,302.83	$3,573.22	$769.32	$5,645.37	-$303.39
11	0	100	$3,610.93	$5,233.99	$0.00	$0.00	$5,233.99	$1,085.70	$3,573.22	$920.73	$5,579.64	-$345.65
11	0	200	$3,568.13	$5,276.79	$0.00	$0.00	$5,276.79	$1,085.70	$3,573.22	$1,011.16	$5,670.07	-$393.28
20	0	100	$3,448.18	$5,396.74	$0.00	$0.00	$5,396.74	$1,302.83	$3,573.22	$920.73	$5,796.78	-$400.04
20	0	200	$3,420.63	$5,424.29	$0.00	$0.00	$5,424.29	$1,302.83	$3,573.22	$1,011.16	$5,887.21	-$462.92
11	-1	-1	$4,340.59	$4,504.33	$0.00	$0.00	$4,504.33	$1,085.70	$3,398.52	$663.14	$5,147.36	-$643.03
11	-1	0	$4,320.37	$4,524.55	$0.00	$0.00	$4,524.55	$1,085.70	$3,398.52	$711.09	$5,195.31	-$670.76
20	-1	-1	$4,179.64	$4,665.28	$0.00	$0.00	$4,665.28	$1,302.83	$3,398.52	$663.14	$5,364.49	-$699.21
11	-1	75	$4,305.28	$4,539.64	$0.00	$0.00	$4,539.64	$1,085.70	$3,398.52	$769.32	$5,253.54	-$713.90
20	-1	0	$4,157.31	$4,687.61	$0.00	$0.00	$4,687.61	$1,302.83	$3,398.52	$711.09	$5,412.45	-$724.84
20	-1	75	$4,142.48	$4,702.44	$0.00	$0.00	$4,702.44	$1,302.83	$3,398.52	$769.32	$5,470.68	-$768.24
11	-1	100	$4,256.03	$4,588.89	$0.00	$0.00	$4,588.89	$1,085.70	$3,398.52	$920.73	$5,404.95	-$816.06
11	-1	200	$4,213.24	$4,631.68	$0.00	$0.00	$4,631.68	$1,085.70	$3,398.52	$1,011.16	$5,495.38	-$863.70
20	-1	100	$4,087.72	$4,757.20	$0.00	$0.00	$4,757.20	$1,302.83	$3,398.52	$920.73	$5,622.08	-$864.88
20	-1	200	$4,060.17	$4,784.75	$0.00	$0.00	$4,784.75	$1,302.83	$3,398.52	$1,011.16	$5,712.51	-$927.76

In addition, concerns expressed by local officials (e.g., FEMA certification for the 100-year flood in Centralia and the added protection provided by the 20,000-acre foot flood storage pool) were considered in determining which of the alternative configurations would be carried forward as the preferred alternative. This included the features that have the highest net benefit in combination with addressing local concerns regarding the dam. The configuration finally identified as the preferred alternative includes the following:

- Modifications to the Skookumchuck Dam including 20,000 acre-feet of flood storage
- Construction of set back levees providing 100-year flood protection on the Chehalis River
- Construction of set back levees providing 100-year flood protection on a portion of the Skookumchuck River
- Non-structural components

The preferred alternative is described more fully in the following section; the levee alignment is illustrated on Figure 2.2.

2.5 Preferred Alternative

2.5.1 Setback Levees

The levee system is intended to provide 100-year protection from the Chehalis River flooding. The setback levees would protect existing residential and commercial structures, I-5, and other transportation infrastructure from flooding. Large areas of the floodplain that are not developed would not be protected, so construction of the levee system would not encourage new floodplain development. Flood protection would extend along the Chehalis River from approximately RM 75 to RM 64, as well as along most of the lower 2 miles of both Dillenbaugh Creek and Salzer Creek. In addition, levee protection will be provided on the Skookumchuck River for backwater effects of the Chehalis River. The affected reach extends approximately 2 miles upstream on the Skookumchuck to the confluence with Coffee Creek.

A description of the levee alignment by reach is provided below. Additional detail on the levee alignment and design features is provided in the GRR.

Reach 1 – Fords Prairie. Reach 1 starts at Galvin Road in the Fords Prairie area, approximately 0.5 mile east of the Galvin Bridge near RM 64. The levee alignment travels generally south to the WDFW Bird Farm, where it is approximately 1,800 feet from the Chehalis River. From there, the alignment travels east to Bryden Avenue and then north to the high school track and stadium. The alignment heads east behind the stadium and then north to the east end of Borst Avenue near the Harrison Avenue/I-5 interchange. The embankment for the I-5 southbound lanes would be incorporated as part of the levee system. The levee alignment continues south to the right bank of the Skookumchuck River and ties into the bridge abutment. From the left bank of the Skookumchuck River, the levee alignment continues south to the sewage treatment plant.

Reach 2 – Sewage Treatment Plant. Reach 2 travels around and behind the existing sewage treatment plant and connects with high ground about 200 feet east of the Mellen Street Bridge right bank abutment.

Reach 3 – Mellen Street Bridge to Salzer Creek Bridge. Reach 3 begins approximately 200 feet east of the Mellen Street Bridge abutment and heads south along the river side of the Airport Way right-of-way. The alignment crosses Airport Way and continues along the I-5 right-of-way until it intersects with the Salzer Creek Bridge abutment.

Reach 4 – Salzer Creek Right Bank. Reach 4 starts at the I-5/Salzer Creek Bridge intersection and follows the right bank of Salzer Creek. The alignment then crosses the railroad tracks and ties into an existing levee at the fairgrounds. The alignment crosses National Avenue and then follows Salzer Creek north to Kresky Avenue, where it travels along the west side of the road. The alignment travels northward generally along the alignment of Pacific Avenue and then switches east and north until it ties into high ground at Summa Street.

Reach 5 – Salzer Creek Left Bank. Reach 5 starts at the south Salzer Creek Bridge abutment. The alignment parallels the railroad tracks until it turns eastward across Coal Creek where a culvert will be installed. It then ties in with an existing levee and crosses National Avenue.

Reach 6 – Coal Creek. Reach 6 starts at National Avenue and heads east to Kresky Avenue. The levee in this reach would consist of raising an existing floodwall around the perimeter of a parking lot.

Reach 7 – Salzer Creek to Airport. Reach 7 starts at the Salzer Creek Bridge abutment on the west side of I-5. The alignment parallels Airport Way until it connects with an existing airport levee, which would be widened and raised. This portion of the alignment parallels Airport Way to the south until it reaches the intersection of Airport Way and Arizona Avenue. An existing levee on the south side of Airport Way will be removed out of consideration for an environmentally sensitive area located on the south side of the road. The alignment continues from Arizona Avenue to Louisiana Avenue and continues along the southbound lanes of Louisiana Avenue.

Reach 8 – SR-6 to Railroad Underpass. Reach 8 starts at the I-5/SR-6 interchange southbound on-ramp and travels along the right side of the road until it reaches Dillenbaugh Creek Bridge and crosses the creek. A flood control box with a flap gate would be installed at this crossing. During major floods, the control box would prevent Dillenbaugh Creek flows from flowing east to west and entering the Chehalis River. The levee alignment continues south until it reaches the railroad underpass.

Reach 9 – Dillenbaugh Creek. Reach 9 starts on the north side of the I-5 bridge abutment at RM 0.5 on Dillenbaugh Creek. The alignment crosses the railroad tracks and Dillenbaugh Creek. A flood control box would isolate Dillenbaugh Creek flows to the west side of I-5 during major floods. The levee alignment in this reach is offset from I-5 to allow for future widening of the I-5 interchange.

Reach 10 – Dillenbaugh South. Reach 10 runs along the southbound on-ramp and interchange area. Construction in this reach would not be necessary if the Rice Road interchange is improved prior to implementation of the preferred alternative.

Reach 11 – West Reynolds Avenue to BNRR. Reach 11 starts at West Reynolds Avenue near the intersection of the BNRR tracks, the Chehalis Western tracks, and I-5 underpass. The levee alignment runs south, parallel to the BNRR tracks to a point approximately 200 feet from the Skookumchuck River.

Reach 12 – Chehalis Western RR to Harrison Street Bridge. Reach 12 starts on the west side of the Chehalis Western tracks and follows the left bank of the Skookumchuck River until it reaches existing high ground. None of the construction would be immediately adjacent to the riverbank. The alignment follows high ground and then travels over the existing road through Fort Borst Park, until it reaches the I-5 embankment approximately 100 feet north of the Skookumchuck River.

Reach 13 – Harrison Street Bridge to I-5 Right Bank. Reach 13 starts on the right bank just downstream of the Harrison Street Bridge and follows the perimeter of Hayes Lake, continuing along the edge of an existing access road that ties into I-5.

Reach 14 – Left Bank I-5 to Harrison Street Bridge. Reach 14 starts approximately 100 yards south of the I-5 bridge abutment on the left bank of the Skookumchuck River. The alignment heads east following high ground and then ties into an existing berm behind a nursing home. From this point, the alignment continues northeast and ties into Denny Way. The alignment continues to Latona Street and the Harrison Street Bridge. From the upstream side of the bridge, the alignment travels on the left bank along First Street, continuing one block west of M Street, where it ties into existing high ground.

Reach 15 – Harrison Street Bridge to Chehalis Western Railroad. Reach 15 begins at the Harrison Street Bridge along First Street and turns north on M Street to an existing raised driveway. A levee segment would surround a residential area and tie into an existing Chehalis Western rail embankment approximately 200 feet from the Skookumchuck River.

Reach 16 – Chehalis Western Railroad to Existing Left Bank Levee. Reach 16 connects high ground near the Chehalis Western embankment to the BNRR embankment. A portion of this reach follows an existing ridgeline along the Skookumchuck River floodway, where it ties into an existing levee near the intersection of West 7th Street and G Street.

2.5.2. Skookumchuck Dam Modifications

The short tunnel with gates and rubber crest weir was the only dam modification design that proved to be feasible from an engineering standpoint. Replacing the rubber crest weir with slide gates further modified this design. Storage of water to a pool elevation of 492 feet would provide flood storage from 455 to 492 feet, such that the total flood storage would be about 20,000 acre-feet.

The Corps determined that the preferred alternative would be the least environmentally damaging alternative based on the following restrictions on flood storage at Skookumchuck Dam: water storage in the Skookumchuck reservoir above pool elevation 477 feet could only be used for flood damage reduction. Water would be stored above this elevation no longer than 5 days for the 50-year to 100-year flood. For the 2-year to 50-year flood, water storage above elevation 477 should not occur more than every other year, and storage above elevation 477 would be no longer than 5 days for these events.

2.5.3 Non-Structural Features

The following outlines the non-structural features that are a part of the preferred alternative. The local sponsor will implement these actions to the maximum extent practicable. These actions will be included in the revised floodplain management plan for the project. This plan will be completed prior to the signing of the cooperative agreement for project implementation. The Corps will provide technical support to assist in development of sound actions within the project area to assure the integrity of any project structural components.

The Corps considered non-structural measures during the alternative evaluation process. Many of these measures are already being implemented at the County and City level. This includes ordinances on construction in the floodways, emergency warning systems, and other non-structural solutions such as building of homes and businesses and property buy-outs. Land use management plans are also in the process of being revised by Lewis County to have requirements that are more restrictive.

The following describes the non-structural component for the preferred alternative. Further effort on non-structural options will be evaluated during the development of a new floodplain management plan for the project area to be compliant with Executive Order 11988. This will occur during the project design process.

Elevation of Structures. Implementation of the preferred alternative will result in slightly increased flood elevations over existing conditions (average of 4 inches for the 100-year event) for eight residential structures in the study area. To address this issue, the Corps conducted a reconnaissance level analysis of raising the affected structures so that first floor elevations would be 1 foot above the with-project 100-year water surface elevation (WSE). The estimated cost for elevating structures is based on cost data obtained for previous Corps studies, which indicates an average cost of $25,000 per residence. Most of the costs of raising a structure are incurred in separating the structure from its foundation and installing a raised foundation. The height of this raised foundation is not generally a significant factor in the total cost and was not used in this estimate. However, the average number of feet these structures are below the 100-year WSE was recorded.

The affected structures are located in two sub-areas. The eight structures would be raised an average of 1.85 feet at a total cost of $200,000. The flood damage reduction benefits of raising these structures were based on data taken from the HEC-FDA model results. These data indicated average annual flood damages would be reduced by $1,730 per structure, or $13,840 for all eight structures. The average annual benefits of $13,840 compared to average annual costs of $12,910 results in a B/C ratio of 1.1 to 1.0 for this non-structural project component.

The two sub-areas, the number of affected residences, their average elevation below the 100-year without and with-project WSE, and the first cost and average annual cost to elevate to one foot above the 100-year with-project WSE are presented below:

Table 2.5.3-1 Costs of Elevating Structures with Induced Flooding

Sub-Area	Number of Effected Residences	Ave Elevation Below 100yr WSE Without Project	Ave Elevation Below 100yr WSE With Project	Average Change in 100yr WSE due to project	First Cost Estimate	Average Annual Costs @ 6.125% over 50 Years
BELOW AIRPORT	6	0.66	1.2	0.51	$ 150,000	$ 9,682
NORTH OF SR6	2	0.29	0.5	0.18	$ 50,000	$ 3,228
Totals/Averages	8	0.475	0.85	0.345	$ 200,000	$ 12,910

Define a New 100-Year FEMA Floodplain. A new 100-year FEMA floodplain map will be generated after the recommended plan has been approved and FEMA has accepted that project will be completed. The communities will adopt this map.

Flood Warning System. Currently the Cities and the County utilize the Emergency Broadcast System (EBS) and other forms of public information such as radio and television to transmit emergency and warning transmissions for the area. Also, three local emergency/information phone numbers have been established to answer the public's questions or receive important flood information from residents. There are also neighborhood notification networks. Lewis County Emergency Management division is responsible for carrying out the emergency response program. The City of Chehalis has warning sirens to notify the community of flood hazards, as well as a telephone network through the Chamber of Commerce. They also utilize a website to show where flooding is occurring. The community is also working with the National Weather Service to post bulletins of flood hazards. The flood warning system will be further addressed in the flood management plan.

Additional initiatives that are being considered by Lewis County include:

1) Installing additional river gauging stations to help in flood warning and emergency response activities. Potential additional gauges may include the following:

a. Updating the Newaukum gauge near Chehalis with telephone-linked capabilities.
b. Adding a telephone-linked gauge at South Fork Chehalis
c. Installing gages on other major tributaries within the Centralia/Chehalis area.

2) The Cities of Chehalis and Centralia and the County Engineer will coordinate the flood forecasting efforts.

3) Formalizing and updating the road closure database, creating a predictive tool by coordinating related flood stages to road closures.

4) Increasing distribution of flood information materials by making them available at the Emergency Management Office and at libraries throughout the County.

5) Updating Federal Insurance Rate Maps based on historical flood records to provide more accurate flood hazard information.

6) Enacting a public disclosure ordinance to provide a property's floodplain status at the time of purchase.

7) Documenting flood warning and emergency response activities for submittal to Community Rating System. These will count as credits to reduce flood insurance premiums.

Restriction of Development. The Corps will determine in the design phase the new floodway and flow paths within the project area after the implementation of the structural features. The local community will utilize this information to ensure local ordinances are being followed. This would include utilizing the newly developed 100-year floodplain and hydraulic modeling. The local jurisdictions can either amend their own Flood Hazard and SEPA ordinances and their own Shoreline Master Programs (as directed under the state Shoreline Management Act) or utilize the State's guidelines. In addition to defining the 0.2-foot floodway, development is also discouraged within other critical portions of the floodplain, specifically in areas considered to be significant flow paths. Flow paths are naturally occurring swales, which are normally dry, but which historically conveyed significant amounts of flowing water during floods. The following is a brief description of the current ordinances for floodway construction for Lewis County, the

City of Chehalis and the City of Centralia. These ordinances generally support having an approved filling/floodplain development plan, and provide for a hydraulic analysis to show a 0.2 ft rise or less in the floodwater surface elevation.

Lewis County – Development within the FEMA floodway is highly discouraged. Landfills, substantial improvements, and new residential structures are entirely prohibited. Commercial development is allowed, but only if accompanied by an engineer's certification that the proposed development will not result in any increase in flood levels during the 100-year flood. Variances are possible for development within the floodway but Lewis County does not encourage them.

City of Centralia – Development is not allowed in the FEMA floodway. Centralia ordinances state that no impact or 0 foot rise is required of any development. Request for variances are few and are seldom granted. Applicants for projects that lie in both the Flood Plain Ordinance and the Shoreline Master Program areas are required to apply for, and obtain, both permits. In addition, any development within the FEMA flood fringe must be elevated to at least 1 foot above the elevation of the 100-year flood (these elevations are based on the FIRM).

City of Chehalis – Development within the FEMA floodway is highly discouraged. New residential structures are entirely prohibited in special flood hazard areas. Commercial development is allowed, but only if accompanied by an engineer's certification that the proposed development would not raise flood levels at all during the 100-year flood. In addition, all new development and substantial improvements must comply with all applicable flood hazard reduction provisions of the city, state and federal regulations.

Restriction of Fill in the Floodplain. This measure ensures that there are restrictions to new filling of the floodplain by requiring that fill be mitigated by removal of equal volume of fill at the site or elsewhere in the floodplain or floodway. Cut and fill balances should be retained within the project site whenever possible. In the Comprehensive Flood Hazard Management Plan for Lewis County, details adding the requirement for compensatory storage to the Flood Damage Prevention Ordinance is a method for reducing the effects of filling in the flood fringe. Whenever fill material is added to the flood fringe, the area that the fill occupies is removed from the potential flood storage area. Under compensatory storage requirements, and individual placing fill in the flood fringe must excavate an area of equivalent volume to eliminate the effects of the fill material on the flood storage.

Lewis County – The standard is that fill materials must be obtained from the site to the extent practicable. If the fill cannot be so obtained from the same site, it must be obtained as practical from the flood hazard area. In addition, the fill must have a beneficial use and be deemed necessary.

City of Centralia – Filling in the flood fringe landward of the floodway is allowed. All construction must be consistent with the model National Flood Insurance Regulations.

City of Chehalis – As a part of the Shoreline Management Plan, there is a restriction of a one-to-one fill and cut within the floodplain area.

Stormwater Management. This measure relates to increasing the detention from a 25-year design storm to meet the Washington State Department of Ecology stormwater management criteria. The local communities are evaluating these new criteria and determining whether they can meet the new Ecology regulation. Better management of stormwater will assist in reduction of flooding in the project area. The Corps will continue to evaluate the timing of stormwater versus the watershed runoff, to determine an optimum management of stormwater release during a flood event. The Corps will continue to assess the development of local stormwater plans.

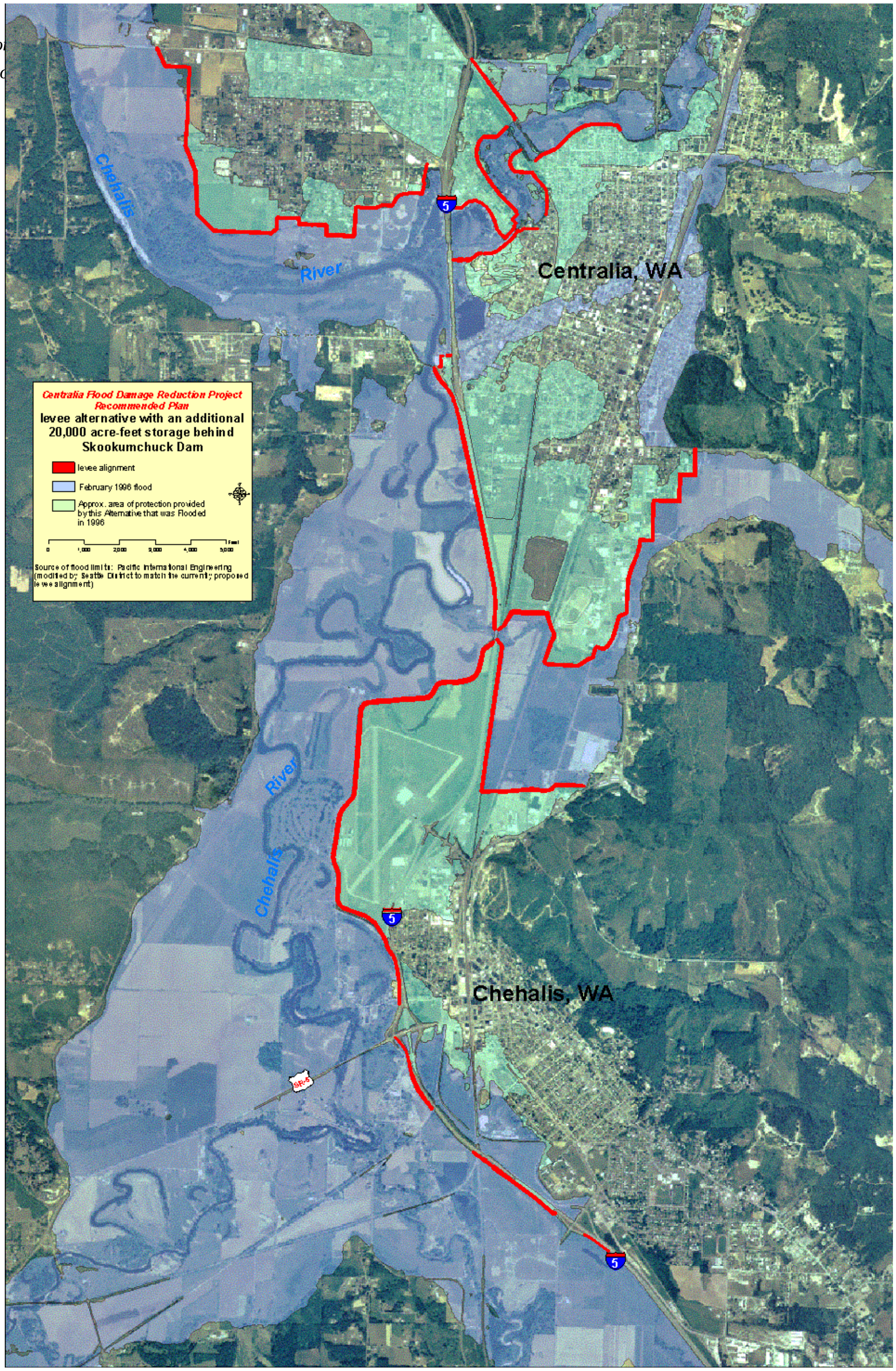


Figure 2.2 Preferred Alternative, 100-year flood

2.6 Potential Restoration Sites

Incorporating appropriate fish and wildlife habitat restoration measures to the maximum extent practicable is one of the defining criteria of the project and consistent with the Corps mission for environmental sustainability. Habitat restoration would provide benefits over and above the benefits of any mitigation actions undertaken to offset the potential environmental impacts of a project. Mitigation actions proposed to offset the environmental impacts of the preferred alternative are described in Chapter 4.

Potential habitat restoration sites were identified during the reevaluation study. The restoration measures will be evaluated further during the design phase to be incorporated into the preferred alternative for the purpose of achieving an environmental sustainable project.

Each of the potential restoration measures is conceptual at this point and may be altered, eliminated, or combined with others as more detailed design studies are conducted. In addition, consultation with local Tribes and resource agencies will also be conducted prior to implementation of any of the potential restoration measures. The descriptions below are intended to provide a conceptual idea of what each restoration measure would involve, the target habitat conditions expected to be achieved, and the actions required to achieve those targets.

The locations for proposed restoration measures were selected based on habitat needs as reported in existing literature and studies, and opportunity for implementation. The following list is not intended to include all potential restoration measures that could be undertaken in the upper Chehalis basin.

As discussed above, additional analyses and consultation with resource agencies would need to be completed prior to implementing any of the potential restoration measures. The following list is not intended to include all potential restoration measures that could be undertaken in the upper Chehalis basin.

MF Newaukum Revegetation, Tauscher Road. This site is located at approximately RM 1 on the Middle Fork Newaukum River. The land is in timber production, and a riparian buffer comprising numerous 30-year old conifers has been left along the stream. The buffer width is 50 to 100 feet in most areas and canopy closure over the stream is 80 to 100 percent. This riparian zone appears to extend for most of the length of the Middle Fork. Downstream of Tauscher Road, there is a riparian corridor approximately 500-feet wide. The water was turbid when observed in March 2001, likely from road runoff or timber harvested areas upstream.

This site should be protected to prevent future degradation. Restoration measures at this site would be minimal but would provide further enhancement to an existing area of good riparian habitat and protection from adjacent and upstream timber harvest. Measures would include under plantings of conifers and native shrubs to ensure succession to coniferous forest, as well as placement of large woody debris in the channel to provide more aquatic habitat diversity and trap sediments. Some removal of blackberries may be necessary. Geomorphically, there are no major issues with this site. Additional vegetation and large woody debris would further stabilize the stream channel and banks.

NF Newaukum Revegetation, Tauscher Road. The North Fork at Tauscher Road has a long pool with riffles upstream and downstream. The riparian zone is 25 to 50 feet wide, but sparse, with an understory of reed canary grass. Alder, cottonwood, and some sparse Douglas fir are the dominant trees, and most are less than 50 years in age. The water was visibly turbid when the site was visited in 2001, even though precipitation had not occurred recently. The pool had accumulations of silt, while the riffles were of medium gravel, with 10 to 15 percent fines. No large woody debris was observed in this reach. The property on the right bank downstream of the bridge has a steelhead pond. Riprap is along the banks adjacent to the bridge and downstream at the next bend. The site is approximately 5 acres.

Restoration measures at this site would include under planting of riparian species for a 50-foot wide buffer including conifers and shrubs, removal of invasive vegetation, and placement of large woody debris in the channel. The banks are low, so no bank sloping would be necessary. Geomorphically, this should stabilize the channel and banks.

Main Stem Oxbow Reconnections. This site includes four separate oxbows in the main stem floodplain between RM 68 and RM 73 along the Chehalis River. Each oxbow is isolated from the river except during flows greater than a 5-year event. Two of the oxbows are located within the Riverside Golf Course, one is designated as Horseshoe Lake, and the fourth is an unnamed large oxbow northwest of Airport Road. Currently, the riparian zone around the oxbows ranges from 0 to less than 100 feet wide, although the typical width is less than 25 feet, particularly on the golf course oxbows. Riparian vegetation consists of young cottonwood, alder, Oregon ash, and some willows. Reed canary grass and blackberries are also common. Yellow pond lilies and *Polygonum* species are common aquatic plants in the oxbows. Waterfowl such as geese and ducks utilize these oxbows at least seasonally. The total combined site area is approximately 38 acres.

Restoration measures would include excavation of channels to connect the upstream and downstream ends of the oxbows to the river for most winter and spring flows (November-

June). In addition, riparian zones would be restored or increased in size around the perimeters and inlet/outlet channel banks. Within the golf course, riparian zones could-likely only be 50 feet in width or less. A minimum 100-foot wide riparian zone is proposed, however, for both Horseshoe Lake and the airport oxbow. Detailed design would require additional hydraulic and sediment transport analyses to confirm sediment transport issues and develop channel geometries and profiles.

Mainstem Riparian Revegetation, RM 66-80. This large-scale restoration project addresses the Centralia reach of the Chehalis River. In this reach, the riparian vegetation is the most denuded and land uses are of the highest impact. The riparian zone ranges from nonexistent to extremely narrow. In some areas, no buffer separates livestock and agricultural runoff from the river. The riverbanks are severely eroding in many locations. This reach also has a very low gradient and the channel has incised. Little to no large woody debris is present. This reach is on the 303(d) list of impaired water bodies for high temperatures, low DO, high levels of fecal coliform, and increased nutrients.

This restoration measure comprises a large-scale riparian revegetation effort. Banks would be sloped back to a 2:1 or flatter ratios in areas on the inside of meander bends or wherever feasible. A minimum 100-foot wide zone would be revegetated with native riparian species. In areas where native trees already occur, they would be left in place to the maximum extent practicable and supplemented with under plantings of conifers and shrubs. Invasive vegetation would be removed, including blackberries and reed canary grass. Large woody debris would be keyed into the banks where bank sloping is proposed to add increased stability and improve aquatic habitat. The total riparian restoration area is approximately 321 acres.

Skookumchuck Revegetation, Chehalis Confluence. This site is at the confluence of the Skookumchuck River with the Chehalis River. The right bank of both rivers is within Fort Borst Park. The left bank of the Skookumchuck is also publicly owned. The left bank of the Chehalis is a privately owned agricultural area.

Currently, the Chehalis River is very incised through this reach and the left bank overtops at approximately a 5-year event. In the park and other public land, there is an extensive riparian zone (more than 100 feet wide) dominated by cottonwoods of about 50 years in age as well as alder, ash, and willows. There is significant coverage of reed canary grass in the understory. On the left bank of the Chehalis, there are only sparse, young (less than 20 years old) trees on the bank, which are limited to the top of the slope. The south bank of the main stem Chehalis, both upstream and downstream of the confluence, has minimal riparian vegetation and high eroding banks. Riprap is present in some locations. The Skookumchuck enters the Chehalis at an angle of approximately 90º over a gravel delta and is a popular fishing area. The site is approximately 15 acres.

Restoration measures at this site would include sloping the south bank of the Chehalis back to a 2:1 or lower ratio and planting a 200-foot wide riparian zone for a distance of approximately 3500 feet.

Skookumchuck Revegetation, RM 12. This site extends from approximately RM 12 to RM 13 on the Skookumchuck River, upstream of Bucoda. The river runs through a moderately wide valley in this reach and is confined to the south side of the valley. The left bank has moderate shading of second-growth deciduous trees. The right bank (north side) is bordered entirely by agricultural and pasture lands. The riparian vegetation present on the right bank is composed almost entirely of reed canary grass and is extremely narrow. There are no fish passage barriers, but habitat and cover are very limited. The site is approximately 23 acres.

Restoration measures at this site would include placement of large woody debris in the channel and planting a 100-foot wide riparian buffer along the right bank. Under planting of conifers may be beneficial on the left bank. Removal of invasive plant species would also be conducted.

SF Chehalis Revegetation and Wetland Creation, RM 0-5. The lower miles of the South Fork Chehalis River lack suitable quantity and quality of riparian vegetation. The typical width varies between 10 and 25 feet and it comprises mostly young deciduous trees with only a few conifers. The surrounding lands are agricultural and rural residential with timber harvest on the uplands. Although this reach is not listed on the 303(d) list, it is known to experience high water temperatures and elevated levels of fecal coliform due to uncontrolled runoff of agricultural wastes. Channel migration has been reduced and large woody debris is infrequent and recruitment is very low. Glide habitat dominates the aquatic habitat, but pools and riffles are present in moderate rates and a limited number of side channels exist.

Restoration measures include a large-scale riparian revegetation effort along with moderate wetland creation. Banks would be sloped back to a 2:1 or flatter ratio in areas on the inside of meander bends or wherever feasible and the floodplain would be excavated down to allow seasonal inundation in some areas. A 50- to 100-foot wide corridor would be revegetated with native riparian species and exotic species would be removed from that area. In areas where native trees already occur, they would be supplemented with under plantings of conifers and shrubs. Clumps of large woody debris would be keyed into the banks where sloping actions are proposed to enhance stability and increase aquatic habitat diversity. Livestock fencing would be implemented as needed. The bank sloping aspect should be evaluated to ensure it does not cause channel migration in areas of development. It appears that minimal channel migration is occurring in this reach, but more detailed hydraulic and geotechnical analysis would need to be conducted to evaluate the stability of the sloped banks and wetlands.

SF Chehalis Reconnections and Wetland Creation, SF and Main Stem Chehalis Confluence. This site is located at the confluence of the South Fork and the main stem Chehalis rivers. Between these rivers, a large fallow pasture exists, which is bisected by SR-6 and the railroad tracks. This area floods currently at about a 2- to 5-year event and would benefit from a significantly improved floodplain plant community. The main stem left bank is in early successional stages of reforestation with young willows and alders and is frequently flooded. Coarse gravel bars are present in large amounts in this area and some channel migration is occurring. A moderate amount of large woody debris is present in the channel.

Restoration actions at this site would include revegetation of the riparian areas on the left bank of the main stem and between the main stem and South Fork. Additionally, two 2-acre wetland areas would be excavated, the first on the inside of the meander bend of the main stem, and the second between the railroad and SR-6 on the left bank of the South Fork. Wetlands would increase channel diversity and off-channel habitat, and would be designed to prevent fish stranding. Riparian zone widths would be a minimum of 100 feet. In addition, non-native plant species would be removed and large woody debris placement would occur throughout the connection channels and wetlands.

Restoration measures at this site would also include excavation of a meandering low-flow channel through the wet meadow, excavation of wetland areas adjacent to the channel as needed for annual inundation, removal of reed canary grass and other invasive species, placement of large woody debris in the channel, and replanting approximately 28 acres with riparian and wetland species. Additional livestock fencing would be constructed where needed.

Newaukum Revegetation and Wetland Creation, at Chehalis Confluence. At this site, the left bank of the Chehalis main stem is vegetated with mature cottonwoods at the top of bank. Banks along the lower Newaukum and right bank of Chehalis have minimal riparian vegetation and are experiencing some significant erosion, particularly just downstream of the railroad bridge on the

Newaukum. A fallow pasture area is located at the confluence on the left bank of the Newaukum and right bank of Chehalis. The Newaukum carries a moderate amount of small/medium gravel into the Chehalis. The lower reach is incised, probably to meet the highly incised Chehalis River channel. No large woody debris was observed. The total site area is 8 acres.

Restoration measures at this site would include creation of a 2-acre forested wetland and revegetation of both the main stem and Newaukum banks both upstream and downstream of the confluence. The forested wetland would be created by a 3 to 4-foot depth excavation of the fallow pasture area to receive inundation from approximately the 2-year event. Revegetating the right bank of the Chehalis downstream of the confluence would be assisted by sloping the bank to a 2:1 or lower ratio. Riparian buffers or under plantings in all areas would be a minimum of 100 feet wide. Clumps of large woody debris would be placed along the outside bend to prevent erosion and increase aquatic habitat.

Geomorphically, the floodplain excavation should not be lower than the elevation of the 1.5-year flow in order to keep the main stem from migrating into the Newaukum and bridges. Sloping the banks may provide more stability in an erosional area, but some protection other than vegetation, such as fabric or large woody debris, may be required.

Realignment of the Newaukum channel to reduce erosion specifically under the railroad and Newaukum Avenue bridges would not be advised because it would shorten the channel and increase velocities.

Newaukum Reconnection and Wetland Creation, Stan Hedwall Park. At this site, the Newaukum River flows along the south side of Stan Hedwall Park, which has a low-lying, grassy area. A park road elevated on a berm isolates this low-lying area from the river except during flood events. A culvert is present under the road that appears to receive water during high flows (probably greater than the 5-year event). The riparian zone varies from 50 to 100 feet wide with sparse mature cottonwoods and some sparse, younger alders. Reed canary grass dominates both riverbanks. The Newaukum is moderately incised in this reach, but the substrate is medium gravel with approximately 10 percent fines. An island occurs in the river at the upstream end of the park, dominated by willows and reed canary grass. The lesser channel around the island is very silty. Soils on banks are clays and silts. Existing culverts in this area appear to be used to drain the low-lying areas after flooding.

Restoration measures at this site would include the conversion of the low-lying zone into a seasonally inundated wetland and revegetation of the upstream and downstream banks of the Newaukum. The park road would both be notched and bridged to allow flow-through or be removed and reconstructed farther north to allow wetland creation. Under either scenario, the existing berm would be partly left in place, but open channels would be excavated through the berm to connect the wetland to the river. A riparian buffer 100 feet in width would be established on both banks for approximately 1,200 linear feet. Clumps of large woody debris would be placed within the wetlands and Newaukum River to stabilize banks and increase aquatic and terrestrial habitat diversity. The existing old meander immediately upstream of the road would be excavated as needed to allow continuous connections during winter and spring flows (November-June) and additional riparian restoration would be done along both banks of the old channel, including the removal of non-native species.

Newaukum Revegetation, RM 0-10. The lower Newaukum River downstream of the North Fork and South Fork confluence is completely surrounded by agricultural lands and rural residential development. Numerous roads and bridges cross the river and the riparian zone is typically very narrow to non-existent. The lower portion of the river is listed on the 303(d) list for high temperature and elevated levels of fecal coliform bacteria. Livestock have access to the river in many locations. The upper watershed is mixed between agricultural uses and timber harvest. Erosion of fine sediments from the banks and from upstream roads and landslides are also a problem. Large woody debris is present in moderate amounts, but there is a lack of recruitment, and amounts will probably decline over time in the absence of riparian revegetation. The aquatic habitat is dominated by glides, although riffles and pools are present in moderate amounts. The riparian revegetation area is 114 acres.

Restoration measures in this reach would include a large-scale riparian revegetation effort. Banks would be sloped back to a 2:1 or lower ratio on the inside of meander bends or wherever feasible. A minimum 50 to 100-foot wide buffer would be revegetated with native riparian species. In areas where native trees already occur, the area would be supplemented with underplantings of conifers and shrubs. Invasive vegetation would be removed. Large woody debris would be keyed into the banks where sloping actions are proposed. Fencing to prevent livestock access would occur as needed.

NF/SF Newaukum Confluence Connections and Wetland Creation. This site is located adjacent to the North Fork/South Fork Newaukum River confluence. The North Fork from the North Fork Road down to the confluence has only a sparse riparian zone (young alder and willows), but is primarily dominated by reed canary grass. The floodplain area on the right bank appears to be fallow, although it may be used for pasture later in the season. The South Fork has a moderately good riparian zone as does the main stem left bank downstream of the confluence. The water in the North Fork was turbid during the site visit in 2001 and the channel is incising to some extent. Substrate is small/medium gravel, but highly embedded. No large woody debris was observed. The site is approximately 31 acres.

Restoration measures at this site would include some minor excavation of the floodplain to ensure annual inundation, placement of large woody debris in the channel of the North Fork, South Fork and main stem, and replanting riparian vegetation in the floodplain area and a 50 to 100-foot wide buffer along the North Fork. Geomorphically, there are no issues with this project. Vegetation and large woody debris would stabilize the stream channel and banks.

Salzer Creek Revegetation and Wetland Creation, Chehalis Confluence. Salzer Creek runs through a narrow ditch lined primarily with reed canary grass with only a few sparse, immature willows, young alders and ash. The lower end is in the process of incising to meet the highly incised Chehalis River. Salzer Creek has severely degraded water quality and is on the 303(d) list for high temperatures and elevated levels of fecal coliform. Agriculture is the dominant land use and livestock access to the creek occurs frequently. An oxbow of the Chehalis River is located approximately 300 feet to the south of Salzer Creek at this site and has year-round water. The oxbow is currently connected to the main stem during 2-year events via a lower-lying swale (observed to be connected in winter 2001). The restoration area is 8 acres.

Restoration measures at this site would include excavating an upstream and downstream channel at both ends of the oxbow, which would provide a connection to Salzer Creek during normal winter/spring flows (November-June). Invasive vegetation would be removed, a 100-foot wide riparian buffer would be established around the new channels and wetlands, and large woody debris would be placed in Salzer Creek, the main stem, and the oxbow. The buffer would extend from the main stem, around the wetlands and oxbow to Airport Road, and up Salzer Creek to Airport Road. Small upland areas could be incorporated into the wetland to increase terrestrial habitat diversity.

Salzer Creek Reconnection and Wetland Creation, Frozen Foods Site. At RM 0.25 on Salzer Creek, just upstream of the railroad mainline crossing, the creek has been realigned in a series of 90º bends to run between two agricultural fields. The north side property (right bank) is used for disposal of frozen food liquid waste. The riparian zone on the upstream half of the property is approximately 50 feet wide, but the downstream half of the property has very sparse vegetation, primarily a few willows. Salzer Creek has been realigned to the property boundary and is essentially in a ditch. The creek approaches the railroad bridge at a sharp angle and may be causing erosion at the bridge. The water quality is very poor; high temperatures, turbidity, and fecal coliform are concerns.

Restoration measures at this site would include realignment of the creek through what appears to be the old meandering channel swale, excavation of the site to create a wetland and upland mosaic, placement of large woody debris in the channel and floodplain, removal of invasive vegetation, and revegetation of approximately 4 acres with wetland and riparian species. Although these measures result in a slight shortening of the creek length, the proposed location is more geomorphically stable and is likely the historic alignment. It will also eliminate a severe 90º turn occurring immediately upstream of the railroad bridge and reduce the need for future placement of riprap or other bank protection.

Salzer Creek Revegetation and Wetland Creation, RM 3.1. This site is located on Salzer Creek at approximately RM 3.1, upstream of and immediately adjacent to Centralia-Alpha Road, which crosses the creek and floodplain. Salzer Creek flows through pasture both upstream and downstream of Centralia-Alpha Road and has a very narrow or non-existent riparian zone for some distance (more than 1 mile in both directions). A mobile home park with about 50 to100 homes is located immediately downstream of the road in the floodplain. The dominant streamside vegetation is reed canary grass with a few sparse alders and Oregon ash. The creek is contained within an apparent ditch and the water was turbid and foamy, which typically indicate the presence of fine sediment runoff, nutrients and bacteria. Salzer Creek is listed on the 303(d) list for bacteria and high temperatures. There is a fallow field adjacent to the creek on its left bank upstream of the road. No cattle were observed in the creek at the site, but they were present in the creek approximately 1.5 miles upstream. Approximately 600 to 800 feet upstream of the road crossing, Salzer Creek enters some seasonal wetlands and no defined channel exists within the wetland. It is assumed that fish passage is not possible above this point. The floodplain currently receives overbank flows at a 2 to 5-year event. The site is approximately 28 acres.

Restoration measures at this site would include excavating a meandering low-flow channel through the wet meadow, excavation o wetland areas adjacent to the channel as needed for annual inundation, removal of reed canary grass and other invasive species, placement of large woody debris in the channel, and replanting approximately 28 acres with riparian and wetland species. The area would be fenced off from livestock as needed.

Salzer Creek Revegetation and Wetland Creation, RM 4.5. This site is located between the Proffitt Road crossings on Salzer Creek at approximately RM 4.5. The creek flow is ditched and runs through pastures with essentially no riparian buffer. Reed canary grass dominates the creek banks along the entire reach. Livestock were observed adjacent to and in the creek in the vicinity. Water quality was very poor based on visual observations. The site is approximately 17 acres.

Restoration measures at this site would include excavation of a meandering channel, excavation of a wetland complex adjacent to the channel, removal of reed canary grass and other invasive species, placement of large woody debris in the channel, and replanting of a 100-foot wide riparian zone on each bank. The area would be fenced off from livestock as needed. Figure 2.6 shows the area of proposed mitigation and some of the restoration sites.

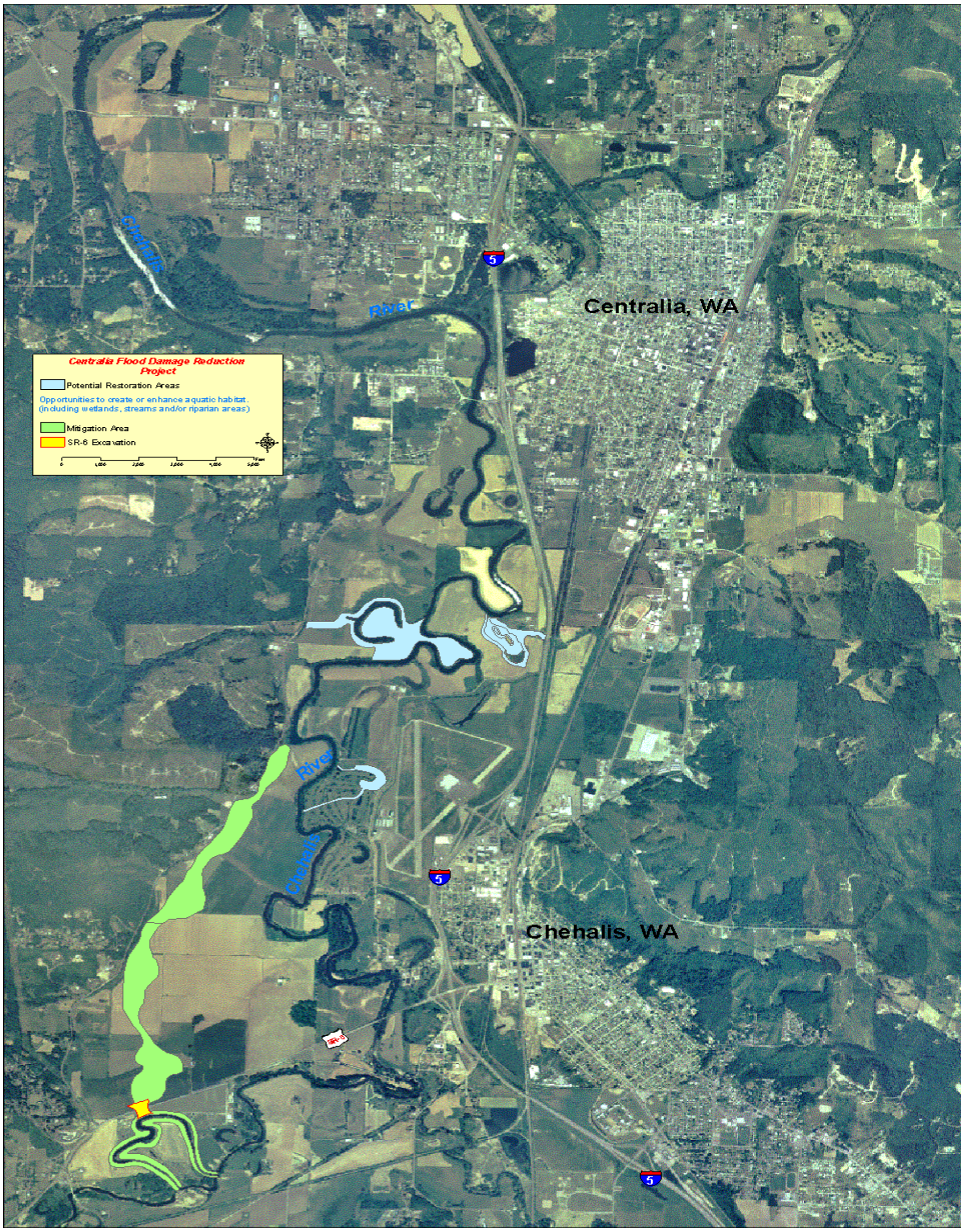


Figure 2.6 Mitigation area and some restoration areas.

3. AFFECTED ENVIRONMENT

3.1 Hydrology and Hydraulics

3.1.1 Introduction

The Chehalis River is approximately 125 miles long, originating in the Willapa and Doty hills southeast of Aberdeen and flowing northeast and then northwest before emptying into Grays Harbor. In addition to the Willapa and Doty hills, the basin uplands include the western flank of the Cascade Mountains and the southern Olympic Mountains. The entire Chehalis drainage basin has an area of approximately 2,114 square miles, with 1,294 square miles draining above the Chehalis River at Porter gage and 895 square miles draining above the Chehalis River at Grand Mound gage.

From its headwaters in the extreme southwestern corner of the basin, the Chehalis River flows east for about 25 miles to its confluence with the Newaukum River at Chehalis. From Chehalis, the river flows north to its confluence with the Skookumchuck River at Centralia. The Chehalis then flows generally north and west for about 50 miles to its mouth at Grays Harbor on the Washington coast.

The Chehalis River valley is characterized by a broad, well-developed floodplain and low terraces surrounded by highly dissected uplands of low to moderate relief. The valley bottom lies at an elevation of approximately 150 feet, and upland elevations average 300 to 600 feet. The higher elevations in the basin range from about 1,000 feet in the lowland hills to 2,658 feet at Capital Peak in the southern Olympic Mountains, to 3,110 feet in the Boistfort Hills in the southern portion of the basin, and 3,800 feet in the foothills of the Cascade Mountains east of Chehalis and Centralia.

3.1.2 Upper Chehalis River Basin

The slope of the upper Chehalis River is steep from its source to Chehalis, falling an average of 16 feet per mile. The slope flattens to about 3 feet per mile in the valley surrounding Chehalis and Centralia, where the river occupies a meandering channel. Downstream from Chehalis, the average width of the floodplain is 1.5 to 2 miles. The floodplain in this region shows little relief, which has resulted in a sinuous river course with numerous oxbow lakes and abandoned channels.

The upper Chehalis River has three main tributaries: the Skookumchuck River, Newaukum River, and South Fork Chehalis River.

3.1.2.1 Skookumchuck River

The Skookumchuck River originates in the Gifford Pinchot National Forest northeast of Centralia. It drains an area of approximately 181 square miles and flows into the Chehalis River at RM 67. The Skookumchuck River basin ranges in elevation from 160 feet at the mouth to 3,800 feet at the headwaters, with approximately two-thirds of the basin located below elevation 1,000 feet.

The basin has three distinctly different hydrologic regions, all of which are of approximately equal size. The region above Bloody Run Creek has a drainage area of 66 square miles, and is a steep, forested, mountainous area with elevations generally above 1,000 feet. In this region, the river flows through a steep-sided, narrow floodplain and drains into the reservoir behind Skookumchuck Dam. The region from Bloody Run Creek to the mouth of the Skookumchuck (excluding the Hanaford Creek drainage) has a drainage area of 56 square miles and contains a relatively broad floodplain bordered by steep-sided ridges. The slope of the river to the town of Bucoda is steep, falling an average of 19 feet per mile; below Bucoda, the slope flattens to about 5 feet per mile. Hanaford Creek, the largest tributary, has a drainage area of 59 square miles and enters the Skookumchuck River at RM 3.8.

The Skookumchuck River is regulated by the Skookumchuck Dam, which is owned and operated by Scottish Power (PacifiCorp). The dam is located at RM 21.9, just upstream from Bloody Run Creek. The dam, which was completed in 1971, is an earth fill structure approximately 190 feet high with a crest elevation of 497 feet. The primary purpose of the dam currently is to supply water for the Centralia coal-fired power plant, which has authority to divert up to 54 cfs of water from the Skookumchuck River. A portion of the water supplies a Washington Department of Fish and Wildlife (WDFW) fish rearing facility located approximately 0.5 mile below the dam.

Outflow from the reservoir is either over the spillway crest at elevation 477 feet or through the outlet works with intake gates at elevations 449, 420, and 378 feet. The discharge capacity is approximately 220 cfs when the pool elevation is at the spillway invert. Because of the limited outlet capacity, the reservoir typically fills early in the flood season and subsequent flood flows are passed over the spillway, which has a capacity of 28,000 cfs. The normal active storage capacity of the reservoir is 38,700 ac-ft between elevations 400 feet (normal minimum operating pool) and 492 feet (maximum operating pool). Additional usable storage of 3,170 acre-feet is available between elevations 378 feet (invert of the lowest intake) and 400 feet. Dead storage is approximately 1,420 ac-ft between elevations 340 and 378 feet. At the normal minimum operating pool elevation, the reservoir extends approximately 3 miles up the valley and covers an area of approximately 640 acres.

3.1.2.2 Newaukum River

The Newaukum River drains 175 square miles of lowland and foothills southeast of Chehalis and enters the Chehalis River at RM 75. Elevations in the Newaukum River basin range from 180 feet at the confluence to a little over 3,000 feet in the upper basin.

The Newaukum River is composed of the North, Middle, and South forks. Upstream portions of the North and Middle forks have slopes of 83 feet per mile; the South Fork has a slope of 188 feet per mile above the town of Onalaska. The average channel slope for the entire Newaukum River basin is 35 feet per mile. The Newaukum River has no dams and is free flowing from its head to the confluence with the Chehalis River.

3.1.2.3 South Fork Chehalis River

The South Fork Chehalis drains 130 square miles and joins the mainstem Chehalis River at RM 86. The lower South Fork Chehalis Basin (up to RM 9) consists of a broad, flat valley with small streams draining the hills on either side. From RM 9 to RM 15, the valley narrows from 1.5 miles to 0.75 mile in width.

3.1.2.4 Other Tributaries

China Creek is a relatively small, short stream that flows through Centralia to the Chehalis River. Its watershed encompasses approximately 6 square miles, draining an area that ranges in elevation from 180 feet to 570 feet. Much of the watershed is moderately steep. Most of the channel consists of pipes and culverts where the stream runs through Centralia.

Salzer Creek flows into the Chehalis River from the east, just south of the Centralia city limits. Salzer Creek originates in the low-lying hills east of Centralia and Chehalis and drains an area of 24.5 square miles. The watershed has a maximum elevation of approximately 800 feet.

Dillenbaugh Creek also enters the Chehalis River from the east, at Centralia. It originates in the steep foothills southeast of Chehalis, and drains an area of approximately 15 square miles. The gradient of Dillenbaugh Creek in its upper reaches is steep, falling at about 70 feet per mile. After the stream flows out onto the Newaukum River floodplain, the gradient drops as Dillenbaugh Creek parallels the Newaukum and Chehalis rivers for nearly 3 miles before entering the Chehalis River. The lower reaches of Dillenbaugh Creek collect much of the storm drainage from the City of Chehalis.

3.1.3 Climate

The study area has a predominantly marine climate characterized by mild temperatures both summer and winter. Extreme temperatures are unusual for the area because prevailing westerly winds bring maritime air over the basin and provide a moderating influence throughout the year.

During the spring and summer, high-pressure centers predominate over the northeastern Pacific, sending a northwesterly flow of dry, warm air over the basin. The dry season extends from late spring to midsummer, with precipitation generally limited to a few light showers during this period. Average summer temperatures are in the 50s and 60s (°F), although hot, dry easterly winds that occasionally cross the Cascade Mountains can raise daytime temperatures into the 90s.

In fall and winter, strong winds and heavy precipitation occur throughout the basin. Storms are frequent and may continue for several days. Successive secondary fronts with variable rainfall may move onshore daily or more often. Heavy rainfall frequently is produced by these storms when warm, saturated air rises over the coastal range and west slopes of the Cascades.

The Centralia-Chehalis area receives moderate to heavy rainfall when storms move onshore and through the basin. Normal annual precipitation at Centralia is 41.6 inches, with 77 percent falling during the period October through March.

Snowfall in the region is generally low. The average annual snowfall is approximately 9 inches, with a recorded extreme maximum of 45 inches. Most of the snowfall occurs in January, with an average of about 4.5 inches.

Precipitation totals at Centralia for the ten largest one-day, two-day, and three-day storms of record are shown in Table 3.1-1:

Table 3.1-1: Precipitation Totals Ranked for 10 Largest Storms at Centralia.

One-Day Storm		Two-Day Storm		Three-Day Storm	
Month & Year	**Total Precip. (in.)**	**Month & Year**	**Total Precip. (in.)**	**Month & Year**	**Total Precip. (in.)**
Jan. 1990	4.13	Nov. 1986	6.09	Nov. 1986	6.49
Nov. 1990	3.96	Dec. 1933	5.10	Feb. 1996	6.40
Dec. 1933	3.95	Feb. 1996	5.02	Jan. 1990	5.87
Nov. 1986	3.22	Jan. 1990	4.96	Dec. 1933	5.49
Oct. 1942	3.22	Nov. 1990	4.82	Dec. 1937	5.41
Feb. 1996	3.34	Nov. 1932	4.02	Nov. 1990	5.25
Feb. 1951	3.15	Feb. 1951	3.84	Nov. 1932	4.47
Nov. 1932	3.07	Oct. 1942	3.59	Feb. 1951	4.22
Dec. 1937	2.10	Dec. 1937	3.58	Oct. 1942	4.20
Jan. 1972	1.95	Jan. 1972	3.13	Jan. 1972	3.64

Source: USACE, 1997

3.1.4 Stream Flow Characteristics

3.1.4.1 Stream Gage Stations

Table 3.1-2 summarizes information for stream gages maintained by the U.S. Geological Survey (USGS) in the upper Chehalis River basin. In addition to the USGS stream gage stations, the National Weather Service (NWS) maintains wire weight stage gages at the Mellen St. and Pearl St. bridges. These gages are used by NWS for flood forecasting and warning.

Table 3.1-2: USGS Stream Gages.

Station Name	Station ID	Drainage Area (Sq. Mi.)	River Mile	Record Period
Chehalis River near Doty	12020000	113	101.8	1939-Present
Elk Creek near Doty	12020500	46.7	2.5	1942-1970
S.F. Chehalis River near Boistfort	12020900	44.9	8.0	1965-1980
S.F. Chehalis River at Boistfort	12021000	48	6.0	1942-1965
Chehalis River near Chehalis	12023500	434	77.5	1929-1931
M.F. Newaukum River near Onalaska	12024000	42.4	8.0	1944-1971
N.F. Newaukum River near Forest	12024500	31.5	6.5	1960-1966
Newaukum River near Chehalis	12025000	155	4.1	1929-1931 1942-Present
Salzer Creek near Centralia	12025300	12.6	3.9	1968-1971
Skookumchuck River near Vail	12025700	40	28.8	1967-Present
Skookumchuck River near Centralia	12026000	61.7	21.0	1929-1969
Skookumchuck River below Bloody Run Creek	12026150	65.9	20.7	1969-Present
Skookumchuck River near Bucoda	12026400	112	6.4	1967-Present
Lincoln Creek near Rochester	12027000	19.3	9.0	1942-1950
Chehalis River near Grand Mound	12027500	895	59.9	1928-Present

Source: U.S. Geological Survey

3.1.4.2 Runoff

Stream flow generated within the Chehalis River basin originates primarily from rainfall, although snowmelt occasionally augments runoff in the highest elevation reaches. Stream flows in the basin show seasonal variation characterized by sharp rises of short duration from October through March, corresponding to the period of heaviest rainfall. After March, flows tend to decline gradually to a relatively stable baseflow, which is maintained from July into October. The average annual discharge of the Chehalis River at its mouth and at the USGS stream gage near Grand Mound is estimated to be 6.4 million ac-ft and 2.0 million ac-ft, respectively.

3.1.4.3 Historical Floods

Major flooding occurs during the wet season, usually from November through February. Storms that cover the entire basin can cause widespread flooding. Flooding may also be localized; for example, storms centered over the Willapa Hills can cause flooding in the upper Chehalis River, whereas those centered over the Black Hills and Cascade foothills may result in flooding in the Skookumchuck and Newaukum River Basins.

The largest flood discharge on the Chehalis River in the Centralia-Chehalis area recorded in the last 70 years occurred in February 1996. Table 3.1-3 summarizes the largest floods of record in the basin since 1971:

Table 3.1-3: Ten Largest Floods on the Chehalis, Skookumchuck, and Newaukum Rivers since 1971.

Gage	Chehalis River near Grand Mound			Skookumchuck River near Bucoda			Newaukum River near Chehalis		
Date	Stage (ft.)	Disch. (cfs)	Rank	Stage (ft.)	Disch. (cfs)	Rank	Stage (ft.)	Disch. (cfs)	Rank
Feb. '96	20.04	74,900	1	17.87	9,370	1	13.34	13,800	1
Apr. '91	17.66	42,800	7	16.82	7,860	5	12.07	9,210	7
Nov. '90	18.12	48,00	5	17.23	8,400	3	12.73	10,300	4
Jan. '90	19.34	68,700	2	17.33	8,540	2	12.75	10,400	3
Nov. '86	18.41	51,600	3	15.01	5,770	10	12.76	10,700	2
Dec. '77	16.79	36,500	10	16.18	7,170	6	12.49	10,300	5
Dec. '75	17.73	44,800	6	15.42	6,110	8	10.85	8,020	10
Jan. '74	16.88	37,400	9	15.30	5,950	9	11.17	8,440	8
Jan. '72	18.21	49,200	4	16.82	8,190	4	12.12	9,770	6
Jan. '71	17.29	40,800	8	15.82	6,630	7	11.99	8,390	9

Source: USACE, 1997

Brief descriptions of the three most recent, largest floods in the Centralia-Chehalis area (the January 1990, November 1990, and February 1996 floods) are provided below.

January 1990 Flood

The January 1990 flood was primarily the result of a series of back-to-back storms accompanied by heavy rainfall over the 8-day period January 3-10 (Hubbard 1991). The storm system was quite complex and included high winds and strong surges of precipitation. During the 8-day period, 8 inches of rain were recorded at the Centralia climatological station maintained by NWS. This represents 19 percent of the average total yearly precipitation recorded at that station. The most intense precipitation in the basin occurred near the headwaters of the Skookumchuck and Newaukum Rivers.

The surges in precipitation resulted in more than one flood peak in many of the basin's streams, and streams did not return to baseflow between storm surges. The early precipitation saturated soils in the basin and significantly increased the flooding potential when the heaviest rains arrived on January 9. Peaks of record, up to this event, were recorded at the Chehalis River gaging stations near Doty, near Grand Mound, and at Porter. These flood peaks were estimated at the time as the 100-year flood.

November 1990 Flood

Above average precipitation in October and early November resulted in saturated soils that contributed to the flooding potential when a major storm arrived during the period November 21-25 (Hubbard 1994). Wet weather accompanied by cool temperatures in the first part of November lowered snow levels to approximately the 1,000-foot elevation. The Cascade foothills received 6 inches of snow at elevations of 1,000 to 2,000 feet, 12 inches at 2,000 to 3,000 feet, and 12 to 18 inches at 3,000 to 4,000 feet. As a warm front moved through western Washington on November 21, the snow changed to rain, and rising temperatures caused melting of snow up to elevations of 5,500 feet. Over the next three days, intense rain fell on drainages where streams were beginning to swell from snowmelt, and severe flooding followed. Floodwaters receded when a cold front moved that into the area on November 26 lowered freezing levels and diminished precipitation. These flood peaks were estimated at the time as the 75-100 year event.

February 1996 Flood

To date, the February 1996 flood is the flood of record on all the major drainages in the Chehalis River basin. By February 5, soils throughout the basin were at or near saturation from above average precipitation that had fallen in the preceding weeks (USACE 1996). A recent cold snap had caused snow to fall as low as the 500-foot elevation. Warm, moist subtropical air being transported from the Pacific Ocean caused freezing levels to rise above 8,000 feet and resulted in warm, moist rains on the snow pack in the foothills.

A strong, polar jet stream extending into the central and western Pacific Ocean sustained and strengthened storms as they moved into the area off the eastern Pacific. An atmospheric blocking pattern caused stationary major troughs and ridges around the Northern Hemisphere. The Pacific Northwest was situated between a trough to the west and a ridge to the east, creating a condition for weather systems to be at maximum strength when they reached the area. The atmosphere remained in this general pattern for at least 96 hours, during which large amounts of rain fell and quantities of water were released from the snow pack as stream flow. These flood peaks were estimated at the time as another 100-year flood.

3.2 River Geomorphology

3.2.1 Physiography

The Chehalis River Basin is unique in western Washington. It has the largest drainage area of all rivers on the west slopes of the Cascade Range. In addition, it does not adjoin the crest of the range, and contains very little high elevation terrain. Hence, snowmelt plays only a small role in its runoff patterns. Rather, the basin responds directly and relatively quickly to rainfall events, the largest of which occur typically in the fall and early winter months.

The core of the study area (RM 67 to 75) is also unique in that several streams (the Newaukum River, Dillenbaugh and Salzer Creeks, and the Skookumchuck River) converge within a 10-mile reach of the mainstem. Several smaller tributaries also join the mainstem in the core study reach.

3.2.2 Geomorphology

3.2.2.1 Floodplain Characteristics

The Chehalis River has a gradient of about 3 feet per mile in the valley surrounding Centralia and Chehalis, where the mainstem has a meandering channel that occupies a fairly uniform floodplain averaging over 1 mile wide. Most of the valley becomes inundated during large-sized flood events (PIE 1998).

From Chehalis to Montesano, the average width of the floodplain is about 1.5 to 2.0 miles. Surficial sediments within the floodplain attain a maximum depth of 100 feet.

Glancy (1971) estimated the mean annual suspended sediment of the Chehalis River mainstem near Grand Mound at about 150 tons per square mile, and 98 tons per square mile for the mainstem near Porter. The Black River is the main tributary between Grand Mound and Porter, and joins the Chehalis River upstream from Oakville; however, Glancy affirms that the Black River contributes little runoff and sediment to the mainstem. The suspended sediment load passing Grand Mound appears to generally exceed that at Porter during periods of high runoff. Glancy also observed a general decrease in average particle size from Doty to Porter, which may indicate that (1) the proportionate suspension of fine sediment increases in a downstream direction, (2) more of the coarser material moves as bedload past the stations near Grand Mound and at Porter, or (3) individual particle abrasion in a downstream direction effectively decreases average particle size.

Geologic evidence indicates that the Chehalis River has reworked its valley since the deposition of sand and gravel outwash derived from alpine glaciers. This sand and gravel forms the older river terraces that line the valley margins. This timeline would make the recent river deposits less than 7,000 to 10,000 years old. Conditions of the canyon wall imply a mature topographic landscape prior to river sedimentation. This type of landscape would contribute to the long-term, slow aggradation by the river system with deposition of fine sand and some fine gravel, but a predominance of silt, clay, and organic mud. Mapping of the Centralia-Chehalis area by the Natural Resources Conservation Service (formerly Soil Conservation Service) confirms that at least 50 percent of the deposits in the upper 5 feet of the valley sediments are organic mud, silt, and plastic clay.

The Secretary of War (1890) describes the navigability of the Chehalis River from Claquato (upstream from Centralia at RM 82) to its mouth. The mainstem is described as a river that becomes progressively shallower and increasingly blocked by snags and fallen trees in the upstream direction. From Elma to Claquato, “the river is practically blockaded during the summer and fall by snags, shoals, and a general lack of water; at this time the river is a succession of shoals and pools” (Secretary of War 1890, p. 2,984), many of which were recorded as shallow as 6 to 12 inches in depth. The GLO Survey Plat records provide additional accounts of numerous side channels, sloughs, and ponds hydrologically connected to the Chehalis mainstem, the Newaukum, and the Skookumchuck rivers (GLO 1833-1860).

3.2.2.2 Natural Influences

Most of the major physiographic features of the Chehalis River basin were likely in existence before Quaternary time (i.e., 1.6 million years before present) (Glancy 1971). The basin is underlain by a variety of lithologic units that reflect the area’s complex geologic history. The principal units are igneous and sedimentary rocks of Tertiary age (the Tertiary period ranges from 66 million years to 1.6 million years before present) and unconsolidated deposits of Quaternary age; in most places bedrock is deeply weathered, with a soil mantle of varying thickness. The dense natural vegetation of the region generally protects the soil from sheet and rill erosion; however, mass-wasting processes supply large quantities of material to the stream channels for subsequent removal (Glancy 1971).

During Quaternary time, alpine and continental glaciation and eustatic changes in sea level exerted major influences on rivers located north of the basin, such as the upper reaches of the

Wynoochee River, Satsop River, and Cloquallum Creek basins (Glancy 1971). However, the basin was mostly unaffected by glaciation except for areas in the upper South Fork Newaukum River and in the Skookumchuck basin downstream from the Skookumchuck Dam (Huntting et al. 1961). The Puget Lobe of the Cordilleran Ice Sheet reached its maximum southerly extent at Centralia. Glacial outwash terraces can be observed in and around Centralia, and some are exposed along the banks of the Skookumchuck and Chehalis rivers, particularly downstream from RM 67 on the Chehalis.

Soils of the area are fine-grained and deep, primarily due to the extensive weathering when developed on bedrock, and due to deposit thickness when developed on alluvium (Evans and Fibich, 1987). Soils in the uplands are typically well drained, whereas those in the low-lying areas such as floodplains are poorly drained.

The climate in the basin is characterized by warm, wet winters and cool, dry summers. Partly due to topographic controls, a variable weather pattern within the basin results in precipitation that ranges from an average of less than 45 inches per year near Chehalis to an average of more that 120 inches per year in the upper reaches of the Chehalis River. The hydrology of the basin is described in detail in section 3.1.

3.2.2.3 Human Influences

The basin has experienced various forms of development since the mid-19th century. These include extensive logging, diking, road building, damming, grazing and other agriculture, and construction in general.

The Secretary of War's (1890) plan to improve the navigability of the Chehalis River included the removal of snags, overhanging trees, log jams, drift heaps, shoals, and other obstructions to navigability. In one year (1887), 293 large snags were removed from the main channel, beginning at Claquato and ending near Oakville (approximately 16 miles), and masses of log drifts and log jams were loosened or burned (Secretary of War 1887). The practice of removing woody obstructions continued for decades through this reach for purposes of floating logs generated by timber operations (Secretary of War 1892; Wendler and Deschamps 1955).

The earliest logging dams were built in the 1880's and construction of these dams continued through the 1920's. Splash dams were built on Elk Creek, Hope Creek, Chehalis River, South Fork Chehalis, Deep Creek, and the Skookumchuck River. The length of time that the dams remained in the streams ranged from less than one to more than 50 years, with an average of about 20 years. All splash dams were removed, washed out, or burned prior to 1944 except for one splash dam that remained intact on Elk Creek at least through 1955 (Wendler and Deschamps 1955). Splash dams were intentionally destroyed to carry logs downstream, a process termed "splashing." This process significantly affected channel dynamics. The floods of logs and water scoured or moved gravel bars, leaving only barren bedrock or heavy boulders (Wendler and Deschamps 1955). New channels were created in some areas and the geometry (width, depth, cross-section shape) of existing channels was modified. Splashing generally occurred on the average of once each week, but could occur as often as once a day.

If the sudden influx of logs into a stream below the splash dam caused a log jam, dynamite or black powder was used to clear the obstruction (Wendler and Deschamps 1955). Natural log jams were removed in the process as well. Extensive log jams on the mainstem were also removed in the mid-1800s to aid navigation. The lack of log jams and the scour from splash dams has resulted in a simplified stream system in which water and sediment are routed downstream much faster than before logging occurred.

Although much of the study area retains a rural character, the core of the study area has been extensively developed. The cities of Centralia and Chehalis occupy portions of the floodplain, and supporting infrastructure crosses the river and portions of the floodplain, as well as tributaries, and portions of their floodplains. Most of the floodplain is currently used for pasture and growing crops. There is a small amount of impervious surface in the low-lying portions of the floodplain.

3.2.2.4 Channel Pattern and Behavior

Between the confluences with the Newaukum and Skookumchuck Rivers, the Chehalis River is meandering, with a sinuous, single-thread channel and a wide floodplain. As measured from USGS 7.5' topographic maps, the sinuosity of the core reach is 1.95 (river length/valley length), whereas the reach immediately downstream from the Skookumchuck mouth has a sinuosity of 1.70. The lower 4 miles of the Newaukum have a sinuosity of 1.39, and the lower 4 miles of the Skookumchuck have a sinuosity of 1.51. Logjams provide an important mechanism in creating and maintaining multi-thread channels. In the absence of a large sediment load, the removal or loss of large woody debris (LWD) jams eliminate this mechanism for forming new side channels and can lead to the abandonment of existing side channels as the main channel incises and flattens over time.

Channel sinuosity is not so much a driver of channel processes as it is a result of those processes. Sinuosity is most closely related to channel gradient and sediment characteristics. Flatter channels that transport predominantly sand or fine-grained material tend to be more sinuous than steeper channels that transport gravel-dominated sediment. Oxbows are remnants of multi-thread channels or portions of the main channel abandoned as the river avulses to new locations. Primary mechanisms that can drive the formation of multi-thread channels and oxbows include high sediment loads that divert out of the channel through aggressive deposition and large accumulations of LWD that can divert flow onto the floodplain and form new channels.

Numerous oxbows are present in the core reach, although they are less common in the reaches above, below, and in tributaries. No recent meander cutoffs are present. In fact, a particularly narrow meander bend showed virtually no change during the last 50 or so years based on a comparison of aerial photographs taken over that time. The gradient of the core reach is 0.027 percent, meaning that it is gentler than reaches above, below, or in the tributaries (Table 3.2-1). The floodplain is wide, flat, and very gently slopes down valley. In contrast, the floodplain upstream on the Chehalis is narrower and steeper. Downstream from the confluence with the Skookumchuck, the gradient is somewhat steeper, and the bed material is much coarser, including cobbles and gravel.

Table 3.2-1: Comparison of Key Geomorphic Indicators.

Reach	Sinuosity (dimensionless)	Gradient (%)	Mean particle size of grab samples (mm)
Chehalis, RM 67-75	1.94	0.027	0.22
Chehalis, RM 62.5-67	1.70	0.067	30.5
Newaukum, RM 0-4	1.39	0.106	No data
Skookumchuck, RM 0-4	1.57	0.145	33.0

The spatial patterns of the channels in the study area may be a result of a change in substrate related to the Pleistocene glaciation of the area. The change in sinuosity and gradient coincides with the edge of glacial outwash deposits from the Puget Lobe. The transition from fine (sand and smaller) bed and bank material to coarse material (sand, gravel, and cobble) is abrupt. The river may not be able to transport the larger clasts, and this may be responsible for the inflection in the channel profile just downstream from the Skookumchuck confluence.

Based on aerial photograph analysis, the plan form pattern of the Chehalis River has been remarkably stable during the last 50 years, with maximum observed lateral migration of approximately 10 meters in one location, and smaller amounts of localized migration in a few other areas. Oxbows and other abandoned channel features visible in 1949 photos remain visible in 1999 photos, although these features have grown slightly smaller and more disconnected from the main channel, apparently through sediment deposition. The river formed no new abandoned channel features within the core area over the 50-year period of record. There are only four significant sediment bars within the core study area. Sediment bars were visible throughout the period of record in the same locations and showed no discernible change in size. These features were generally narrow and limited in extent. Sediment composition on these bars was predominantly sand and silt with small amounts of gravel (less than 1 inch diameter). The sediment characterization includes sediment samples from these bars that provide quantitative size distribution data (see Section 3.2.2.5).

Although the Chehalis River has changed little in 50 years, the Newaukum and Skookumchuck rivers have experienced changes that are more obvious. A portion of the Skookumchuck River was relocated at the time I-5 was constructed, and the location of the Skookumchuck River confluence has changed as a result. Channel migration on the Newaukum River has occurred within the first 5 miles above the confluence with the Chehalis River.

Channel cross-sections of the Chehalis appear to be relatively stable as well. However, throughout the study area, there are continuous sections of riverbank hundreds of meters in length with bare soils, or with slight vegetation cover, indicating active erosion. This is in apparent contradiction to the aerial photograph observations, and suggests recent erosional events. The recent series of peak flows during the 1990s (see Section 3.1) may be partly responsible for the raw banks. The channel has a low width to depth ratio (less than 10), and is incised into the floodplain. The removal of woody debris appears to be the cause of the incision. However, if incision has occurred, the gradient has likely increased within the core reach. The gradient of the pre-settlement Chehalis River would have been even gentler than it is now.

The height of the riverbank above the water surface decreases progressively downstream between the Newaukum River confluence and the Skookumchuck River confluence. Field investigations conducted by the Corps 2001 showed that the bank height above water surface decreased from about 26 feet (typical) to 16 feet (typical) in this reach. Reported river stage at USGS gaging station 12027500 “Chehalis River at WWTP at Chehalis, WA,” at the time of observation indicates that short-term changes in river stage do not account for this observation.

At approximately RM 72.3, floodwaters have recently flowed out of the channel and scoured vegetation and soil from the riverbank and floodplain.

3.2.2.5 Sediment Characteristics

The Corps 2001 conducted sediment sampling to collect information on the sediment load carried by the Chehalis. A grain size analysis indicates that within the core reach, sand and silt dominate the bed material. However, at the lower end of the study area (approximately RM 62-67), the riverbed is dominated by gravel and cobbles. The average particle size of grab samples taken from sediment bars in this reach was 1.2 inches, which is two orders of magnitude greater than within the core reach.

Sediment samples collected along the Skookumchuck River at Rotary Riverside Park in Centralia contained mostly gravel and some small cobbles. The average particle size of all samples on the Skookumchuck was 1.3 inches, similar to the lower reach of the Chehalis.

Bank material within the core reach of the Chehalis is composed predominantly of fine sand and silt. One sample taken from an actively eroding bank was composed almost entirely of fines (97 percent), whereas another bank sample had an average particle size of 0.9 inch.

3.2.2.6 Large Woody Debris

Evidence from the Queets River provided by Abbe (2000) indicates that woody debris jams historically formed an integral element in large alluvial channels flowing through forested lands in western Washington. In particular, Abbe found that LWD jam formation is a principal mechanism that controls reach-level habitat diversity through the formation of scour pools, bars, in-channel islands, and riparian forest refugia. LWD jams may act as local hydraulic controls over several decades and possibly centuries.

The accounts provided by the Secretary of War and the GLO support the premise that LWD strongly influenced the geomorphic processes in the floodplain areas of the basin. The systematic removal of LWD and the removal of riparian vegetation have very likely changed the channel processes in these systems.

Although it almost certainly played an important role in channel form prior to settlement, there is a noticeable absence of LWD in the channel today. No debris jams or significant accumulations of LWD were observed in any of the study area reaches. This suggests that the supply of LWD is extremely limited. In the core reach, there are a few places with LWD that may be recruited into the channel. Additionally, the tributaries appear to lack the transport capacity to supply significant amounts of LWD to downstream reaches.

As described previously, analysis of aerial photographs indicates that channel migration has proceeded slowly over the past 50 years, and no new oxbows or other channel cut-off features have been formed during that period. Based on estimated sediment accumulation rates and the observed shrinking of the oxbows observed on the floodplain within the core reach, these cut-off features can be interpreted as young features that probably formed within the past few hundred years. These observations, combined with the documented removal and reduction of LWD within the study area, support the hypothesis that logjams drove the process of channel avulsion and oxbow formation, and this process has now been interrupted and discontinued due to the lack of LWD to support this process. The lack of LWD jams in recent years has reduced the length and area of side channels, decreased overall channel length, and allowed the channel to incise.

3.3 Water Quality

3.3.1 Regulatory Background

Water quality in the upper Chehalis River basin is governed by the Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201A) (WDOE, 1997). State water quality standards designate most of the upper basin as Class A (excellent). Class A waters must meet or exceed the requirements for all or substantially all uses as defined by the water quality standards. Characteristics of Class A uses include water supply (domestic, industrial, and agricultural); fish and fish rearing, spawning, and harvesting; wildlife habitat; recreation; and commerce and navigation. Water quality criteria for Class A waters are presented in Table 3.3-1. The water quality standards also identify special conditions, which relax certain criteria for the mainstem Chehalis River near Centralia and Chehalis.

Table 3.3-1: Class A Freshwater Quality Criteria.

Parameter	Criteria
Fecal Coliform	Shall not exceed a geometric mean value of 100 colonies/100mL and no more than 10% of all samples with a geometric mean value exceeding 200 colonies/100mL
Dissolved Oxygen	Shall exceed 8.0 mg/L[a]
Dissolved Gas	Shall not exceed 110% of saturation
Temperature	Shall not exceed 18.0°C due to human activities. When natural conditions exceed 18.0°C, no temperature increases will be allowed which will raise the receiving water temperature by greater than 0.3°C.
pH	Within the range of 6.5 to 8.5 with a human-caused variation of less than 0.5 units
Turbidity	Shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10% increase in turbidity when the background turbidity is more than 50 NTU.
Toxic, Radioactive, or Deleterious Material	Concentrations shall be below those, which have the potential to adversely affect characteristic water uses.
Aesthetic Values	Shall not be impaired by the presence of materials or their effects, which offend the senses of sight, smell, touch, or taste.

3.3.2 Existing Conditions

The primary water quality problems in the upper Chehalis River basin are high temperature, fecal coliform, high pH, and low dissolved oxygen (DO). Water body segments that do not meet state surface water quality standards and are included in the final 1998 Section 303(d) Impaired Water Body List are presented in Table 3.3-2. The Washington Department of Ecology (Ecology) maintains ambient monitoring stations on the mainstem Chehalis (RM 101.7 to RM 59.9) and near the mouths of a number of tributaries, including the South Fork Chehalis, the Newaukum, and the Skookumchuck rivers. Recent water quality data are presented in Table 3.3-3.

Upstream from Centralia, the Chehalis River is a relatively shallow and swift-moving stream. However, in the Centralia reach (RM 65.8 to RM 75.2), the river channel deepens, and stream velocities decrease substantially. The Centralia reach is a natural sill in the river more similar to a reservoir or lake than to a river. Temperature stratification is established during summer months, which leads to higher surface temperatures and prohibits mixing between stratified layers (Pickett 1994). Additionally, oxygen depletion occurs with depth. This naturally slow-moving reach has merited separate criteria for DO and temperature for part of the year. The criteria for this reach include a special condition stipulating that DO shall exceed 5.0 mg/L from June 1 to September 15 and temperature shall be between 18 and 20.4 °C.

Table 3.3-2: Water Bodies on the Final 1998 303(d) List.

WATERBODY SEGMENT	SEGMENT NAME	SEGMENT BOUNDARY DESCRIPTION	PARAMETERS
WA-23-1010	Chehalis River	Porter Creek (RM 33.3) to Scammon Creek (RM 65.8)	Fecal Coliform, Temperature
WA-23-1020	Chehalis River	Scammon Creek (RM 65.8) to Newaukum River (RM 75.2)	Fecal Coliform, Temperature, PCB-1254, PCB-1260
WA-23-1023	Salzer Creek	Mouth at Chehalis RM 69.4 to headwaters	Fecal Coliform, Temperature
WA-23-1027	Dillenbaugh Creek	Mouth at Chehalis RM 74.5 to headwaters	Fecal Coliform, Temperature
WA-23-1030	Skookumchuck River	Mouth at Chehalis RM 66.9 to headwaters	Fecal Coliform, pH, Temperature
WA-23-1070	Newaukum River	Mouth at Chehalis RM 75.2 to headwaters	Fecal Coliform, Temperature
WA-23-1100	Chehalis River	Newaukum River (RM 75.2) to Rock Creek (RM 106.7)	Fecal Coliform, Temperature
WA-23-1102	Stearns Creek	Mouth at Chehalis RM 78.1 to headwaters	Not listed
WA-23-1104	Bunker Creek	Mouth at Chehalis RM 84.8 to headwaters	Not listed
WA-23-1106	South Fork Chehalis River	Mouth at Chehalis RM 88.3 to headwaters	Temperature
WA-23-1108	Elk Creek	Mouth at Chehalis RM 100.2 to headwaters	Fecal Coliform
WA-23-1019	Lincoln Creek	Mouth at Chehalis RM 61.9 to headwaters	Fecal Coliform, Temperature

Table 3.3-3: Ambient Monitoring Water Quality Data (from Michaud *et al*. 2000).

River Mile	Location	Temp (°C)		DO (mg/L)		TP (mg/L)		NH_3 (mg/L)		NO_{2+3} (mg/L)		TSS (mg/L)		FC[2] (cfu/100 mL)	
		Avg	max	avg	min	avg	max	avg	max	avg	max	avg	max	avg	max
Mainstem															
101.7	@ Dryad	10.3	24.5	11.1	8.0	.03	.36	.01	.08	.30	.96	26	782	33	2800
77.7	@ Claquato [1]	10.2	20.1	10.2	7.5	.09	.41	.02	.04	.46	.87	20	102	61	730
67.5	@ Centralia	12.1	21.3	9.7	5.4	.08	.38	.06	.58	.48	1.1	16	109	47	1000
59.9	@ Prather Road	11.2	22.1	10.0	7.2	.06	.14	.03	.12	.59	.86	15	118	37	1500
Tributaries															
3.0	@ South Fork Chehalis	9.5	17.5	10.5	8.0	.05	.08	.02	.05	.56	.77	14	80	117	540
0.1	@ Newaukum	10.8	17.2	10.6	8.7	.03	.05	.02	.03	.61	1.60	27	90	78	760
2.3	@ Skookumchuck	10.6	16.9	10.3	9.1	.04	.14	.02	.07	.54	1.48	8	43	41	960

[1] *Sampled only in 1970s*
[2] *Fecal coliform is calculated as a geometric mean value.*

A Total Maximum Daily Load (TMDL) study conducted by Ecology in 1991 and 1992 found that the upper Chehalis River had problems with low DO from RM 90.0 downstream, elevated temperature from RM 100.5 downstream, and high fecal coliform over the entire stretch with most of tributaries sharing these problems (Pickett 1994). The highest temperatures measured in the upper Chehalis River basin were in the slow-flowing Centralia reach (Pickett 1994). Furthermore, the Class A criterion of 8.0 mg/L was met in less than half of the measurements made from the surface to 2 meters deep. During the summer months (when the special criterion of 5.0 mg/L was in effect) all measurements were above this criterion level; however, in waters 2 meters and deeper, the criterion was met only 70 percent of the time for regular conditions and 40 percent for special condition periods. Downstream from the Centralia reach, from the confluence with Scammon Creek (RM 65.8) to RM 59.9, water quality problems are mainly high temperatures and low DO.

Because of the low elevation, warm summer water temperatures may have been historically present in much of the Chehalis watershed; however, human activities have led to widespread riparian vegetation loss, reduced shading levels, and floodplain isolation contributing to increased water temperatures (Wampler *et al.* 1993). Floodplain isolation results in the loss of wetland and groundwater discharge, hindering the creation of localized areas of cool water habitat available to aquatic organisms. Additionally, the lack of LWD results in a homogeneous riverbed that reduces water penetration into the riverbed. This results in a reduction in intersubstrate flow that creates cooler, oxygenated water in deep pools. Livestock impacts (livestock access and poor livestock waste handling practices) are the primary suspected non-point source of fecal coliform bacteria and pollutants that cause low DO, although commercial and residential sources such as urban storm water and failing septic systems are also possible contributors (Pickett 1994).

3.3.3 Pollutant Loading Sources

Pollutant loading sources to the Chehalis River system include both point and non-point sources. Point sources are discharges regulated under the federal and state National Pollutant Discharge Elimination System (NPDES). The NPDES permit program is designed to protect the quality of receiving waters from various pollutant sources. The program includes permits for municipal wastewater discharge, industrial wastewater discharge, and stormwater discharge during construction and operation of development projects.

A number of facilities in the study area discharge as point sources under the NPDES program. These facilities include municipal wastewater treatment plants (WWTP) at Pe Ell, Chehalis, and Centralia, and one industrial WWTP, WestFarm Foods, which discharge treated wastewater directly to the mainstem Chehalis River. National Frozen Foods and Midway Meats are facilities regulated under State Waste Discharge Permits for land application of wastewater. These operations apply wastewater on fields that border the Chehalis River and Salzer Creek (Pickett 1994).

The WestFarm Foods and Chehalis WWTP’s have a significant influence on the water quality of the Chehalis River due to their location at the head of the Centralia reach (Pickett 1994). The National Frozen Foods spray irrigation system was the source of a major wastewater spill to Salzer Creek in 1979 that caused an extreme DO drop in the Chehalis River. A low-DO event in October 1991 was attributed to an upset at a permitted wastewater treatment facility at the head of the Centralia reach, and to non-point sources, most likely in the Stearns Creek basin or on the mainstem Chehalis River upstream from the Newaukum River and below Adna (Pickett 1994).

Additionally, the Chehalis WWTP raises the level of nitrogen in the river by two to six times the level upstream of the plant.

Currently, the Centralia WWTP discharges effluent into the Chehalis River at the Centralia reach, where natural conditions cause low, slow-moving flows, and high water temperatures in the summer (City of Centralia 1999). The Centralia WWTP has experienced a number of minor permit violations since August 1995 related to effluent concentrations of total suspended solids (TSS), biochemical oxygen demand (BOD), and fecal coliform (Pickett 1994). Centralia is proposing to construct a new regional WWTP with a discharge point downstream from the existing WWTP.

Recognized non-point sources of pollution in the upper basin include agricultural and forest practices; commercial, industrial, and residential development; urban stormwater runoff; land disposal of industrial waste, solid waste and residential sanitary waste; failing septic systems; and groundwater discharge (Pickett 1994). Land use within the upper basin is dominated by forestlands (82.7 percent) and logging activities in these areas can contribute suspended solids to the streams. Although agriculture represents only about 10 percent of the land use in the watershed, agricultural activities (primarily field crop production and animal pasturage) typically occur adjacent to the river corridor and contribute fecal coliform, dissolved oxygen demand (DOD) and nutrients, such as phosphorus and nitrogen, to the mainstem Chehalis River and many of the tributaries (Michaud *et al.* 2000).

3.3.4 Chehalis River TMDLs

Federal law requires states to identify sources of pollution in waters that fail to meet state water quality standards, and to develop TMDLs for addressing those pollutants. The TMDL process is established by Section 303(d) of the Clean Water Act (CWA), and TMDLs are based on the total amounts of a pollutant a water body can receive from all sources and continue to meet water quality standards. Once the TMDLs for a specific water body are determined, the allowable pollutant quantities (calculated on a per-day or a per-liter basis) are divided among the existing dischargers.

As noted earlier, Ecology conducted a TMDL study to evaluate water quality in the upper Chehalis River (Pickett 1994). Over the 1991-1992 period, several surveys in the study area were conducted during the dry season (May to November). Past studies have documented areas of low DO during the summer in the Centralia reach. The Chehalis River and tributaries were evaluated for loading sources and other physical, chemical, and biological river conditions that contribute to the oxygen deficit.

The results of these surveys indicated that widespread thermal stratification occurs in the Centralia reach during the summer months. In deeper waters, hypoxia and anoxia were associated with the thermal stratification. DO was repeatedly below water quality criteria in the surface waters and the tributaries of the Chehalis River. Additionally, violations of both the temperature criterion of 18.0°C and the fecal coliform bacteria criterion were also found in the mainstem Chehalis River and its tributaries. The study found that almost two-thirds of the measurements in the Centralia reach exceeded the temperature criterion for Class A water quality standards during the dry season.

The TMDL for DO approved by Environmental Protection Agency on October 21, 1996 restricts the discharge of BOD material to the upper Chehalis River from May 1 to October 31 each year. In the case of Chehalis and WestFarm Foods, the waste load allocation for the Centralia reach during the May 1 to October 31 period was reduced to zero pounds BOD and ammonia. This TMDL was revised in response to a settlement of legal action initiated by the City of Centralia, the City of Chehalis, and WestFarm Foods (Jennings and Pickett 2000). The revised TMDL modifies the seasonal restrictions on the pollutant discharge for each plant based on river flows, and requires that each plant discontinue direct discharge to the Centralia reach at low flows. Three sets of final limits were developed based on the flow rate of the river: “dry-weather” flows, “very low” flows and “wet-weather conditions.” During periods when the river flow drops below the specific thresholds, the waste load allocations for Chehalis and WestFarm Foods remain the same as in the TMDL previously approved by the EPA. However, when river flows are above those low-flow thresholds, Chehalis and WestFarm Foods are allowed to discharge to the river within the Centralia reach at levels that protect water quality standards for DO.

As part of a 1997 agreement with Ecology, the City of Centralia proposes to move and expand the Centralia WWTP. The proposal involves moving the discharge point downstream from the Skookumchuck River confluence and upgrading treatment technology to improve the quality of the discharge (City of Centralia 1999).

A temperature TMDL for heat caused by solar radiation has been submitted to EPA for the upper Chehalis River basin (Butkus and Jennings 1999). Under Section 502(6) of the CWA, heat is considered a pollutant. The TMDL study indicates that heat generated by solar radiation from sunlight reaching streams provides enough energy to raise water temperatures. Very low-elevation streams are known to be the most dependent on shade to limit temperatures, and the Chehalis River basin has been affected by reduced tree canopy on over 90 percent of the mainstem. Anthropogenic activities, which have contributed to degraded riparian vegetation conditions, include agricultural and silvicultural activities, as well as residential and urban development. Instream flow and channel morphology are additional factors that influence heat distribution. Low flows may contribute to high temperatures by reducing the volume of water that can absorb incoming heat and channel morphology may influence heat distribution. With increased sediment loads, stream channels may become wider and shallower, allowing more thermal radiation to be absorbed by the water surface.

3.3.5 Tributaries

3.3.5.1 Bunker and Stearns Creeks

Although neither Bunker nor Stearns Creek was included in the final 1998 Section 303(d) list for impaired water bodies, water quality problems have been observed in these streams. Exceedances of temperature, DO, and fecal coliform criteria have been observed in Stearns Creek and observed DO levels have been consistently depressed below the 8.0 mg/L criterion during summer months in Bunker Creek (Pickett 1994).

Land use in the subbasin is primarily forestland (81 percent) with 17 percent agricultural and less than 1 percent residential and urban development. Sources of nutrient loading (primarily phosphorus, as Bunker and Stearns Creeks are nitrogen limited) are primarily agricultural (Michaud *et al*. 2000). A survey by the U.S. Fish and Wildlife Service (USFWS) found an estimated 26 percent of stream miles on these streams that were degraded by livestock access and impact and other pollutant inputs (Wampler *et al*. 1993).

3.3.5.2 Dillenbaugh Creek

Dillenbaugh Creek was included in the final 1998 Section 303(d) impaired waterbody list for fecal coliform and temperature. Two reaches were listed for fecal coliform and two reaches were listed for both fecal coliform and temperature. Previous surveys of the creek reveal a wide variety of point and non-point sources of pollution that contribute to water quality degradation (Crawford 1987; Pickett 1992 and 1994). High fecal coliform levels are most probably due to farming activities, such as livestock impacts and a dairy feedlot, although failing or inadequate septic systems adjacent to the creek may also contribute to the problem. Industries in the

Chehalis Industrial Park may contribute to temperature violations. Additionally, an urban storm sewer was found to be the source of several contaminated discharges (Pickett 1992).

This creek also has relatively high turbidity, (TSS), BOD, total organic carbon (TOC), total phosphorus (TP), and total nitrogen (TN) (Pickett 1994). Urban stormwater discharges to Dillenbaugh Creek have been identified as a potential contributor to the high pollutant levels. Another possible source of pollution is the American Crossarm and Conduit (ACC) Superfund site adjacent to the creek. ACC was formerly a wood-treating facility that is now heavily contaminated with pentachlorophenol (PCP). The Remedial Investigation (RI) for the site (Weston 1991) found PCP levels in Dillenbaugh Creek as high as 19 ug/L during the spring of 1991. Additional site improvements have been made at ACC since 1991 as part of an emergency remediation, and levels of PCP have dropped to below established water quality criteria with acute toxicity not appearing to be present (Pickett 1994; Marti 2001).

3.3.5.3 Elk Creek

Previous studies indicate good water quality in Elk Creek with temperature, pH, and DO all within water quality criteria. The exception to this is fecal coliform bacteria (Pickett 1994). One reach of Elk Creek was included in the final 1998 Section 303(d) impaired waterbody list for fecal coliform concentrations. Livestock access and potentially inadequate septic systems may be sources of elevated fecal coliform, TP, and BOD concentrations (Pickett 1994; Wampler *et al.* 1993). The Elk Creek subbasin is dominated by forestland (98.4 percent) with some logging and agricultural activities (0.6 percent of land use) (Michaud *et al.* 2000).

3.3.5.4 Lincoln Creek

The 1991-1992 Ecology survey observed DO consistently below 6.0 mg/L, temperatures above 18.0°C, turbidity and TOC relatively high; the two fecal coliform analyses both well above water quality criteria (Pickett 1994). Lincoln Creek is included in the final 1998 Section 303(d) list for fecal coliform concentrations and temperature. A USFWS degradation survey identified livestock access, livestock waste inputs, and other pollutant sources at numerous locations (Wampler *et al*. 1993).

3.3.5.5 Newaukum River

Although previous surveys indicated mostly good water quality (Pickett 1994), water quality in the Newaukum River basin is degraded and the Newaukum is included in the final 1998 Section 303(d) list for temperature and fecal coliform concentrations. Elevated coliform bacteria levels were associated with the wet season and were not observed during the TMDL study, which was conducted during the dry season (Pickett 1994; Michaud *et al.* 2000).

Ambient water quality data for temperature, DO, pH, TP, inorganic nitrogen, TSS, and fecal coliform for the 1992-1993 water years are presented in Table 3-3.3. While the average TP concentrations were at the lower end of the range for tributaries, inorganic nitrogen concentrations averaged highest in the Newaukum at 0.61 mg/L, although still less than background concentrations of 0.8 mg/L (Michaud *et al.* 2000).

Agricultural activities (17 percent of land use) are likely sources of high inorganic nitrogen yields. Extensive stretches of reduced stream canopy observed between the confluence of the North and South Forks and the mouth of the Newaukum contributes to high temperatures (Michaud *et al.* 2000; Wampler *et al.* 1993).

3.3.5.6 Salzer Creek

Salzer Creek has been the focus of several water quality investigations. In 1979, low DO was observed in the Chehalis River. The source of the problem was identified as the failure of a food processing wastewater pipe leading to a spill in Salzer Creek. The wastewater was to have been land applied on fields adjacent to Salzer Creek by the National Fruit Canning Company (now owned by National Frozen Foods and currently holding a Washington State Discharge Permit to land apply food processing wastewater). In 1986, Ecology conducted a survey of the creek to identify point and nonpoint sources in the drainage and impacts on water quality (Crawford 1987). Low DO and high fecal coliform levels were observed as the main water quality problems. The causes cited were poor farm management practices and leachate infiltration from the Centralia Municipal landfill (currently undergoing corrective action as a federal Superfund site).

Subsequent surveys have found Salzer Creek to be heavily affected by several sources, including stormwater runoff from a drainage sump at the Southwest Washington Fairgrounds (suspected as a contributing source of high nutrients, fecal coliform and low DO), urban and residential sources, livestock activities, and possibly other unidentified sources (Pickett 1994). Salzer Creek was included in the final 1998 Section 303(d) impaired waterbody list for fecal coliform and temperature. Approximately 3 percent of the Salzer Creek basin has been developed for urban, commercial and industrial uses; agricultural uses comprise 12.9 percent; and forestlands dominate the subbasin at 83.9 percent.

3.3.5.7 Skookumchuck River

The Skookumchuck River is the only tributary in the study area for which flows are largely regulated by reservoir releases. Hanaford Creek, a major tributary of the Skookumchuck River, is the site of an open-pit coalmine and power plant. The Skookumchuck River is included in the final 1998 Section 303(d) list for fecal coliform concentrations, pH, and temperature. Land use in this subbasin is dominated by forestlands (86.5 percent), with agricultural activities representing 7.5 percent, commercial and industrial representing 2.4 percent, and urban development representing only 1.4 percent of land use.

During the 1991 survey, temperatures were above 18°C on several occasions and DO was always above the criterion of 8.0 mg/L. Hanaford Creek water temperatures were above 18°C on one of three sampling dates, and DO fell below 6.5 mg/L on one of three sampling dates. Conditions in the Skookumchuck River above Hanaford Creek were similar to conditions at the mouth of the river, with temperature elevated on one of three dates and DO consistently high; however, pH was much higher at the mouth and Pickett (1994) suggests a source in this stretch of the river. Overall, the data indicated that water quality was generally quite good, with turbidity, BOD, TOC, nutrients and chloride all detected at relatively low levels. Hanaford Creek has slightly higher levels than the Skookumchuck for all parameters except inorganic nitrogen.

The Skookumchuck Dam and reservoir, located about 12 miles northeast of Centralia at Skookumchuck RM 21.9, were constructed in 1969-1970 to supply cooling water to the coal-fired Centralia steam electric power plant. An instream flow agreement between PacifiCorp and Washington Department of Fish and Wildlife requires that instream water temperatures be maintained at 10˚ to 13˚C. The dam has a multi-level intake system located at elevations 449, 420 and 378 feet (between 28 and 100 feet below the water surface) that allows water temperature below the dam to be maintained at less than 16˚C. When the reservoir drops below full pool and ceases spill, the water is then drawn from lower outlet gates, which lowers water temperatures in the stream below the dam. Currently, dam operations result in summer water temperatures at or below 13˚C.

3.3.5.8 South Fork Chehalis River

The South Fork Chehalis River is included in the final 1998 Section 303(d) list for exceeding the state water quality criterion for temperature. This subbasin is predominantly forestland (89 percent) with some agricultural activities (9.5 percent).

Previous studies have identified widespread water quality impacts. The USFWS survey identified pollutant inputs in over 15 separate locations, and documented riparian canopy loss over approximately one-third of the river miles and cattle access in over 21percent of the river miles in this subbasin (Wampler *et al.* 1993). The Ecology TMDL study indicated temperature and fecal coliform as water quality problems (Pickett 1994). There are numerous dairies in the South Fork basin and agricultural practices may be a source of fecal coliform, high TP, inorganic nitrogen, and TSS yields (Pickett 1994).

3.3.6 Groundwater

The Centralia area contains one large aquifer (the Fords Prairie aquifer), created by glacial outwash from the north along Waunch and Fords Prairies. The aquifer supplies all domestic water use for Centralia and is classified as a critical aquifer. Domestic water supply comes from several wells throughout the City service area. The total source capacity for the wells is 7,178 gallons per minute (gpm). If a shortage of water occurred due to an extensive drought, the City could draw up to 3,125 gpm from the Newaukum River.

In 1990, the Lewis County Environmental Health Department completed a groundwater study along Fords and Waunch Prairies and found that the underlying aquifer contained elevated levels of nitrates caused by an unknown number of failing septic tanks. In addition, a contaminant plume of tetrachloroethylene (PCE) approximately 1.5 miles long was discovered through routine, required testing for volatile organic compounds. A dry cleaning operation near the Trailer Village Mobile Home Park located near Harrison Avenue and Russell Road was closed approximately 12 years ago and since then, several wells within the trailer park and nearby homes were found to have elevated levels of PCE, ranging from 60 parts per billion (ppb) to 125 ppb. The Safe Drinking Water Act allows a level of 5 ppb. The PCE plume also contaminated a City well referred to as Eshom well located near Galvin Road and Eshom Road. The Eshom well is now closed and the trailer park is currently serviced with municipal water and sewer.

Dangerous levels of toxic chemicals contaminate two separate aquifers in the Chehalis area. Near the City of Chehalis, at the intersection of Hamilton and LaBree Roads, PCE is present in a shallow aquifer and affects two small public water systems and at least one private well. PCE concentrations are as high as 3,000 ppb in the drinking water supply and 36,000 ppb in the groundwater. This area of contamination is now a federal Superfund site.

Another shallow aquifer south of the Chehalis area is contaminated with several industrial chemicals. Contamination by halogenated organics and non-halogenated solvents has been confirmed in ground water under the Lewis County Central Shop at Forest, at the intersection of Jackson Highway and Forest-Napavine Road. Contamination of drinking water by petroleum is suspected at this location. Elevated levels of solvents have also been detected in off-site domestic wells.

3.4 Biological Resources – Vegetation, Wetlands and Riparian Areas

3.4.1 Vegetation

The study area is located in the Puget Trough physiographic province described by Franklin and Dyrness (1973). This consists of lowland areas within a moderate climate. Pre-European settlement vegetation consisted of evergreen forests dominated by western hemlock (*Tsuga heterophyla*), western red cedar (*Thuja plicata*) and Douglas fir (*Pseudotsuga menziesii).* The river valleys likely supported riparian gallery forests dominated by black cottonwood (*Populus balsamifera*), big-leaf maple (*Acer macrophyllum)*, western red cedar, Oregon ash (*Fraxinus latifolia*) and red alder (*Alnus rubra*). Parts of the study area also support native prairies on the glacial outwash plains (i.e. Fords Prairie and Grand Mound). Typical native prairie vegetation consisted of Idaho fescue (*Festuca idahoensis*) and white aster (*Aster curtus*). Wetlands were also common, including peat systems around the northern boundaries of the study area. Typical wetland vegetation likely consisted of multiple species of rushes (*Juncus spp.*), sedges (*Carex spp.*) and willows (*Salix spp*.). Other typical wetland plants would have likely included hardhack (*Spiraea douglasii*), red-osier dogwood (*Cornus stolonifera*), and salmonberry (*Rubus spectabilis*). Typical vegetation communities found are described below:

3.4.1.1 Forested Deciduous Community

This community is generally found near or adjacent to the major rivers and streams and is typical of riparian communities in the Puget Trough physiographic province. These can be either wetland or upland forests. The predominant canopy species are generally black cottonwood with patches of red alder, big leaf maple and Oregon ash or Oregon white oak (*Quercus garryana*).

The understory can include snowberry (*Symphoricarpos albus*), red-osier dogwood, and Indian plum (*Oemleria cerasiformis*).

3.4.1.2 Coniferous Forested Community

Coniferous forests are found in the highland and/or well-drained portions of the study area. Many of these have been in forest production and rotation and are either second- or third-growth forests. Typical community dominants include Douglas fir, western hemlock, and western red cedar. Common understory species include salmonberry, vine maple (*A. circinatum*), and salal (*Gaultheria shallon*)

3.4.1.3 Mixed Forested/Scrub-Shrub – Forest Dominant Community

This community is characterized by approximately 60 percent forest and can either be wetland or upland forests. The forest includes the deciduous and coniferous trees listed above. The understory species are highly variable and can include willows, Oregon ash, Pacific ninebark (*Physocarpus capitatus*), red elderberry (*Sambucus racemosa*), Indian plum, and Nootka rose (*Rosa nutkana*). Invasions of blackberry (*R. procera and R. lacinatus*) may also occur in the understory and in disturbed areas of the other community types as well.

3.4.1.4 Mixed Forested/Scrub-Shrub – Scrub Dominant Community

This community can either be wetland or upland scrub-shrub communities. Common shrubs of this community include red-osier dogwood, willows, snowberry, and bald-hip rose (*Rosa gymnocarpa*). Black cottonwood usually predominates but other tree species found in this unit may include bitter cherry (*Prunus emarginata*), black hawthorn (*Crataegus douglasii*) and Scot's broom (*Cytisus scoparius*).

3.4.1.5 Emergent Community

This community is most common in the study area and consists of wetland and upland pasture, upland prairie, and emergent wetlands. Emergent vegetation includes typical pasture grasses such as reed canarygrass (*Phalaris arundinacea*), bluejoint (*Calamagrostis canadensis*), red fescue (*F. rubra*), tall fescue (*F. arundinacea*), velvet grass (*Holcus lanatus*) and bentgrass (*Agrostis spp*.). Cattail (*Typha latifolia*), sedges, rushes are occasionally found in the emergent wetlands as well as the grass species listed above.

Priority plant communities within the study area are wetlands and riparian areas, as described below:

3.4.2 Wetlands and Riparian Areas

Wetlands (along with other waters of the United States) are those areas specifically administered by the Corps and the (EPA) under the Clean Water Act. The following wetland definition was used for determining and mapping the wetlands within the study area:

> "...those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." [33 CFR 328.3(b) and 40 CFR 230.3(u)]

The USFWS developed the following definition for a riparian classification system in the western United States. This definition was used for determining and mapping riparian areas within the study area:

> “Riparian areas are plant communities contiguous to and affected by surface and subsurface hydrologic features of perennial or intermittent lotic and lentic water bodies (rivers, streams, lakes, or drainage ways). Riparian areas have one or both of the following characteristics: 1) distinctly different vegetation species than adjacent areas and 2) species similar to adjacent areas but exhibiting more vigorous or robust growth forms. Riparian areas are usually transitional between wetlands and uplands.” (USFWS 1998)

The following discussion on wetlands and riparian areas is separated by those systems associated with the Chehalis (which includes the Newaukum River, Black River, Scatter Creek, Scammon Creek, Dillenbaugh Creek, Salzer Creek, Coal Creek, China Creek, Lincoln Creek, and numerous small drainages within the Chehalis River valley) and the Skookumchuck River (which includes Hanaford Creek and Coffee Creek). The reason for this distinction is the different hydrological and geomorphological characteristics of each river that have influenced the extent and characteristics of wetlands and riparian areas associated with them.

3.4.2.1 Chehalis River Wetlands and Riparian Areas

Chehalis River ecosystems are a remnant of a once extensive system of braided channels, wetlands, and riparian areas across a broad floodplain. The river was an extremely dynamic system that carried a high load of organic materials (wood and other debris) with shifting channels. The wetland and riparian plant communities probably supported many of the same species found in the remnant systems today: shrub-shrub and emergent wetlands with evergreen and deciduous wetland and riparian areas along the higher flood terraces. These communities would be typical of a braided river system with frequently shifting stream channels. Functions associated with the historic wetlands would have included habitat for aquatic invertebrates, anadromous and resident fish habitat, wildlife habitat, export of organic matter, and biodiversity. Because of the dynamic nature of the riverbed (rapid erosion and sedimentation), plants found in this environment were likely to be highly adaptable and highly productive as primary producers. This would result in a rich food web supporting invertebrates and vertebrates. The Chehalis River system was likely a rich source of food for a vast variety of both fish and wildlife species. The richness of cultural resource sites around the study area (see Section 3.14) indicates the river was also an important source of food and materials for Native Americans.

Euroamerican settlement brought dramatic changes to the system. Agricultural development resulted in the clearing and draining of all but the most difficult to access or drain wetland systems. Large areas of riparian forests were also cleared. As described in Section 3.2, LWD jams historically were the principal mechanism that controlled river habitat diversity through the formation of scour pools, bars, in-channel islands, and riparian forests in the Pacific Northwest (Abbe 2000).

The historic records support the premise that LWD strongly influenced the hydrologic characteristics of the Chehalis floodplain areas of the basin. The removal of wood and the clearing of riparian vegetation have very likely changed the channel dynamics in this system. The mainstem appears to be undergoing a long-term trend of channel entrenchment since presettlement conditions, which likely began with the regular removal of woody debris. Woody debris removal resulted in concentrating river flow into one main channel. River transport of logs from logging operations also created conditions that further favored processes of entrenchment. Lastly, bank protection measures prevented (and continue to prevent) the mainstem from adjusting to flow events though channel changes.

Historic actions changed the Chehalis River wetland characteristics by reducing both the frequency and duration of low intensity flood events and by decreasing the ability of wetlands to store water. Draining wetlands and channelizing the river system decreased the ability of the entire system to store water (flood retention, ground water discharge), to augment low flows and reduce summer temperatures (discharge cooler groundwater during the summer drought months) and to reduce the peak of flooding events. The Chehalis River system also lost biodiversity due to the loss and/or degradation of habitat and the loss and/or degradation of connectivity between habitats.

The impacts of the historic actions include loss of population and/or population isolation of many species (both plant and animal), loss of primary and secondary productivity, loss and/or degradation of fisheries habitat, loss of flood storage and low flow augmentation, and loss of biodiversity. Today, however, the Chehalis River ecosystem is still a relatively extensive complex of emergent, scrub-shrub and forested wetlands and riparian areas, as well as large area of agricultural wetlands that are actively cultivated during the spring and summer months. Much of the agricultural area of the floodplain has subsurface tiles and ditches to facilitate drainage. Some of the ditches and drains were successful in converting wetland areas into uplands, whereas other systems have failed, resulting in maintenance of wetland hydrology. The extent of either situation is difficult to determine without supporting field observations, although the Soil Survey for Lewis County (USDA 1987) has mapped large units of hydric soils throughout the study area, including the areas currently under cultivation.

Interspersed with the wetland complexes are equally large areas of well-drained soils. This complex variety of soils is a result of the glacial-fluvial history of the area, which was historically part of a broad glacial outwash plain and is currently part of an active floodplain.

The Chehalis River wetlands are supported by a combination of high seasonal water tables, periodic flooding, and seasonal ponding. Those areas directly adjacent to the river probably experience both high seasonal water tables and periodic flooding. The areas away from the river likely are a result of high seasonal water tables and ponding.

The Chehalis River riparian areas are located in parts of the floodplain that are regularly inundated by floodwaters. Some of the riparian areas may also be wetlands, whereas others, located on the well-drained soils, are not inundated long enough to support wetland vegetation.

Functions likely provided by these wetlands include sediment and nutrient removal, peak flow reduction, baseflow support, shoreline stabilization, primary production and organic export, fish and wildlife habitat, and native plant richness. Functions associated with the riparian systems include habitat for passerine birds, small mammals, amphibians, LWD supply, and native plant richness.

Table 3.4-1 provides a summary of the acreage and type of wetlands and riparian areas found within the Chehalis River valley of the study area:

Table 3.4-1: Chehalis River Wetlands and Riparian Areas (in Acres) within the Study Area.

Forested Wetlands	Scrub-Shrub Wetlands	Emergent Wetlands	Riparian Areas
6,385	2,683	1,447	2,693

3.4.2.2 Skookumchuck River Wetlands and Riparian Areas

The historic impacts to the Skookumchuck River are less well documented than those to the Chehalis River. However, the position of the Skookumchuck River in the landscape and the Lewis County Soil Survey (including information on soil forming processes) indicate that historically the Skookumchuck River wetlands were not as extensive as those associated with the floodplain of the Chehalis River.

The confluence with Chehalis River, where the floodplain is the widest, likely supported the largest area of wetlands and riparian habitat along the historic Skookumchuck River. The existing river meanders suggest that this was an area of lower energy, which probably looked and functioned much like the historic Chehalis River in the same reach. Almost all of these wetlands and riparian areas were lost with the development of Centralia.

The Skookumchuck River probably also provided a source of LWD to the system, some of which was trapped with the construction of the Skookumchuck Dam. Although there are no specific records, it is also likely that historically this river system contained much more LWD and log jams than it currently does. These were probably removed to facilitate log transfer downstream, much like the work done on the Chehalis River.

Functions lost or degraded due to historic impacts of the Skookumchuck River include food chain support for invertebrates and vertebrates, sediment removal, shoreline stabilization, high biodiversity for both plants and animals, and high organic export.

The existing wetland systems associated with Skookumchuck River are not as large or diverse as those of the Chehalis River. The river floodplain is narrow and somewhat incised until it reaches the vicinity of Bucoda, where it broadens into its widest area at the confluence with Hanaford Creek and Centralia. Most of the area is in agricultural production, with the exception of the area within Centralia. Wetlands associated with this system are directly adjacent to the river or in the floodplain. This area does not contain extensive areas of hydric soils, which suggests that there may not have been extensive wetlands associated with the river above the confluence with Hanaford Creek. Hanaford Creek, in contrast, supports extensive emergent wetlands with extensive areas of mapped hydric soils (USDA 1987). Areas around the reservoir behind the dam are predominately rock vertical faced walls. There is a small area that could contain riparian habitat but would not be impacted if the water is stored during a flood event no longer than 5 continuous days.

The Skookumchuck River wetlands are supported by a combination of high seasonal water tables, periodic flooding, and seasonal ponding. Those areas directly adjacent to the river probably experience both high seasonal water tables and periodic flooding. The areas away from the river likely are a result of high seasonal water tables and ponding.

Like the Chehalis River systems, some of the riparian areas are also wetlands, whereas those found on well-drained soils are not. The riparian areas are found in parts of the floodplain that are regularly inundated.

Agriculture, logging, urban development, and the construction of Skookumchuck Dam have affected conditions in this reach of the Skookumchuck River. Agricultural development has changed the complexity and extent of wetlands as well as adjacent riparian forests. Urban development (mostly in Centralia) has resulted in the direct loss of wetlands and riparian areas and well as indirect impacts to the remaining habitats.

Functions likely provided by these wetlands include sediment and nutrient removal, peak flow reduction, baseflow support, shoreline stabilization, primary production and organic export, fish and wildlife habitat, and native plant richness. Functions likely provided by the riparian areas include habitat for passerine birds, small mammals, amphibians, LWD supply, and native plant richness.

Table 3.4-2 provides a summary of wetland and riparian acreage and type associated with the Skookumchuck River within the study area:

Table 3.4-2: Skookumchuck River Wetlands and Riparian Areas (in Acres) within the Study Area.

Forested Wetlands	Scrub-Shrub Wetlands	Emergent Wetlands	Riparian Areas
1188	612	90	81

3.5 Biological Resources – Wildlife

Wildlife populations in the study area consist primarily of species associated with open forest canopies and young vegetation. The climax deciduous forests associated with the pre-settlement era were removed in the 19th century, converting the hardwood wetland floodplain and lowland habitat of the study area into agriculture and timber production. As development of the area has increased, forested habitat in the riparian zone along the mainstem Chehalis and tributaries has been reduced to narrow strips. Near Centralia and Chehalis, wildlife populations are characterized by species associated with urban development. Species that are not tolerant of human activity no longer use those areas. This section describes the species and habitats known to be present, as well as the existing conditions of riparian habitat along the mainstem Chehalis River within the study area. A more comprehensive catalog of faunal groups within the study area is presented in Appendix A.

3.5.1 Existing Wildlife Habitat Conditions

Field studies were conducted in 2000-2001 for Lewis County to identify wildlife habitats in the study area (PIE 2001). Detailed discussion of the results of these studies is presented in Appendix A.

Wildlife habitat associated with the Chehalis River riparian and riverine areas was evaluated by examining the width of the existing riparian zone, the riparian vegetation species and their value to wildlife habitat, and wetlands associated with the riparian corridor.

The majority of the Chehalis River within the study area lacks riparian cover, and the riparian zones that are present average only 45 feet in width. Consequently, there has been a loss of habitat connectivity and instream temperature protection due to reduced riparian function throughout the study area. The dominant tree species within the riparian zones along the Chehalis River are black cottonwood and big-leaf maple, with an understory shrub layer of vine maple and willow. The majority of wetlands in the study area are emergent wetlands dominated by reed canary grass and other pasture-type grasses. The following overview of the existing riparian habitat conditions along the Chehalis River is based on observations made during the 2000-2001 field surveys.

From the confluence of the Chehalis River and Lincoln Creek upstream to the mouth of the Skookumchuck River, the habitat is dominated by hardwood riparian woodland with a secondary or shrub layer beneath. This hardwood riparian area averages 51 feet wide throughout this segment, largely because of the wetland areas located along the right bank. The dominant canopy species are black cottonwood and big-leaf maple, with vine maple and willow dominating the understory. Some areas along the left bank have reed canary grass beneath a narrow margin of cottonwoods. Cottonwood snags are prevalent throughout this reach. Beyond the riparian buffers, the area is developed into either pasture lands or residential and commercial properties.

From the mouth of the Skookumchuck upstream to the mouth of the Newaukum River, 30 percent of the riparian habitat has no vegetative cover. Big-leaf maple is the dominant canopy species on the remaining riparian habitat. Where a shrub layer exists, red-osier dogwood is dominant. Ground cover is dominated by reed canary grass and Himalayan blackberry. The average width of the riparian buffer, where present, is 35 feet in this reach. The adjacent oxbows are bordered by western red cedar with an understory of big leaf maple, red-osier dogwood, and Pacific willow (*S. lasiandra*), with reed canary grass beneath. LWD and snags are scarce; only one snag was observed in this entire section. Beaver, raccoon, and deer were observed throughout this section, and waterfowl utilize the oxbow ponds.

The section from the mouth of the Newaukum to approximately 5 miles upstream from the South Fork Chehalis River confluence contains dense stands of Himalayan blackberry and reed canary grass dominating the understory. Red alder and big-leaf maple are co-dominant in the overstory, and black cottonwood is sporadically present. The average riparian width is 42 feet in this section. There are emergent wetlands within the riparian buffer immediately adjacent to the river, with forested wetlands set back from the river. There are also areas devoted to agricultural use adjacent to the river. During the field surveys, waterfowl, otter, deer, songbirds, beaver and bald eagles were observed using these wetlands.

The remaining upstream portion of the Chehalis River within the study area has fewer riparian wetlands, yet the average width of the riparian buffer is 46 feet. Red alder and big-leaf maple with a red-osier dogwood and vine maple understory dominate the hardwood overstory. The valley bottom in this reach is narrower, with channel erosion evident along both banks and overhanging vegetation present. Snags and burrows were observed within this reach, with songbirds, deer, beaver, otter, coyote, and small mammals also evident. Significant portions of this valley are wetlands, but these areas are generally farmed and do not provide typical wetland functions.

Wildlife habitat has been reduced throughout much of the study area through depletion of riparian buffers and the loss of hardwood wetlands and off-channel areas as a result of agricultural, residential, and commercial development. This loss of quality riparian, wetland, and off-channel habitat and function limits the quantity and diversity of wildlife species present within the study area.

3.5.2 Priority Habitats

Priority habitat is defined by WDFW as those habitat types or elements with unique or significant value to a diverse assemblage of species. Priority habitat that was identified within the study area is described below.

3.5.2.1 Freshwater Wetlands

This habitat supports (at least periodically) hydrophytic plants, has a substrate that is predominantly undrained hydric soils that are saturated or covered with shallow water at some time during the growing season. Freshwater wetlands are located throughout the study area, with higher concentrations along the Chehalis and Skookumchuck rivers (PIE 2001).

3.5.2.2 Fresh Deepwater

These are habitats where hydrophytes are the dominant plants; however, the water in these areas is too deep to support emergent vegetation. This environment also includes all underwater structures and features such as caverns, woody debris, and rock piles. Fresh deepwater habitat is found in the Skookumchuck reservoir, as well as in several large ponds along the Skookumchuck and Chehalis rivers.

3.2.2.3 Cliffs

Cliffs are considered priority habitat if they are greater than 25 feet high and occur below elevation 5,000 feet. They must also contain high densities of wildlife breeding and nesting area to be classified priority habitat. Cliffs were observed along the banks of the Skookumchuck reservoir during the 2000-2001 field surveys (PIE 2001).

3.5.2.3 Instream

This habitat comprises the physical, biological, and chemical processes and conditions that interact to provide life history requirements for fish, wildlife, and invertebrate resources in a lotic environment. Instream habitat is found throughout the study area, and includes all the major rivers and their tributaries.

3.5.2.4 Mature Forest

This habitat type includes tree stands with average diameters exceeding 21 inches diameter at breast height (dbh). The density of trees, number of snags and quantity of large downed logs is generally less than that of old-growth forest. Stands of mature forest are found throughout the upper Newaukum, Skookumchuck, and Chehalis River Basins (PIE 2001).

3.5.2.5 Riparian Habitat

This habitat includes the area adjacent to streams and other water bodies, beginning at the ordinary high water mark and extending to the terrestrial areas that are influenced by, or directly influence, the aquatic ecosystem. These areas include the entire floodplain and riparian areas of wetlands that are directly connected to stream courses. Riparian habitat has been reduced throughout the study area and is now present only in narrow strips along the lower portions of the Skookumchuck, Newaukum, and Chehalis Rivers (PIE 2001).

3.5.2.6 Rural Natural Open Space

This habitat includes open space that (1) functions as a corridor connecting other priority habitats (especially areas that would otherwise be isolated), (2) is an isolated remnant of natural habitat larger than 10 acres surrounded by agricultural or urban developments, or (3) provides habitat for a priority species. This habitat must also contain unique species assemblages in agricultural or urban areas to be classified as a priority habitat. Most areas of open space habitat within the study area have been affected by agriculture or urban development and very few of these areas provide migratory corridors.

3.5.2.7 Talus Slopes

Talus slopes are a priority habitat if the rock rubble is homogenous, averages 0.5 to 6.5 feet in size, and is composed of basalt, andesite, and/or sedimentary rock. Mine tailings and riprap may also be included. One talus slope in the northeast corner of the Skookumchuck reservoir was identified during field surveys (PIE 2001).

3.5.2.8 Snags and Logs

Areas with abundant and well-distributed snags and logs are considered priority snag and log habitat. This habitat may consist of single snags or logs, or groups of snags or logs of exceptional value to wildlife due to their scarcity or location within the landscape. Snags must be greater than 20 inches dbh and 6.5 feet tall and logs must be greater than 12 inches in diameter at the largest end and at least 20 feet long in order to be classified as a priority habitat. Snags and logs are present in many locations throughout the study area, but in limited quantity. Reduced riparian buffers and the clearing of snags have depleted the sources of this habitat type within the study area.

3.6 Biological Resources - Threatened and Endangered Species

The following species appear on the List of Endangered and Threatened Wildlife and Plants, as authorized by the Endangered Species Act of 1973. These species have been identified as potentially occurring in the study area:

- Bald eagle (*Haliaeetus leucocephalus*) (threatened)
- Marbled murrelet (*Brachyramphus marmoratus*) (threatened) and designated critical habitat
- Northern spotted owl (*Strix occidentalis caurina*) (threatened) and designated critical habitat
- Coastal/Puget Sound population segment bull trout (*Salvelinus confluentus*) (threatened)
- Canada lynx (*Lynx canadensis*) (threatened)
- Gray wolf (*Canis lupus*) (endangered)
- Grizzly bear (*Ursus arctos*) (threatened)
- Kincaid's lupine (*Lupinus sulphureus kincaidii*) (threatened)
- Golden paintbrush (*Castilleja levisecta*) (threatened)

Candidate species:

- Oregon Spotted Frog (*Rana pretiosa*)
- Whulge's Checkerspot (*Euphydryas editha taylori*)
- Mardon Skipper (*Polites mardon*)

Federal species of concern include California wolverine (*Gulo gulo luteus*), Pacific fisher (*Martes pennanti pacifica*), western pocket gopher (*Thomomys mazama*), Pacific Townsend's big-eared bat (*Corynorhinus townsendii townsendii*), long-eared myotis (*Myotis evotis*), long-legged myotis (*M. volans*), western gray squirrel (*Sciurus griseus*), Northern goshawk (*Accipiter gentilis*), peregrine falcon (*Falco peregrinus*), olive-sided flycatcher (*Contopus cooperi*), Pacific lamprey (*Lampetra tridentata*), river lamprey (*L. ayresi*), Columbia torrent salamander (*Rhyacotriton kezeri*), Van Dyke's salamander (*Plethodon vandykei*), Larch Mountain salamander (*Plethodon larselli*), Cascades frog (*Rana cascadae*), tailed frog (*Ascaphus truei*), western toad (*Bufo boreas*), valley silverspot (*Speyeria zerene bremeri*), tall bugbane (*Cimicifuga elata*), white-top aster (*Aster curtus*), and pale larkspur (*Delphinium leucophaeum*).

Finally, several state-listed species of concern include the great blue heron (*Ardea herodias*), bufflehead (*Bucephala albeola*), wood duck (*Aix sponsa*), osprey (*Pandion haliaetus*), band-tailed pigeon (*Columba fasciata*), and western pond turtle (*Clemmys marmorata*). The Olympic mud minnow (*Novumbra hubbsi*) is a state candidate species.

3.6.1 Aquatic Species

Several of the species of concern are especially adapted for slack-water, muddy bottom conditions. These species include the Olympic mudminnow, Pacific and river lampreys, and western pond turtle. According to the WDFW Priority Habitats and Species (PHS) database, these species are found in ponds associated with low gradient streams (or along side channels or heavily vegetated banks of such streams), such as Hanaford Creek, Lincoln Creek, Bunker Creek, and Deep Creek. Western toad and Oregon spotted frog are found in shallow marshes, generally with stable water levels. The PHS database lists no western toads in the study area, and the Oregon spotted frog is known only from one location in the South Puget Sound region, in Thurston County, several miles from the study area. Western pond turtles are currently only known to occur in two locations in Washington, both near the Columbia River in Skamania and Klickitat counties. A small population has been introduced to a pond complex in Pierce County (WDFW 2002).

A few of the sensitive species listed for the study area are found almost exclusively in fast-moving, clear, cold-water streams. These species are the Columbia torrent salamander, Van Dyke's salamander, Cascades and tailed frog. These habitats do not occur along the mainstem Chehalis or lower reaches of the tributaries. Tailed frogs and Van Dyke's salamanders have been found in the Skookumchuck River and tributaries beginning about 5 miles upstream from the reservoir. Columbia torrent salamanders have been found about 10 miles southwest of the study area.

Amphibian and reptilian populations and distributions within the study area are poorly documented. The Washington State Gap Analysis Project (Dvornich *et al.* 1997) identified suitable habitat for amphibians and reptiles, then cross referenced these habitats with museum records and documented sightings. The results of the gap analysis, indicating habitat and recorded presence of amphibians and reptiles within the study area are included in Appendix A**.**

3.6.2 Terrestrial Species

3.6.2.1 Prairie Species

The Whulge's checkerspot, Mardon skipper, western pocket gopher, western gray squirrel, valley silverspot, white-top aster, and pale larkspur are all restricted to prairie habitats. Nearly all of the extant prairie habitats in the vicinity of the study area occur at Grand Mound Prairie. The Boistfort Prairie also supports the checkerspot and skipper, Kincaid's lupine and pale larkspur. The golden paintbrush is known to occur in only 5 sites as of 1981 (WDNR 1981). One of these sites was in Thurston County, presumably on Grand Mound Prairie. In the current Natural Heritage Database, the only extant population listed occurs in the Deception Pass area of Skagit County (WDNR 2002).

3.6.2.2 Species of Forested Habitats

Over 20 bald eagle territories are known to be in the study area (WDFW 2002), and individuals are often observed throughout the area during the winter. The primary prey base of these bald eagles is not known, but very likely includes anadromous fish returning to spawn, and waterfowl. It is possible that bald eagles in the study area supplement their diet with resident fish, carrion, rabbits, and other small mammals, as these are known food items in places where anadromous fish spawn and waterfowl are scarce (especially during the eagle nesting season). No communal night roosts are known to occur in the study area (WDFW 2002).

Bald eagle nest sites have been identified along the mainstem Chehalis River. Nest sites also occur along the upper Skookumchuck River, and along the Newaukum River. Most of these nests are in large cottonwood trees, although some are in spruce trees. Bald eagle nesting was observed in the vicinity of the Skookumchuck reservoir during field surveys conducted in 2000-2001 (PIE 2001).

The PHS database lists 4 observations of marbled murrelet flights within the study area. These do not necessarily reflect a nest location, but probably do indicate nesting activity somewhere nearby. All of these observations occurred west of the study area, and several miles south of the Chehalis River. There are no marbled murrelet observations within the Skookumchuck River Basin.

Suitable spotted owl habitat within the study area is limited due to extensive recent logging activities. The presence of mature forest is requisite to attract nesting pairs to the area. Only two spotted owl observations are known near the study area; both of these occurred several miles to the south and west.

The ranges of Canada lynx, gray wolf, and grizzly bear do not generally include the study area, although on occasion it may be possible for individuals to wander into the area. However, all three species are largely restricted to high elevations in the north Cascade Mountains in Washington, and are not expected to be found in the study area.

Other species restricted to forested landscapes include California wolverine, Pacific fisher, Pacific Townsend’s big-eared bat, long-eared myotis, long-legged myotis, northern goshawk, olive-sided flycatcher, tall bugbane, and band-tailed pigeon. Only tall bugbane is cited in the PHS database as occurring within the study area. Three discrete populations are noted in the area. Although observations of other species are not noted in the database, it is likely that the two species of myotis, the northern goshawk, the olive-sided flycatcher, and band-tailed pigeon are all found in areas that still support mature or successional-stage forests. According to the PHS database, a California wolverine was sighted in the area several years ago. However, this occurrence is regarded as highly unusual, since the normal habitat for wolverine is high elevation forests.

3.6.2.3 Species of Riparian Habitats

Four state-listed candidate species, the great blue heron, bufflehead, wood duck, and osprey, are found in riparian habitats within the study area. The bufflehead and wood duck are cavity nesters. The heron builds nests in colonies in living trees and the osprey selects large, dead snags for nesting. All of these require mature riparian forests to develop trees and snags large enough to support large nests and cavities. A few areas of mature riparian forest occur along the mainstem Chehalis and Skookumchuck Rivers. During the 2000-2001 field surveys, great blue herons were frequently observed in and along the Chehalis, Skookumchuck, and Newaukum Rivers. No great blue heron nesting was observed within the study area (PIE 2001). During the field surveys, osprey were observed in the Chehalis and Newaukum River basins and one pair of wood ducks was sighted in the Newaukum basin (PIE 2001).

3.6.2.4 Species of Other Habitats

The peregrine falcon nests on cliffs, or tall man-made structures, including high bridges, and typically forages over open spaces. No peregrine falcon nests are known in the study area (WDFW 2002). The Larch Mountain salamander is found almost exclusively on steep talus slopes, where the rocks range in size from 0.5 to 2.5 inches in diameter (WDFW 1993). One talus slope in the northeast corner of the Skookumchuck reservoir was identified during field surveys (PIE 2001), but no records of the Larch Mountain salamander in the study area were found in the PHS database.

3.7 Biological Resources – Fish

The study area provides a variety of aquatic habitat types, each inhabited by a discrete community of cold and warm water fishes. Although the study area remains relatively rural, agricultural activities, industrial development, and urban growth have resulted in stream segments with high sediment oxygen demand (resulting in low DO), high summer water temperatures, and suspended sediment and contaminants from upland runoff. Existing side channels, wetlands, and riparian habitats have also been affected by development. Flood control measures, including construction of levees, have also affected streams in the study area by removal of riparian vegetation and, in some cases, triggering channel incision. The mouths of some tributaries have been altered as a result. Although some historic environmental concerns (e.g., point-source pollution, floodplain construction) affecting stream habitats have been reduced markedly, mainstem habitats are still in limited supply and runoff from some upland areas still contains high levels of fecal coliform bacteria and other common contaminants. High water temperatures in the mainstem and some tributaries remain a concern.

The following section provides a description of the community structure and habitat utilization of fishes within the study area habitats.

3.7.1 Community Structure

The Chehalis River and its tributaries support many species of salmonids, including spring and fall chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), and chum (*O. keta*) salmon. Summer and winter steelhead (*O. mykiss*), rainbow (*O. mykiss*), and both sea-run and resident cutthroat trout (*O. clarki clarki*) are also present (WDF 1975). Although sockeye salmon (*O. nerka*) and pink salmon (*O. gorbuscha*) have been observed in streams in the lower Chehalis basin, it is thought that these fish are strays from other river systems and are not indigenous to the Chehalis River Basin (WDF 1975; WSCC 2001). Brook trout (*Salvelinus fontinalis*) have been introduced into some lakes and streams within the Chehalis watershed (Envirovision 2000). Little is known about the distribution and status of brook trout, but populations appear to be small.

The Chehalis River watershed probably represents the southern end of the range of anadromous bull trout/Dolly Varden trout (*Salvelinus confluentus/S. malmo*) on the west coast. In its final rule for determination of bull trout as a threatened species, USFWS noted that a subpopulation of native char was reported to occur in the Chehalis River/Grays Harbor basin (USFWS 1999). However, data confirming the presence of such a subpopulation are limited; very few native char have been collected during monitoring studies over the past 30 years. A single fish was captured in the Chehalis River at RM 50 in 1997 and another was captured near Oakville in 1973 (USACE 2001). During the 11-year period that WDFW has operated a smolt trap in the Chehalis River, only one char has been observed (in 1997) (WDFW 1998b). The Corps conducted a literature review of bull trout in the lower Chehalis River, which revealed few instances of bull trout in the study area (USACE 2001). Char do appear to utilize the tidally-influenced lower reaches of the Chehalis River, as evidenced by the capture of 7 sub-adult char in Grays Harbor in the winter of 2001 by R2 Resources, Inc. The origin of these fish is unknown. There are no confirmed genetic data to determine whether the captured char are bull trout or Dolly Varden trout.

The Chehalis River system also supports white sturgeon (*Acipenser transmontanus*), green sturgeon (*A. medirostris*) and the non-native American shad (*Alosa sapidissima*) (Hiss and Knudsen 1993). Several exotic warmwater species, including largemouth bass, perch, catfish, sunfish (*Lepomis cyanellus*), and many other resident fishes are present.

3.7.2 Distribution and Habitat Utilization

3.7.2.1 Chehalis River

The mainstem Chehalis River provides spawning and rearing habitat for salmonids as well as access to upriver habitat. In the Centralia reach, the mainstem generally lacks suitable riffles for spawning, while low flows coupled with high water temperatures during the summer and early fall limit the availability of rearing habitat. High sediment loads in this reach of the Chehalis River also decrease the area and quality of spawning and rearing habitat. No pools of sufficient depth or cover to provide holding or rearing habitat are present (PIE 2001). In the upper portion of the study area (upstream from the confluence with the South Fork Chehalis), the mainstem provides spawning and rearing habitat for spring and fall chinook, coho, and steelhead. Several quality pools are present in this area, along with LWD, which offers holding habitat for migrating salmonids (PIE 2001).

The timing of the Chehalis River spring chinook run is not known with precision. The Washington Department of Fisheries (1975) stated that fish enter the river in March through mid-August, but chinook catches in the Confederated Tribes of the Chehalis Tribe reservation fishery have been reported as early as February. Chinook spawn in the mainstem and in the tributaries in late August through September, with spawning in the upper basin occurring slightly later. Fry emerge late the following winter. Juvenile spring chinook generally remains in the river for over a year, with seaward migration taking place the second spring after emergence.

Adult fall chinook begin entering the Chehalis River in August, with the run peaking in September and tapering off through November (WDF 1975). Spawning generally occurs during October through mid-December. Within the study area, fall chinook salmon spawn in suitable riffles in the reach between the mouth of the Skookumchuck River and the mouth of the Black River, as well as in areas upstream from Centralia and Chehalis. Fall chinook fry emerge in late winter through early spring, and remain in freshwater for 3 to 5 months before beginning their seaward migration.

The Chehalis and nearby drainages produce more coho smolts than any other system along the Washington coast, and in 1999 was the third largest producer in Washington state (WSCC 2001). Coho salmon begin entering the Chehalis in September and continue through November, with spawning occurring over the period from October through January (WDF 1975). "Late-run" coho, which enter the river in mid-November through February, are not found in significant numbers within the study area and upper portions of the basin. Coho tend to seek out smaller tributary streams, and the mainstem Chehalis River within the study area provides little suitable coho spawning habitat. Coho fry emerge from the gravel in late spring. They typically migrate seaward during April, May, and June of their second year, although some fry and fingerlings migrate downstream in their first year during periods of flooding and heavy runoff.

Chum salmon enter the Chehalis system in early October through mid-December and spawning peaks in mid-November. Within the study area, chum salmon spawn in suitable riffles in the reach between the mouth of the Skookumchuck River and the mouth of the Black River. Chum fry begin their seaward migration shortly after emergence in early spring.

Wild summer steelhead in the Chehalis River system is a distinct stock based on the geographical isolation of the spawning population. Specific spawning locations are unknown, but it is thought that wild summer steelhead may spawn in the upper reaches of the Chehalis River. Run timing is generally from May through October, and spawning is believed to occur from February through April. Wild winter steelhead are distinct from wild summer steelhead based on run timing. Run timing for winter steelhead in the mainstem Chehalis is December through May, with spawning occurring from mid-February through early June.

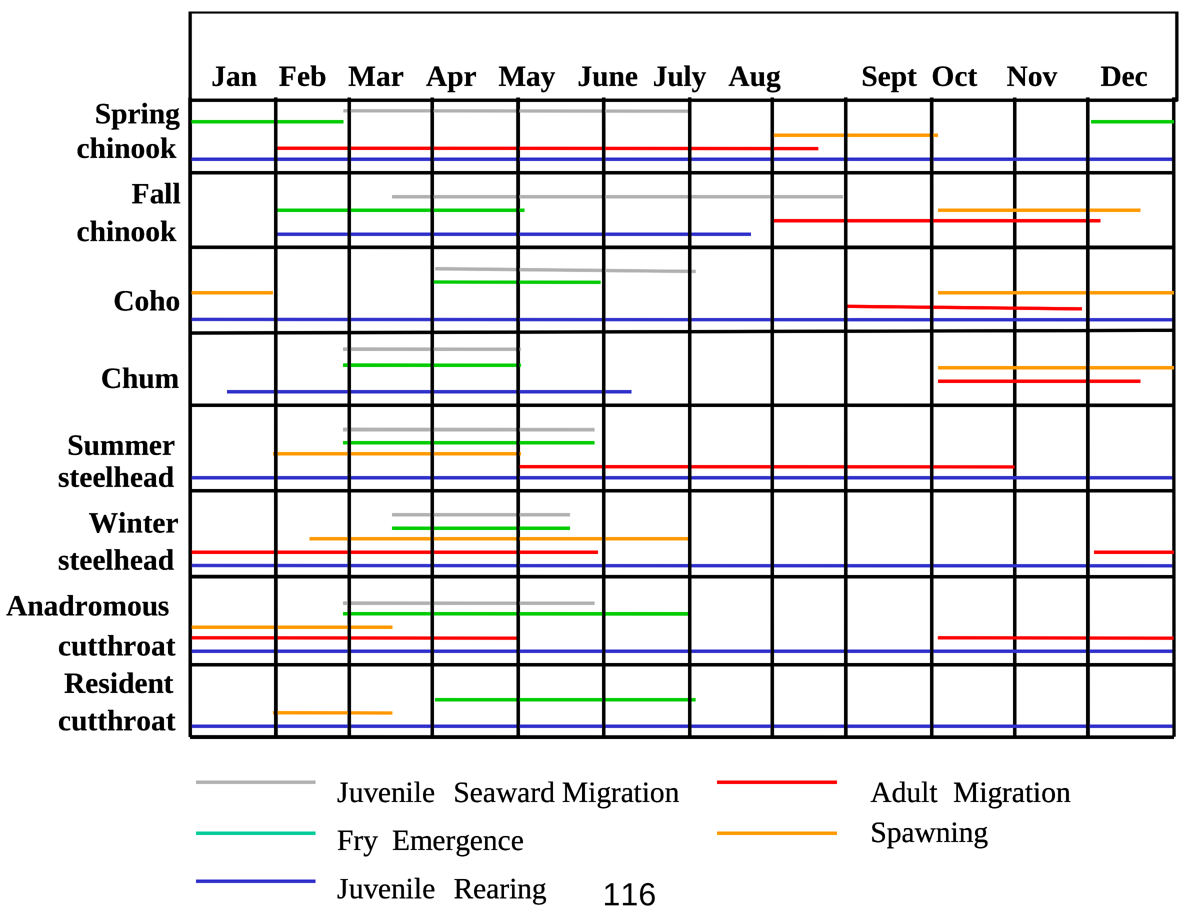
American shad have been observed in the Chehalis River as far upstream as Rainbow Falls (RM 97), but the largest concentration of shad spawning is thought to be near Rochester (Hiss and Knudsen 1993). Within the study area reach there is likely little shad spawning, as there are few areas of suitably sized gravels.

Sturgeon are known to be present in the Chehalis River as far upstream as the mouth of the Newaukum River. A few juveniles, apparently months old, were seined from the mainstem Chehalis during summer in the early 1970s (Hiss and Knudsen 1993). Within the study area, there are a few locations in the mainstem Chehalis River that contain larger cobble substrates that could be used for spawning. However, use of these areas by sturgeon is considered unlikely.

The Olympic mudminnow, which is listed by Washington State as a sensitive species, is not known to occur in the mainstem Chehalis River, although suitable habitat occurs in some off-channel ponds. This species is known to be present in China Creek, which enters the Chehalis near Mellen Street (City of Centralia 1999).

There are currently no dams or other man-made structures that block the upstream or downstream movement of anadromous fish in the mainstem Chehalis. As described in Section 3.3, water quality in the Centralia reach frequently fails to meet Class A water quality criteria for temperature and DO during the dry season. The combination of low flows, high water temperatures, and low DO levels in late summer and early fall may form a block to fish migration in the Centralia reach. Upstream from the South Fork confluence, there are numerous culverts on tributaries that are known to block passage of cutthroat trout, and several culverts that block passage for both cutthroat and steelhead (WSCC 2001). In addition, one culvert on a tributary to the East Fork Chehalis is known to block migrating coho. A natural barrier to salmon migration occurs at RM 97, where Rainbow Falls occasionally hinders passage of adult fish at low flows.
The matrix below summarizes the timing of migration, spawning, emergence, and rearing of various species in the Chehalis system:

Table 3.7.2 Matrix of migration, spawning, emergence and rearing



3.7.2.2 South Fork Chehalis

The South Fork Chehalis River supports runs of spring and fall chinook and coho salmon, as well as steelhead trout. Coho are the most abundant salmonid in this stream (WSCC 2001). The coho stock in the South Fork Chehalis River basin is classified as part of the much larger population of coho found throughout the Chehalis River system upstream from the Satsop River confluence. Similarly, spring chinook and fall chinook salmon in the South Fork Chehalis are components of the Chehalis River chinook stocks. Winter steelhead in the South Fork Chehalis River are part of a larger population found throughout the Chehalis River basin upstream from the Satsop River (WSCC 2001). This stock does not include spawners in the Skookumchuck and Newaukum basins.

Although the South Fork Chehalis is used primarily for upstream access and rearing, there are some suitable, riffles that provide limited spawning for chinook. Coho and steelhead spawning is confined primarily to tributary streams containing suitable spawning gravels. Low flows, high water temperatures, high silt loads, and concentrations of predatory fish are factors that limit successful salmon spawning in the South Fork Chehalis.

There are limited opportunities for salmonid rearing and holding in the South Fork Chehalis River. One reach was identified as having side channel habitat that could be utilized by juvenile salmonids for rearing (PIE 2001). LWD functioning as holding habitat for fish was observed in two reaches; however, no pools of sufficient depth or cover that could provide rearing or holding habitat were identified. High silt loads from extensive bank cutting limit the availability of holding and rearing pools throughout the South Fork.

There are several culverts on South Fork tributaries that are known to be barriers to migrating salmon, steelhead, or both (WSCC 2001). The length of stream habitats blocked by these culverts has not been determined.

3.7.2.3 Skookumchuck River

The Skookumchuck River provides spawning and rearing habitat for spring and fall chinook and coho salmon, and supports winter steelhead and resident cutthroat trout. Chum salmon used this stream historically, but have not been found in the Skookumchuck for many years (WDF 1975). The Olympic mudminnow is reported to occur in Hanaford Creek (WDFW 1999).

The spring chinook and fall chinook stocks in the Skookumchuck River are considered components of the larger Chehalis River chinook stocks. Chinook use the mainstem Skookumchuck River for spawning and rearing from the mouth up to the Skookumchuck Dam at RM 21.9.

The coho stock in the Skookumchuck River is classified as part of the much larger population of coho found throughout the Chehalis system upstream from the Satsop River confluence. Coho use the mainstem Skookumchuck up to the dam for spawning and rearing, and spawn in the accessible reaches of tributaries. Wild winter steelhead in the Skookumchuck River basin are considered to be part of a larger population that includes Newaukum River winter steelhead.

Prior to construction of the Skookumchuck Dam, coho and steelhead utilized the Skookumchuck River up to an impassible falls near RM 28.9. The dam, which was built in 1970, blocks natural passage to all anadromous fish. It is estimated that 3.6 miles of spring and fall chinook mainstem habitat and 7 miles of coho mainstem habitat were lost when the dam was constructed (WSCC 2001). WDFW traps returning steelhead at a collection facility at the base of the dam, and transports them to stream reaches upstream from the dam for spawning. Steelhead smolts are transported downstream by allowing water over the spillway from March 15 to June 1 (USFWS 1982). Following dam construction, cutthroat were planted above the reservoir by the Washington Department of Game, but this practice was discontinued in 1980.

Several reaches of the Skookumchuck River below the dam contain pools of sufficient depth and cover to provide quality rearing and holding habitat for salmonids, particularly in the upper and lower reaches (PIE 2001). Several side channels that provide rearing habitat for juvenile salmonids are present in the upper and middle reaches.

There are two culverts on Skookumchuck River tributaries in the upper basin that are known to be barriers to steelhead (WSCC 2001).

3.7.2.4 Newaukum River

The Newaukum River, including its North and South forks, supports runs of spring and fall chinook and coho salmon as well as steelhead. American shad use the lower Newaukum River for spawning (WDF 1975).

The spring and fall chinook stocks in the Newaukum are considered components of the Chehalis River chinook stocks; this drainage contributes an estimated 34 percent of the spawning population of Chehalis River spring chinook and an estimated 6 percent of the total spawning population of Chehalis River fall chinook (WSCC 2001). Spring and fall chinook spawn up to RM 12.5 on the North Fork and up to RM 31 on the South Fork Newaukum River.

The coho spawning in the Newaukum River are considered part of the Chehalis River population found upstream from the Satsop River. Coho salmon use the mainstem Newaukum River for rearing and transportation, and use tributary streams for spawning and rearing. Winter steelhead in the Newaukum River basin are considered to be part of a larger population that includes Skookumchuck River winter steelhead. Steelhead use the mainstem Newaukum River for rearing and transportation, and use tributary streams for spawning and rearing. Coho and steelhead have been documented as far upstream as RM 18.5 on the North Fork and up to RM 32.2 on the South Fork Newaukum River. Tributaries producing coho and steelhead include Allen and Taylor creeks (mainstem tributaries), Lucas, Bear, Mitchell, and Johns Fork creeks (North Fork tributaries), and Bearnier, Beaver, Frase, Gheer, Kearney, and Lost creeks (South Fork tributaries).

The South Fork Newaukum River contains a number of deep pools with cool water temperatures, which provide excellent rearing habitat for juvenile salmonids, as well as adult resting and maturation habitat. The area and quality of rearing and maturation habitat on the North Fork is limited by low flows, high water temperatures, high silt loads, and large concentrations of predatory fish (WDF 1975).

A diversion dam was built in 1918 at RM 12.5 on the North Fork Newaukum to provide water for the cities of Centralia and Chehalis. This dam blocked access for anadromous fish until 1970, when a fish ladder was constructed. On the South Fork, a series of falls upstream from RM 31 apparently block salmon from utilizing some potential upstream production areas (WDF 1975).

3.7.3 Stock Status and Population Trends of Salmonids in the Chehalis River Basin

Many Chehalis River basin wild salmon and steelhead populations have been extensively influenced by hatchery releases of non-native stocks (Hiss and Knudsen 1993; WSCC 2001). Many hatcheries developed brood stocks from outside strains, and most Chehalis basin salmonid populations have had considerable non-native influence. Stocks occurring in the Study Area that are considered to be of mixed origin include Chehalis River fall chinook, Chehalis River coho, and Skookumchuck/Newaukum River winter steelhead (Envirovision 2000).

Reports developed by WDFW and Western Washington Treaty Indian Tribes summarize the most recent information available on the status of salmonid stocks in the Chehalis basin and study area (WDFW and WWTIT 1994; WDFW 1998b and 2000).

Escapement estimates for years 1986-1996 for coho and fall and spring chinook within the study area are presented in Appendix A. Steelhead red count summaries for years 1989-1996 are also presented in Appendix A.

3.7.3.1 Spring Chinook

There is one stock of spring chinook found in the Chehalis River basin and the study area. The Chehalis River stock of spring chinook is considered a native stock and is maintained by wild production. The stock is considered healthy. From 1982 through 1991, escapement ranged from 610 to 3,488. With the exception of 1988 and 1989 (two strong return years), average escapement during the 1982-1991 period was approximately 1,400 (WDFW and WWTIT 1994). Since 1991, the average escapement has increased to 2,379 (WSCC 2001). The population trend is considered stable or possibly positive (Envirovision 2000).

3.7.3.2 Fall Chinook

There are seven stocks of fall chinook in the Chehalis River basin, one of which (the Chehalis River stock) is found in the study area. The Chehalis River stock of fall chinook salmon is of mixed origin, and is maintained by wild production. The stock is considered healthy. From 1985 through 1990, escapement ranged from 2,971 to 7,837 (WDFW and WWTIT 1994). Estimates indicate that recent escapement levels have been stable (WSSC 2001). There is no recent population trend reported for Chehalis River fall chinook (Envirovision 2000).

3.7.3.3 Coho

Of the seven stocks of coho in the Chehalis basin, one (the Chehalis River stock) occurs in the study area. The Chehalis River coho stock is of mixed origin, with composite production of hatchery and wild fish. The stock is considered healthy. Between 1984 and 1991, escapement averaged 18,510, and then declined to an average of 14,625 between 1992 and 1998. However, a portion of the population has recently increased its level of returns, resulting in numbers similar to the 1984-1991 period (WSCC 2001). No recent population trend has been reported for this stock (Envirovision 2000).

3.7.3.4 Fall Chum

There are two stocks of fall chum in the Chehalis River basin, one of which (the Chehalis River stock) is found in the study area. The Chehalis River fall chum stock is considered native, and is maintained by wild production. The stock is considered healthy. Escapement levels and population trend for this stock are unknown (WDFW and WWTIT 1994).

3.7.3.5 Summer Steelhead

There are two stocks of summer steelhead in the Chehalis River basin. One, the Chehalis River stock, occurs in the study area. The origin of the stock is unknown; a native stock originally returned to the Wynoochee River and possibly other rivers, but there is uncertainty about the contribution by hatchery summer steelhead spawning in the wild (WDFW and WWTIT 1994). The stock is maintained by wild production. The status of the stock and population trends are unknown. Escapement is not monitored for this stock, nor has an escapement goal been identified.

3.7.3.6 Winter Steelhead

Of the eight stocks of winter steelhead in the Chehalis River basin, two (the Chehalis River and the Skookumchuck/Newaukum River stocks) occur in the study area. The Chehalis River stock is native and is maintained by wild production. This stock is considered healthy. From 1984 through 1992, escapement ranged from 2,540 to 4,156. The Skookumchuck/Newaukum River winter steelhead stock is of mixed origin and is maintained by composite production. Production is partially sustained by hatchery production at the Skookumchuck Dam. The stock is considered depressed, with a negative population trend. From 1984 through 1992, escapement ranged from 644 to 1,202 (WDFW and WWTIT 1994). From 1996 to 1999, wild escapement ranged from only 193 to 473, below the wild escapement goal of 766 (WSCC 2001).

*3.*7.3.7 Coastal Cutthroat

The Chehalis River stock complex of coastal cutthroat trout includes fish in the Skookumchuck and Newaukum Rivers, the smaller tributaries and headwaters of the Chehalis River, and tributaries downstream from the study area. The stock complex is considered native and is maintained by wild production. The status of the stock complex and population trend are unknown. Some researchers believe that that stock complex may be depressed (Envirovision 2000). However, WDFW (2000) indicates that cutthroat are relatively abundant and widely distributed in the basin, based on juvenile density sampling at over 80 sites in the upper basin and returns to a trap operated by the Quinault Indian Nation on the West Branch Hoquiam River.

3.7.3.8 Bull Trout/Dolly Varden Trout

A described in Section 3.6, the Coastal/Puget Sound population segment bull trout is listed as threatened under the Endangered Species Act. A native, wild-producing stock of bull trout/Dolly Varden trout has been identified in the Chehalis River/Grays Harbor system. However, most information on this stock consists of anecdotal accounts by sport fishers, and the stock status and population trend are unknown (WDFW 1998b).

3.8 Land Use and Planning

Political jurisdictions in the study area include Lewis and Thurston counties, the cities of Chehalis and Centralia, and the towns of Pe Ell and Bucoda. Unincorporated communities include Adna, Doty, Dryad, Fords Prairie, and Galvin.

The study area is generally devoted to rural residences, commercial agriculture, and timber production; small areas of commercial business and light industry are typically located near freeway interchanges. Large tracts of undeveloped land occur along the South Fork Chehalis River, to the east of Centralia along Hanaford Creek, and in the Skookumchuck River basin upstream from Bucoda. In the population centers of Centralia and Chehalis, land uses include a full range of residential, commercial, service, industrial, and public uses.

3.8.1 Lewis County

The majority of the study area lies within the unincorporated portions of Lewis County. The overall character of the study area in Lewis County is rural residential and agricultural, with large areas of undeveloped forestland. Industrial developments include the Centralia Steam

Plant located in the Hanaford Valley, and light industrial establishments near I-5 from Rush Road to the Labree Road overpass. Concentrated retail and commercial development has occurred near the intersection of I-5 at the Harrison Avenue overpass in Centralia. Agricultural fields and pastureland predominate along the west side of I-5 and along SR-6 downstream from the confluence of the South Fork and mainstem Chehalis.

3.8.1.1 Comprehensive Plan

The Lewis County Comprehensive Plan and Environmental Impact Statement was adopted May 10, 1999. According to the Plan, over 98 percent of land in Lewis County is open space or remote rural areas with less than 2 percent available for urban development. Currently, only 1 percent of land lies within urban areas, with much of that devoted to right-of-ways and public uses. An additional 1 percent is classified as “Rural Areas of More Intense Development” which includes small communities in unincorporated areas as well as small commercial and industrial enclaves.

As mentioned above, the majority of the study area lies within unincorporated portions of Lewis County near the cities of Centralia and Chehalis. Most of the study area occupies land which is developed as rural residential and agricultural, however several areas along the Chehalis, Skookumchuck, and Newaukum Rivers contain low-density residential and commercial development. Class A farmland is presently adjacent to the Chehalis and South Fork Chehalis Rivers west of Chehalis. The majority of lands surrounding the study area west of Chehalis consist of forest resource lands. Residential land use areas not inside city limits include several areas of medium-density development southwest of Adna, west of Chehalis across the Scheuber floodplain, and south of Chehalis, with commercial and industrial development concentrated within the designated Urban Growth Areas of Centralia and Chehalis.

Mineral resource lands present in Lewis County include coal, clay, cinnabar ore, gold, silver, copper, iron, graphite, shale, and arsenic. Mineral resource lands include:

- existing permitted surface mining operations
- areas containing mineral deposits the significance of which cannot be evaluated from available data
- mines of local importance.

There are several mineral resource lands throughout the study area. These include coal, clay, shale, and gravel mining operations, most of which are less than 25 acres in size. The Centralia Mining Company coal mine, located northeast of Centralia, is the largest tract of mineral resource land (greater than 1,000 acres) in the study area. There are several small mines located north of Centralia; two near Schaefer Park, and three adjacent to I-5 north of Reynolds Avenue. Two small mines are located northeast of Chehalis, and several small mines are located along SR-6 west of Adna. At present, no mineral resource lands are located within the footprint of the current levee alignment proposal for the proposed project.

Specific goals and corresponding policies that relate to land use in Lewis County are stated in the Plan. An overall goal for urban growth within the County is to encourage development in urban areas where adequate public facilities and services already exist. One policy to achieve this goal is the development of planned communities, which insures development of adequate services and facilities. To reduce urban sprawl, a goal is to reduce the conversion of undeveloped land into low-density development. A policy to achieve this goal is to identify short-term and long-term planning areas to help consolidate development around existing utilities and services. Additional land use goals include building efficient transportation systems based on regional priorities and coordinated with County and city comprehensive plans and promoting economic development and opportunities for all citizens.

3.8.1.2 Shoreline Management

The Revised Shoreline Master Program for Lewis County, adopted in June 1980, sets forth policies, rules, and regulations for the development of shorelines located within the County. The Program sets guidelines for development of shoreline areas with several goals in mind. These goals include:

- Encouraging full and complete utilization of resources in a manner consistent with minimizing adverse effects to the shoreline environment;
- Maintaining and developing shoreline public access and recreational opportunities, and;
- Encouraging sound management of renewable shoreline resources and preservation of non-renewable, historic, and/or cultural shoreline resources.

The Program separates shoreline environments into four designations: Natural, Conservancy, Rural, and Urban. These designations are an indicator of the amount of development pressure each shoreline area can be expected to withstand. Designations are determined using various criteria including soil classifications, slopes, ownership data, and existing and projected land uses, and reflect the condition of the shoreline and its relation to surrounding environments and land uses. There are several rivers and streams located in the study area that fall under the jurisdiction of the Shoreline Management Act, and are addressed in the Program.

In addition to Lewis County's shoreline environment designations, the Shoreline Management Act of 1971 designates shorelines of statewide significance. Shorelines of statewide significance comprise the main bodies of water within the County that are important to people of the state and the county. These shorelines are managed in the same manner as all other shorelines of the County; however development along these shorelines also requires thorough review by affected state agencies before permits can be issued.

Based on streamflow (mean annual flow of 1,000 cfs or more), one shoreline within the study area has been designated as a shoreline of statewide significance under the Shoreline Management Act. This shoreline is located on the Chehalis River from the mouth of the South Fork Chehalis River downstream to the Lewis County and Thurston County line.

3.8.1.3 Floodplain Management

Much of the study area within Lewis County occurs within the floodplains of the Chehalis, Skookumchuck, and Newaukum Rivers. The majority of developed lands within these floodplain areas are currently devoted to rural agricultural and low-density rural residential development; however some areas of higher-density residential, commercial, and industrial development do occur. Most, if not all, of these current floodplain uses were developed prior to the adoption of the current floodplain development restrictions.

Title 15, Chapter 15.35 "Flood Damage Prevention" of the Lewis County Code states methods and policies for promoting public health and safety, as well as minimizing public and private loss due to flood conditions in specified areas. Specified areas, or "designated floodways", are defined as the floodways that have been delineated on the Flood Insurance Rate Map or the flood boundary/floodway map of the "Flood Insurance Study for Lewis County," dated November 1981. These include any areas subject to a base or 100-year flood event. As a result of work completed as part of this project, new projections of the 100-year floodway have been calculated. However, maps based on these projections have yet to be submitted to, or adopted by, the Federal Emergency Management Agency or local governments.

Specific methods for reducing potential floodwater damage, as stated in Chapter 15.35, include:

- Restricting or prohibiting uses which could result in damages to persons or property due to water or erosion, or which could result in increases in erosion or flood height or velocity;
- Requiring that uses vulnerable to floods be protected against flood damage at time of initial construction, and;
- Controlling filling, grading, dredging, and other development that may increase flood damage, unnaturally divert floodwaters, or result in increased flood hazards in other areas.

3.8.1.4 Stormwater Management

Recent population growth into rural portions of the study area within Lewis County has increased development pressures in those areas. Construction of roads, buildings, and other impervious surfaces has led to increasing amounts of stormwater runoff, which can be detrimental to surface water quality. Stormwater management policies for Lewis County are outlined under Title 15, Chapter 15.45 "Stormwater Management" of the Lewis County Code. The purpose of this Chapter is to provide for adequate stormwater quality and quantity controls in order to protect property rights, preserve fish and wildlife habitat, and preserve water quality.

The minimum stormwater management requirements for new development and redevelopment under Chapter 15.45 are adopted from the Stormwater Management Manual for Western Washington. The Manual identifies minimum requirements for stormwater management for developments, including: preparation of stormwater site plans, source control of pollution, on-site stormwater management, runoff treatment, wetlands protection, and basin/watershed planning. Depending on the size and type of the planned development, different combinations of these minimum requirements may be needed. Also, some sites may require additional controls depending on special water quality and/or basin concerns.

3.8.1.5 Public Services

Fire protection services are provided by several jurisdictions within the Lewis County portion of the study area. The Centralia and Chehalis Fire Departments provide fire protection within their respective city limits. Outside of Centralia and Chehalis, fire protection services within the study area are provided by Lewis County Fire Protection Districts Numbers 1, 5, 6, 11, 12, 13, and 16. Small towns within the study area are also served by their own fire departments. Many of the firehouses in the area are relatively small and are staffed by mostly volunteer firefighters.

Police services within the study area are provided by the Lewis County Sheriff's Department Patrol Areas 1, 2, 3, and 5, the Washington State Patrol District #5, and several municipal police departments. Centralia and Chehalis, as well as small towns such as Pe Ell, are served by municipal police departments. The Lewis County Sheriff's Department supplements service within incorporated areas of Lewis County, as well as providing primary service to unincorporated areas. The Washington State Patrol provides service along the I-5 corridor and along several state highways in the area.

Emergency medical services are provided by primary response ambulance units and one area hospital. Ambulance service is mainly provided by local fire departments, although private ambulatory services do operate in some portions of the study area. There is one full service hospital in the study area, located on Cooks Hill Road west of the Mellen Street bridge in Centralia. Currently, access to the hospital is hindered during flood conditions on the Chehalis River.

Utilities within the study area in Lewis County include water and sewer, electricity, natural gas, telephone, and television cable. Water service in the study area is supplied by four major providers. The City of Chehalis provides water service to the majority of Chehalis, and extends service approximately 17 miles south of the city limits along Jackson Highway and the North Fork Road. The City of Centralia Water System serves Centralia and some of the immediately surrounding areas. Boistfort Valley Water serves approximately 20 square miles from the Boistfort Prairie area to north of Claquato. American Water Resources manages several small water supply systems throughout Lewis County, including along Middle Fork Road, State Highway 508, Jackson Highway, and Hanaford Road within the study area. The Town of Pe Ell also has a small water supply system managed by the town.

There are currently three main sewer service providers within the Lewis County portion of the Study Area: City of Chehalis, City of Centralia, and Lewis County Sewer District #1. The City of Chehalis provides sewer service within the city boundaries as well as several miles south, incorporating much of the City's Interim Urban Growth Area (IUGA). The City operates one sewage treatment facility located immediately northwest of the SR 6/I-5 Interchange. In addition to Chehalis, the facility also treats sewage from both the City of Napavine and Lewis County Sewer District #1 through a shared interceptor sewer system. The facility has an average daily treatment of 1.45 million gallons per day (MGD). Currently, access and operation of the facility are hindered when flood conditions occur on the Chehalis River.

The City of Centralia provides sewer service to the incorporated areas of the city as well as the Fords Prairie and Salzer Creek areas. The City maintains one sewage treatment facility located immediately northwest of the Mellen Street/I-5 Interchange, with an average daily treatment of 1.45 MGD. Currently, access and operation of the treatment facility are negatively impacted during flood conditions.

The third major sewer services provider located in the Lewis County portion of the study area is Lewis County Sewer District #1. It provides service to the Jackson Highway/Bishop Road area southeast of Chehalis. As mentioned earlier, the Sewer District pipes sewage from its collection area to the Chehalis treatment facility.

The Town of Pe Ell also operates a small sewage treatment facility located at the northwest corner of the town limits along the Chehalis River. The facility serves 320 customers inside the town limits, and 3 customers outside the town limits, with a peak discharge of 114 gallons per minute.

With the exception of Centralia, all areas of Lewis County within the study area are provided electricity by Lewis County Public Utilities District (PUD). Lewis County PUD serves approximately 27,000 customers with a system capacity of 180 megawatts. The City of Centralia and some adjacent areas are served by Centralia City Light. The City generates approximately 30 percent of its power needs at the Centralia Steam Plant, with the remaining 70 percent being purchased from Bonneville Power Administration.

Natural gas service is provided to the study area by Puget Sound Energy (PSE). PSE purchases the gas from several regional suppliers, such as Northwest Pipeline Corporation, which operate pipelines in the area.

The major carrier of telephone service within the study area is US West Communications, which maintains both aerial and buried copper and fiber lines. These telephone lines may be used for voice or data transmission. US West also supplies cellular communications to portions of the study area.

Cable television service in the Centralia/Chehalis area is provided by TCI Cablevision. Most outlying areas receive cable through use of personal satellite dishes.

3.8.1.6 City of Centralia

The Centralia Comprehensive Plan was adopted on December 8, 1998. According to the Plan, the predominant land use is residential development, which accounts for 35 percent of the total land base. Commercial and industrial development account for 6 percent and 5 percent, respectively. The remaining land uses, including parks/open space, public/right of ways, vacant, and undeveloped critical areas, account for 54 percent of the current land uses. The majority of commercial uses occur near the Harrison Avenue overpass and in the downtown area, while industrial uses are mainly adjacent to the rail lines.

Existing zoning regulations within Centralia city limits allocate approximately 73 percent of the City's land for residential development. The remaining 26 percent is allocated to commercial and industrial development, with commercial development accounting for 15 percent and industrial development accounting for 11 percent.

There are several goals related to land use, and policies designed to achieve them, that are outlined in the Comprehensive Plan. One goal for residential development is to protect, preserve, and enhance existing residential neighborhoods. Policies designed to achieve this goal include providing guidelines for development of transitional land uses which buffer residential areas from intensive commercial and industrial uses, protecting existing residential areas from encroachment by incompatible land uses, and encouraging beautification and upgrading of residential structures and landscaping.

Goals for commercial development within Centralia include orderly growth and continued vitality of existing commercial areas. Policies designed to achieve these goals include providing adequate and safe vehicular and pedestrian circulation throughout commercial areas, supporting programs that preserve and enhance existing commercial areas, and coordinating with other jurisdictions to ensure that adjacent commercial areas are compatible with development in Centralia. Goals for industrial development include encouraging the expansion of existing industries and the siting of new industries, and ensuring that industrial uses develop as efficient and attractive working environments. Policies designed to achieve these goals include ensuring that industrial areas are adequately served by roads and utilities, and requiring mitigation of off-site impacts.

3.8.1.7 City of Chehalis

The City of Chehalis Comprehensive Plan and Environmental Impact Statement was adopted July 12, 1999. According to the Comprehensive Plan, the current distribution of land use within Chehalis city limits favors residential development, which accounts for 38 percent of the total land use allocation. Included in residential land use are single family (24 percent), multifamily - medium density (4 percent), multifamily - high density (9 percent), and transitional (1 percent) housing. Commercial development, including the Central Business District, comprises 23 percent of land allocation, while industrial development also comprises 23 percent. Planned Unit Development (PUD) accounts for 16 percent of allocated land use.

Currently, there are relatively few large, vacant parcels of land within the city limits that are available for development. Constraints such as floodplains, shoreline areas, steep slopes, and wetlands further limit development in more than one-third of the city's total land area. The remaining opportunities for development include infilling on smaller parcels, development of parcels with natural constraints, and redevelopment of vacant or underused parcels.

Due, in part, to the limited capacity for development within the city limits, the IUGA adopted for the City of Chehalis is located primarily south of the existing city limits. The bulk of the land within the IUGA (53 percent) is intended for industrial use. Land intended for residential use comprises 15 percent, and 32 percent is set aside for commercial use.

The overall goals related to land use in the City of Chehalis as stated in the plan are as follows:

- Manage growth in such a way as to ensure that suitable land is available to support residential, commercial, and industrial uses, while also preserving open space and recreational opportunities
- Encourage growth in urban areas where sufficient public facilities and services exist or can be provided
- Ensure that land uses are related in ways that are compatible with projected growth in the area to provide maximum efficiency.

Specific goals for residential development include maintaining the low-density character of the community while also providing affordable housing to all segments of the population. This includes ensuring that residential areas are sufficiently supported by public facilities and services as well as commercial and retail activities, while minimizing impacts to surrounding residences.

Goals for commercial and retail land use are to encourage redevelopment of existing commercial areas, such as the Central Business District, and to provide a wide range of services and opportunities to residents. Commercial zones offer job opportunities to residents, as well as providing an important economic base for the community.

Recent trends indicate that much of the industrial growth within Lewis County is likely to occur in the City of Chehalis. Therefore, goals for industrial land use are to facilitate this growth by providing easy access to industrial transportation corridors such as I-5 and existing rail lines. The goals also seek to ensure compatibility between industrial and residential zones to better take advantage of an expanding labor force.

3.8.1.8 Pe Ell

The Comprehensive Plan for the Town of Pe Ell was adopted in June, 1997. According to the Plan, 47 percent of land use within Pe Ell city limits (not including right-of-ways) is currently classified as residential development. Within the residential classification, low density residential (one or more acre per dwelling unit) comprises approximately 36 percent of residential development, while single family residential (less than one acre per dwelling unit) comprises approximately 64 percent. Commercial and industrial land use accounts for approximately 2 percent of the total non-right-of-way land use; however, existing land in this category is exclusively commercial. Open space (agriculture, pasture, forest, natural area) comprises 27 percent of non-right-of-way land use, while public/community and vacant parcels comprise 11 percent. The estimated area in right-of-ways is approximately 29 percent of the total land in Pe Ell.

The overall land use goals as stated in the Plan are to ensure the following:

- Continuance of the existing town design by adopting policies for future residential development
- Development of vacant, buildable lots and agricultural lands into low-density residential uses
- Conformity and compatibility of commercial activities within the central business core, while also promoting downtown economic revitalization to provide new job opportunities for local residents

- Limited highway commercial and industrial development, with carefully designed access points, compatible with surrounding residential uses.

In addition to these overall goals, specific goals of the Plan include discouraging or prohibiting development within floodplains, wetlands and other critical areas, creating and maintaining buffer areas in and around developments, and providing suitable space to accommodate future institutional and public land uses.

3.8.2 Thurston County

The northern portions of the study area lie in southern Thurston County and are predominately rural residential/agricultural and undeveloped areas of wooded land and open fields. Agricultural fields and small rural residential enclaves are sparsely distributed along the Chehalis River, and along the Skookumchuck River below the Skookumchuck Dam. Timber production is prevalent in the areas surrounding the Skookumchuck reservoir. The Town of Bucoda is the only area of significant commercial or industrial activity located within the study area in southern Thurston County.

3.8.2.1 Comprehensive Plan

The Thurston County Comprehensive Plan was revised in 1998. According to the Plan, land use in southern Thurston County is primarily low-density (one unit per 5 acres [1/5]) rural residential development and long-term agriculture land. Long-term forestry lands and open space are also prevalent throughout the area. Within the study area, long-term agriculture and rural 1/5 residential are the dominant land uses adjacent to the Chehalis River south of Grand Mound. The land within Waunch Prairie south of Bucoda is primarily rural 1/5 residential, becoming interspersed with long-term agriculture and long-term forestry land east of Bucoda to the Skookumchuck Dam. The land east of the dam, surrounding the Skookumchuck reservoir, is exclusively devoted to long-term forestry.

There are several mineral extraction sites present within the Thurston County portion of the study area. A portion of the Centralia Mining Company coal mine is located southeast of Bucoda, and smaller rock quarries are located at the upstream end of the Skookumchuck reservoir, south of Skookumchuck Road near RM 16, and adjacent to the Skookumchuck River at RM 17.4.

Land use goals for residential development in southern Thurston County include maintaining the rural aspects of the County, while also providing buffering and transitions between environmentally sensitive areas and existing rural development, and areas of higher density development. Goals for commercial development include providing commercial services to rural and urban residences in an efficient manner, redeveloping and infilling existing rural commercial areas, and providing limited expansion of commercial centers to serve the growth of surrounding communities.

Land use goals for industrial development include sitting industrial developments in close proximity to agriculture, forest, and mineral resource lands in order to make accessibility to these and other resources efficient.

3.8.2.2 Shoreline Management

Shoreline development in Thurston County is regulated by policies set forth in the Shoreline Master Program for the Thurston Region, the Shoreline Management Act of 1971, and Title 19 of the Thurston County Code. These policies are designed to encourage proper development of shoreline areas, while minimizing harmful impacts to the shoreline environment. Within the Thurston County portion of the study area, the Chehalis River and Skookumchuck River fall under the jurisdiction of the Shoreline Management Act.

3.8.2.3 Floodplain Management

The portion of the study area that occurs within Thurston County is prone to flooding by the Skookumchuck River. The land in this area is primarily used for agriculture, with some areas of rural residential development also present. A portion of the town of Bucoda, consisting primarily of low-density, single-family residential developments, is located in the Skookumchuck floodplain.

Title 14, Chapter 14.38 "Flood Hazards" of the Thurston County Code sets forth provisions to promote public safety and general welfare, and to minimize damage due to flood conditions in specified areas. These areas of special flood hazard are identified on the Flood Insurance Rate Maps prepared by the Federal Insurance Administration, and supplemented by "The Flood Insurance Study for Thurston County", dated November 1980.

3.8.2.4 Stormwater Management

Stormwater management policy in Thurston County is set forth in Title 15, Chapter 15.05 "Thurston County Stormwater Standards" of the Thurston County Code. Regulations pertaining to the control of new development and redevelopment construction stormwater outflow and/or treatment are stated in the Drainage Design and Erosion Control Manual for Thurston County. Currently, the County is reviewing Ecology's Stormwater Management Manual for Western Washington for future incorporation into County policy.

3.8.2.5 Public Services

Police protection for the Town of Bucoda, as well as areas of Thurston County within the study area, are provided by the Thurston County Sheriff's Department. Fire protection and emergency medical assistance within the city limits of Bucoda are provided by the Bucoda Volunteer Fire Department. Fire protection and emergency medical assistance in all other unincorporated areas are provided by Thurston County Fire District #12 (Tenino) and Medic One of Thurston County.

Utilities provided in the area of Bucoda include electricity, telecommunications, and cable television. Electricity service is provided to Bucoda by Puget Sound Power and Light (Puget Power). Bucoda is served by a 115 kV line that originates from a Puget Power distribution station in Tenino.

Telecommunication services are provided to Bucoda and the surrounding areas by the Tenino Telephone Company. Cable television service is provided by TCI Cablevision, which operates a cable that runs adjacent to SR 507.

3.8.2.6 Bucoda

The Bucoda Comprehensive Plan was adopted in 1994. According to the Plan, approximately 83 percent of the total land area within Bucoda is currently zoned for residential use. Commercial land use accounts for approximately 8 percent, while industrial use accounts for approximately 9 percent of the total land zoned in Bucoda. While industrial and commercial zoning accounts for approximately 17 percent of the total land in Bucoda, actual land use in these areas is dominated by residential development and vacant space.

The Bucoda Comprehensive Plan was created with several goals relating to land use. These goals include:

- Promotion of contiguous, non-sprawling residential development using existing undeveloped lands within Bucoda city limits
- Preservation of the small, clean, and rural town character as well as the protection of the town's many historical landmarks and areas
- Protection of the aquifer and aquifer recharge areas from which the town obtains its water supply.

With the population of Bucoda not expected to experience significant growth in the next twenty years, there is sufficient developable land within city limits to allow for compatible residential, commercial, and industrial development without increasing the areal extent of the town. However, there are several constraints to development in many areas within the city limits, which include:

- Proximity of the Skookumchuck River and its adjacent floodplain which occurs within the eastern and southern portions of the city limits;
- Locations of wetlands, steep slopes, and sensitive aquifer recharge areas, and;
- Current extent of the town's water supply and sewage treatment capabilities.

Specific goals for residential development, as stated in the Plan, include maintaining the rural, small town character by developing residential areas in contiguous patterns in order to protect and enhance neighborhood development while reducing low-density sprawl. This emphasis on neighborhood enhancement must also be compatible with adjoining commercial and industrial land uses to avoid residential disturbances. Future commercial development in Bucoda will occur near the entry to the town adjacent to SR 507. Goals for commercial development are to provide easy access for pedestrians and adequate parking for professional, service, and retail oriented activities. Commercial development will also serve as an aesthetic benefit as well as improve business access to residents and visitors to the town.

Goals for industrial development include ensuring the compatibility of industrial usage with surrounding land uses. Another goal is to use the existing rail line to attract clean industrial activity that would provide more employment opportunities to local residents. Such industrial activities could include warehousing, storage, light industrial activities, and machine and repair shops.

3.9 Recreation and Aesthetic Resources

Diverse outdoor recreational opportunities exist within the study area. These include both public and private recreational areas and facilities. Recreational areas range from developed urban parks to open space that provides recreation such as nature study. Table 3.8-1 lists recreational lands and facilities within the study area.

Most of the developed recreation areas are within Centralia and Chehalis. The most intensively developed areas are Fort Borst Park in Centralia and Stan Hedwall Park in Chehalis. Generally, there are four types of parks: mini, neighborhood, community and regional parks. Neighborhood and community parks predominate, as they provide the widest range of active and passive recreation opportunities. Mini parks supplement the neighborhood parks and meet casual recreational needs. Regional parks offer unique recreation opportunities not commonly offered at other parks.

3.9.1 Developed and Undeveloped Parks

Schaefer County Park. Located along the Skookumchuck River approximately 2 miles north of Centralia on SR 507, Schaefer Park covers approximately 14 acres. It provides picnicking, designated swim areas, covered shelter, hiking, a volleyball court, a playground, fishing, horseshoe pits, and group picnic area. The park contains riparian wetlands associated with the Skookumchuck River. Half the park has trails, which pass through alder and vine maple forests near the river and its backwaters. River-associated wildlife includes muskrat and beaver.

Fort Borst Park. Fort Borst Park is one of the most developed parks in the region. Centered on the Historic Borst Family Homestead, the park has a variety of recreation opportunities, including fishing, swimming, picnicking, nature study, bird watching, boating, and hiking. Facilities include fields for soccer, softball, and baseball, tennis courts, horseshoe pits, volleyball courts, picnicking areas, an arboretum, a boat launch, historical Borst Home and Fort Borst Blockhouse, community kitchens, playground, and the Centralia Parks & Recreation Office.

Rotary-Riverside Park. Situated off Harrison Avenue along the Skookumchuck River, this park offers a campground, picnicking areas, fishing, horseshoes, outdoor shelter, a playground, soccer and baseball fields, a fitness trail, and natural area.

Stan Hedwall Park. This regional park totals 202 acres in size. The developed portion of the park is 111 acres and includes a little league complex with four fields, a playground, two full-sized baseball fields, four softball fields, soccer fields, a 29-unit campground with hook-ups, a nature study area, picnicking areas, and a community kitchen. The City of Chehalis has capital improvement projects slated for Stan Hedwall Park over the next 20 years (City of Chehalis, 1999).

Westside Park. This 0.9-acre park in Chehalis provides a children's play area, basketball courts, and picnic shelters.

Duffy Park. There is a demonstration forest that was logged and replanted in 1993 and 1994 and a trail system in this 4.5 acre park.

Millett Field. There are 3.3 acres at Millett Field, which include an open play field, a tennis court, basketball court, and a small natural area.

Recreation Park. There are 12 developed acres at this park. There is a playground, a community kitchen, a softball complex, outdoor swimming pool, and several picnic shelters. Sixteen improvement projects are planned for the next 20 years.

McFadden Park. McFadden Park covers 28 acres and offers open space for hiking, bird watching, and nature study.

Dobson Park. Dobson Park covers 26 acres located along the Chehalis River across from and adjacent to the confluence of the Newaukum River. The park has trails and a scout lodge, which is currently not used.

Other parks in the Centralia and Chehalis area include:

- Cedar Street Park
- Alexander Park
- Wilbur Parkins Park
- Seminary Hill Natural Area
- Central Park
- Ed S. Mayes Park
- Logan Community Park
- Plummer Lake Boat Launch

3.9.2 Golf Courses

There are three golf courses in the study area: Centralia Public Golf, Riverside Country Club, and Newaukum Valley Golf. The Rainbow Miniature Golf & Driving Range is also located within the study area.

3.9.3 Historic Steam Train

The Chehalis-Centralia Railroad is a restored 1916 logging train that operates over a nine-mile section of track that extends southwest from Chehalis. The line winds through scenic rolling hills, through farmland, and over several wooden bridges. An especially scenic portion of the line follows the Chehalis River in the study area.

3.9.4 Rivers, Creeks, Lakes, and Ponds

The major watercourses traversing the study area are considered important open space and recreational assets. These include portions of the mainstem Chehalis River, the Skookumchuck River, and the Newaukum River.

Mainstem Chehalis. Within the study area, the Chehalis River provides boating, angling, and swimming, although the river flows through mostly private land with limited public access. Fort Borst Park offers access and a boat launch to the Chehalis River. Dobson Park, across from the Newaukum River confluence, has some lightly used trails for access to the Chehalis River. Rainbow Falls State Park, which is located at the upstream end of the study area, offers fishing and swimming. There is also unofficial, dispersed recreational use along the river throughout the study area.

Skookumchuck River. There is significant recreational use of the Skookumchuck River from its confluence with the Chehalis River to just below Skookumchuck Dam. There is easy river access at Fort Borst Park, Riverside-Rotary Park, and Wilber Parkins Park in Centralia. Schaefer Park near Bucoda offers river access as well, and has a boat launch. Dispersed recreation along undeveloped reaches of the river also occurs throughout the study area, although much of the river passes through private property. Below Skookumchuck Dam, there is good angler access, as well as swimming, bird watching, and nature study opportunities.

Salzer Creek. Recreational use of Salzer Creek is dispersed and there are no developed recreational sites. Exploration of the creek corridor is likely the extent of most recreational use.

Newaukum River. Stan Hedwall Park along the Newaukum River is the primary location of recreation use on the Newaukum River. Other dispersed recreation, largely from private property, occurs also.

Hayes and Plummer Lakes. Hayes Lake is a historical river meander that was created when I-5 was constructed. Administered by WDFW, this 20-acre lake is undeveloped, but is used by anglers and hikers. Plummer Lake is approximately 10 acres and is administered by the City of Centralia. There is a car-top boat launch at the lake.

3.9.5 Chehalis to Raymond Riverfront Trail

The former railroad grade from Chehalis to Raymond was acquired and converted to a multi-use trail under the Rails-to–Trails program. The Chehalis to Raymond Trail has not been developed through the study area.

Table 3.9-1: Public Parks and Recreation Areas within the Study Area.

Name	Size (acres)	Location	Facilities
Schaefer County Park	14 acres	One mile north of Centralia on Bucoda Highway/SR 507	Picnicking, designated swim area, covered shelter, hiking, volleyball court, playground, fishing, horseshoes.
Cedar Street Park		Centralia	
Fort Borst Park		West of I-5 off Exit 82	Soccer and baseball fields, tennis courts, access to Chehalis and Skookumchuck rivers, wading pool, horseshoes, volleyball, picnicking areas, arboretum, rhododendron gardens, youngsters fishing lake, historical Borst Home, one room schoolhouse, Fort Borst Blockhouse, outdoor shelters, community kitchens, and playground.
George Washington Park		Between Pearl and Silver Streets	Memorial walk.
Stan Hedwall Park	202	Rice Rd., Chehalis	Playground, soccer/softball/baseball fields, volleyball courts, horseshoe pits, arboretum, campground.
Westside Park	0.9	Chehalis	Play area, picnicking.
Duffy Park	4.5	Chehalis	Nature study.
Millett Field	3.3	Chehalis	Tennis courts, natural area. play fields
Recreation Park	12	Chehalis	Swimming, open fields, playground
McFadden Park	28	Chehalis	
Dobson Park	26	Chehalis	
Alexander Park	6	Chehalis	
Wilbur Parkins Park		Meridian St. along the Skookumchuck River	Picnicking, fishing.
Seminary Hill Natural Area		East of downtown Centralia	Trails.
Central Park		Downtown Centralia	
Ed S. Mayes Park		Centralia	Flower gardens
Rotary-Riverside Park		Off Harrison Avenue (exit 82) along the Skookumchuck River	Campgrounds, picnicking, fishing, horseshoes, outdoor shelter, playground, soccer and baseball fields, fitness trail.
Logan Community Park		Intersection of Logan and Vienna Streets	Playground, tennis and basketball courts, horseshoes, picnic shelter, youth play court area.
Plummer Lake Boat Launch		West end of Lewis Street	Car top boat launch.
Rainbow Falls State Park	139	17 miles west of Chehalis on SR 6.	Camping, picnicking, hiking, biking, and equestrian trails, fishing, swimming, horseshoes, softball field, nature study, flower garden.

3.9.6 Aesthetics

Although most of the study area lies within unincorporated Lewis County, the most commonly accessed viewshed is from I-5 through the cities of Centralia and Chehalis. Other common views include those from SR 6 and SR 508. The quality and characteristics of these viewsheds are as follows:

I-5 enters the study area from the north immediately south of SR 12 and travels in a direct line through Centralia and Chehalis. Most of the urban development in both cities is east of the highway and remains low in the valley; views of the surrounding hills are unobstructed, and Mt. Adams and Mt. St. Helens appear in the distance. Development along the highway is predominantly retail and associated signage. Because most of the interstate through the study area is at a higher elevation than surrounding area, the commercial and retail development falls into the foreground. The mid-view and background views are rural and natural. The relatively straight route of I-5 through the study area maintains a consistent scenic presentation of the view. Since the highway is not divided, the northbound views are similar in aesthetic quality, without views of Mt. Adams or Mt. St. Helens.

SR 6 travels in an east-west alignment across the study area, traversing a broad floodplain with mostly agricultural, residential and scattered commercial use. The route is level and, although it follows the course of the Chehalis River, the river is only visible at crossings. Westbound travel affords unobstructed views of the hillsides above the floodplain and eastbound travel provides a view of Chehalis in the foreground with hillsides and mountains in the background.

SR 508 follows the South Fork Newaukum River from I-5 to Onalaska. SR 508 travels mostly through agricultural and forested areas with rural residential development adjacent the road. Most long-range views are obstructed by roadside vegetation. Otherwise, there are unobstructed views of forested hills.

3.10 Transportation and Traffic

This section describes existing transportation conditions within the study area. Information on major routes was gathered from the *2000 Annual Traffic Report* (WSDOT and FHWA 2001) and accident summaries compiled and prepared by WSDOT. Some of the major effects of flooding on transportation are also described in this section.

3.10.1 Major Transportation Routes in the Study Area

3.10.1.1 Interstate 5

Interstate 5, which is part of the federal interstate highway system, extends from the U.S./Canadian border in Blaine, Washington, south to the Mexican border. I-5 is the major north-south route in western Washington for travel between cities. Within the study area, the interstate crosses through the city centers of Centralia and Chehalis. Except for this 12-mile stretch of road, I-5 passes primarily through rural areas within the study area. State Route 12 intersects I-5 at milepost (MP) 68 and is jointly designated with I-5 for 20 miles, until Exit 88 where it continues east of the interstate.

Most of I-5 within the study area is a four-lane highway with 10-foot outside shoulders, and a median that ranges from 15 to 40 feet in width (FHWA and WSDOT 1998). The most recently published Average Daily Traffic (ADT) volumes cited an average of 54,800 vehicles from 5 milepost stations between MP 69 and 86 in the year 2000, ranging between 45,000 and 65,000 vehicles (WSDOT and FHWA 2001). For the area between MP 63 and 95 on I-5, there were 836 accidents between 1998 and 2000, averaging 279 a year. Roughly 60 percent of those accidents involved property damage, and approximately 40 percent were injury accidents.

3.10.1.2 State Route 12

State Route 12 (SR 12) shares the I-5 corridor between MP 68 and 88 (20 miles). U.S. 12 is a major route used for travel to and from the southeastern cities of Washington (Walla Walla, Yakima, Tri-Cities) and cities on the Olympic Peninsula (such as Aberdeen).

Because U.S. 12 is separated into three fairly distinct sections in the study area (corridor west of I-5, the section also designated as I-5, and the corridor east the I-5 intersection), the following traffic information is also split into three sections. The portion of U.S. 12 that enters the study area from the west extends from approximately MP 42 to 46. The average traffic volume of seven stations within this stretch was 10,543 in 2000. The lowest volume was 8,500 vehicles, while the highest recorded volume was 16,000 vehicles. The portion of the route shared by I-5 (approximately MP 47 to 67) had an ADT of 9,267 vehicles in 2000 (averaged over three station counts, ranging from 6,900 to 11,000 vehicles). The section of U.S. 12 extending east from I-5 within the study area between MP 67 and 80 had readings for ADT volumes at twelve stations ranging from 5,900 and 7,600 vehicles; the average was 6,908 vehicles (WSDOT and FHWA 2001).

3.10.1.3 State Route 6

State Route 6 (SR 6) transects the southwestern quarter of the study area. It intersects I-5 at the Exit 77 interchange.

Although there are approximately 30 miles of SR 6 in the study area, there are only traffic data for the last few miles of the route as it ends in Chehalis. In 2000, the average traffic volume was 8,567 vehicles from six stations between MP 49 and 51. The lowest volume reading was 6,000 vehicles while the highest was 10,000 vehicles (WSDOT and FHWA 2001).

3.10.1.4 State Route 507

State Route 507 (SR 507) begins in the City of Centralia and intersects I-5 at MP 82. It continues north within the study area for approximately 15 miles.

Although SR 507 extends through approximately 15 miles of the study area, there are only traffic data for the first 5 miles of the route as it begins in Centralia. The average traffic volume was 8,057 vehicles between fourteen stations between approximately MP 0 and 5. The lowest volume reading was 2,100 vehicles while the highest was 14,000 vehicles. Additionally, the SR 507 Couplet running through Centralia did not differ much in the annual volume of traffic (7,950 vehicles) as compared to the other sections measured within the study area (WSDOT and FHWA 2001).

3.10.1.5 State Route 508

State Route 508 (SR 508) transects the southeastern corner of the study area. It begins just east of the community of Napavine, at the Exit 71 interchange of I-5.

SR 508 extends approximately 18 miles from I-5 to the east boundary of the study area. The traffic data from MP 0 to approximately 18 revealed an ADT volume of 3,754 vehicles, as averaged from thirteen locations in 2000; they ranged from 1,400 to 6300 vehicles (WSDOT and FHWA 2001).

3.10.2 Scheduled Road Improvement Projects and Ongoing Studies

Washington State Department of Transportation is currently evaluating alternatives for improvements to I-5 between the Toutle Park Interchange (Exit 52) and the Maytown Interchange (Exit 95), including the portion of the highway that runs through the study area. Improvements are being proposed to accommodate the expected 2020 travel demand and to upgrade transportation facilities to meet current WSDOT and Federal Highway Administration (FHWA) design standards. Alternatives are being evaluated for widening existing four-lane segments of I-5 to a six-lane divided highway and improving existing interchanges, including the SR 12 West Interchange (Exit 88) within the study area. Improvements could also include widening or replacement of bridges and overcrossings; alignment improvements, drainage improvements, and frontage road relocations (FHWA and WSDOT 1998). As part of this process, raising the grade of the highway by up to six feet across portions of the Chehalis River floodplain is being evaluated in order to reduce flooding-related closures of the highway in the Centralia/Chehalis area. If the flood reduction project is built then I-5 would potentially not have to be raised.

In addition, a number of projects are scheduled by local jurisdictions to improve current road conditions within the study area. The projects currently planned for each jurisdiction are identified in the following paragraphs.

3.10.2.1 Lewis County

The following projects are included in the Lewis County Draft 2002-2007 Six Year Transportation Improvement Program:

- 2002 – Centralia-Alpha Road – Resurfacing 2.3 miles
- 2002-2004 – Centralia-Alpha Road – Resurfacing 3.0 miles
- 2003-2004 – Jackson Highway – Road Improvements 2.6 miles
- 2003-2007 – Centralia-Alpha Road – Resurfacing 2.3 miles
- 2004-2007 – Centralia-Alpha Road – Resurfacing 2.1 miles
- 2004-2007 – Jackson Highway – Road Improvements 2.0 miles
- 2005-2007 – Jackson Highway – Resurfacing 2.9 miles

3.10.2.2 Thurston County

The following projects are included in the Thurston County Roads and Transportation Capital Projects, 2002-2007:

- 2002-2004 – Skookumchuck Road Upgrade, Coal to Whitefish
- 2003-2007 – Grand Mound Growth Area – road upgrades and a bridge replacement

3.10.2.3 City of Centralia

The City of Centralia Six Year Transportation Improvement Program from 2002-2007 includes the following projects:

- 2002 – Maple Street Bridge replacement
- 2003-2004 – Central Boulevard. Area Transportation Improvements – construction of new truck route
- 2003 – Harrison Avenue widening

3.10.2.4 City of Chehalis

Included in the City of Chehalis Six Year Transportation Improvement Program from 2002-2007 are the following projects:

- 2002-2003 – National Avenue Asphalt Overlay
- 2003 – Kresky Avenue Flood Mitigation Feasibility Study
- 2003-2004 – SW Newaukum Improvement
- 2004-2005 – SW Snively Avenue Improvement
- 2005-2006 – Downtown Market Boulevard. Improvement
- 2006-2007 – NW Front, NW Pacific, and NW Park Improvements

3.10.3 Pedestrian and Bicycle Facilities

Sidewalks serve a majority of the streets within the cities of Centralia and Chehalis, Bucoda, and other incorporated areas. In the unincorporated portions of Lewis County, sidewalks are found mostly in newer areas developed under the County’s current development standards. Paved shoulders and shared roadways provide pedestrian transport in much of the rural County. Hundreds of miles of pathways and trails traverse the forest and timberlands in Lewis County and in the Skookumchuck drainage in southern Thurston County.

Within the City of Chehalis, bicycle paths are designated on several streets throughout the city, including Market Street/National Avenue, Kresky Avenue, Chehalis Avenue, and St. Helens Avenue/Lawrence Road. The Port of Chehalis Comprehensive Plan (May 1997) evaluated long-range plans for pathways that would connect sites on Maurin Rd., Bishop Rd., and Jackson Highway with recreational facilities in the city, potentially converting abandoned railroad beds for bicycle and pedestrian use. Most of these run through the urban growth area and into Lewis County. Bicycling in the Centralia/Chehalis and surrounding area is very popular, drawing cyclists regionally for organized rides and tours.

3.10.4 Public Transit

Transit service is provided by Twin Transit, serving the Lewis Public Transportation Benefit Area (LPTBA). The LPTBA has an estimated population of 20,305, with the cities of Chehalis and Centralia as the core of the service area (City of Chehalis 1999). In 2000, the system average 22,000 passenger trips per month, with a total of 264,952 riders in that year (Twin Transit, pers. com 2001).

Twin Transit provides daily fixed route and para-transit service. The buses are wheelchair-accessible and fixed-route service runs seven days per week on three routes. The Lewis County Mall in Chehalis and the Centralia Train Depot serve as transfer points between routes. Connecting service to Thurston County’s Intercity Transit is also available. Twin Transit serves two park-and-ride facilities.

3.10.5 Airports

The Chehalis-Centralia Airport is located in Chehalis, west of the I-5 interchange at Exit 79. Runway 15/33 is 5,000 feet long and serves approximately 36,000 operations annually (City of Chehalis 1999). Approximately 65 percent of the air traffic handled by the airport is local general aviation, and 35 percent is transient general aviation. A second runway, runway 1/19, was permanently closed several years ago when its usable length was reduced.

3.10.6 Rail Transportation

Passenger rail transportation is provided by Amtrak, which serves the Centralia/Chehalis area with six daily trains. The station is located in Centralia, just east of SR 507. This service operates on track owned by Burlington-Northern Santa Fe Railroad (BNSF).

Freight rail service is provided by BNSF and Union Pacific (The Chamber 2001). These rail lines serve several commercial and industrial operations in the area, and a spur line extends into the Port of Chehalis Industrial Park (City of Chehalis 1999).

The Port of Chehalis owns the CM&E rail line, which connects to the BNSF mainline via the City of Tacoma rail line near Main Street in Chehalis. The CM&E rail line extends approximately 10 miles west to the Curtis Industrial Site.

3.10.7 Flooding

Flooding has occurred along the I-5 corridor within the study area, and in some cases has resulted in the closing of the interstate and other transportation routes. I-5 was closed for several days during the flood events in 1990, and substantial portions of the interstate between the 13th Street interchange in Chehalis and the Mellen Street interchange in Centralia were under water in February 1996, closing the highway for four days (FHWA and WSDOT 1998). WSDOT and FHWA minimum flood criteria require that the mainline pavement not be flooded during the 50-year flood event. Sections of I-5 that do not meet this standard include portions between the Chamber of Commerce Way interchange in Chehalis and the Mellen Street interchange. A section of the interstate around the 13th Street interchange in Chehalis also does not meet the 50-year flood standard.

All primary arterials in the City of Centralia are inundated with flood water during a 100-year flood event, which eliminates access to all major healthcare facilities (i.e., Centralia Providence Hospital) and severely hampers evacuation activities related to convalescent facilities, isolated residential areas and other public health and safety facilities, such as treatment plants, water wells, dikes and levees. Further, flooding significantly impacts the ability of police patrol cars and other civil service vehicles to reach people in need (Calkins, pers. com. 2001).

Within Centralia, SR 507 (named throughout the city as Mellen Street, Alder, Cherry Street, Pearl Street, Tower Avenue and Sixth Street) also becomes completely inundated in a large flood event. In addition to this major route, many of the smaller routes surrounding the city become significantly inundated, resulting in other portions of Lewis County becoming isolated from needed services and facilities (Calkins, pers. com. 2001).

Interstate commerce can only reach the cities of Centralia and Chehalis from the north (Olympia) via I-5. During a flood event, the interchanges at I-5 Exits 81 and 82 are flooded and impassable, in addition to the section of I-5 flooded to the south of Centralia (Calkins, pers. com. 2001).

3.11 Air Quality

3.11.1 Regulatory Background

The Federal Clean Air Act (CAA) was enacted in 1969, and established the National Ambient Air Quality Standards (NAAQS). The NAAQS includes both primary and secondary standards for various air pollutants. Unless a state has adopted more stringent standards, NAAQS apply (Table 3.11-1). The primary standards define maximum concentrations of specific pollutants, which are set to protect the public health. The secondary standards define maximum concentrations of certain pollutants that are known or suspected of causing damage to vegetation, visibility impairment or material soiling.

Air quality regulation in Washington is divided between the (EPA) Region 10 and WDOE. EPA and WDOE establish regulations designed to limit emissions from air pollution sources and to minimize concentrations of pollutants in the outdoor air. Although their regulations are similar in stringency, each agency has established its own standards. Washington has established additional state ambient standards for total suspended particulates and sulfur dioxide standards more stringent than the federal requirements.

The EPA developed the General Conformity Rule to implement section 176(c) of the CAA. The rule became effective on January 31, 1994. The underlying principle of the General Conformity Rule is that Federal actions must not cause or contribute to any violation of a NAAQS. A conformity determination is required for each pollutant where the total of direct and indirect emissions caused by a Federal action in a non-attainment area exceeds minimum threshold levels listed in the General Conformity Rule (40 C.F.R § 93.153.).

WDOE has established state local ambient air quality standards that are equivalent to the national standards with a few limited additional conditions. The Southwest Clean Air Agency (SWCAA), the agency responsible for air quality regulation in the Centralia area, has adopted the EPA and Ecology's standards by reference.

3.11.2 Existing Conditions

Under federal regulations, areas that violate primary ambient air quality standards are designated as non-attainment areas, and State Implementation Plans must be developed to bring these areas into attainment. For the Centralia area, the Southwest Clean Air Agency (SWCAA) is the direct manager of air quality issues. Based on local air quality monitoring data and WDOE and SWCAA analysis, the EPA has determined that the Lewis County area is either in attainment or unclassified for each of these standards. Because the area meets all ambient air quality standards, SWCAA's regulatory program has been developed to maintain air quality. This includes general regulations and project-specific programs.

Table 3.11-1: National, State, and Local Ambient Air Quality Standards.

Pollutant	Averaging Time	National (Primary)	National (Secondary)	Washington State
Total Suspended Particulates	Annual Geometric Mean	No Standard	No Standard	60 ug/m^3
	24 – Hour Average		No Standard	150 ug/m^3
Particulates PM_{10}	Annual Arithmetic Mean	50 ug/m^3	50 ug/m^3	50 ug/m^3
	24 – Hour Average	150 ug/m^3	150 ug/m^3	150 ug/m^3
Particulates $PM_{2.5}$	Annual Arithmetic Mean	15 ug/m^3	15 ug/m^3	No Standard
	24 – Hour Average	65 ug/m^3	65 ug/m^3	No Standard
Sulfur Dioxide (SO_2)	Annual Average	0.03 ppm	No Standard	0.02 ppm
	24-Hour Average	No Standard	0.50 ppm	0.10 ppm
	3-Hour Average	0.14 ppm	No Standard	No Standard
	1-Hour Average	No Standard	No Standard	0.40 ppm [A]
Lead (Pb)	Quarterly Average	1.5 ug/m^3	1.5 ug/m^3	No Standard
Carbon Monoxide (CO)	8-Hour Average	9 ppm	9 ppm	9 ppm
	1-Hour Average	35 ppm	35 ppm	35 ppm
Ozone (O_3)	1-Hour Average	0.12 ppm	0.12 ppm	0.12 ppm
	8-Hour Average [B]	0.08 ppm	0.08 ppm	No Standard
Nitrogen Dioxide (NO_2)	Annual Arithmetic Average	0.053 ppm	0.053 ppm	0.05 ppm

Notes: ppm = parts per million ug/m^3 = micrograms per cubic meter
[A] 0.25 not to be exceeded more than two times in any 7 consecutive days.
Primary standards are listed in this table as they appear in the federal regulations.
[B] Eight-hour ozone standard went into effect on September 16, 1997, but implementation is limited.

Air quality at a given location is described by the concentration of air pollutants in the atmosphere. Units of concentration measurement are generally expressed in parts per million (ppm) for micrograms per cubic meter (ug/m^3). The significance of a pollutant concentration is determined by comparing it with an appropriate Federal and/or state standard. For the purpose of this study, a significant air quality impact is defined as an exceedance to the standards that cannot be minimized to a level below the standards.

A list of facilities that are currently permitted by the state to emit air pollutants in the study area is presented in Table 3.11-2. The latest annual emissions inventory from SWCAA for Lewis County are shown in Table 3.11-3.

Table 3.11-2: Ecology Facility List of Air Pollutant Emitters.

Facility Site Name	Ecology Identifier	Description
Cascade Hardwood	39118225	Small source governed only by local air authorities.
Columbia Harbor Lumber Co.	85236989	Small source governed only by local air authorities.
Darigold Inc. Chehalis dba Westfarm Foods	28466988	Facility that would be regulated under operating permit program but has opted to keep its emission limits lower than the threshold for the program.
Northwest Hardwoods Inc. Fill	1155	Small source governed only by local air authorities.
Northwest Pipeline Corp. Chehalis Meier	93825228	Facility that as a part of its process will emit air pollutants and is seeking construction permits for either a new source or changes to an existing facility.
Pacific Power	98913453	Facility that as a part of its process will emit air pollutants and is seeking construction permits for either a new source or changes to an existing facility.
TransAlta Centralia Mining LLC	55942474	Small source governed only by local air authorities.
Washington Natural Gas Chehalis	2298122	Facility that would be regulated under operating permit program but has opted to keep its emission limits lower than the threshold for the program.
West Coast Mills Inc.	98535131	Small source governed only by local air authorities.
Wood Products Div Wayne Dalton Corp.	78756294	Small source governed only by local air authorities.

Table 3.11-3: 2000 Lewis County Emissions (in Tons per Year).

SOURCE	CO	SO2	VOC	NOx	PM	PM-10
Industry	2537	83620	465	20331	4145	2615
On-road Vehicles	14348	133	1183	3141	5384	2956
Non-road Mobile Sources [1]	4541	48	762	579	71	71
Area Sources [2]	6758	10	2269	154	1019	911
TOTAL	28184	83811	4679	24205	10618	6553

Notes: [1]Non-Road Mobile Sources include aircraft, vessels/ships, railroads, lawn and garden equipment, recreational vehicles, and light commercial, industrial, construction agricultural, and logging equipment.
[2] Area Sources include solvent utilization, gasoline storage and transport, stationary source fuel combustion, woodstoves/fireplaces, residential trash and yard burning, slash burning, structure and wildfires.

3.12 Noise

Sound travels through the air as waves of minute air pressure fluctuations caused by vibrations. Several frequency-weighting schemes have been used to develop composite decibel scales that approximate the way the human ear responds to noise levels. The weighting of noise levels at different frequencies is due to the psychological perception of noise by humans. The A-weighted decibel scale (dBA) is the most widely used for this purpose.

The decibel (dB) scale used to describe sound is a logarithmic scale that accounts for the large range of audible sound intensities. People generally perceive a 10 dB increase in a noise source as a doubling of loudness. For example, an average person will perceive a 70 dB sound level as twice as loud as a 60 dB sound. Most people under normal listening conditions would probably perceive a 5 dB change.

Sound levels typically decrease by about 6 dB for every doubling of distance from the noise source, when distance is the only factor considered. Noise levels at different distances can also be affected by several factors other than the distance from the noise source. Topographic features and structural barriers that absorb, reflect, or scatter sound waves can increase or decrease noise levels. Atmospheric conditions (wind speed and direction, humidity levels, and temperature) can also affect the degree to which sound is attenuated over distance. As a result, the existing noise environment can be highly variable depending on local conditions.

3.12.1 Regulatory Background

The Federal Noise Control Act of 1972 (Public Law 92-574) requires that all federal agencies administer their programs in a manner that promotes an environment free from noises that may jeopardize public health or welfare.

Noise levels in the study area are regulated under the provisions of Chapter 173-60 WAC. Administered by WDOE, these regulations set maximum permissible noise levels for various types of land uses, based on three classes of Environmental Designation for Noise Abatement (EDNA): residential (Class A), commercial (Class B), and industrial (Class C). WAC 173-60 establishes maximum permissible noise levels for noise sources shown in Table 3.12-1. These maximum noise levels may be exceeded by 5, 10, and 15 dBA for limited durations (15, 5, and 1.5 minute periods in any one hour, respectively). Construction noise is regulated for rural and residential receiving properties during night hours (10 p.m. to 7 a.m.) only.

Table 3.12-1: Maximum Permissible Sound Levels $L_{eq.}$

	Receiving Property			
Noise Source	**Residential Day**	**Residential Night**	**Commercial 24 hours**	**Industrial 24 hours**
Residential	55	45	57	60
Commercial	57	47	60	65
Industrial	60	50	65	70

In addition to state regulations, the City of Centralia has a noise ordinance (Ordinance No. 1754), which prohibits any person from causing a "public disturbance noise." This includes "creation of frequent, repetitive, or continuous sounds which emanate from any building, structure, [etc]…which unreasonably disturbs or interferes with the peace and comfort of owners or possessors of adjacent property….".

3.12.2 Existing Conditions

The study area includes a mixture of residential, commercial, industrial, and agricultural lands. A variety of noise sources are present in the area. Based on observations made in the vicinity, sources of noise include the following:

- Traffic on I-5 and other roadways
- Trains passing through the rail corridor
- Agricultural machinery operated on agricultural land
- Various commercial and industrial activities
- General aviation aircraft

WSDOT conducted noise monitoring at near-highway locations, including the Chehalis-Centralia urban areas, order to characterize existing levels near I-5 (FHWA and WSDOT 1998). Highway noise, caused by passing vehicles, was considered to be the predominant noise near interstate highways. Other noise sources, which could affect the noise environment, include two rail lines and aircraft using the Chehalis-Centralia Airport. However, these noise sources are sporadic, and have little effect on the equivalent noise levels in the study area. Data collected during the WSDOT study are presented in Table 3.12-2:

Table 3.12-2: Noise Monitoring Summary (FHWA and WSDOT 1998).

Location	Monitored L_{eq} (dBA)	Approx. Distance to I-5 (meters)
1652 Bishop Road (Chehalis)	70	92
1034 Prindle Road (Chehalis)	62	84
1090 Prindle Road (Chehalis)	74	18
Corner NW Maryland St. & NW Folsom St. (Chehalis)	76	9
772 NW Maryland St. (Chehalis)	63	38
1213A Long Road (Centralia)	73	23
Lakeshore Motel at Plummer Lake (Centralia)	70	11
505 Lakeshore Drive (Centralia)	64	229
1317 Alexander (Centralia)	59	130
Borst Park (Centralia)	65	61
1112 Eckerson Road (Centralia)	66	92

Note: The noise descriptor, L_{eq}, is the equivalent continuous sound level in decibles, measured in dBA.

3.13 Hazards and Hazardous Materials

3.13.1 Regulatory Background

Federal, State, and local legislation regulates the proper use, disposal, and cleanup of hazardous materials.

The Comprehensive Environmental Response, Compensation and Liability Act (CERLA, also known as the Superfund Act) of 1980 (Public Law 96-510) is intended to protect the public and the environment from the effects of prior hazardous waste disposal and hazardous materials spills. CERCLA provides funds to compensate victims and to decontaminate the environment. The Superfund Amendments and Reauthorization Act (SARA) of 1986 (Public Law 99-499) amends some provisions of CERCLA and includes a Community Right-to-Know program that provides for public access to information on the presence of hazardous chemicals in their communities and releases of these chemicals into the environment.

The EPA administers the Resource Conservation and Recovery Act (RCRA) of 1976 (Public Law 94-580), along with the Hazardous and Solid Waste Amendments of 1984. This legislation provides the principal regulations for the storage, transportation, and disposal of both solid and hazardous waste. RCRA imposes requirements for reporting and permitting activities involving hazardous waste, and exercises operational control over those who generate, treat, store, transport, or dispose of hazardous waste.

Various State laws also govern hazardous materials and hazardous waste management. State hazardous waste regulations, analogous to RCRA, are primarily contained in the Washington State Dangerous Waste Regulations Chapter 173-303 WAC and the Model Toxics Control Act Chapter 173-340 WAC. The Hazardous Waste Control Law lists hundreds of hazardous and potentially hazardous chemicals. In addition, this code establishes criteria for identifying hazardous materials; regulates the storage, transport, and disposal of hazardous wastes; and identifies hazardous wastes that cannot be disposed of on land. The Washington State Dangerous Waste Regulations (Chapter 173-303-145 WAC), provides response authority for releases of hazardous substances, including spills, and hazardous waste disposal sites that pose a threat to the public health or the environment. Similar to CERCLA, Washington's cleanup law, the Model Toxics Control Act (Chapter 173-340 WAC), sets the standards and requirements for the cleanup of hazardous waste sites in order to protect the state's citizens and environment. This code establishes cleanup levels and points of compliance that are to be applied on a site-by-site basis. Cleanup levels determine the level a particular hazardous substance will not threaten human health or the environment, and points of compliance designate the location on the site where the cleanup levels must be met.

The Army Corps of Engineers Regulation 1165-2-132, Hazardous, Toxic and Radioactive Waste (HTRW) Guidance for Civil Works Projects, provides guidance for considering issues associated with HTRW, which may be located within project boundaries or may affect or be affected by Corps Civil Works projects. This regulation outlines procedures to facilitate early identification and appropriate consideration of HTRW concerns in the reconnaissance, feasibility, preconstruction engineering and maintenance, repair, replacement, and rehabilitation phases of a project. Specific goals include (1) identification of level of detail for HTRW investigations and reporting for each phase of a project (2) promotion of early detection and response by the appropriate responsible parties; (3) determination of viable options to avoid HTRW problems; (4) the establishment of a procedure for resolution of HTRW concerns, issues or problems.

3.13.2 Criteria for Determining Baseline Conditions

The Corps conducted a preliminary HTRW evaluation via the Internet and through coordination with the Department of Ecology Toxics Cleanup Program, Southwest Regional Office, for occurrence of HTRW on lands, including structures and submerged land, in the study area. The evaluation included a project review, review of site literature and project features, database search, review of available records and aerial photography, site inspections, and interviews. The following potential indicators were searched for: landfills, sumps, disposal areas, aboveground and underground storage tanks, vats, containers of unidentified substances, spills, seepage, slicks, odors, dead or stressed vegetation, water treatment plants, wells, ditches, abandoned buildings, and transport areas (such as boat yards, harbors, rail yards, airports, truck terminals, and fueling stations).

The evaluation included a review of historical documentation; a review of regulatory listings and, if necessary, review of site files; site visits; and interviews with regulators, site owners and tenants where available or necessary. Regulatory lists reviewed included:

- EPA Lists: CERCLIS and the NPL
- Washington Lists: Confirmed and Suspected Contaminated Sites, State Cleanup Sites (MTCA), Voluntary Cleanup Sites, Hazardous Waste Generator Sites, Underground Storage Tanks, Leaking Underground Storage Tanks.

The assessment covered all study regions, within the general vicinity of the proposed project or existing features proposed for significant modifications. Several site visits were conducted over the past few years. A Preliminary Assessment/Site Investigation will be conducted to determine the presence of contamination within the main footprint of the preferred alternative.

3.13.3 Potential HTRW Concerns

Sites of potential concern within the study area (both identified and unidentified sites) include the following:

- **Old Centralia Landfill.** Adjacent to and downstream from the City of Centralia Wastewater Treatment Plant at the Mellen St. Bridge is the old Centralia Landfill (a separate site from the Municipal Landfill). WDOE does not have any available environmental data on the landfill, but considers this site potentially contaminated.

- **Fort Borst Park**. This park is Located south of Harrison Avenue and between Belmont Avenue and I-5. Stormwater runoff from I-5 is of concern in this area west of the highway. The Borst Park BP/Unocal No. 4722 is another concern in this area. Leaking underground storage tanks and product lines were removed from the site in 1991 (RZA AGRA 1992). New USTs were installed in 1994 with the construction of the present service station (GeoEngineers 1995).

- **Industrial Park in Northeast Chehalis**. The industrial park is located downstream from the point where Coal Creek flows into the Chehalis River valley. Land use is primarily commercial and industrial, with LUSTs the primary concern. A site visit behind the building at 1685 North National Avenue indicated the possibility of a tank removal. Review of the UST and LUST lists indicates tanks were removed.

- **Salzer Creek Flats.** This area is north of Salzer Creek and east of Centralia and Chehalis. Land use includes commercial, residential, and agriculture. A site visit revealed a previously unidentified diesel UST and a small oil spill associated with farm equipment at this site. Additionally, a salvage yard is located in the area.

- **Jorgenson Mill on Central Avenue**. WDOE is currently investigating this abandoned mill site.

- **Charlie's Towing at 2413 Cooks Hill Road**. Ecology is concerned about potential heavy metal and petroleum hydrocarbon contamination from prior use as autobody repair shop. This property extends north from Cooks Hill Road to the Chehalis River.

- **Chehalis-Centralia Airport.** The airport is located on the west side of I-5 between Chehalis and Centralia. Leaking USTs are of central concern at this site. A Complaint Investigation Report was filed by Ecology in October 1991. The file states that aviation fuel was forced from one of the USTs during the January 1990 flood. This tank and two others were removed from the site in 1991 with 425 cubic yards of contaminated soil. The airport is currently operational and surfaces are paved or grass covered.

3.14 Cultural Resources

3.14.1 Archaeology and History

Artifact forms found in this region suggest that the archaeological record may span roughly the past 8-10,000 years. The earlier part of this long interval (prior to about 4000 B.P.) appears to represent highly mobile hunting and gathering economies that depended heavily on hunting of large game. After about 3000 years B.P. a subsistence system involving heavier dependence on fishing and vegetal resource collecting emerged. This system involved a greater degree of sedentary occupation, especially during the winter months when stored foods provided a major part of the food supply. From spring through fall months, village groups split into smaller family foraging groups that moved between a series of resource collecting sites where roots, berries, salmon, various other fish, deer, elk, smaller mammals, and waterfowl were exploited. This semi-sedentary form of land use persisted through the first half of the 19^{th} century.

The flood control project area lies within the traditional territory of the Upper Chehalis Tribe, a division of the Southwestern Coast Salish. This area contained habitats for many important food resources in the Native economy: salmon, various other fish, camas, berries, acorns, bracken fern roots, deer, elk, and waterfowl. Most of these resources were available within the project area and archaeological sites associated with their harvest or capture are expected to exist there. Because of frequent winter flooding, most of the project area is not well suited to winter residential sites or villages. Those settlement types most likely to be represented in the project area are the various warm season resource collecting camps and stations.

Euroamerican presence in the area was of a relatively low intensity in the early 1800s, and primarily associated with the fur trade and the travel route between the Hudson Bay Company's posts at Fort Nisqually and Cowlitz Farm. By the mid-1850s, Euroamerican settlement of the area began with settlement focusing initially on the prairies around the confluence of the Skookumchuck and Chehalis rivers. By the last decade of the 1800s, the greater Centralia area supported a population of about 5000 people. The mainstays of the economy included harvesting and milling of timber, two large brick manufacturing yards, a furniture factory, coal mining, and diverse agricultural activities including hop growing. Most of these activities persisted as central elements of the local economy through the remainder of the historic period.

3.14.2 Previous Cultural Resources Investigations and Known Cultural Resources

Previous cultural resources investigations have been carried out for a variety of construction projects including natural gas pipelines, highway building, a sewage treatment plant, the Corps of Engineers Centralia-Chehalis urban levee alignments project, City of Centralia waterline routes, a fiber optic cable, a gas-fired combustion turbine generation plant. The peak of archaeological work in this area took place in the 1970s but some work has continued up to the surveys for the proposed flood control project during the past year. These projects have inventoried a total of 69 prehistoric archaeological sites, most of which are characterized as open campsites or lithic scatters comprised of flaked stone and fire-modified rock.

A cultural resources reconnaissance for a Corps of Engineers flood control project in the Centralia-Chehalis urban area was done in 1977. This survey covered 445 acres, recorded 20 new sites and 7 previously recorded sites. Most sites were located on the floodplain, but several were on higher ground such as on outwash terraces and upland forest locations. Stone tool forms represented suggest an 8000 year history of usage.

A total of 16 historic sites has been previously recorded for the project area. Nine of these sites pertain to historic structures that are associated with the concentration of the region's populations. These six include: the Old Ferry Site (45LE176), the Claquato Church (45LE236), the Fort Borst Blockhouse (45LE239), the O. B. McFadden house (45LE240), Centralia College (45LE244), the Borst House (45LE245), the Olympic Club saloon (45LE246), the Starke farmstead (45TN73), and a split cedar rail fence (45TN74) probably associated with the Starke residence. The site of the Centralia Massacre (45LE243) was the site of a unique incident.

A cultural resources reconnaissance of the Skookumchuck Reservoir that was carried out in the fall of 2000 recorded three previously unidentified prehistoric lithic scatters, one previously recorded lithic scatter, and elements of a historic period granite quarry site (Hercules Quarry #6). The prehistoric sites appear to represent occupations older than 3-4000 years in age.

During the summer of 2001, a cultural resources reconnaissance was carried out of approximately a 10 percent sample of the total acreage of properties in the flood control project area that had a Right of Entry contract in place. These properties are largely confined to the west side of I-5 and the Chehalis River, an area of notable information deficiency in the previous surveys. This reconnaissance covered 266 acres and employed systematic shovel probes for those tracts of land where ground surface was obscured by vegetation. A total of nine new sites and one isolate were recorded and boundaries of two previously recorded sites were extended.

Cultural materials identified at these sites were predominately fire-modified rock with some formed tools and debris from stone tool manufacture.

The topography of the Chehalis River floodplain contains slight elevation differences that are expressed as linear ridges or as knolls. It is likely that these features represent geomorphic features formed during the terminal Pleistocene or during subsequent erosional and depositional episodes, but modern agricultural practices have probably modified the sharpness of these features. Previous cultural resource investigations indicate a tendency for sites to be concentrated on these slightly elevated landforms. These investigations also allow an estimation of the average density of prehistoric sites within the project area: 1 site/19 acres.

Substantial areas of the floodplain within the project area are cultivated and this activity causes some ongoing loss of integrity of archaeological deposits that are within the plow zone. Because most of the recorded archaeological sites in the project area have not been tested, depth characteristics, integrity, and status relative to the National Register of Historic Places are mostly unknown.

3.15 Environmental Justice

Executive Order 12898 requires the Federal government to achieve environmental justice by identifying and addressing disproportionately high adverse effects of its activities on minority and low-income populations. It also requires the analysis of information such as the race, national origin, and income level for areas that would be affected by environmental actions.

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies.

The demographics of the study area were examined to characterize the groups of people found within the study area. The data came from U.S. Census bureau data from the State of Washington, Lewis County, Thurston County, the cities of Chehalis and Centralia, the towns of Bucoda, Rochester, Pe Ell, and Grand Mound, and the Chehalis Reservation. The town of

Galvin is also within the study area, but no census data were available specifically for Galvin. Table 3.15-1 below provides a summary of the some of the census data used for this review.

Table 3.15–1: Census Data Summary for the Study Area.

Entity	Total Population	Race	% of Total Population by Entity	% of Total State Population	% Families BPL[2]	% Individuals BPL[1]
Washington State	5,894,121		100%	100%	7.3%	10.6%
		White	81.8%			
		Black or African American	3.2%			
		American Indian or Native American	1.6%			
		Asian	5.5%			
		Native Hawaiian or other Pacific Islander	0.4%			
		Other	3.9%			
		Two or More Races	3.6%			
		Hispanic or Latino (of any race)[3]	7.5%			
Chehalis Reservation	691		100%	0.01%	19.7%	24.4%
		White	34%			
		Black or African American	0.4%			
		American Indian or Native American	56.2%			
		Asian	0.0%			
		Native Hawaiian or other Pacific Islander	0.0%			
		Other	1.7%			
		Two or More Races	7.1%			
		Hispanic or Latino (of any race)[2]	7.5%			
Lewis County	68,600		100%	1.16%	10.4%	14.0%
		White	93.0%			
		Black or African American	0.4%			
		American Indian or Native American	1.2%			
		Asian	0.7%			
		Native Hawaiian or other Pacific Islander	0.2%			
		Other	2.6%			
		Two or More Races	2.0%			
		Hispanic or Latino (of any race)[2]	5.4%			
Thurston County	207,355		100%	4.0%	5.8%	8.8%
		White	85.7%			
		Black or African American	2.4%			
		American Indian or Native American	1.5%			
		Asian	4.4%			
		Native Hawaiian or other Pacific Islander	0.5%			
		Other	1.7%			
		Two or More Races	3.9%			
		Hispanic or Latino (of any race)[2]	4.5%			

[2] *BPL – Below the Poverty Level*

[3] *Pursuant to the U.S. Census Bureau (Census 2000), the percent of the Hispanic or Latino population is in relation to the entire population, regardless of race. Using the State values as an example, 7.5% of the population is Hispanic or Latino, in relation to 92.5% of non-Hispanic or Latino.*

Table 3.15–1: Census Data Summary for the Study Area (Cont.)

Entity	Total Population	Race	% of Total Population by Entity	% of Total State Population	% Families BPL[1]	% Individuals BPL[1]
City of Chehalis	7057		100%	0.12%	16%	19.8%
		White	89.6%			
		Black or African American	1.3%			
		American Indian or Native American	1.5%			
		Asian	1.2%			
		Native Hawaiian or other Pacific Islander	0.2%			
		Other	4.0%			
		Two or More Races	2.2%			
		Hispanic or Latino (of any race)[2]	7.9%			
City of Centralia	14,742		100%	0.25%	13.6%	18%
		White	89.8%			
		Black or African American	0.4%			
		American Indian or Native American	1.2%			
		Asian	0.9%			
		Native Hawaiian or other Pacific Islander	0.3%			
		Other	4.9%			
		Two or More Races	2.4%			
		Hispanic or Latino (of any race)[2]	10.2%			
Town of Bucoda	628		100%	0.01%	18.5%	25.1%
		White	92%			
		Black or African American	0.0%			
		American Indian or Native American	0.8%			
		Asian	2.2%			
		Native Hawaiian or other Pacific Islander	0.3%			
		Other	1.3%			
		Two or More Races	3.3%			
		Hispanic or Latino (of any race)[2]	2.1%			

[1] *BPL – Below the Poverty Level*

[2] *Pursuant to the U.S. Census Bureau (Census 2000), the percent of the Hispanic or Latino population is in relation to the entire population, regardless of race. Using the State values as an example, 7.5% of the population is Hispanic or Latino, in relation to 92.5% of non-Hispanic or Latino.*

Table 3.15–1: Census Data Summary for the Study Area (Cont.)

Entity	Total Population	Race	% of Total Population by Entity	% of Total State Population	% Families BPL[1]	% Individuals BPL[1]
Town of Rochester	1,829		100%	0.03%	6.2%	7.7%
		White	88.4%			
		Black or African American	0.2%			
		American Indian or Native American	1.7%			
		Asian	0.9%			
		Native Hawaiian or other Pacific Islander	0.1%			
		Other	5.5%			
		Two or More Races	3.2%			
		Hispanic or Latino (of any race)[2]	10.4%			
Town of Grand Mound	1,948		100%	0.03%	13.5%	14.8%
		White	88.0%			
		Black or African American	0.3%			
		American Indian or Native American	1.2%			
		Asian	0.3%			
		Native Hawaiian or other Pacific Islander	0.1%			
		Other	6.6%			
		Two or More Races	3.4%			
		Hispanic or Latino (of any race)[2]	10.2%			
Town of Pe Ell	657		100%	0.01%	20.0%	22.4%
		White	93.2%			
		Black or African American	0.3%			
		American Indian or Native American	2.3%			
		Asian	0.9%			
		Native Hawaiian or other Pacific Islander	0.6%			
		Other	1.1%			
		Two or More Races	1.7%			
		Hispanic or Latino (of any race)[2]	2.3%			

[1] *BPL – Below the Poverty Level*
[2] *Pursuant to the U.S. Census Bureau (Census 2000), the percent of the Hispanic or Latino population is in relation to the entire population, regardless of race. Using the State values as an example, 7.5% of the population is Hispanic or Latino, in relation to 92.5% of non-Hispanic or Latino.*

Two distinct minority groups are evident in the study group: the American Indian and Native American population and the Hispanic or Latino population. Low-income populations are found throughout the study area, with no distinct pattern. Almost all of the communities, with the exception of Rochester, have a higher number of families and individuals below the poverty level than the State average.

Executive Order 12898 also requires Federal agencies to identify the need to ensure the protection of populations relying on subsistence consumption of fish and wildlife, through the analysis of information on such consumption patterns and communications to the public of associated risks. Consumption records were not available; however, the Confederated Tribes of the Chehalis has an active interest in the maintenance of fishery resources for consumptive use as well as sources of income to Tribal members.

Public involvement activities were related to developing public information on the study and reaching all groups within the study areas. The public involvement/outreach strategy consisted of (1) a series of workshops and public meetings, (2) workshop and meeting notices, news releases, and public information brochures, and (3) speaking engagements at community service clubs and local organizations by Corps and Lewis County personnel. The events were held in several locations throughout the study area. Local newspapers and local radio stations also provided extensive coverage of the study.

Lewis County also solicited the active involvement of Native American tribes, local land use planners, environmental groups, local governmental agencies, businesses, interested groups, and private citizens.

3.16 Socioeconomics

Lewis County's population increased moderately from 59,358 in 1990 to 68,600 in 2000, ranking 15th among the 37 counties in the state. During the period from 1969 to 1999, Lewis County's population increased by 52.6 percent, trailing the state increase of 72.2 percent and outpacing the national population increase of 35.5 percent. From1988 through 1997, the average annual growth rate was 1.8 percent. The statewide average growth for the same period was 2.2 percent. Most recently, the growth rate in Lewis County has been stagnant, with an average annual increase of 0.3 percent from 1998 to 2000. There was essentially no population growth in 2000.

After several years of economic distress in the early 1980s associated with cutbacks in the timber industry, Lewis County has begun to show some positive growth. From 1986 to 1997, the civilian labor force increased annually by an average of 3.4 percent, and nonagricultural jobs increased by an average of 3.1 percent. The unemployment rate decreased from 11 percent in

1993 to 8.2 percent in 1999. However, with a three-year average unemployment rate (January 1999 – December 2001) of 8.8 percent, Lewis County is designated as a “distressed area” under state guidelines (Washington State ESD 2002). Lewis County’s economy is currently in transition. Although much of the County’s economic activity remains focused on agriculture and forestry, substantial gains have been made in light industry and retail trade. Overall, the County is moving from a resource-based, extractive economy to one seeking emphasis on light manufacturing, wholesale distribution, and commerce. In 2000, the largest employer was the service industry at 45 percent, followed by retail trade at 16 percent and construction at 8 percent.

In 1999, Lewis County had a per capita personal income (PCPI) of $20,851, ranking 23rd in the state. This was 69 percent of the state average of $30,380 and 73 percent of the national average of $28,546. This reflects an increase of 4.8 percent from 1998. During the same period, the state increase in PCPI was 6.3 percent and the national increase was 4.5 percent.

The total personal income (TPI) for Lewis County in 1999 was $1,430,803, ranking 16th in the state and accounting for 0.8 percent of the state total. The TPI for 1999 reflects an increase of 5.6 percent from 1998, compared with a state increase of 7.6 percent and a national increase of 5.4 percent.

The TPI includes the earnings (wages and salaries, other labor income, proprietors’ income), dividends, interest, and rent; and transfer payments received by the residents of Lewis County. In 1999, earnings were 58.1 percent of TPI; dividends, interest, and rent were 19.5 percent; and transfer payments were 22.4 percent. From 1998 to 1999, earnings increased 6.1 percent; dividends, interest, and rent increased 4.5 percent, and transfer payments increased 5.6 percent.

Total earnings by persons employed in Lewis County increased from $849,512 in 1998 to $901,965 in 1999, a change of 6.2 percent. The largest earnings by industries in 1999 were services, accounting for 17.8 percent of earnings. State and local government accounted for 16.9 percent of earnings and retail trade accounted for 16.0 percent. Of the employers that accounted for at least 5 percent of earnings in 1999, the slowest growth in earnings from 1998 to 1999 occurred in state and local government, which increased 4.3 percent. The fastest growth in earnings during this period occurred in construction, which increased 15.2 percent. Construction accounted for 7.1 percent of total earnings in 1999.

The 1997 model-based median household income in the county was $32,557. The percent of persons below the poverty level was 14.2 percent in Lewis County; the statewide poverty rate in 2000 was 10.2 percent

According to the 2000 census, there were 29,585 housing units in the county. Of these, 63.5 percent were owner occupied, 25.4 percent were renter occupied, and 11 percent were vacant.

4. ENVIRONMENTAL EFFECTS

This chapter provides a description of the environmental consequences of the preferred alternative relative to the no action alternative on all elements of the affected environment as described in Chapter 3.0.

In general, the discussion for each of these elements of the affected environment includes an analysis of individual short-term and long-term affects for both the no-action and preferred alternative as described in Chapter 2.0. Additionally, planning for this project has identified a major mitigation feature located in the Scheuber Ditch SR-6 area (Figure 2.6). This feature is proposed to provide mitigation within the project area to address project impacts from several disciplines. Focusing on mitigation principally within the Scheuber ditch area is intended to consolidate multiple mitigation objectives to achieve added benefits through increased floodplain connectivity and improved interaction between wetland, fish and wildlife ecology. The following paragraphs give a brief overview of the components of this mitigation proposal.

Scheuber Ditch/SR6 Mitigation

The Scheuber floodplain actions would involve the creation of a pond/wetland complex on the west side of the Chehalis/Centralia reach of the mainstem Chehalis River, north and south of SR-6. The purpose of the effort is to reconnect portions of the Chehalis River to the adjacent floodplain, providing functioning habitat for fish and wildlife as well as attenuation of flood flows. There are four elements of the project:

The oxbow immediately south of SR-6 would be reconnected to the Chehalis River by increasing to 400 feet the width of a low area between the oxbow and the river. This reconnection would provide surface flows to the oxbow at approximately the 1 or 2-year flood stage. Invasive plants would be removed and a 100-ft wide riparian zone would be planted around the oxbow. The area would be fenced off from livestock as needed. A shallow channel would also be excavated from the northern edge of the oxbow to SR-6. A 400-ft section of the State highway will be elevated onto a causeway with the shallow channel continuing beneath approximately 1000 feet to a new wetland area. The channel would carry flows at the 1 and 2-year flood stage. This would result in approximately 21 acres of new wetland habitat with 11 acres of riparian planting.

North of the highway, excavation and grading would allow distribution of flows through a series of interconnected ponds and wetlands. The existing topography and hydric soil distributions indicates that the wetlands are best located at the base of the slope on the west side of the floodplain near at the confluence of Bunker Creek and Scheuber ditch. The pond/wetland area would cover approximately 80 acres. The area would be configured as a high-interspersion habitat to increase productivity, refuge function, and hyporheic recharge. An existing unnamed creek would flow into the pond/wetland area and provide positive flow back through the shallow channel into the oxbow when Chehalis River flows are below approximately the 5-year flood stage. This would maintain water quality and increase function for salmonid rearing. Invasive plants would be removed from the area and shrubs and small trees such as alders, willows and dogwoods would be planted along the borders of the ponds and on the small islands within the complex to offer shading of aquatic habitat and foraging opportunities for terrestrial wildlife. An understory of shrubs and small trees as well as native grasses and forbs would be planted on the outer margins of the complex. LWD would be placed in the new channels and wetlands.

The connection between the pond/wetland complex and Scheuber ditch will include a sill so that flows below the 5-year flood stage will not flow north to the downstream end of the ditch, but rather would recede back through the pond/wetland complex. From the north end of the pond/wetland complex, a 400-ft wide riparian area (200 feet on each side) will be planted along both banks of Scheuber ditch to its downstream end, providing approximately 75 acres of riparian habitat. The ditch would be reconfigured to add meanders. This would provide primarily an aesthetic benefit, giving the ditch a more natural appearance.

A second wetland complex would be created at the north (downstream) end of Scheuber ditch. This area would be excavated and graded with a configuration similar to the complex at the south end and designed to provide many of the same functions. The complex would receive inflow from Coal Creek and Scheuber ditch from the south. These would provide flow through the wetland into the Chehalis River. The wetland would also receive backwater from the Chehalis River at annual high flows, which would provide refuge from high velocities for coho, chum and chinook salmon. Vegetation planting and LWD placement would occur as described above for the south wetland complex. The north wetland complex would encompass approximately 46 acres.

The mitigation project will provide wildlife and fisheries habitat, floodplain function and vegetative diversity in the mid-Chehalis basin. The project will also provide hydraulic function. Discussion of the relevance of each discipline to the conceptual mitigation project described above is included in the pertinent sections of this chapter.

4.1 Hydrology and Hydraulics

4.1.1 No Action Alternative

Under the No Action alternative, levees and other features of the preferred alternative would not be constructed. No structural changes would be made to the Skookumchuck Dam. Reservoir operations would not be modified for flood control, but would continue to be operated on a fill-and-spill basis with provision for a minimum 95 cfs outflow throughout the year. Minor and major flooding would continue to occur on the Chehalis River and tributaries, and the project area would continue to experience flood-related damages currently estimated at $9.5 million annually. Although no major projects with significant effects on hydrology and hydraulics have been approved in the area, other agencies or jurisdictions would continue to undertake flood hazard reduction measures. These efforts could include measures such as additional floodproofing or relocation of structures. Improvements to Interstate 5 to accommodate future traffic demands would require raising portions of the roadway in the vicinity of Centralia-Chehalis or other measures to provide flood protection. Widening and elevating the roadway would entail additional fill that would incrementally add to the loss of floodplain storage in the area. Although WSDOT has not completed detailed hydraulic studies, initial analysis indicated that this loss would have minor effects on 50-year and 100-year flood elevations (FHWA and WSDOT 1998). Widening of the freeway, construction of interchanges, and other improvements would increase the area of impervious surface and increase highway runoff. It is likely that bridges and culverts along I-5 would need to be modified to maintain adequate flow capacities.

4.1.2 Criteria for Determining Significance of Effects

A significant effect on hydrology and hydraulics would occur if project construction and/or operation would:

- Substantially alter streamflow characteristics within, downstream, or upstream of the project area.
- Cause a substantial increase in flood stage within, downstream, or upstream of the project area such that there would be increases in flood hazards. This could include increased damage to existing structures, closure of transportation corridors, or risk to life.
- Cause a substantial increase in flow velocity within, downstream, or upstream of the project area such that there would be significant increases in bank erosion, damage to existing structures, or risk to life.
- Substantially reduce recharge of groundwater resources in the project area.

4.1.3 Preferred Alternative

4.1.3.1 Short Term Effects

In locations where roadways would be modified as part of levee construction, flows in culverts or under bridges would be redirected for short periods during construction. Removal of vegetation, soil disturbance, and construction of temporary haul roads would temporarily increase runoff from construction areas. During levee construction, stormwater runoff would be routed to catch basins or other detention structures and treated in accordance with applicable criteria contained in the *Stormwater Management Manual for Western Washington* (Washington Department of Ecology 2001). With proper runoff controls in place, substantial increases in stormwater flows to local drainages are not expected.

Structural modifications to Skookumchuck Dam would be constructed during the late summer when the pool elevation in the reservoir is low. Since the modifications likely could not be completed in a single season, construction would be scheduled over two summers. During the interim fall and winter seasons, the reservoir would be allowed to fill and flows would be passed over the spillway as they are under existing operations. Since changes in the reservoir outflow regime would not occur until after construction of the dam modifications is complete, no short-term effects on hydrology and hydraulics are expected.

4.1.3.2 Long Term Effects

The preferred alternative would alter flood hydrology and hydraulics in the project area. The levee system would result in some reduction of the floodplain area that is inundated and alter floodwater storage. However, because the levees would be set back a significant distance from the existing streambanks, there would be relatively little effect on the active floodplain. As a result, the active floodplain would generally function in a manner similar to existing conditions. The areal extent of flooding would be only slightly modified during small floods. Notable changes in the areal extent of flooding would occur only during floods larger than the 2-year event. The areas that would be protected from flooding during these events are mostly urban areas east of I-5. The protected areas are, in general, not within the active floodway, but rather are backwater or temporary storage areas where short-duration flooding occurs with little flow velocity.

There would be a change in peak flood stage at several locations in the project area. There would be a decrease in the 100-year peak flood stage below RM 70.74 on the Chehalis River. The peak flood stage would increase between RM 70.74 and RM 78; the maximum increase would be 0.61 feet at RM 72.8. The 100-year peak flood stage would decrease by 0.18 feet at the Galvin Road Bridge, and by 0.24 feet at Grand Mound. Between Grand Mound and Porter, the peak flood stage decrease would vary between 0.07 feet and 0.49 feet.

Along the Skookumchuck River, the 100-year peak flood stage would decrease from 0.47 feet to 4.25 feet from RM 10 to the mouth. There would also be significant flood damage reduction to communities upstream; for example peak flood stages would be reduced by 3.22 feet at Bucoda.

During major floods, control boxes would isolate the flow of Dillenbaugh Creek and keep it from entering the Chehalis River to prevent backwater from flooding I-5 and Chehalis. Construction of the levee system may involve relocation of a channelized portion of Dillenbaugh Creek in the area between the Rice Road interchange and the BNRR tracks. Other reaches to the south may also need to be relocated. Detailed design of the channel relocation will be completed in future design phases.

The areas that would be protected from flooding do not represent significant sources of groundwater recharge to the Chehalis basin. The vast majority of groundwater recharge in the basin occurs as a result of the infiltration of direct precipitation. The infiltration of floodwaters in floodplain areas represents only a minor contribution to groundwater recharge. This occurs because of the limited areal extent of the floodplain, the relatively short duration of flooding, and the predominantly fine-grained soils in the area. The areas that would be protected from flooding are mostly developed and have a high percentage of impervious surfaces (e.g., roads, parking lots, roofs) that further limits recharge of groundwater resources.

Recharge in floodplain areas often constitutes bank storage that provides baseflow to the stream immediately following a flood, but provides little baseflow thereafter. Since flooding in the Chehalis River basin generally occurs from late October through March, baseflow contributions from bank storage to the river would be negligible during the low flow periods that typically occur in later July through early October. Overall, the levee system is predicted to have an undetectable and insignificant effect on groundwater recharge and baseflow contribution to the Chehalis River.

Modification of the Skookumchuck Dam would provide up to 20,000 acre-feet of flood storage and alter the timing and duration of flood flows from the reservoir. During non-flood periods, flows from the dam would be similar to those under the existing operation. Although a rule curve for managing high flow events has not been finalized, it is assumed that reservoir operations would be modified to allow drawdown of the pool to elevation 455 feet in late fall. Any inflows less than 3,000 cfs would be allowed to discharge directly though the new spillway outlet gates. When inflows exceed 3,000 cfs, the flood control pool would be used to store most of the flood flow, except for a constant minimum outflow of 95 cfs. Because of the contributions of tributary streams below the dam, flows in the Skookumchuck River downstream from the dam would still be well above 95 cfs during floods. During a flood, outflows from the reservoir would be reduced to prevent Chehalis River flows at Pearl Street from exceeding 5,000 cfs. After the event passes, water stored in the reservoir would continue to be released at volumes high enough to reach but not exceed 5,000 cfs at Pearl Street. Discharge of flood flows from the dam would likely be limited to 3,000 cfs, which is essentially bankfull flow in the upper reaches of the Skookumchuck below the dam. As a result of the modified operations, flood peaks would be reduced, the timing of peak flows would be delayed, and the duration of bankfull flows would be extended. Depending on the event, bankfull discharges could last from a few hours for smaller floods up to approximately 5 days for extreme floods.

The reduction in overbank flooding on the Skookumchuck is not expected to significantly affect groundwater recharge in the Skookumchuck subbasin. The large volume of tributary input, frequency of local flooding, and location of adjacent wetlands indicate that the Skookumchuck subbasin approaches or exceeds groundwater saturation without the addition of water from winter and early spring floods.

Changes in flow velocities within the Chehalis and Skookumchuck Rivers are expected to have a negligible effect on bank erosion and would not increase damage to structures or risk to life.

Hydraulic modeling of the preferred alternative indicates that there would be little effect on flood stages downstream from Centralia. Because the levee system would cause relatively little change in the active floodplain, flood flows would be conveyed downstream in a manner similar to existing conditions. Improved flood storage at the Skookumchuck reservoir would result in flood stage reductions up to several tenths of a foot in areas downstream from the confluence with the Skookumchuck River. There would be negligible effect on the timing and duration of flooding downstream of Centralia.

4.1.4 Summary

In summary, over the long term, implementation of the preferred alternative would change the hydrology and hydraulics of flood flows along the Chehalis and Skookumchuck rivers and tributaries but not substantially. The levee system would reduce the floodplain area that is inundated and alter floodwater storage characteristics, but these changes would be minimized by the levee setbacks and therefore no significant impacts. Significant reductions in groundwater recharge and baseflow (flow velocity within, downstream, or upstream of the project) support are not expected. There would be a slight reduction (no substantial increase) in flood stages downstream of Centralia.

4.1.5 Mitigation

Mitigation actions in the SR 6/Scheuber floodplain area would reconnect portions of the Chehalis River to its floodplain. This would increase the frequency with which flood flows enter that area and allow distribution of flows through a series of interconnected ponds and wetlands. These actions would be expected to enhance local groundwater recharge associated with minor (1 to 2-year) floods and provide some attenuation of flood flows from larger events.

4.2 River Geomorphology

The alternatives considered include project components that could directly modify geomorphic features and alter geomorphic processes that form and maintain the river channel and its floodplain. Geomorphic features and processes documented within the project area are described in detail within Section 3.2. The assessment of potential environmental effects on river geomorphology describes the potential changes in geomorphic features and processes related to specific project elements for the No-action Alternative and the Preferred Alternative.

4.2.1 No Action Alternative

Under the No Action Alternative, geomorphic processes would continue to operate under the current flow and sediment regime. Recent trends (last 50 years) indicate that channel change proceeds within the project area at a slow rate primarily through localized bank erosion, channel migration, and sediment accumulation within the channel and on the floodplain. The project area will continue to be a zone of sediment accumulation in which the rates of channel adjustment vary in response to temporal changes in sediment delivery.

4.2.2 Criteria for Determining Significance of Effects

A significant effect on river geomorphology would occur if construction and/or operation activities would:

- Result in the loss of flushing flows such that sediment transport is significantly affected.
- Increase flood duration such that significant erosion or depositional changes occur and negatively affect channel processes.
- Increase erosion or degrade channel processes through excessively rapid ramping up of flow as flow management at the dam transitions from storage during the flood peak to release following the peak.

4.2.3 Preferred Alternative

The combined setback levee and Skookumchuck Dam modification alternative will alter flood hydrology and hydraulics within the project area. Since hydraulics drive the sediment transport and erosion processes that modify channel form, the assessment of environmental effects on river geomorphology evaluates the magnitude and location of changes to sediment transport capacity within the project area. Specific potential changes considered within the geomorphic analysis include the following:

- Proposed modifications to the Skookumchuck Dam would alter the shape of flood hydrographs within the Skookumchuck River. Possible hydrograph changes include reduced peak flow, delayed timing of peak flow, rapid ramping of flow volume when stored water is quickly released, and extended duration of elevated flow as the reservoir is drained after the flood event. In localized areas that typically experience bank erosion or riverbed scour, these hydrologic changes could affect the rate and extent of erosion and scour.

- The proposed levee network would reduce the extent of active floodplain that receives floodwaters. The proposed levee network would modify the locations and timing of temporary floodwater storage on the floodplain. This change in storage would alter the peak water surface elevation at several locations and modify the timing and duration of floodwater routing. Such changes could alter the locations and rates of sediment transport, deposition, bank erosion, and riverbed scour.

4.2.1.1 Short Term Effects

These potential effects were analyzed by evaluating changes in shear stress and velocity values at cross sections within the Skookumchuck River and the Chehalis River. The details of the dam operation plan are not yet completed as part of the conceptual design. For the purpose of modeling flood hydraulics and dam operation, simplified hydrographs were developed to maximize the flood control benefits afforded by the reservoir by providing maximum flood storage and evacuating the reservoir as quickly as possible after the flood event. These dam management release hydrographs will need to be refined as the actual dam operation plan is developed. The evaluation of potential geomorphic effects is based on the flow hydraulics predicted by the current flood hydraulic model including the simplified dam management release hydrographs.

4.21.2 Long Term Effects

The evaluation of potential geomorphic changes showed that the anticipated hydrologic and hydraulic changes would have no effect on sediment transport capacity and potential for bank erosion within the Chehalis River except in a short (500 ft) reach of the river immediately upstream of the airport. Within this river reach floodwaters will be backwatered during extreme flood events reducing transport capacity locally and potentially encouraging additional sediment deposition within the channel in this area.

Within the Skookumchuck River, the potential for geomorphic change is greater than it is within the Chehalis River, but actual changes will depend strongly on the final dam operation plan for regulating flow releases. The simplified dam release hydrographs eliminated storm peaks, ramped from 95 cfs up to 3000 cfs very quickly, and maintained continuous, steady release rates between 2,000 and 3,000 cfs for approximately 5 days. The potential geomorphic effects of this hydrograph diminish progressively downstream because the flood wave attenuates as it propagates down the river. The steady release rate of 3,000 cfs is high enough to transport sediment and modify channel form. Since this elevated flow extends the duration of erosion and channel adjustment in comparison to the pre-modification hydrograph, there will be some impact on channel morphology. The specific locations and cumulative magnitude of potential channel changes have not been mapped out as part of the current analysis. This additional analysis should be performed in support of developing a refined plan for dam operation.

4.2.4 Summary

In summary there would be no net loss in flushing flows or an increase in flood duration. Erosion or degraded channel processes will not occur based on the ramping up of the flow as the requirement for fisheries habitat will dictate ramping procedures as discussed in Appendix B.

4.2.5 Mitigation

The current analysis determined that significant effects on channel morphology are possible if dam operation maximizes flood mitigation benefits without accounting for potential geomorphic impacts. Potential geomorphic effects can be reduced at the expense of diminished flood control. Mitigation needs will depend on the specific impacts associated with the refined operational guideline for Skookumchuck Dam and hydrologic reporting both anticipated to be completed in Planning, Engineering and Design phase of the proposed project. The relations between flow releases and geomorphic processes conceptually described above will guide the development of the operational guidelines to optimize the balance of flood management benefits and geomorphic impacts associated with dam operation.

4.3 Water Quality

4.3.1 No-Action Alternative

Under this alternative, no action would be taken by the Corps to change the current status of water quality in the project area. Therefore, water quality within the project area would not be affected by construction activities and would be expected to remain similar to existing conditions.

4.3.2 Criteria for Determining the Significance of Effects

A significant effect on water quality would occur if construction and/or operation activities would:

- Violate any water quality standards or waste discharge requirements
- Substantially degrade surface water and/or groundwater quality
- Contaminate a public water supply
- Substantially increase suspended solids in and turbidity of the river
- Discharge contaminants into the river

4.3.3 Preferred Alternative

4.3.3.1 Short Term Effects

Levee construction would involve disturbance of soil that could cause changes in water quality if sediments are introduced into streams. This could result in increases in turbidity, suspended solids, and biostimulatory nutrients within and downstream of the project area. Implementing pollution control plans throughout construction can minimize these potential impacts. For example, trench soils will be placed well above the streambank and protected with silt fences, hay bales, or other facilities that would reduce sediment runoff into the stream. Please see section 4.13.5 for measures that would be taken to minimize hazardous material spills.

4.3.3.2 Long Term Effects

Potential long-term consequences of the preferred alternative include increased levels of fine sediment and contaminants in stream corridor from nonpoint source runoff. However, long-term effects of the levee would also be minimized through the levee design; setting levees back away from river as far as possible, or a minimum 50-foot buffer zone from water edge to levee toe when setback is not possible will reduce levee-related adverse effects to non-significant levels.

4.3.4 Skookumchuck Dam Modifications

The construction and excavation of Skookumchuck Dam spillway sluices, intake structures, and other activities associated with this feature would be performed during summer months when water levels are low and water quality effects from short-term construction activities would, therefore, be minimized. Modifications to the Skookumchuck Dam have been designed to improve storage efficiency and should not result in changes to the seasonal water levels in the Skookumchuck River during the fall and winter months when flood storage would be required.

Since dam construction, sediments from the upper basin have likely been trapped by the reservoir. This sediment accumulation may provide a benefit by reducing the turbidity downstream during fill and spill operations. However, data are not available to further interpret the sediment supply and transport characteristics of the Skookumchuck River below the dam. Potential long-term effects such as increased moderate flows may result in greater scour of substrate and increased sedimentation, however, whether sediment movement impacts will continue in the long term or become significant is difficult to predict. The geomorphic analysis of the proposed modifications to the Skookumchuck Dam suggests that the modifications would have a negligible effect on sediment transport capacity and potential for bank erosion (Section 4.2).

4.3.5 Summary

In review of the information available, it appears that soil disturbance resulting from construction activities would be a temporary unavoidable impact. Construction-related sediment disturbances and potential effects from turbidity, suspended solids, hazardous construction materials would be minimized through the implementation of erosion and pollution control plans (refer to section 4.13). Long-term effects of operation and maintenance of the preferred alternative include increased runoff and increased sedimentation, which would be considered an unavoidable adverse effect. However, proposed mitigation and restoration activities have the potential to improve long-term water quality, and therefore minimize adverse water quality effects. There would be no contamination to the public water supply nor would contaminants be discharged into the river.

4.3.6 Mitigation

Construction related disturbances and potential effects would be avoided or minimized through the levee design and implementation of pollution control plans. Design objectives include:

- Setting back levees away from river as far as possible.
- Providing a minimum 50-foot buffer zone where possible between water edge and levee toe when setback is not possible.
- Minimizing in-water work.
- Carry out construction during biological window

No other mitigation is anticipated.

4.4 Biological Resources – Vegetation and Wetlands and Riparian Areas

4.4.1 No-Action Alternative

4.4.1.1 Vegetation Impacts.

Short Term Effects

Existing practices for land use and development (including forestry and agriculture) will continue to be in place that can result in the modification, loss and/or adverse impacts to existing vegetation communities. These are not expected to change as a result of the No-Action alternative.

Long Term Effects

It is likely that changes to existing vegetation communities will continue to occur as the study area develops and population increases. Forestry and agricultural practices are likely to continue into the foreseeable future, although it is possible that more forest and agricultural land will be converted to residential and commercial uses.

4.4.1.2 Wetland and Riparian Area Impacts

Short Term Effects

The existing permitting process for wetland filling and alteration will continue to be in place as well as existing unregulated activities that adversely impact wetlands. These are not expected to change as a result of the No-Action alternative. There is very little regulatory authority covering riparian areas that are not wetlands, so existing activities that adversely impact riparian areas are expect to continue.

Long Term Effects

While no major projects with significant impacts have been approved in the project area, flood damage reductions measures would continue to be explored. The WSDOT is still likely to pursue improvements to I-5 to accommodate traffic demands, which may include flood-proofing measures such as raising the freeway or constructing levees. Given the extent of wetlands within the project area, loss and/or degradation of wetland resources would be expected with these projects. Riparian areas are much more limited within the project area. Future impacts would need to be assessed on a case-by-case basis, but the Corps expects any major flood damage reduction measures would include impacts to riparian areas.

4.4.2 Criteria for Determining the Significance of Effects

The following criteria are used to determine if the preferred alternative has the potential to result in significant impacts to vegetation, wetlands and riparian areas. A significant effect on vegetation, wetlands and/or riparian areas would occur if construction and/or operation activities would cause:

- Substantial loss and/or degradation of vegetation, wetlands and/or riparian areas that provide habitat to threatened or endangered species.
- Substantial loss and/or degradation of vegetation, wetlands and/or riparian areas that provide habitat to migratory birds.
- Substantial loss and/or degradation of vegetation wetlands and/or riparian areas that support or provide habitat for species of Federal or State interest.
- Substantial loss and/or degradation of wetlands and/or riparian areas that provide low-flow augmentation.
- Substantial loss and/or degradation of wetland and or riparian area diversity and structure.

4.4.3 Preferred Alternative

4.4.3.1 Vegetation Impacts.

The assessment of vegetation was based on the review of existing resources on the vegetation characteristics of the study area (Franklin and Dyrness 1973) in addition the Washington State Department of Natural Resources databases on native plant communities. Other sources include the Lewis County and Thurston County soil surveys (UDSA 1991 and 1987, respectively) and site inspections of the study area.

Short Term Effects

Construction of the levees would result in the clearing and grading of approximately 45 acres of terrestrial (excluding wetland and riparian habitats, in Section 4.4.2) habitat. The majority of this area currently consists of farmland that is either in pasture grass production or corn. Other areas in the footprint of the preferred alternative include freeway right-of-way, Lewis County roads and road right-of-way, and Lewis County parklands. Very little native terrestrial vegetation, if any, is located within the preferred alternative footprint. Short-term effects would include disturbance and loss of existing vegetation.

Long Term Effects

The terrestrial vegetation communities that would be affected by the preferred alternative are widespread throughout the study area and the preferred alternative would have negligible impact on vegetation biodiversity and abundance. Most of the plants within the communities are either planted pasture grasses or crops and/or invasive non-native species such as Scot's broom and blackberries. The levees will be seeded with similar grasses to those currently in the project foot print and kept maintained (mowed and clear of large woody vegetation) for structural integrity. Long-term effects to terrestrial vegetation would be minimal.

4.4.3.2 Wetland and Riparian Area Impacts

The inventories for wetlands and riparian areas were prepared by the U.S. Fish and Wildlife Service and were based on 1998 color-infrared aerial photography. This level of effort was adequate to determine the extent of resources within the project area with the exception of determining the extent of emergent and/or farmed wetlands. This is due to the fact that it is difficult to determine the extent of emergent and farmed wetlands with the late-season photography typically used for inventory level wetland determinations; by the time the aerial photographs are taken all evidence of hydrology has usually disappeared.[4]

To account for some of the limitations of the wetland inventory maps in regards to seasonal and/or farmed wetlands the extent of mapped hydric soils was evaluated to determine the potential extent of wetlands with in the study area. This information was available from the soil surveys from Lewis and Thurston Counties as well as web-based data from the USDA web page (USDA 2002). A hydric soil is a soil that is saturated, ponded, or flooded long enough in the growing season to support anaerobic conditions in the upper part (NTCHS 2001). All wetlands have hydric soils. However, not all hydric soils support wetlands due to the fact that many

[4] Early season (spring) aerial photography in the Pacific Northwest is difficult to obtain because of the persistent cloud cover. Most aerial photography is taken between late July and early September when clear conditions are more likely.

hydric soils have been drained and/or converted for agriculture and no longer exhibit hydrologic characteristics typical of wetlands.

Between these two mapping and inventory conventions, forested wetlands, riparian areas, and scrub-shrub wetlands were reasonably well mapped and represent a reasonable estimate of extent. This is because the vegetation communities in these systems are persistent and distinct and therefore easy to interpret from aerial photography, regardless of the season. The emergent and/or farmed wetlands are likely *underrepresented* on the wetland maps and likely *over represented* on the hydric soils maps. As such, the wetland impact assessment for emergent wetlands is based on the soils maps because these maps represent the maximum possible extent of direct wetland impacts from the preferred alternative. The Corps also assumes that this maximum estimate can be reduced with further design modifications. Once a final design footprint is established, the Corps will complete a more precise wetland and riparian area delineation of the project area based on field data.

The preferred alternative would result in the direct loss of wetlands and riparian areas within the footprint of the levees. Table 4.4-1 provides a summary of the total of wetland and riparian impacts from the levee footprint by specific areas. The only wetland type within the project footprint is farmed wetlands and/or emergent wetlands. As such, the wetland impact acreage is based on extent of mapped hydric soils.

Table 4.4-1: Project Features, Linear Feet, Total Acreage of Project Footprint, and Total Impact Areas for Riparian Areas and Wetlands.

Reach #	Project Levee	Feature Wall	Linear Feet	Total Acreage	Riparian Areas[5] (Acres)	Wetlands[6] (Acres)
1	X		14,676	11.500	0.00	0.00
2	X		658	0.500	0.00	0.00
3a		X	700	0.010	0.00	0.00
3b	X existing		3,000	0.000	0.00	0.00
3c		X	700	0.010	0.00	0.00
3d	X		2,905	5.200	0.00	5.00
4	X		12,599	11.700	0.00	11.70
5	X		4,767	4.500	0.00	4.50
6a	X		1,445	1.400	0.00	1.30
6b		X	1,034	0.010	0.00	.01
7a	X		12,792	9.000	0.00	7.00
7b		X	1,305	0.800	0.00	0.00
8a		X	250	0.003	0.00	0.00
8b		X	150	0.002	0.00	0.00
8c	X		1,511	1.600	0.00	1.40
9a	X		185	0.200	0.00	0.00
9b	X		60	0.003	0.00	0.00
9c	X		2,581	3.100	0.00	3.10
10		X	1,750	0.020	0.00	0.00
11	X		2,331	1.600	0.00	0.00
12	X		3,834	3.400	0.00	0.00
13		X	3,050	0.040	0.00	0.00
14	X		2,082	2.200	0.60	0.00
15	X		3,869	2.700	0.00	0.00
16	X		3,419	2.700	0.20	0.00
Totals			**81,653**	**62.198**	**0.8**	**34.01**

Total wetland loss is estimated to be 34 acres of wetlands over approximately 15 miles of levees and floodwalls. Approximately 14 miles of the preferred alternative consists of levees and 1 mile of floodwall.

Short term Effects

[5] Forested riparian areas were the only type within the impact area footprint
[6] Farmed and/or emergent wetlands were the only type within the impact area footprint

The levee alignment is in segments and located in areas that can be grouped based on specific locations and site characteristics within project area. The following discussion focuses on 5 areas of levees and the wetland and riparian impacts associated with them.

Chehalis reaches 1 and 2 are the northern most end of the preferred alternative set back well away from the river and follow high ground. There are no wetlands or riparian area within the impact footprint.

Chehalis reach 3 is immediately adjacent to the western edge of I-5 and to the east of the Chehalis River. The wetlands associated with this reach are emergent and/or farmed wetlands (pasture or grain crops). Functions associated with these wetlands include migratory waterfowl habitat, groundwater recharge and discharge, floodwater storage and low flow augmentation. Any wetlands and riparian areas directly adjacent to the river may also provide a source of organic detritus (food chain support) to the river. Reach 3 provides abundant small mammal habitat and therefore support a large raptor population. These functions would be lost or adversely impacted due to project construction. Wetland impact acreage for this reach is 5 acres of farmed and/or emergent wetlands. No riparian habitat was mapped or noted during field inspections for this reach.

Total impact area for reaches 1, 2 and 3 is 17 acres of area (including 5 acres of wetland), 21,239 linear feet of levees and 1,400 linear feet of floodwalls.

Salzer Creek reaches of the preferred alternative are on the east side of the Chehalis River and I-5, south of the City of Centralia and north of the City of Chehalis. Most of alignment surrounds areas of existing development, which resulted in crossing pastures and open fields. Most of the pastures and field have been mapped as either wetlands or as having hydric soils or both. Functions associated with wetlands include small mammal habitat, sediment and nutrient trapping, flood water storage and low flow augmentation. These functions would be lost or adversely impacted under the preferred alternative. Total impact acreage is estimated to be 17.5 acres of wetlands. No riparian areas were mapped or noted during field inspections within the footprint of the preferred alternative.

Total impact area for these reaches is 17.6 acres of area (of which 17.5 are wetlands), 18,811 linear feet of levees and 1,034 linear feet of floodwalls.

The Dillenbaugh Reach sections of the preferred alternative are immediately adjacent to the west side of Interstate-5, south of Reaches 1, 2, and 3, east of the Chehalis River. The alignment is located within emergent and farmed wetlands. Functions associated with these wetlands include floodwater storage, sediment and nutrient trapping, low flow augmentation, small mammal habitat, and raptor habitat. These functions would be lost or adversely impacted to project construction. Total impact is estimated to be 11.5 acres of wetlands. No riparian areas were mapped or noted during field inspections for these sections of levees.

Total impact area for these reaches is 15 acres of area (of which 11.5 are wetlands), 17,129 linear feet of levees and 3,455 linear feet of floodwalls.

There are several smaller sections of levees that provide flood protection around the Skookumchuck River within the City of Centralia. In the Skookumchuck Reaches, levees are set back away from the river except for a narrow area where the flood plain in constricted upstream from the confluence with the Chehalis. The levees would transverse two riparian areas that are located adjacent to I-5 (Reaches 14 and 16). Although the inventory information indicates a loss of riparian areas at these Reaches, the impacts may be avoided through further refinement of project design. Functions associated with riparian areas include passerine bird habitat, source area of large woody debris to the Chehalis and Skookumchuck Rivers, shading for cooler water temperatures, aesthetics (adjacent to residential lakes), and passive recreation (bird watching). These functions may be lost or adversely impacted due to project construction. Maximum total impacts would be the loss of 0.8 acres of riparian habitat.

Total impact area for these reaches is 12.6 acres of area (including 0.8 acres of riparian habitat), 15,534 linear feet of levees and 3,050 linear feet of floodwalls.

Long-Term Effects

The long term impacts associated with the potential loss of wetlands within the project area could include loss of animal and plant biodiversity and abundance (due to loss of habitat), decreased ability for flood water storage and low flow augmentation within the floodplain, and decreased connectivity between habitats. The levees may also result in additional ponding of water behind levees and/or a disruption of lateral surface and groundwater flow, which would change the hydrologic characteristics of existing wetlands. In the case of ponding, some areas of existing upland may develop into wetlands or existing areas of wetlands may be expanded. If there is substantial disruption of lateral surface and ground water flows that cutoff or diminish sources of water, then existing wetlands may be lost or adversely affected.

The maximum total wetland loss from the preferred alternative is approximately 3% of the estimated total wetlands within the study area (12,335 acres of mapped wetlands). Localized impacts could have synergistic and/or cumulative impacts to the entire area.

Indirect Effects

In addition to the possible short and long-term impacts of the preferred alternative within the study area, additional indirect impacts may also be associated with this alternative. The preferred alternative is located within the active floodplain of the Chehalis River. Floodplains are complex systems of ground and surface water flows that largely drive the characteristics of both wetlands and riparian areas. Changes in the floodplain that can change surface and groundwater interaction will likely have some affect on the existing wetland and riparian areas. The levee and floodwall feature can trap water, which may expand the boundaries of existing wetlands and possibly create or restore wetlands in areas that do not currently exhibit wetland hydrology. Conversely the levee and floodwall alignment may disrupt some of the surface and ground water flow patterns, which may result in less water for existing wetlands. However, the complexity of the sources of water for the Chehalis floodplain wetlands and riparian areas (flooding, groundwater saturation, surface water ponding, and high precipitation) makes cause and effects relationships difficult to predict. The proposed location of the preferred alternative alignment, which is mostly setback from the river or located in areas that are already highly disturbed (along the freeway right-of-way), minimizes the potential for indirect impacts. However, their maybe some development in areas that are better protected with the levee’s in place unless local laws prevent development from occurring.

4.4.3.3 Skookumchuck Dam Modifications

Short-Term Effects

The Skookumchuck Dam modifications would not result in direct loss of wetlands and riparian areas, but may alter respective characteristics based on the operational plan for releases from the reservoir. No short-term impacts are associated with construction of the dam modifications.

Long-Term Effects

There are a limited number of wetlands and riparian areas along the Skookumchuck River. There are no wetlands or regularly flooded riparian areas surrounding the reservoir. The existing wetlands and riparian areas are linear features likely influenced by annual high water periods. The preferred alternative would change the duration and frequency of floods, especially between the 5- and 10-year floods; these floods would occur less frequently[7]. For example, the current 10-year event, after project construction, would have the characteristics of the current 50-year event.

The change in these flood events are not likely have any noticeable effect on wetlands within the preferred alterative footprint because these systems are much more influenced by frequency of events rather than by magnitude. Riparian areas, however, rely on higher magnitude events for recruitment of seed sources, scouring of weedy vegetation, and input of sediment and organic materials. The degree to which riparian areas on the Skookumchuck River rely on these events is currently unknown, but the preferred alternative identifies riparian impacts on the Skookumchuck as the subject of study during the design process. Should impacts to riparian areas be indicated as a result of these studies, operational procedures at the dam will be evaluated to offset potential impacts. Mitigation would also be included as part of the preferred alternative should any unavoidable impacts be identified.

Indirect Effects

The Skookumchuck is an incised river within a terrace. The riparian areas and wetlands that are directly associated with the Skookumchuck River would be directly impacted, rather that indirectly from implementation of the preferred alternative. There are other wetlands within the study area surrounding the Skookumchuck, but their position in the landscape (in depressions or low-lying areas well away from the river floodplain) indicated that they are more influenced by ground and surface water rather than flood events. The preferred alternative would likely have minimal impact on these systems.

4.4.5 Summary

In review of the information available and provided for above, the proposed project is determined not to significantly impact vegetation. Direct short- and long-term effects to wetlands caused by the preferred alternative could be significant due to the 34-acre wetland

[7] Yearly floods and 2-years floods will occur with the same frequency and duration as the current condition under the preferred alternative.

impact; however, measures would be taken in design to further avoid and/or minimize those impacts. Proposed mitigation would offset the possibility of significant impacts to wetlands by restoring some of the historic function to the Chehalis River. No significant impacts are expected to occur to riparian areas. Measures would be taken in design to further avoid and/or minimize impacts to the 0.8-acre area that is currently within the preferred alternative footprint.

4.4.6 Mitigation

Throughout the development of the preferred alternative, impacts to sensitive areas was included as a component of the alignment. Care was taken to stay close to developed areas, keep the alignment setback as far possible from the Chehalis River, tributary streams, wetlands, and riparian areas. The design also incorporated areas of existing levees or tied into an existing levee system. Lastly, floodwalls were incorporated into the design where levees would have encroached upon the river.

The Corps will continue to evaluate measures during the design process methods to avoid direct impacts to vegetation, wetlands, and riparian areas. These measures may include:

- Additional adjustments to the levee alignment, where possible, to avoid direct impacts.
- Evaluation of the changes to the flood regimes of the Skookumchuck River.

Measures that would avoid and or reduce potential indirect impacts include:

- Strict controls on construction stormwater to avoid direct discharges to wetlands and other aquatic habitats.
- Place of construction areas away from wetland and riparian habitats.
- Placement of construction access roads outside of wetland and riparian areas.

4.4.6.1 Levee and Floodwall Alignment

Under the preferred alternative, unavoidable impacts include disturbance to approximately 45 acres of existing upland vegetation (although this consists of disturbed communities and/or farmed areas), 34 acres of wetland impacts (based on the extent of hydric soils) and .8 acres of riparian area impacts. These numbers may be reduced through design, but the following mitigation scenario is intended to offset impacts to the full impact area. Functions associated with theses impacts include migratory and passerine bird habitat, small mammal habitat, floodwater retention and detention, low flow augmentation, habitat biodiversity, groundwater recharge, nutrient and sediment removal, nutrient and organic input to other aquatic ecosystem (streams, rivers), passive recreation and aesthetics.

Mitigation for unavoidable impacts to vegetation, wetlands and riparian areas from the preferred alternative will be incorporated into the Scheuber Floodplain plan as describe in Section 4 (Introduction). This includes:

- Reconnecting an abandoned oxbow south of SR to the Chehalis River and connecting this 21-acre feature to a series of interconnected ponds and wetlands north of SR 6, near the confluence of an unnamed creek and Scheuber ditch. The pond/wetland area would cover approximately 80 acres.
- The pond/wetland complex will be connected to the Scheuber ditch. A second wetland complex would be created/restored at the north (downstream) end of the ditch. This area would be similar to the southern wetland complex. The complex would receive inflow from Coal Creek and Scheuber ditch from the south. These would provide flow through the wetland into the Chehalis River. The wetland would also receive backwater from the Chehalis. The north wetland complex would encompass approximately 46 acres.
- Approximately 7,500 feet of Scheuber ditch would be re-aligned to a more natural looking feature.
- Approximately 8,000 feet of 400-foot riparian zone (200 feet on each side) would be planted with native vegetation along the newly aligned Scheuber ditch.
- Additional riparian plantings would be done around the wetland complexes.
- Invasive species would be removed from the mitigation area.

The proposed mitigation area contains farmed areas that are both upland and wetland. Due to the difficulties in inventorying farmed wetlands, on-site delineation of the mitigation would occur during design to determine the extent of restored wetland versus created wetlands. On-site wetland and riparian delineations will also be done for the preferred alternative footprint to determine the exact extent of impact area. If more mitigation acreage is needed after this evaluation, this proposed area of mitigation will likely be able to incorporate additional acreage of created and/or restored wetland and riparian areas.

Additional areas at Dillenbaugh Creek are also being evaluated as potential mitigation sites, if necessary. This would include relocation of Dillenbaugh Creek away from I-5 and the enhancement of wetland areas that are currently in pasture grass production.

The intent of the proposed mitigation is to restore some of the historic function of the Chehalis River and the associated wetland and riparian areas. These functions include low flow augmentation, organic input, passerine and migratory bird habitat, fishery support habitat, sediment and nutrient trapping (water quality improvement), groundwater recharge, habitat biodiversity, and floodwater retention and detention. It also is in a fairly visible area from Interstate 5, SR-6, and Scheuber Road, which would increase the aesthetic values of the area and provide passive recreation opportunities.

4.4.6.2 Skookumchuck Dam Modifications

In summary potential long-term impacts to Skookumchuck River riparian areas remain largely unknown, although wetland impacts are not expected to occur. If design analysis indicates substantial impacts are expected to occur to either wetland or riparian areas (or both), re-evaluation of the proposed dam operation would occur. The significance of potential impacts and the ability of mitigation to offset the impacts would also be re-evaluated. Mitigation would be incorporated for any unavoidable impacts to wetlands and/or riparian areas.

4.5 Biological Resources - Wildlife

4.5.1 No Action Alternative

Under this alternative, the Corps would take no action that would result in changes to the existing conditions. There would remain concerns over the historical loss of riparian habitat, wetlands, and connectivity. Assuming WSDOT implements plans for improving I-5, flood-proofing measures such as raising portions of the roadway or constructing levees would likely result in loss of wetlands that provide habitat for wildlife. Other development in the area would continue to occur in accordance with local comprehensive plans and would likely result in some losses of wetlands, riparian areas, and uplands that are used by wildlife species.

4.5.2 Criteria for Determining Significance of Effects

The following criteria were used to evaluate the significance of effects on Wildlife within the project area. Construction and operation activities would result in significant effects if they were to:

- Decrease remaining riparian habitat.

- Reduction of remaining wetlands.
- Reduction or loss of remaining habitat connectivity.

4.5.3 Preferred alternative

4.5.3.1 Short Term Effects

The noise and activity associated with levee construction would cause disturbance of songbirds, waterfowl, raptors, small mammals, deer, and other wildlife that use habitats within or near the construction area. This disturbance would be temporary and displaced animals would be expected to use other nearby habitats while construction of the levee system is underway. Because the species that inhabit these areas are generally tolerant of human activity, this temporary disturbance is not expected to have significant adverse effects on wildlife.

4.5.3.2 Long Term Effects

Because the levees are set back from the mainstem of the Chehalis and the Skookumchuck Rivers, effects on riparian habitat and habitat connectivity will be minimized. Within the levee footprint, areas of riparian forest and wetland would be permanently converted to upland habitat. Areas to be converted currently provide habitat for a variety of wildlife, including some game species, small mammals, reptiles and amphibians, and songbirds. The maximum area of impact to wetland habitats is estimated to be approximately 34 acres. Levee segments adjacent to the western edge of I-5 would affect emergent wetlands that provide habitat for these animals as well as for migratory waterfowl. In upland areas within the levee footprint, topography and vegetation communities would be permanently modified by levee construction. . Following construction, the levees would provide some wildlife habitat, although the quality of this habitat would be limited by the need to perform periodic maintenance and by type of vegetation (mainly grass and shrub cover) that would be allowed to colonize the levee slopes.

4.5.4 Dam Modifications

4.5.4.1 Short Term Effects

Short term effects to wildlife from construction of the Skookumchuck Dam outlet facility is limited to temporary disturbance at the site and along associated transportation corridors. Noise associated with construction and vehicular traffic may cause some wildlife species to relocate to less disturbed areas.

4.5.4.2 Long Term Effects

Dam modifications should not have impacts to wildlife habitat as long as the high pool does not exceed five consecutive days of storage. Exceeding high pool events may cause stress to the reservoir vegetation community. Frequency of events requiring storage above 477 feet should not occur more often than every other year to avoid impacts to the habitats surrounding the reservoir.

4.5.5 Summary

The mainstem of the Chehalis has poor wildlife habitat because of inadequate off-channel habitat and wetlands. Riparian habitat along the mainstem of the Chehalis River has been largely lost through various land use practices or processes resulting in a limitation of riparian habitat to narrow bands along tributaries and around confluences By 1938, significant changes had already occurred due to conversion to agricultural fields making it difficult to determine what habitats have been lost. Along the South Fork of the Chehalis River riparian vegetation is rated poor for 70% of the sub-basin and is particularly sparse in the mid and lower reaches. This lack of riparian vegetation compounds the forest connectivity loss that is present along the entire length of the Chehalis River within the project area (Appendix A). The smaller tributaries such as Salzer Creek, China Creek, Big Hannaford Creek, and Elk Creek are also lacking in riparian vegetation. It has been suggested that before development of this area into agriculture farmlands and residential development, the area consisted of predominately bottomland hardwood forest, indicative of a floodplain for this area. No mature forests exist within the project area.

By combining the levee construction, and dam modifications there will be no additional impacts to the marginal wildlife habitat that currently exist in the project area other than wetland impacts. However, there is potential to have a positive effect on wildlife by creating additional wetlands, connectivity, and additional riparian zones. There will be no loss in remaining habitat connectivity, riparian habitat or remaining functional wetlands. Impacts to wetlands will be on the marginal converted wetlands that are now used for farming.

4.5.6 Mitigation

The preferred alternative will impact approximately 34 acres of wetlands and the mitigation for that impact will occur in the SR-6, Scheuber Ditch, and Oxbow area. That mitigation will consist of creating a riparian zone of 200 feet in width on either side of the ditch. It is anticipated that the mitigation for the wetlands may also offset the impacts to wildlife habitat for the preferred alternative by mitigating for impacted habitat connectivity, wooded wetlands, and riparian zones.

4.6 Biological Resources- Threatened and Endangered Species

Threatened and endangered species include those named by the (USFWS) as appearing on the List of Endangered and Threatened Wildlife and Plants, as authorized by the Endangered Species Act of 1973, as well as species listed by the state of Washington.

4.6.1 No Action Alternative

Under the No Action alternative, the Corps would take no action that would result in changes to the existing conditions. There would remain concerns over the historical loss of riparian habitat, wetlands, and connectivity. Assuming WSDOT implements plans for improving I-5, flood-proofing measures such as raising portions of the roadway or constructing levees would likely result in loss of wetlands that provide habitat for wildlife. Other development in the area would continue to occur in accordance with local comprehensive plans and would likely result in some losses of wetlands, riparian areas, and uplands that are used by threatened and endangered species.

4.6.2 Criteria for Determining Significance of Effects

The following criteria were used to evaluate the significance of effects on threatened and endangered species within the project area. Construction and operation activities would result in significant effects if they were to result in:

- Substantial disruption to the magnitude and frequency of water flow through the project area such that existing hydrologic processes are interrupted.
- Substantial loss and or degradation of riparian and shoreline vegetation that provide critical habitat to threatened and endangered species.

- Substantial loss and or degradation of wetland hydrology or vegetation that provide critical habitat to threatened and endangered species.
- Substantial reduction or loss of habitat connectivity critical to providing transportation, refuge and other habitats critical to threatened and endangered species.

4.6.3 Preferred Alternative

The project is not expected to result in significant effects to sensitive species. Less than 1 acre of riparian habitat, and between 18 and 34 acres of wetland habitats (all of them pastures) would be covered or otherwise destroyed by project construction. None of these riparian areas and wetlands is known to provide habitat to sensitive species, based on searches of the PHS and Natural Heritage databases. No nest or roost trees of bald eagles would be affected by the project, and project construction activities are not expected to significantly affect bald eagle nesting. Following are brief discussions of the general nature of the project's effects on specific habitat types.

4.6.3.1 Wetland Species

The levee would cause a relatively significant reduction in the areal extent of flooding in the lower Skookumchuck River valley in the Centralia area. However, increases in the peak stage within the Skookumchuck River channel would occur as a result of the levees keeping a higher proportion of the flow confined to a smaller floodplain area (i.e., less out of channel flow entering the floodplain due to the levees).

The alteration in duration and frequency of flooding in the floodplain results in adverse effects to the floodplain habitats, including the riparian areas and adjacent wetlands. These effects can result in loss of native plant seed dispersal and seedling desiccation, as well as allow invasion of exotic invasive species (Duncan, 1993; Nilsson, 1982; Meffe, 1984; Moyle, 1986—all in Poff, 1997). A lack of seedling recruitment would result in a long-term decay and turnover to a less desirable plant community (Bren, 1992). Aquatic species that have adapted to the natural variation of a free-flowing river will lose their ecological advantage over less variable-tolerant species, and result in a change in the overall dynamic of the aquatic ecology (Cushman, 1985; Petts, 1984; Travnichek, et al, 1995). Wetlands may not be maintained if not frequently flooded.

Having acknowledged these potential effects from altered hydrologic regimes, it must be said that these effects will scarcely be noticeable in the Chehalis and Skookumchuck Basins. The levee system is designed to contain the 100-year flood. While this means that lesser flood flows will be contained within the levees and not be allowed to enter the larger floodplain, for the most part very little habitat would be affected. The levee system will remove flooding from built-up areas. It is designed to have minimal environmental effects, by virtue of being set back as far as possible in every location. What this means is that the levee would be built against road shoulders; along fence lines; along residential back yards. In a few cases, structures will be sacrificed in order to preserve additional habitat. The primary area of impact to wetland habitat would be along the lower two miles of Salzer Creek; the levee in this location would cut across approximately twenty acres of wet pasture, removing about half of it from flooding. However, investigations of groundwater in the basin appear to show that it is fed and recharged primarily by rainfall, rather than flooding. Thus the wetlands in this area (and elsewhere in the project area where wetlands would be cut off from flooding) are expected to remain functional (COE, 2002). While these wetlands are considered to have limited functional value for aquatic life because they are all wet pasturelands, and well removed from the streams due to the levees being set back (though certainly some loss of function will result by removing floods—seed dispersal, organic/detrital inputs, flood storage, water quality improvement, wildlife habitat (refuge during floods), and perhaps others). On a basin-wide scale, these minor losses of function are considered to be insignificant. This is especially so when the mitigation and restoration plans are factored in, which are expected to fully compensate for the lost function caused by levee construction.

4.6.3.2 Riparian Species

While the project will affect riparian habitats in subtle ways, no direct losses of riparian trees would occur, with the exception of three short stretches along the Chehalis River. One of these locations is approximately 1/8 mile in length; just a few trees would be lost from another site (near Mellen Street); and a number of trees would be lost from the SR-6 restoration effort to reconnect the oxbow to the river. It is likely that some nest trees for all of these species could be lost (buffleheads and wood ducks are cavity nesters; ospreys place a nest in the top of a large, broken-top snag or on top of a transmission line pole; great blue herons build nests in colonies in various kinds of trees—however, no great blue heron colonies are found within the action area (WDFW, 2002). The loss of these few trees is not expected to be significant to these species.

On the Skookumchuck River, flood events under the proposed project will represent a change from the current condition. Existing operations do not mitigate for downstream flooding which results from overbank flows upon reaching full pool. The proposed project will store the peak of flood flows behind the reservoir and release water to maintain flows of less than 5,000 cfs at Pearl Street in Centralia. The result will be the elimination of large overtopping events (greater than 2 years) as they are replaced with smaller events of greater frequency and duration. Refer to Section 2.4 for sediment routing and timing effects.

In most urbanized and altered river systems, overbank flooding does not allow for adequate return pathways to the river. The result is often juvenile and adult salmon stranded in pasturelands, roadside ditches and suburban neighborhoods with no mechanism for reentry to the river. Under natural conditions, where reaches have good connectivity by way of small tributaries, extensive side channel habitats or wetlands, overtopping events represent rearing opportunities for juvenile salmon and provide refuge for adults to escape the turbulent, debris filled mainstem. Field investigations along the Skookumchuck found most tributaries had good connectivity to the mainstem. In contrast, there were few mainstem reaches with connected side channel habitat and floodplain connectivity (PIE, 2000).

Potential effects to river channel vegetation are primarily due to the lack of overbank flooding at flows above 3,000 cfs at the dam and 5,000 cfs at the mouth. Vegetation reliant upon flows under these levels should continue without harm and may even increase as high flows are moderated during floods. Thus the primary impact of the project is the loss of the larger overbank events and their effects on future woody debris recruitment. Much of the river length would still be overtopped by a 2-year event (Appendix B). Therefore, riparian habitat recruitment is expected to continue, helping to maintain a supply of LWD, and other organic materials to the river.

4.6.3.3 Prairies, Forests, and Other Habitats

This project would not affect prairie habitats, as the levee system will not be constructed in prairies, and the limits of flood control effects would not reach prairie habitats. No fast-moving, cold-water streams would be affected by the project, nor would off-channel, slow-moving, warm-water habitats. The potential exception to the latter is the mainstem Chehalis River itself, through which lampreys and anadromous fish migrate. The infrequent changes to river flows resulting from the project would be indistinguishable to these fish. Open spaces where peregrines typically hunt will remain intact with this project; furthermore, no nests of peregrines are known in the action area (WDFW, 2002). Finally, no talus slopes would be affected by the project.

4.6.4 Summary

Endangered Species Act Section 7 consultation has been initiated with USFWS. A biological assessment has been transmitted to the USFWS for their review and is attached (Appendix E). Determinations for bald eagle and bull trout are not likely to adversely effect. The remaining species determinations are no effect. There would be no substantial disruption, loss, or degradation of riparian, shoreline vegetation, connectivity, wetland hydrology or vegetation within the proposed project area.

4.6.5 Mitigation

The preferred alternative will impact approximately 34 acres of wetlands and the mitigation for that impact will occur in the SR-6, Scheuber Ditch, and Oxbow area. That mitigation will consist of creating a riparian zone of 200 feet in width on either side of the ditch. It is anticipated that the mitigation for the wetlands will also offset the impacts to wildlife habitat for the preferred alternative, by mitigating for connectivity, wooded wetlands, and riparian zones. Specific mitigation requirements for threatened and endangered species will be negotiated through the ESA Section 7 consultation process.

4.7 Biological Resources - Fish

4.7.1 No Action Alternative

4.7.1.1 Short-term Effects.

Short-term effects to fisheries from the no action alternative arise principally from urban development needs of the basin as well as construction related impacts from planned transportation projects. There are no anticipated short-term project related impacts to fish from agricultural practices under the no-action alternative. Existing agriculture conditions will remain unchanged without the preferred project. Fish impacts from levee construction would be avoided.

Short-term effects to fish from urban and infrastructure development include only those projects reasonably foreseeable in the absence of the preferred project and related to flood control. The relocation of the wastewater treatment plant is likely to have some short-term impacts by way of vegetation loss, elevated turbidity and potential for small-scale contaminant releases. Modifications to Interstate 5 to reduce future flooding may also have some short-term impacts to fish, as the potential exists for elevated turbidity and short-term water quality impacts. Planning and construction methods and monitoring will determine significance of these short-term impacts.

4.7.1.2 Long-term Effects:

Chehalis River and Tributaries

Long-term effects to the environment under the no action alternative from agricultural practices are limited to impacts from the continuance of existing farming and livestock practices as well as from natural sources within the project area. Activities in the project area will continue to provide high summer levels of fecal coliform and turbidity to the project area from natural processes, livestock, heavy vegetation management, irrigation and frequent disturbance of unprotected soils. Fish impacts are those related to loss of off-channel and wetland habitats; loss of riparian cover, food productivity and also from degraded water quality. Water quality impacts to fish are principally those of elevated pesticides, and turbidity. Low dissolved oxygen, altered pH and elevated levels of suspended solids, metals other contaminants may also continue to the detriment of fish resources.

Long-term urban impacts from industrial and residential sources under the no action alternative will be limited to existing impacts from development and industrial activities. Runoff from developed areas, sewer and wastewater outfalls will continue to enter the Chehalis River. Additional wetland and riparian habitat loss will continue as natural habitats are converted through residential development, urban growth and associated infrastructure improvements. Fish impacts are those related to the continued loss of off-channel and wetland habitats, loss of riparian corridor and the associated loss of cover and food productivity. Sources of degraded water quality will also continue. Water quality impacts are principally those of elevated fecal coliform from upland runoff, pesticides, and elevated metal concentrations from industrial and residential practices as well as road runoff. Low dissolved oxygen, altered pH and elevated levels of suspended solids, metals other contaminants may also continue to the detriment of fish resources. Foreseeable long-term benefits are also possible. A planned relocation of the Chehalis

Wastewater Treatment Plant from its current location on the Chehalis River may provide some opportunities to reduce fecal coliform and related water quality problems.

Long-term urban impacts from planned infrastructure improvements under the no action alternative will be limited to impacts from the raising of I-5 and multiple smaller improvements throughout the cities. Under current proposal is a project to raise portions of I-5 in the project area to protect against flooding and closure. The resulting impacts to fish may include a loss of some accessible wetlands and minor removal of vegetation within the project footprint.

Skookumchuck River

Skookumchuck reservoir will continue to remain at full pool between late winter and spring allowing for water levels to remain adjacent to the vegetated shorelines of the reservoir. When the reservoir begins to recede in the summer, access to upper benthic communities and terrestrial prey input for resident and anadromous fish will become restricted. Reservoir drawdown will continue to deny fish the shade, productivity and shoreline cover afforded by reservoir vegetation. Reservoir operations will continue to inundate some areas of potential steelhead and resident trout spawning habitat in the tributaries, notably Fall Creek, Turvey Creek and the Skookumchuck River.

The existing Skookumchuck dam trap and haul facility will continue to operate for adult migrating steelhead. The steelhead will continue to be collected at the downstream weir, and be transported above dam for release. The existing outmigration chute and flume bypass system on top of the dam will continue to pass the majority of juvenile steelhead. Sluice gate operation may continue to affect some portion of outmigrating fish.

Temperature control of the lower river by Skookumchuck Dam would remain unchanged. The manner in which the Skookumchuck Dam is operated affects fish spawning and rearing habitat will continue to result in summer water temperature at or below 50° F to 55°F. During the period April 1 through August 31, Skookumchuck Dam will continue to provide a maximum flow of 95 cfs or natural flow plus 50 cfs, whichever is less. It would continue to provide minimum instream flows of 140 cfs September 1 through October 31 for fish spawning and 95 cfs November 1 through March 31 for incubation.

The existing “fill-and-spill” operation will continue to provide a nearly natural winter hydrograph for spawning, incubating and rearing salmonids in the river. Negative flood impacts from existing operations on aquatic resources may continue in the form of excessive redd scour in confined or steep sections of the river and as severe overtopping in areas of limited mainstem connectivity. Positive benefits associated with overtopping in areas of extensive mainstem connectivity may continue resulting in unrestricted access to accessible overwintering areas and improving overwintering success by passing natural freshets. Flooding will continue to be a source of water quality degradation from petrochemicals, fecal coliform, metals and possibly other chemicals that are mobilized during overbank flooding and potentially transported into the channel.

Drawdown will remain a natural event resulting from reduced inflows above Skookumchuck Dam during this period. The Skookumchuck River downstream of the dam will continue to mimic natural inflow. Fish impacts may include dewatering of late spawning salmonids and stranding of juvenile fish in off-channel ponds as the waters recede. However, the prolonged nature of drawdown in the Skookumchuck River should allow for fish to adjust to the receding hydrograph and minimize the occurrence of stranding.

4.7.2 Criteria for Determining Significance of Effects

A determination on significance of impacts from the preferred alternative is based on the existing conditions briefly described below. Criteria for significance have been developed to determine the projects potential to add or detract from the existing environmental conditions of the Chehalis River study area. Through this planning process, opportunities to avoid and minimize negative impacts have been be identified and unavoidable adverse impacts flagged for further consideration. Additional information on impacts from flood control operations within the Skookumchuck River can be found in Appendix B. The potential for effects on fish resources are further defined as short-term and long-term effects. A significant effect on fish and fish habitat would occur if construction and/ or operation activities would result in:

- Substantial disruption to the magnitude and frequency of water flow through the project area such that existing hydrologic processes are impacted.
- Substantial loss and or degradation of riparian and shoreline vegetation that provide critical invertebrate production and migratory habitat to anadromous and resident fish.
- Substantial loss and or degradation of low flow fish habitat that provide critical habitat to anadromous and resident fish.
- Substantial loss or degradation of gravels that provide critical spawning habitat to anadromous and resident salmonids.
- Substantial loss or degradation of winter off-channel and backwater habitats that provide critical refuge habitat to anadromous and resident fish.

- Substantial loss or degradation of tributary mouths such that headcutting or similar erosion impacts fish passage.

4.7.3 Preferred Alternative

The preferred alternative is described in detail within section 2.0 and also within the Skookumchuck Dam Fisheries Impact Report (Appendix B). Briefly, the preferred alternative includes modifications to Skookumchuck Dam for flood control and a levee system consisting of 16 reaches.

4.7.3.1 Short-Term Effects

Short-term impacts to fish from the preferred alternative are likely to be construction-related effects or short-term water quality degradations likely to occur as the project area adapts to landscape changes (elevated turbidity, loss of riparian habitat). Short-term impacts to fish may result from modifications to Skookumchuck Dam in support of flood control and the construction of a new levee alignment. These impacts are primarily related to short-term riparian disruption and water quality problems.

Chehalis River and Tributaries
Project area short-term impacts from the construction of levees are most likely to be associated with a temporary reduction in water quality as soils are disrupted by clearing and filling and increased construction traffic. Even with runoff controls in place, elevated levels of turbidity are likely. Actual affects on fish resources will be dependant on the size and location of the levee alignment with fish effects increasing with proximity to the river.

Fish resource impacts specifically from levee construction are anticipated to be those associated with loss of riparian vegetation, loss of off-channel habitats and floodplain disconnection. Fish impacts will be directly related to the proximity of the levee prism to the riverbank and its location within the floodplain. Constructing levee systems outside the riparian buffer areas will provide opportunity for riparian development and reduced impacts to fish.

Requirements for adequate riparian buffers are dependent on the size of the river and regulatory statutes. Most existing requirements found to be currently accepted, recommend riparian buffer zone requirements between 50 feet (for water quality) and 300 feet (riparian function) from the rivers edge. Since larger rivers have larger riparian needs, levee prisms built within 300 feet from the river should be considered to have indirect effects on fish and levee construction within 100 feet of the river considered to have direct affects to fish habitat, which may result in a reduction in productivity.

Habitat changes from encroachment on a riparian buffer may range from simplifying or altering existing riparian vegetation and habitats to heavy alteration of the banks and underwater habitats. Associated impacts to fish from these alterations are considered larger in cases where streambank habitats are lost or where off channel habitats and tributaries are made inaccessible. If bank alterations or riparian alterations are large enough, the capacity of a river system to hold and support fish resources may be reduced.

The current levee alignment for the preferred project recommends a total of 80,000 linear feet of levee construction or upgrading, most of which is located away from fish bearing rivers and creeks. Of the total construction length, 15,350 feet or 20% of the overall length is located within 300 feet of the river. The length of levee closer than 100 feet and more likely to have direct affects on fish resources is 8700 feet or 10.8% of the overall length. Not all levees currently proposed closer than 100 feet of the river are located directly on the riverbank. Bank stabilization and direct impacts to aquatic habitat is limited to 1900 feet (2%) of the total levee alignment and dispersed among 6 distinct locations. Seventy-eight percent (6800 feet) of levee proposed within 100 feet of a fish-bearing stream will affect tributaries directly. The remaining 1900 feet (22%) of levee will be located adjacent to the Chehalis River.

The size and nature of levee construction is in keeping with typical levee construction and rehabilitation projects permitted elsewhere in the basin and throughout the State of Washington. The proposed levee construction is a mixture of several cross sections and floodwalls with and average width of 33.4 feet but ranging between 15.5 and 49 feet wide Figure 4.7.3. Anticipated short-term impacts to fish resources from construction of each reach are described below according to levee reach.

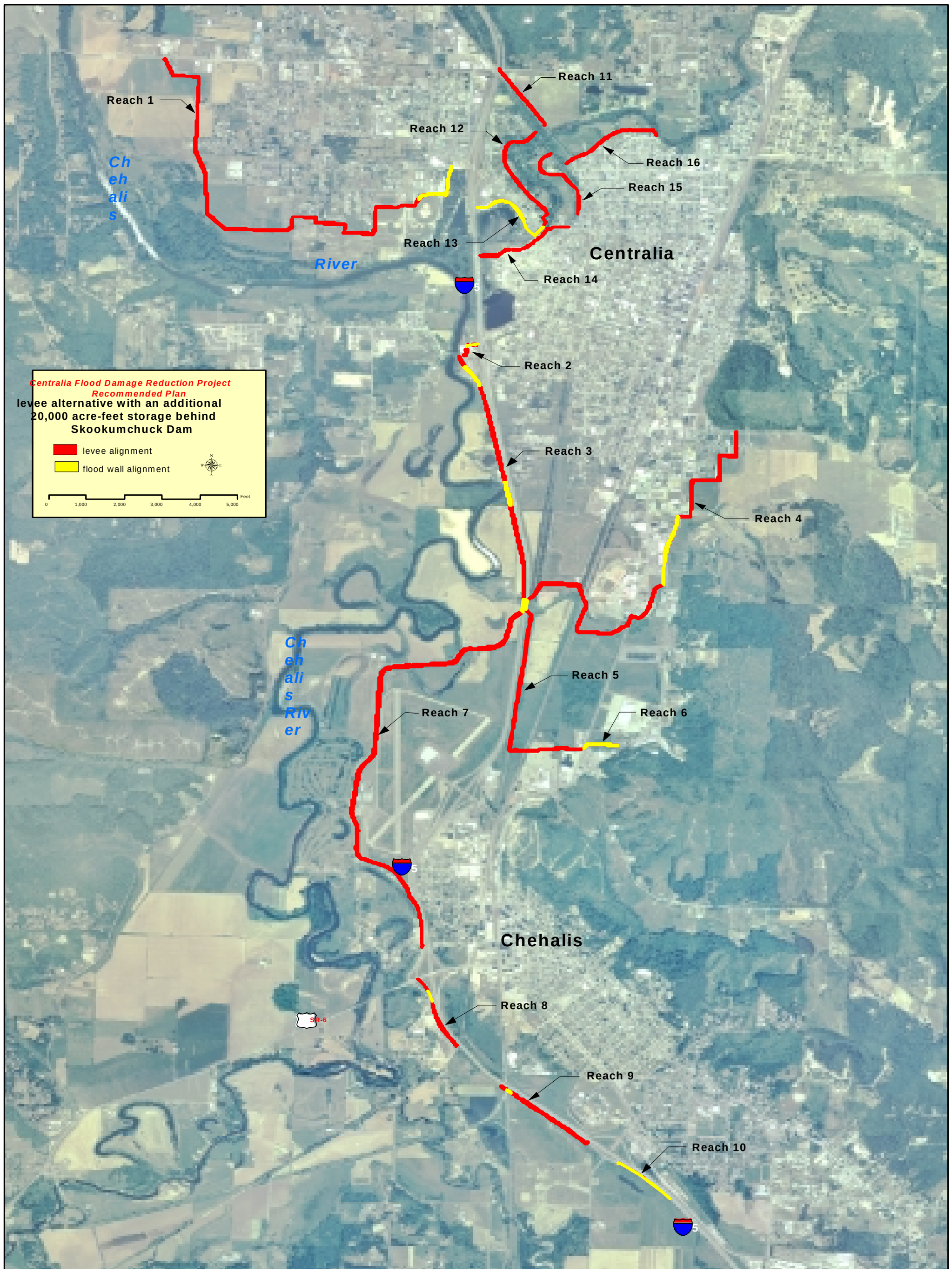


Figure 4.7.3 Levee and Flood Wall Alignment

Reach 1- Fords Prairie (CH-1)
None Anticipated

Reach 2. Sewage Treatment Plant (CH-2)
In this reach, 300 feet of levee alignment will be constructed approximately 200 feet from the Chehalis River. The levee is located around and behind existing sewage treatment plant structures. Short-term impacts could include minor and temporary turbidity increases. The existing riparian cover is limited in this reach. Salmon spawning or rearing habitat should not be affected.

Reach 3. Mellon Street to Salzer Creek Bridge (CH-3)
A combination of floodwall and levee construction is proposed within this reach to limit impacts to the Chehalis River. Attempts to limit Chehalis River interaction with the alignment has resulted in only two locations closer than 300ft of the channel for a total length of 1450 feet. Impacts from the levee proposed within 100 feet will be limited to 250 feet. A floodwall is proposed for all areas where the river is closer than 300 feet to the alignment. Short-term impacts to fish will be limited to potential increases in construction run-off and traffic. Salmon spawning or rearing habitat should not be impacted.

Reach 4. Salzer Creek Right Bank (Ch-5N)
Levee construction in this reach is designed to prevent floodwaters from the Chehalis River from backing up Salzer Creek. The levee alignment follows the right bank of Salzer Creek and will be constructed within 300 feet of the creek for approximately 2750 feet of which 1800 feet is proposed within 100 feet of the creek. An existing levee will be utilized along an additional 2150 feet of length but all work will be conducted landward of it's existing location. The end of this reach will tie into an existing levee. The alignment will not directly cross the confluence of Salzer Creek but the levee will require armor rock to be placed along 150 feet of the right bank bridge abutment of I-5. Short-term impacts will most likely be temporary increases in turbidity and construction related spills and debris. Armoring of the bridge abutment will be conducted outside the creek channel and carry no significant short-term impacts. Some riparian loss may occur if the existing levee needs to be cleaned prior to additional construction landward of its location.

Reach 5. Salzer Creek Left Bank (CH-5S)
As with reach 4, the intent of this levee section is to prevent Chehalis River flooding from entering the Salzer Creek basin. It does not propose to cross the Salzer Creek confluence but

will require approximately 150 feet of armor rock along the left bank bridge abutment at I-5. The remainder of the levee system ties into an existing railroad grade and then after turning and crossing Coal creek, it ties into an existing levee. The constructed levee section crossing the confluence of Coal Creek will receive a culvert and flap gate structure to maintain Coal Creek flow and connectivity. Short-term impacts are associated with levee construction and flap gate construction and are likely limited to temporary increases in turbidity to Salzer Creek and the potential for construction related spills. Riparian loss will be limited since the majority of this levee section parallels a railroad grade that is principally unvegetated. The bridge abutment armoring will be conducted outside the creek channel and carry no significant short-term impacts. Salmon spawning or rearing habitat should not be impacted.

Reach 6. Coal Creek. (CH-6)
None anticipated

Reach 7. Salzer Ck to Airport (CH-4)
This alignment follows along Airport Way with Airport Way located between the levee or floodwall construction and the Chehalis River until it connects to an existing airport levee. The existing levee will be widened from the landward side. None of the levee alignment is in proximity to the Chehalis River or other fish bearing streams except for approximately 250 feet near the Salzer Creek Bridge. In this reach, the creek may require armoring but the levee alignment does not propose construction within the Salzer Creek channel. An existing levee on the south side of Airport Way will be removed out of consideration for an environmentally sensitive area located on the south side of the road. Short-term impacts in this reach are limited to potential riparian loss in the area around the Salzer creek armoring and minor potential for construction related spills and turbidity. Some riparian loss may occur along 4650 feet of the existing airport levee if it is cleaned prior to landward levee construction. Vegetation along the existing levee to be removed may also be removed and temporarily lost.

Reach 8. SR-6 to Railroad Underpass (DB-2)
Levee construction in this reach will not come near fish bearing creeks except where it crosses Dillenbaugh Creek. The levee will cross Dillenbaugh Creek perpendicularly at the point where it exits a large wetland complex east of I-5. A control box with a flap gate will be installed at this crossing to prevent Chehalis River floodwaters from entering the wetland at extremely high floods (1 foot below the 100-year event) and from flooding residences. Short-term impacts may include temporary creek disturbance in the location of the levee crossing and minor riparian loss in proximity to Dillenbaugh Creek.

Reach 9. Dillenbaugh Creek (DB-3)
This levee reach is designed to protect I-5 from Chehalis River floodwaters. The levee alignment has been offset 78 feet to compensate for planned widening of I-5 in the project area. Dillenbaugh Creek follows a straight ditch along this levee reach for 3100 feet and will require relocation to allow for the levee prism. An additional 1,150 feet of levee will be constructed within 100 feet of the creek, which may pose some direct impact but will not require channel relocation. Dillenbaugh Creek also enters the wetland complex east of I-5 in this reach. A control box with a sluice gate at the point where the creek enters the wetland will be necessary to prevent Chehalis floodwaters from flooding the wetland and residences at extreme high floods (1 feet below 100-year event). The short-term impacts of this reach include temporary riparian loss at the relocation reach and adjacent levee sections as well as increased potential for turbidity and construction related spills. Although the reaches of Dillenbaugh Creek in this levee section are channelized and disrupted, there is a potential for temporary loss to spawning and rearing habitat if construction is not timed appropriately. The establishment of accepted work windows and precautionary guidelines should ensure no significant short-term impacts occur during construction of this levee section.

Reach 10. Dillenbaugh South (FW-2)
Construction of this reach is necessary only if Rice Road is not raised prior to implementing the preferred project. If needed, the project proposes a short floodwall located East of Dillenbaugh Creek where it comes within 300 feet of the creek in two locations for a total of 1100 feet. Of that length, 750 feet appears closer than 100 feet from the creek. Potential short-term impacts are most likely to be temporary increases in turbidity to Dillenbaugh Creek from levee construction and an increased risk of construction related spills. Temporary riparian loss may be short-term impact for the levee portions closest to Dillenbaugh Creek but no construction is likely on the banks of the creek.

Reach 11. West Reynolds Ave. to BNRR (SK-1)
No effects anticipated.

Reach 12. Chehalis Western RR to Borst Park (SK-2)
This reach roughly follows the left bank of the Skookumchuck River for approximately 2050 feet all of which is closer than 300 feet to the river. Of that length, approximately 700 feet is closer than 100 feet but none is proposed for construction adjacent to the riverbank. Still, the orientation of the levee will require approximately 300 feet along the outside bend to be armored

from flood related erosion. Some existing armor rock may need to be maintained in the vicinity of the Harrison Street right bank bridge abutment. Short-term impacts from this levee construction are anticipated to be loss of riparian vegetation mostly associated with the armoring of the outside bend and possible temporary increases in turbidity from construction.

Reach 13. Harrison Street Bridge to I-5 right bank (FW-3)
This levee reach follows Hayes Lake for the protection of residences near the Skookumchuck River confluence with the Chehalis River but the levee is not in close proximity to either river.

Reach 14. Left bank I-5 to Harrison Street Bridge (SK-3)
This reach follows the left bank of the Skookumchuck River between the Harrison Street Bridge and Interstate 5. The alignment is in proximity to the Skookumchuck River and approximately 1000 feet of the levee will be near or on the riverbank. Where possible a floodwall is proposed to limit riparian disturbance. The alignment near the river increases to 2100 feet when areas closer than 300 feet are included. Armor rock will be necessary in areas adjacent to the riverbank to prevent scour and erosion from floodwaters. Short-term impacts will be loss of riparian and possibly aquatic habitat from the construction of levee adjacent to the riverbank as well as potential increases in turbidity and risk of construction related spills. The channel adjacent to the levee area is considered marginal spawning habitat. There are no notable off-channel or other rearing habitats in the levee reach.

Reach 15. Harrison St Bridge to Chehalis Western. Railroad. (SK 4)
This reach follows existing road infrastructure and may come into proximity with the Skookumchuck River in two locations for a combined 950 feet but does not appear to come closer than 300 feet at either location. Short-term impacts include the potential for increase turbidity from construction.

Reach 16. Chehalis Western RR to BNRR (SK-5)
This reach ties into the existing levee system of the Skookumchuck River and comes within 300 feet of the river in one location for 500 feet. Of that length, 100 feet is closer than 100 feet of the river. The levee reach is setback from the river except where it is necessary to connect with the existing levee system. Short-term impacts from this levee reach may include temporary loss of riparian corridor and some aquatic habitat as the levee comes to the riverbank to join with the existing levee and a potential for increased turbidity and construction related spills. The riparian corridor in this area is narrow in the reach affected by the levee construction and riparian disturbance is not anticipated to be significant.

Skookumchuck River

Short-term impacts to fish anticipated from modifications to Skookumchuck Dam may be associated with outlet gate construction. More information on Skookumchuck modifications and impacts can be found in Appendix B. In summary, impact from structural modification is anticipated only for concrete work in and around the dam. However, concrete pouring, drilling and mixing can have impacts to fisheries and wildlife by raising pH levels or elevating water temperatures if conducted in small poorly circulated aquatic environments, if allowed to cure in large quantities underwater or if concrete dust and slurry is inappropriately managed. Since most of the construction is conducted upland and the Skookumchuck River is large enough to ameliorate the effects of curing small concrete projects, experiencing events of elevated pH, temperature or extended turbidity is not anticipated. Cofferdams may be employed to further minimize water quality degradation from construction activities at Skookumchuck Dam. Similarly, construction activities may alter access to fish passage routes or temporarily reduce passage efficiency. Construction of spillway gates may cause some disturbance to outmigrating juvenile salmonids if not timed and conducted appropriately. Adherence to accepted construction windows and proper sediment and construction management should reduce opportunity for significant short-term effects from Skookumchuck Dam modifications.

4.7.3.2 Long-term Effects

Long-term effects to the environment from the preferred alternative will most likely include impacts from maintenance of the proposed levees and operation of the Skookumchuck Dam Flood Control project. Long-term impacts are anticipated principally from loss of riparian and aquatic habitat from portions of the proposed levee system; changes in adult and juvenile migratory pathways during major flood events, tributaries habitat/flow alterations and flow changes from the operation of Skookumchuck Dam as a flood control project.

Chehalis River and Tributaries

Long-term impacts from the preferred alternative are most likely to be associated with a permanent reduction in riparian corridor succession and loss of in stream habitat from bank stabilization and altered fish accessibility to tributaries during flood events. Actual affects on fish resources will be dependant on the size and location of the levee alignment as the effects on fish habitat increases with proximity of the levee to the river.

As stated earlier, the current levee alignment for the preferred project indicates a total of 80,000 linear feet of levee construction or upgrading, most of which is located away from fish bearing rivers and creeks. Of the total construction length, 15,350 feet or 20% of the overall length is located within 300 feet of the river. The amount of levee less than 100 feet and therefore more likely to have direct affects on fish resources is 8700 feet or 10.8% of the overall length. Not all levees currently proposed closer than 100 feet of the river are located directly on the riverbank. Bank stabilization and direct aquatic impacts are limited to 1900 feet (2%) of the total levee alignment and further dispersed among 6 distinct locations. Approximately 6800 feet (78%) of the levees within 100 feet of a fish-bearing stream affect tributaries. The remaining 1900 feet (22%) of levee is located adjacent to the Chehalis River. General alignment and levee features can also be found in technical memorandum #4 (Corps 2001a, tech memo. 4).

Reach 1- Fords Prairie (CH-1)
None anticipated

Reach 2. Sewage Treatment Plant (CH-2)
Long-term impacts at this reach should be limited to indirect effects to fish resources from loss of floodplain connectivity along the stretch nearest the Chehalis River (300 feet). Direct impacts to instream habitat, rearing habitat and other habitat requirements for anadromous and resident fish are not anticipated.

Reach 3. Mellon Street to Salzer Creek Bridge (CH-3)
Long-term impacts at this reach will include indirect and direct impacts to fish resources from loss of floodplain connectivity along the 1450-foot reach of levee within 300 feet of the Chehalis River (at 300 feet). Direct impacts to instream habitat, rearing habitat are not anticipated but some long-term reduction in woody debris recruitment or drainage patterns may occur.

Reach 4. Salzer Creek Right Bank (Ch-5N)
This levee reach will require at least 1800 feet of levee construction in proximity to Salzer creek. While the levee is not expected to be on the riverbank, some loss of riparian cover is likely and may result in reduced terrestrial prey production, canopy cover and woody debris recruitment from levee maintenance. There are no significant off channel habitats in the reach but some small reduction in mainstem rearing habitat may occur depending on final placement location. A 150-foot section of levee located near the Salzer Creek Bridge will require armoring for erosion protection and may result in direct loss of instream habitat if constructed below ordinary high water. Significant impacts to spawning and migration of adult and juvenile fish are not

anticipated, as the levee alignment does not direct alter tributary connectivity with the Chehalis River.

Reach 5. Salzer Creek Left Bank (CH-5S)
As with reach 4, the intent of this levee section is to prevent Chehalis River flooding from within the Salzer Creek basin. Long-term impacts from this levee section are limited to possible direct impacts from armor rock placement near the Salzer Creek Bridge. A 150-foot section of levee located near the Salzer Creek Bridge will require armoring for erosion protection and may result in direct loss of instream habitat if constructed below ordinary high water. Significant impacts to spawning and migration of adult and juvenile fish are not anticipated, as the levee alignment does not direct alter tributary connectivity with the Chehalis River.

Reach 6. Coal Creek. (CH-6)
None anticipated

Reach 7. Salzer Ck to Airport (CH-4)
This alignment follows along Airport Way with Airport Way located between the levee, floodwall construction and the river until it connects to an existing levee around the airport. The existing levee will be widened from the landward side. None of the levee alignment is in proximity to the Chehalis River or other fish bearing streams except for approximately 250 feet near the Salzer Creek bridge which may require armoring but is not proposed for construction within the Salzer Creek channel. Direct effects from this armoring will be seen only at high water events and only for the length of levee armored. Removal of the old levee may increase floodplain connectivity to previously isolated habitats and wetlands. Long-term vegetation maintenance may result in some loss of riparian function but the setback nature of the levee alignment should result in minimal impacts to fish.

Reach 8. SR-6 to Railroad Underpass (DB-2)
Levee vegetation management along this levee reach could create long-term impact through maintained reduction riparian vegetation and canopy cover along the levee alignment. Impacts are most likely where the levee parallels a large wetland complex and at the site of the control box installation. Additionally, the control box structure may prevent adult access and juvenile passage when closed during large flood events. The frequency of control box operation is anticipated to be sporadic and not likely to cause significant limitations to fish use of the wetland. The wetland should also remain open at the control box site during the outmigration period. Salmon spawning or rearing habitat should not be affected.

Reach 9. Dillenbaugh Creek (DB-3)
This levee reach is designed to protect I-5 from Chehalis River floodwaters. The alignment has been offset 78 feet to make room for expected widening of I-5 in the project area. Dillenbaugh Creek in this reach is degraded and contained within a straight ditch for 3100 feet. The levee will require a portion of the creek to be relocated to allow room for the levee prism. This creek relocation may prove to be beneficial if opportunities to reestablish sinuosity, vegetation, overstory and aquatic habitats are incorporated into design. Long-term impacts will be negative and possibly significant if the creek is simply relocated without enhancement. An additional 1,150 feet of levee alignment will not require creek relocation but will be within 100 feet of the bank and may result in some maintained loss of canopy cover as a result of levee vegetation maintenance. Currently, there is no riparian vegetation within these reaches of Dillenbaugh Creek. Rearing and other aquatic habitats are likely to be affected as a result of the channel relocation. Properly designed, the relocated channel should provide better aquatic conditions than the current condition. Additionally, the control box structure may prevent adult access and juvenile passage during large flood events. The frequency of control box operation is anticipated to be sporadic and not likely to cause significant limitations to fish use of the wetland. The wetland should also remain open at the control box site during the outmigration period. There is no spawning habitat within these reaches of Dillenbaugh Creek.

Reach 10. Dillenbaugh South (FW-2)
Construction of this reach is necessary only if Rice Road is not raised prior to implementing the preferred project. The reach consists of a short floodwall located east of Dillenbaugh Creek where it comes within 300 feet of the creek in two locations for a total of 1100 feet. Of that length, 750 feet appears closer than 100 feet from the creek although not on the banks of Dillenbaugh creek. Potential long-term effects are a maintained lack of riparian canopy. The floodwall approach should reduce the footprint and allow for a reduced need to manage vegetation.

Reach 11. West Reynolds Ave. to BNRR (SK-1)
No adverse effects are anticipated.

Reach 12. Chehalis Western RR to Borst Park (SK-2)
Long-term effects from construction of this levee reach are associated with indirect fish habitat impacts from the 2050 feet of levee within 300 feet of the bank and some degree of direct impact from the 700 feet of levee construction within 100 feet of the riverbank. The most likely source

of long-term fish effects may result from the 300 feet of levee that will require armor rock for erosion protection. This 300 feet may result in some long-term habitat impairment, vegetation loss and loss of riparian canopy. A reduction in woody debris recruitment may also occur. The conversion of approximately 700 feet of streambank habitat to levee could represent a permanent habitat loss if the construction is not planned and mitigated appropriately.

Reach 13. Harrison Street Bridge to I-5 right bank (FW-3)
None anticipated

Reach 14. Left bank I-5 to Harrison Street Bridge (SK-3)
Long-term impacts from construction of this levee reach are associated with indirect fish impacts from the 2100 feet of levee within 300 feet of the bank and some level of direct habitat or fish impact from the 1000 feet of levee construction within 100 feet of the riverbank. Within this reach, most of the 1000 feet proposed levee will be on or near the riverbank increasing the potential for riparian and aquatic habitat impacts. The reach is not generally considered highly productive spawning habitat. Further detailed planning is still necessary. The conversion of approximately 1000 feet of streambank habitat to levee could represent a permanent habitat loss if the construction is not planned and mitigated appropriately.

Reach 15. Harrison St Bridge to Chehalis W. RR. (SK 4)
None anticipated

Reach 16. Chehalis Western RR to BNRR (SK-5)
Long-term impacts from construction of this levee reach are associated with indirect fish impacts in one location totaling 500 feet of levee of the bank and some level of direct habitat or fish impact from the 100 feet of levee to be constructed within 100 feet of the riverbank increasing the potential for riparian and aquatic habitat impacts. The reach is not generally considered highly productive spawning habitat. Further detailed planning is still necessary. The riparian corridor in this area is narrow in the reach affected by the levee construction and riparian disturbance is not anticipated to be significant from conversion of approximately 100 feet of streambank habitat.

Skookumchuck River
Long-term impacts to fish anticipated from modifications to Skookumchuck Dam are most likely associated with the management of the Skookumchuck River system to accommodate flood control needs and can be separated into 2 geographic areas. First is the possible long-term affect

of operating a flood control dam on the reservoir. Secondly is the possible long-term impact on downstream fish resources from flood control construction and dam operations. The following section is a summary of potential long-term impacts from operation at Skookumchuck Dam. Additional information on Skookumchuck modifications and impacts can be found in Appendix B.

Reservoir operations will increase winter pool fluctuations and require fish-bearing tributaries around the reservoir to adapt to a winter varial zone. These difficulties are not likely on the Skookumchuck River due its size and winter flow volume but may occur on smaller tributaries. Absent a flood event, the preferred project would strive to keep a winter pool at elevation 455 which will result in a reduction in availability of shoreline vegetation to fish until the February refill. In addition, the lower reservoir may increase the opportunity for cutthroat trout to prey upon juvenile steelhead as surface acreage becomes smaller and terrestrial food sources become less available. Fish passage issues may also become a long-term adverse impact if the tributaries cut through unconsolidated soils exposed by the lowered reservoir. Heavy tributary scour through the reservoir sediments can create fish passage difficulties for resident fishes during the winter. Changes to sedimentation, woody debris movement, channel movement and other channel maintenance processes are not anticipated.

At the dam, the creation of a flood control project will allow all flows to be passed through the new larger gates and it may influence fish migration pathways. Since flow is a primary factor for passage selection, some percentage of steelhead and resident trout moving through the dam between November and February would likely travel through the new outlets even if access to the spillway was available. In the winter however, fish passage would be limited to some adult steelhead that fall back after transfer, and resident trout. Steelhead out-migration generally occurs after the flood control season. If the new outlet structures are inefficient or otherwise compromise fish passage efficiency, it should be considered a long–term fish impact. Planning is ongoing to design outlets that minimize or avoid impacts to fish passage and consider its reconnections to the river.

The preferred project would not allow the reservoir to refill in winter as it does currently. Early winter freshets that are normally captured in the reservoir would be passed to maintain a reservoir elevation of 455. These freshets may have positive effects on fish migration as they can influence adult salmon movement. Adult salmon may use inflow pulses caused by fall rains to begin moving toward their spawning grounds where they may continue have benefits by assisting to initiate spawning. Juveniles rearing in the river may also use fall freshets to begin moving into side channels and other over wintering habitat prior to the onset of winter. It is presumed the reservoir will be managed to maintain the minimum pool in anticipation of floods, which would result in most freshets being passed quickly. If the flood control operation calls for capture of the freshets until the pool has filled to a critical point, than the benefits of the freshets would be diminished.

Downstream of the project, late fall flood flows could have long-term impacts to spawning salmon depending on the duration of high flow events. Freshets captured and then released over an extended timeframe, may artificially elevate river stage and put redds built by salmon on high gravel bars at risk of desiccation. This impact is most commonly a problem in spring when high flows are less likely to keep higher elevation redds watered and typically affects spawning steelhead most heavily. Conversely, a modified hydrologic regime that allows for extensive and frequent connections to side channel complexes and other off-channel rearing areas may benefit rearing juvenile salmon. Juvenile benefits from frequent and low level flooding of off-channel habitats are predicated upon having good habitat in reaches with good connectivity by way of small tributaries, extensive side channel habitats or wetlands. Overtopping events in these reaches may represent a long-term benefit by providing rearing opportunities for juvenile salmon and refuge for adults to escape the turbulent and debris filled mainstem. Areas of poor river connectivity would not realize these benefits and may even constitute a significant long-term risk of adult and juvenile salmon stranding. Most likely in the urbanized and altered sections of the river, overbank flooding in these areas would not allow for adequate return pathways to the river and possibly result in excessive juvenile and adult salmon stranding in pasturelands, roadside ditches and suburban neighborhoods with no mechanism for reentry to the river.

4.7.4 Summary

4.7.4.1 Chehalis Levees

In general, areas directly impacted by the preferred alternatice include opportunities for further minimization of impacts. Minimization techniques will be necessary to avoid excessive impacts from long-term loss of instream habitat, juvenile cover and refuge habitats and reductions in riparian canopy.

Despite additional minimization techniques however, vegetation maintenance in these areas may still propagate a long-term reduction in riparian habitat by limiting overstory growth, associated prey resources, woody debris recruitment and cover habitat. Areas of indirect impact to fish from levee construction (construction between 100 feet and 300ft from fish habitat) could also have long-term impacts to water quality, nutrient transport and runoff but the limited amount of this type of impact should not result in significant impacts to resident or anadromous fish.

Long-term impacts from the construction of these tributary levee systems and control structures are different for each tributary. Levee construction around the tributary confluences has associated long-term impacts similar to those of the Chehalis River levee. Potential impacts include a loss of riparian overstory and a related reduction in woody debris requirement, reduction in shading and terrestrial prey production. The degree of this impact is directly related to the proximity of the levees to the tributary.

Watershed-scale long-term impacts should not be appreciable as the amount of Chehalis River and tributary floodplain will be allowed to remain largely intact. Significant alterations to groundwater flow and sediment transport are not anticipated under the proposed alternative. Allowing floodwater inundation over a large segment of he existing floodplain may minimize future human development and institutionalize the presence of necessary floodplain processes.

4.7.4.2 Skookumchuck Dam Modifications

Impacts most likely above the dam appear related to increased reservoir fluctuations, which may cause fish to adapt to water surface fluctuations, create potential fish blockages at tributary mouths and increase turbidity potential. Alterations to sedimentation, woody debris movement, channel movement and other reservoir maintenance processes are not anticipated.

Impacts to fish at the dam are not anticipated. Construction of the outlet facility should occur outside the fish migration window and done principally in the dry. When completed, the outlet should pass fish effectively or provide a full pool prior to the onset of outmigration. A full pool condition would allow for fish to outmigrate through the existing spillway.

Below the dam, the preferred project would allow for early winter freshets that are normally captured in the reservoir would be passed to maintain a reservoir elevation of 455 potentially benefiting juvenile and adult salmon. Flow fluctuations may provide an opportunity for annual high flow events but would eliminate large-scale flooding. Annual overbank flooding events may represent a long-term benefit by providing rearing opportunities for juvenile salmon and refuge for adults to escape the turbulent and debris filled mainstem. Areas of poor river connectivity would not realize these benefits and may even constitute a significant long-term risk of adult and juvenile salmon stranding.

4.7.5 Mitigation

Proposed mitigation for fish impacts will be managed principally through avoidance and minimization techniques aimed at reducing the amount of direct and indirect impact to fish and fish habitat through construction timing, levee alignment and location. Fish impacts associated with changes to the Skookumchuck River hydraulic regime during the flood control season will require further study. During the PED phase, operational features of the dam will be defined and appropriate mitigation identified that may include habitat improvements, acquisition and protection. Additional recommendations for mitigation of fish impacts can be found in Appendix B.

The creation of a Scheuber Ditch connection through SR-6 may also be constructed for the benefit of fish and fish habitat. Construction of the SR-6 bypass for mitigation purposes along with oxbow connections will enhance fish habitat in that reach while allowing juvenile fish off-channel habitat during high flow events. Specific engineering criteria related to channel formation, access and reconnection will need to be defined in PED to ensure adequate access, and survival of fish using the site. The combination of a Scheuber Ditch bypass, habitat efforts on the Skookumchuck should provide opportunity for adequate mitigation of unavoidable adverse impacts to fish and fish habitat resulting from the proposed project. A final evaluation and accounting will occur during the design phase.

4.8 Land Use and Planning

4.8.1 No Action Alternative

Under the No Action alternative, no project features would be constructed. Consequently, lands that are currently within the 100-year floodplain would remain prone to flooding. Undeveloped lands within the floodplain that are located within designated urban growth areas established by city or county comprehensive plans would undergo development in accordance with applicable requirements under the Growth Management Act (GMA) (RCW 36.70A). In accordance with the GMA, growth outside the designated urban growth boundaries could occur only if it were not urban in nature.

4.8.2 Criteria for Determining Significance of Effects

The following criteria were used to evaluate the significance of effects on land use. A project alternative would result in a significant effect if it would:

- Physically divide an established community.
- Result in the dislocation of large numbers of residents or businesses.
- Lead to major changes in land ownership or use patterns.
- Result in major changes in population density or growth rates.
- Conflict with applicable land use plans, policies, or regulations of any entity with jurisdiction over the area, including local comprehensive plans and zoning ordinances as well as federal and state policies and regulations for development in floodplains.

4.8.3 Preferred Alternative

Under this alternative, a series of levees would be constructed in and around the cities of Centralia and Chehalis. Levees would be constructed at selected locations along the Chehalis and Skookumchuck Rivers as well as along several tributaries (i.e., Salzer Creek, Dillenbaugh Creek). The levee alignment would protect residential, commercial, and industrial structures, as well as transportation corridors and other infrastructure from flooding during the 100-year event.

Direct impacts to current land uses as a result of levee construction would include the permanent conversion of lands (approximately 66 acres) within the levee footprints and, potentially, temporary disruption of land uses in construction staging areas. Design objectives intended to minimize the impacts of levee construction on adjacent land uses include using the existing levee system to the extent possible, using existing roads as levees where possible, and avoiding the relocation of structures and residential areas.

These design objectives also minimize impacts to the Chehalis River shoreline that is designated as a shoreline of statewide significance. Levees, floodwalls, and bank stabilization features would be placed along or immediately adjacent to the Chehalis River shoreline in two locations in the reach between Mellen Street and the Salzer Creek bridge, where there is limited area between the riverbank and the I-5 embankment. For the most part, however, project features would be set back 200 feet or more from the river, and overall impacts on the Chehalis River shoreline would be negligible.

4.8.3.1 Centralia Area

The levee alignment places levees within a variety of land use designations in and around the City of Centralia. In the Fords Prairie area, the levee footprint falls within several zoning districts, including light industrial and Port of Centralia master plan property immediately south of Galvin Road. The levee footprint continues south then east through unincorporated areas, continuing into the low-density residential land use designation within Fort Borst Park.

Levees would also be placed west of the Chehalis River in low density residential lands near Graf Road, within medium density residential and limited business district lands northeast of the hospital, and along Cooks Hill Road between land designated as low density residential to the north and high density residential to the south.

Several levee segments would be constructed along the Skookumchuck River within Centralia. One segment would be constructed along the north side of the river extending from approximately RM 1.4 to the west side toe of I-5. The levee would more or less follow the course of the river, with the footprint located in low density residential, highway commercial, and core commercial zones. A second levee segment would be constructed south of the Skookumchuck River from approximately RM 2.1 west to the toe of I-5. The levee footprint would affect primarily low-density residential lands, with medium density residential land being affected adjacent to I-5. A third levee segment would be constructed north of the river, adjacent to and east of the Burlington Northern-Sante Fe rail line at approximately RM 1.5. This levee segment would be located outside Centralia city limits.

There are also several areas north of Salzer Creek that would be affected by the levee alignment footprint. The footprint in this area would begin east of I-5 at Salzer Creek, then continue north and east through City-designated light industrial lands west of the Fairgrounds. The footprint would pass south of the Fairgrounds outside of City limits, then north again through lands designated for general commercial use. The levee would then proceed outside City limits again to the east. In this area, the levee footprint would border a County-designated low density residential zoning classification to the east.

Levees would also be placed adjacent to the Centralia Wastewater Treatment Plant, with one segment continuing south under Airport Road through commercially designated lands before leaving Centralia city limits. The levee footprint in this area borders undeveloped land north of the airport designated as commercial.

4.8.3.2 Chehalis Area

The levee alignment footprints in and around the City of Chehalis would also affect a variety of land use designations. East of I-5 south of Salzer Creek, the levee alignment would cross commercial and residential high density multi-family zoning designations. The actual land use in this area is primarily commercial, with some undeveloped parcels present. South of the airport, the levee alignment would border several areas designated as residential transition. Further south along the west side of I-5, the levee system would border areas designated as residential high density multi-family. The southern-most levee footprints, adjacent to I-5 and Dillenbaugh Creek, would occur within planned unit development lands south of the City.

4.8.3.3 Protected Areas

Under the alternative, the levees would be set back away from the Chehalis and Skookumchuck Rivers as far as possible; therefore, there would not be large areas of currently undeveloped land that would be protected by the levees. However, there are some isolated areas of undeveloped land that would be afforded protection by the levees. These include areas north and south of Centralia High School, lands adjacent to I-5 northwest of the Fairgrounds, and lands immediately north of the Centralia-Chehalis airport. Several small tracts of undeveloped land adjacent to I-5 in the Chehalis area would also be protected.

There are several areas where currently undeveloped lands within city or county growth management boundaries would be protected. These undeveloped lands within unincorporated areas include land designated as low density residential adjacent to Centralia High School, commercially designated lands north of the airport adjacent to I-5, and several low density residential and commercial parcels northwest of the Fairgrounds and southeast of Summa Street and Kresky Avenue.

Undeveloped, protected parcels located within the City of Centralia growth management boundaries include light industrial and Port of Centralia master plan properties south of Galvin Road, light industrial lands east of the Fairgrounds, and commercial properties located north of the Fairgrounds and south of the Centralia Wastewater Treatment Plant.

Within the City of Chehalis there is one parcel of land within the growth management boundaries that would be protected under the preferred alternative. The parcel is designated as commercial and is located immediately north of the airport.

Urban development would not occur in areas protected by the levees unless they are located within city or county growth management boundaries. Protected lands within the growth management boundaries would be developed in accordance with jurisdictional growth plans adopted under the GMA. Any changes to the jurisdictions' growth plans would require amendment under the GMA process.

With respect to the goals and policies for land use established in the Lewis County, City of Centralia, and City of Chehalis comprehensive plans, the proposed levees would provide a positive benefit for land use in the Centralia/Chehalis area. The levees would protect existing residential, commercial, and industrial structures from damage during flood events.

The protection of existing residential, commercial, and industrial properties is vital to the achievement of the goals and policies set forth in the city and county comprehensive plans. One common goal stated in the comprehensive plans is the protection and continued growth of the area's commercial and industrial sectors. The protection of these properties, as well as transportation corridors and infrastructure, would allow for their continued growth under the policies and requirements set forth in the adopted land use plans. Protection of residential areas within the floodplain would ensure that managed growth can occur to accommodate the projected population growth rates in the area.

4.8.3 Summary

4.8.3.1 Chehalis levees

Lands that would be affected by levee construction are currently designated rural open space under the Lewis County Comprehensive Plan, and are primarily devoted to agriculture.

4.8.3.2 Skookumchuck Dam Modifications

Modifications to the Skookumchuck Dam have been designed to improve water storage efficiency and would contribute to the management of flood flows in the area. Construction of the dam modifications would have little direct effect on land use in the area, although operations at the dam and reservoir would be subject to temporary disruption during construction. Fluctuations in reservoir levels are not expected to change land uses within the reservoir area; logging operations in the vicinity of the reservoir should not be affected. However, the modified reservoir operations would provide a significant reduction in flood stage near Bucoda, and protect existing residences and commercial establishments within Bucoda that are currently subject to flooding from the 100-year event. Protected parcels that are currently undeveloped would be subject to growth management restrictions under the Thurston County Comprehensive Plan.

Overall, the effects of the preferred alternative on land use are expected to be positive, as the alternative would afford protection to existing residential, commercial, and industrial areas and supporting infrastructure. Based on the above criteria, there would be no significant direct impacts on land use. Implementation of the preferred alternative is not expected to induce significant development outside established urban growth boundaries, nor result in major changes in land use patterns.

4.8.4 .Mitigation

None anticipated.

4.9 Recreation and Aesthetic Resources

4.9.1 No Action Alternative

There are no effects associated with recreational activities under the no action alternative. Development of planned recreational resources and opportunities would continue unaltered by the proposed project. The aesthetic values of the study area would remain unaffected Development along travel corridors would continue as planned under existing conditions.

Recreational activities associated with river access would not be affected by construction or operations of the levees, since boat ramps will not be removed and the existing parks will remain in place. Some positive affects could result from the creation of proposed wetlands and riparian areas as either mitigation or restoration activities to offset the levees. The Skookumchuck Reservoir already has restricted access and therefore no affects on recreation can be expected from dam modifications. During project construction, access will be limited or denied to those areas where the levees are located. This will be a temporary negative affect.

4.9.2 Criteria for Determining Significance of Effects

The criteria used for the determination of effects on recreation and aesthetics is based on the following:

- Displacement of fishing and hunting opportunities.
- Displacement or preclusion of hiking and other related outdoor activities.
- Alteration of current landscape and scenery.

4.9.3 Preferred Alternative

The aesthetic environment around the levee alignment will be affected by the preferred alternative. Some of the levees will have aesthetic impacts by altering the views surrounding the project area. Following roads, existing levees and existing features to reduce the changes in aesthetics and utilize existing topography, have minimized this impact. The levees will be planted with grasses and maintained to keep a more natural character within the project. Most views will not be blocked by the levees themselves and background aesthetics should remain unchanged. There are temporary aesthetic affects during project construction while heavy machinery, increased activity, and exposed soils alter the existing views.

4.9.4 Summary

Riparian plantings and wetland creation conducted as a part of the preferred alternative, would not preclude or eliminate any recreational opportunities post-construction. The visual impact of levee construction will occur temporarily, but this is not expected to be a significant affect on the long-term aesthetics of the project area. The project would not alter the rural aesthetic in the project area nor reduce hunting or fishing opportunities.

4.9.5 Mitigation

None Anticipated.

4.10 Transportation and Traffic

4.10.1 No Action Alternative

Under the No Action alternative, no project features would be constructed. Roadways that are currently subject to inundation during flood events would remain vulnerable to flooding. During floods, road access to major healthcare facilities would still be eliminated, and access to convalescent facilities, isolated residential areas, and public health and safety facilities would still be impeded. The existing levee around the airport would continue to be overtopped during the 50-year flood and larger events. SR-6 would still be regularly overtopped by floodwaters, and I-5 would remain subject to closure during larger floods. Widening of I-5 and other improvements that are necessary to address design deficiencies and meet the expected 2020 travel demand could not be undertaken in the Centralia-Chehalis area unless the highway grade were raised in portions of the floodplain in order to meet state and federal highway flood clearance requirements.

4.10.2 Criteria for Determining Significance of Effects

The following criteria were used to evaluate the significance of effects on transportation in the study area. A project alternative would result in a significant effect if it would:

- Result in permanent road closures.
- Result in temporary road closures that would redistribute traffic in a way that would cause peak-hour traffic volumes to exceed available capacity on any roadway.
- Result in temporary road closures requiring lengthy detour routes to be established.
- Cause substantial disruption of rail traffic through the area.

4.10.3 Preferred Alternative

4.10.3.1 Levee Construction

During levee construction, there would be an increase in traffic on local roads as construction equipment, supplies, and workers are transported to and from the area. Temporary haul roads will need to be constructed in some locations; these roads would be a minimum of 12 feet wide for one-way traffic and 24 feet wide in locations where two-way traffic must be accommodated. Some existing roadways would also be used as haul roads; these would be surveyed before and after project construction and restored to pre-project condition. The local sponsor would select the routes used for hauling of construction materials. The hours of operation would be specified to minimize traffic delays as much as possible.

There would be temporary closures on roadways adjacent to or within the levee footprint. Roads that could be affected by closures during construction include secondary routes in the Fords Prairie area, Airport Road, routes near the fairgrounds, and routes in the vicinity of the Harrison

Street bridge. Temporary road closures could also occur in other areas. During construction, temporary access ramps would be provided at road crossings and driveways.

An assessment of the I-5 embankment material would be done to verify that using portions of the highway as a levee would not affect the integrity of the roadway or embankment. Project construction is not expected to cause major disruption of traffic on I-5, but modifications to the Salzer Creek bridge that would be needed to address flooding problems there may entail temporary traffic delays. Safety measures will be coordinated with WSDOT for levee construction immediately adjacent to I-5.

Several roads in the project area may be raised or relocated on top of the levee, although it would be possible to build a levee or a floodwall parallel to existing roads in some areas. The local sponsor would review the options and determine the best approach for the local community. In locations where roads are raised or levees are constructed adjacent to driveways, permanent ramps would be constructed or a flood fight plan would be established to close off low-lying driveways during flood events. In a number of areas, openings in floodwall segments would be needed to provide access to commercial buildings. Flood fight plans would be developed for these locations.

Construction of the levee system would eliminate inundation of I-5 during the 100-year flood event. Transportation routes in virtually all of the Fords Prairie area would be protected. Transportation corridors in large portions of Centralia would be protected. The Mellen Street underpass would be protected from backwater flooding, maintaining a critical open access route to the hospital. However, portions of Cooks Hill Road, a primary route to the hospital, would still be inundated during the 100-year flood. The next phase of the project will include an investigation of options for protecting Cooks Hill Road to ensure that access to the hospital remains open during large floods. Flooding and interior drainage problems in China Creek would leave roadways adjacent to China Creek and east of the BNRR tracks south to Salzer Road vulnerable to flooding. A separate investigation to address problems with China Creek will be conducted in the next phase of the project. The Chehalis-Centralia airport and adjacent areas would be protected from flooding during the 100-year event, although a section of the south end of Airport Road would still be subject to inundation. South of Salzer Creek, portions of the BNRR tracks and National Avenue would also remain subject to inundation during larger flood events.

4.10.3.2 Skookumchuck Dam Modifications

Construction of the Skookumchuck Dam modifications would cause a minor, temporary increase in traffic on SR 507 and Skookumchuck Road as construction equipment, supplies, and workers are transported to and from the site. The modified reservoir operations would provide a significant reduction in flood stage near Bucoda, and reduce flooding of roadways in the Bucoda area that are currently subject to flooding from the 100-year event.

4.10.4 Summary

Overall, the effects of the preferred alternative on transportation would be beneficial, as it would protect existing transportation infrastructure from inundation during large floods. There would be no permanent road closures, and temporary closures are not expected to cause significant peak-hour traffic delays. Lengthy detour routes would be avoided. There may be some disruption of rail traffic during construction, but this is not expected to be substantial. Based on the above criteria, there would be no significant impacts on transportation.

4.10.5 Mitigation

Several project construction procedures and design considerations are intended to mitigate temporary and long-term impacts on transportation. As described above, existing roadways used as haul roads would be surveyed before and after construction and restored to pre-construction conditions. Temporary access ramps would be installed at road crossings and driveways to provide access during construction. Permanent ramps would be installed in locations where roads are raised or levees are constructed adjacent to driveways, or a flood fight plan would be established to close off low-lying driveways during flood events. In a number of areas, access to commercial buildings would be provided by openings in floodwall segments, and flood fight plans would be developed for these locations.

4.11 Air Quality

4.11.1 No Action Alternative

Air quality would remain similar to existing conditions under this alternative. If the construction associated with the preferred alternative does not occur, air quality within the region would not be affected in the short-term by construction.

With the no action alternative, uncontrolled floodwaters would be allowed to collect and pass through urbanized portions of the project area, causing damage to homes, businesses, and existing flood control devices. During and after significant flood events it may become necessary to utilize heavy equipment to clear debris, remove sedimentation and repair existing levees. These emergency operations will generate additional short-term pollutants.

4.11.2 Criteria for Determining Significance of Effects

The following criteria were used to determine the significance of effects on air quality. The Chehalis Flood Damage Reduction Project would result in a significant effect on air quality if it would:

- Violate any NAAQ or SWCAA standard or contribute substantially to an existing or projected air quality violation.
- Expose sensitive receptors to substantial concentrations of pollutants.
- Result in substantial emissions.
- Result in deterioration of air quality.

4.11.3 Preferred Alternative

4.11.3.1 Short-Term Effects

Two potential sources of air emissions are construction activities and construction related motor vehicle traffic. Construction includes excavation and the moving of earth to create the levees and the Skookumchuck Dam modifications. It is assumed that the project would generate pollutants of CO, ROG and NOx, and PM10 during the construction period.

Excavation activities would release dust particles as a result of wind erosion over exposed earth surfaces and of the activities of construction vehicles and equipment. Dust releases generally constitute the largest source of PM10 during construction. Although most of the dust particles would settle out immediately adjacent to construction areas, a small fraction would temporarily contribute to the area's ambient PM10 level. Exhaust from construction vehicles may increase concentrations of pollutants such as CO in the project area. CO emissions emitted as vehicle exhaust are the primary pollutant of concern because of their potential to cause CO hotspots. Concentrations of pollutants such as CO, elevated levels of PM10 may occur in the immediate vicinity of the excavation area.

Air quality affects due to excavation activities and construction vehicle emissions are temporary unavoidable significant adverse impacts. Impact would be considered less than significant with implementation of construction mitigation measures. All site work will comply with SWCAA regulations, which require reasonable precautions such as application of dust suppressants to avoid dust emissions.

4.11.3.2 Long Term Effects

The levee, flow way bypass, and dam modifications are passive flood control features. These features are not anticipated to generate operational air pollutants. No stationary sources of air pollution will be associated with the operation of these flood control features; therefore, no significant long-term effects are expected.

4.11.4 Summary

Air quality impacts due to construction activities and vehicle emissions are temporary and occur only when construction activities are taking place. All site work will comply with SWCAA regulations, which require reasonable precautions such as application of dust suppressants to avoid dust emissions. Unfavorable effects would be considered less than significant with implementation of construction mitigation measures. There will be no substantial emissions or deterioration of air quality.

4.11.5 Mitigation

Implementation of the following mitigation measures will reduce construction impacts to a less-than-significant level.

- Water all active construction areas at least twice daily.
- Cover all trucks hauling soil, sand, and other loose materials or require all trucks to maintain at least two feet of freeboard.
- Apply water three times daily or apply (non-toxic) soil stabilizers on all unpaved access roads, parking areas, and staging areas at construction sites.
- Sweep daily (with water sweepers) all paved access roads, parking areas, and staging areas at construction sites.
- Limit traffic speeds on unpaved access roads to 15 mph.
- Install sandbags or other erosion control measures to prevent silt runoff to public roadways.
- Suspend excavation and grading activity when winds (instantaneous gusts) exceed 25 mph.
- Limit the area subject to excavation, grading, and other construction activity at any one time.

No additional mitigation is anticipated.

4.12 Noise

4.12.1 No Action Alternative

No construction would occur with this alternative, and as a result, noise levels within the project area would not be affected by short-term construction. Noise levels would remain similar to existing conditions.

4.12.2 Criteria for Determining Significance of Effects

The established daytime standard cited by all respective noise elements is 60 dBA Ldn. Potential noise effects of the project were evaluated. A noise impact is considered significant if it would:

- Result in noise levels that would exceed the adopted noise standards of the City of Centralia or current state standards.
- Require construction activities that create short-term impacts exceeding local requirements at sensitive receptors in the area.
- Be incompatible with the noise environment in the area.

4.12.3 Preferred Alternative

4.12.3.1 Short-Term Effects

Typical construction noise levels at 50 feet from the source are summarized in Table 4.12-1. The types of construction equipment expected for this project include trucks, backhoes, bulldozers, and loaders. Table 4.12-2, which assumes this combined source-noise level, summarizes predicted noise levels at various distances from an active construction site. These estimates of noise levels take into account distance attenuation (6dBA per doubling of distance),

Table 4.12-1: Typical Construction Equipment Noise Levels

Type of Equipment	Noise Level in dBA at 50 feet
Bulldozer	85
Front Loader	85
Grader	85
Backhoe	80
Scraper	89
Electrical Generator	81
Roller	74
Compactor	82
Crane with Headache Ball	88
Concrete Pump	82
Concrete Vibrator	76
Concrete and Dump Trucks	88
Air Compressor	81
Pile Driver (Peak)	101
Pneumatic Tools	85

Table 4.12-2: Construction Noise in the Vicinity of an Active Construction Site

Distance Feet	Noise Level dBA	Distance Feet	Noise Level dBA
50	94	1,500	62
100	88	2,000	59
200	82	2,500	56
500	73	3,000	53
600	71	4,000	49
800	69	5,280	45
1,000	66	7,500	38

Notes: The following assumptions were used: Basic sound-level drop-off rate = 6.0 dBA/doubling. Molecular adsorption coefficient = 0.7 dB/1000 feet.
Anomalous excess attenuation = 1.0 dB/1000 feet.
Reference noise level = 94 dBA.
Distance for reference noise level = 50 feet.
This calculation does not include the effects, if any, of local shielding, which may reduce sound, levels further.

attenuation from molecular absorption, and anomalous excess attenuation (Hoover 1996). Assuming an attenuation of 6 dBA per doubling of distance, construction equipment noise in the range of 70 to 96 dBA would generate noise levels of up to 66 dBA at a distance of 1,000 from construction equipment, which is above typical ambient noise levels. Noise levels for construction and excavation activities associated with the SR-6 floodplain modification and dam modifications features will most likely be similar to the construction of the levee system. However, the area to be excavated is in a sparsely populated, mostly agricultural area, therefore with lower level of human receptors. The dam site is not close to residential, commercial or industrial development, therefore, human receptors are limited.

4.12.3.3 Long-Term Effects

Maintenance of the levee systems would include the control of vegetation growth if the levees were re-vegetated. Control may include use of power lawn mowers. The typical range of sound of a power lawn mower is usually 80 – 95 dBA, which is above typical ambient noise levels. The addition of periodic mowing along the I-5 corridor would not significantly impact noise levels in the project area. However, periodic maintenance of levees near residential areas, such as Fords Prairie and the Skookumchuck River, would be more significant, depending upon levee distance from the houses.

4.12.4 Summary

Noise levels will vary in proportion to the level of urban development within each reach. Noise associated with operation of earth-moving equipment usually exceeds background levels for short periods of time during construction. Noise effects would be mostly temporary and with construction noise abatement should be less than significant. Additional periodic noise created by levee maintenance would be an adverse unavoidable effect. All noise levels will not exceed noise standards of current city or state standards.

4.12.5 Mitigation

To reduce the potential for temporary, adverse noise impacts associated with construction, the contractor should be required to comply with all federal, state, and local regulations relating to construction noise. The following measures should be incorporated into contract specifications to help reduce the effects of construction noise:

- Restrict construction within 1,000 feet of residences to daytime hours. No construction should be performed within 1,000 feet of an occupied dwelling unit on Sundays, legal holidays, or between 10:00 p.m. and 6:00 a.m. on other days. Any variance from this condition would require approval.
- All equipment should have sound control devices no less effective than those provided on the original equipment. No equipment should have unmuffled exhaust.
- As directed by the construction manager, the contractor should implement appropriate additional noise mitigation measures, possibly including changing the location of stationary construction equipment, shutting of idling equipment, rescheduling construction activity, notifying adjacent residents in advance of construction work, or installing acoustic barriers around stationary construction noise sources.

No additional mitigation is anticipated.

4.13 Hazards and Hazardous Materials

4.13.1 No Action Alternative

No hazardous materials concerns would be associated with this alternative as no action would be taken that would result in impacts to the project area. Hazards and hazardous materials concerns would remain similar to existing conditions under this alternative.

4.13.2 Criteria for Determining Significance of Effects

The following criteria were used to evaluate the significance of effects of the preferred alternatives on HTRW sites. These criteria are based on Corps Regulation No. 1165-2-132. Construction and operation activities would result in a significant effect if they would:

- Create a potential public health hazard.
- Involve the use, production, or disposal of materials or wastes that pose a hazard to people, animals, or plant populations in the affected areas.

4.13.3 Preferred Alternative

4.13.3.1 Chehalis Levees

As this is a passive flood control feature not anticipated to generate hazardous materials with no source of hazardous materials associated with operation of these flood control features, significant long-term effects are not expected. Known soil and groundwater HTRW contamination will be avoided. However, this alternative places levees near or on sites that may be potentially contaminated as listed in section 3.13. If unknown contaminated soils or groundwater is encountered, construction could increase contaminant flow into the river or cause a groundwater plume to spread, both of which would be considered to be long-term significant effects. Other concerns include effects from hazardous materials associated with construction activities.

Potentially beneficial effects of the preferred project include protection of contaminated sites from floodwaters, limiting environmental and human exposure to hazardous materials. Examples of areas that would be protected include the Centralia Municipal Landfill Superfund site, the former American Crossarm and Conduit Superfund site, and the industrial area between Centralia and Chehalis.

4.13.3.2 Dam Modifications

Short-term concerns consist of hazardous materials associated with construction activities. As this is a passive flood control feature not anticipated to generate hazardous materials with no source of hazardous materials associated with operation of these flood control features, no significant long-term effects are expected.

4.13.4 Summary

The Centralia Flood Damage Reduction Project with Preferred Alternative should not directly contribute to long-term effects involving hazardous materials because the project does not expect to include the long-term use, storage, or disposal of hazardous materials. The hazardous waste mitigation measures identified in section 4.13.5 would ensure that construction activities associated with the proposed action would not contribute to effects from hazardous materials on people or the environment. The proposed action should have less-than-significant negative hazards or hazardous materials effects assuming measures to minimize adverse project effects would be implemented and operation and maintenance of the project does not create adverse effects, therefore, there would be no public health hazard or the use of materials or wastes that would pose a hazard to people, animals or plant populations.

4.13.5 Mitigation

Although not expected, accidental spills of construction materials, such as concrete, fuels, oil, and sealants, can adversely impact streams and waterways. Careful adherence to the project's spill prevention and emergency cleanup plan will ensure that a management system is in place to prevent or respond to accidental spills. The spill prevention and emergency cleanup plan defines the requirements for storage, handling, and containment of hazardous materials to emphasize protection of water quality. Requirements of the spill prevention and emergency cleanup plan may include:

- The proper storage of hazardous materials on impervious bermed areas.
- That hazardous materials that occur on-site during construction be handled and disposed of in a manner that does not cause contamination of storm water.
- There should be easy access to spill cleanup and containment equipment that should be located onsite.
- That construction vehicles and equipment be maintained outside the river channel
- Staging areas should be located 50 to 100 feet from the waterway to reduce the loss of riparian vegetation and limit potential damage from any spills.
- Fueling and maintenance of equipment should be conducted away from streams and waterways.

Soil excavated from any site in the project area may have some level of contamination. Despite attempts to identify all contaminated areas within the project area, there is a possibility that additional contamination may be discovered during construction. While there are no known concentrations of compounds expected, it is possible that some hazardous waste could exist in the subsurface environment. These compounds could result from agricultural land use within the project area, petroleum hydrocarbon storage or use, or placement of contaminated fill material that was not known, or never recorded. If hydrocarbon (or other) contaminated soil is encountered during site construction, there could be effects to worker safety if the concentrations of contaminated soil encountered exceed worker health and safety standards.

No additional mitigation is anticipated.

4.14 Cultural Resources

The following sections discuss potential effects on cultural resources for both the no action and preferred alternative. It should be emphasized that, because most of the cultural resources within the project area have not been evaluated for eligibility to the National Register of Historic Places (NRHP), this analysis is necessarily based on very incomplete information.

4.14.1 No Action Alternative

This alternative would involve no action in regard to the Centralia Flood Damage Reduction Project. Impacts to cultural resources involved with this alternative would include effects derived from the continued development and expansion of the communities of Centralia and Chehalis and the natural effects from continued flooding by the Skookumchuck, Newaukum, and Chehalis Rivers.

4.14.2 Criteria for Determining Significance of Effects

The following criteria were used to evaluate the significance of effects of the preferred alternatives on cultural resource sites. Construction and operation activities would result in a significant effect if they would:

- Cause the disturbance or loss of known cultural resource sites.
- Preclude the use of landscape features for cultural resources purposes.

4.14.3 Preferred Alternative

The Skookumchuck Dam modification and Chehalis River levees are the preferred alternative based on the available information, and with consideration for project purposes. The levee construction would impact archaeological sites; such was the determination of Jones et al. (1978). However, alignments of proposed levees are now more generally confined to the boundaries of urban development where the propensity for sites is typically lower than near landforms such as oxbow lakes, river meanders.

4.14.3.1 Chehalis Levees

The impacts to cultural resources involved with the implementation of this project feature have been summarized by Jones et al. (1978). The archaeological reconnaissance related to this project alternative was directed towards proposed levee alignments, as they existed in August of 1977. Jones (et al. 1978) identified 20 previously unrecorded sites and 7 known sites within the area to be affected by the levee alignment. In regard to cultural resources present within the project area:

Of the currently known sites, 14 would be directly impacted or at least partially destroyed by the construction of levees along currently proposed alinements. On the basis of a partial inventory, it is estimated that an additional 40-50 sites might be located along the remainder of the proposed alinements., While many of the sites within the project's primary impact area undoubtedly would provide significant information about the regional cultural record, available reconnaissance inventory data are not sufficient for making significant determinations on a site-by-site basis. Nevertheless, current information is sufficient to lead to the conclusion that potentially significant cultural resources will be affected by project actions and that further steps should be initiated to develop management alternatives that will enhance the preservation and protection of significant cultural resource properties (Jones et al. 1978:128).

Jones et al. (1978) proposed management recommendations consisting of two-part cultural resources inventory and subsequent testing. They recommended collection of site inventory data for both primary and secondary impact areas with a 100 percent effort directed at primary areas and a 5-15 percent effort directed at secondary areas (Jones et al. 1978:132). Testing of archaeological sites identified by a cultural resource inventory would be directed in accordance with the final location of proposed levee alignments. Testing at these locations would be aimed at assessing eligibility of sites for the National Register of Historic Places (Jones et al. 1978:137).

4.14.3.2 Skookumchuck Dam Modifications

The proposed modifications to Skookumchuck Dam are largely structural, however, the resulting change in reservoir levels would affect cultural resources present within the drawdown zone (Schalk et al. 2001). These modifications would effectively expand the maximum reservoir capacity an additional 15 feet (the capacity to inundate an additional 50 acres) bringing the maximum pool elevation up to 492 feet above mean sea level (Schalk et al. 2001:1).

Proposed structural changes to the dam include: the construction of a separate intake tower, the construction of a new spillway with two sluice gates, and a new intake structure atop of the existing spillway chute. Schalk et al. (2001:38-39) describe the following potential effects to cultural resources present in Skookumchuck Reservoir if this alternative should be implemented.

Raising the pool level of Skookumchuck Reservoir has potential to adversely affect archaeological sites in a variety of ways. First, for those sites that have flat benches or terraces that extend inland from the current upper pool elevation, reservoir erosion effects may be extended to inland portions of those sites that have as yet not been subjected to erosion.

Lithic or other cultural remains may be eroded out of intact sediments and contextual information thereby lost. Sites 45TN202, 45TN245, and 45TN247 each appears to have some potential for this type of adverse effect.

A second possible adverse effect is that raising the pool level is likely to produce impacts on archaeological deposits that are located in the *present* drawdown. A higher pool level implies that fine sediments removed from the margins of the higher pool will be redeposited on archaeological deposits that would be located within the lower portion of the drawdown. This siltation process has the potential to bury archaeological deposits, making them inaccessible to archaeological investigation.

A third kind of effect on archaeological sites that may occur as a result of raising the maximum pool level in the reservoir is the erosion of as yet unrecorded archaeological sites that may be present within that rather narrow band of land that lies between 477 feet elevation and 492 feet elevation. Although landforms suitable for occupation are quite limited in the project area, such areas do exist. These locations are densely vegetated at present and very difficult to survey.

If tree removal is carried out in the elevation zone between 477 and 492 feet, then this action could also cause project effects on cultural resources. Construction of access roads and operation of heavy equipment could cause impacts on known or as yet unidentified cultural resources.

No impacts of the proposed raise in maximum pool level on the (granite) quarry can be identified at this time. The project should have no adverse effect on this site (Schalk et al 2001:38-39).

For a more detailed discussion of cultural resources present in Skookumchuck Reservoir in relation to the Centralia Flood Damage Reduction Project, refer to (Schalk et al. 2001).

4.13.4 Summary

Several factors make assessing the various alternatives in terms of their relative impacts on cultural resources *quite difficult and subjective*. First, data on cultural resources is uneven across various alternatives and totally lacking for some. The recent archaeological survey (2001), for example, was limited to those properties for which Rights of Entry were available and cannot be considered a representative sample of the APE. Although substantial cultural resource information was collected in the late 1970s for the preferred alternative, the proposed levee alignments have changed since the original fieldwork, reducing the relevance of the original study to the currently proposed footprint. Second, while many sites have been previously recorded within the area encompassed by the various alternatives, information on the horizontal extent, depth, and integrity is lacking for most.

Given the widespread tendency for dense vegetation and poor surface visibility conditions in the project area, these aspects of archaeological sites are not reliably estimated from survey data. Without testing, the actual subsurface character of most of the archaeological sites in the project area is not known. Third, lacking such information that can usually only be obtained in settings like this by archaeological testing, the status of most of the sites in terms of eligibility for the NRHP is unknown.

Simple site counts by alternative or projected numbers of sites do not accurately allow quantitative comparisons of the relative impact of the different alternatives. However, based on the two largest cultural resource survey efforts that have been carried out within the general project vicinity, site densities can be estimated. Site density data from the Jones et al. (1978) study and the 2001 survey suggest an average of about one archaeological site per 19 acres. The determination of a preferred action alternative in regard to cultural resources is dependant upon several factors including the structure of the final “footprint” per alternative, the degree to which cultural resources will be affected, and mitigation protocols for cultural resources as dictated by Corps and the Washington State Office of Archaeology and Historic Preservation (OAHP). The Corps also anticipates developing an MOA with SHPO regarding any cultural resources encountered with the project.

4.14.5 Mitigation

Cultural resource evaluations will be conducted in the Planning, Engineering and Design Phase of the project. At that time, a memorandum of agreement (MOA) will be developed among consulting parties for the care of cultural resources. Discussion and recommendations within the MOA will address specific mitigation needs and approaches for the project. Possible mitigation may include the process for data recovery, monitoring needs, additional consultation requirements and site protection measures.

4.15 Environmental Justice

4.15.1 No Action

The No Action alternative would continue the existing population demographics, although Lewis County is growing in population. What future changes will happen is unknown.

4.15.2. Preferred Alternative

The preferred alternative (and the study area) is located in an area with a slightly greater than average white population for Washington State, with the exception of the Reservation lands. The Reservation had a much greater than the State number for percentage of American Indian population (56.2). The study area, with the exception of Rochester and Thurston County, is higher than the State percentage for both families and individuals living below the poverty level. The Hispanic and Latino population is higher than the State percentage for the Cities of Centralia and Chehalis and the Towns of Rochester and Grand Mound. The groups of potential concern identified in Section 3.15 are the American Indian and Native American population, the Hispanic and Latino population and the low-income population.

The preferred alternative would not disproportionately impact the identified groups. The Confederated Tribes of the Chehalis Reservation lands will not be subjected to any greater flooding events than have already occurred, although they are not included in flood damage reduction measures for the study area. The Corps has been involved in sovereign nation coordination with Native American Tribes (Section 6.1.5). The Towns of Rochester, Pe Ell and Grand Mound will not be subjected to any greater flooding events that have already occurred, although they are not included in the flood damage reduction measures for the study area

The majority of the study area will not be subjected to greater flooding than has already occurred and most will receive greater protection from flood damages. There is a small area of 8 houses in unincorporated Lewis County that may experience greater duration of flooding events, although this area does not have a distinct low-income and/or minority community. These houses will be raised for flood proofing.

The public disclosure process include a wide variety of interest groups that were actively involved in the study process as well as intensive efforts to utilize the local media and local community groups.

4.15.3 Finding of Significance

No disproportionately high and adverse human health or environmental effects on low-income or minority populations are identified for any of the alternatives. The public disclosure process actively sought out interests from all people living within the study area. As such, there are no significant impacts associated with environmental justice issues.

4.15.2 Mitigation

None Anticipated.

4.16 Socioeconomics

4.16.1 No Action Alternative

Under the no action alternative, the regional economic forces in the project area would continue to progress. Urban and agricultural businesses affected by flooding in the project area would continue to incur damages of variable magnitude. Commerce and distribution reliant upon major infrastructure may be occasionally disrupted as floodwaters inhibit transportation across Interstate-5 and major arterials of the project area.

4.16.2 Criteria for Determining Significance of Effects and Summary of Findings

Significant impacts to the socioeconomics of the immediate area are based changes to the following criteria:
- Flooding Potential
- Recreation
- Fishing
- Regional economic effects
- Water Supply

4.16.3 Preferred Alternative

It is anticipated that existing fishery resources may be impacted in a positive way. These effects have not been quantified or translated into monetary values due to uncertainties regarding the actual timing and effects of alternatives on recreation, and regarding plans and policies for recreational facilities and marketing. Lacking a clear vision of these pertinent factors at this time, it would be speculating to quantify recreational effects of the preferred alternative or any of the other alternatives.

There is potential for the preferred project to have a positive effect on the regional economics of the area. Although these positive effects would possibly be limited to the time frame required for construction of the preferred project. The location of the proposed levee system and Skookumchuck Dam modification will not directly impact local businesses. The location does not require the moving of any locally or otherwise owned businesses. However, the resilience of local economies and the cohesion of the local communities to agricultural conversion depend on a variety of factors, including age, ethnic, and racial composition of the community and income, unemployment, and poverty levels. It is anticipated that conversion of agriculture lands will be minimal in comparison to the amount of land that is active in agriculture functions.

4.16.4 Summary

In reviewing existing information, it has become evident that additional socioeconomic details will be needed following this report. Although anticipated to be positive, more socioeconomic information will be collected as this project proceeds to the next phase of planning. With the information available to the Corps at this current time there would be no significant impacts to recreation, fishing, regional economics, water supply, or an increase in flooding for the overall project.

4.16.5 Mitigation

Additional quantification of impacts during specific design of the project may be necessary but specific mitigation beyond avoidance and minimization is not anticipated.

5. Cumulative Impacts

5.1 Introduction

The combined, incremental effects of human activity, referred to as cumulative impacts, pose a serious threat to the environment. While they may be insignificant by themselves, cumulative impacts accumulate over time, from one or more sources, and can result in the degradation of important resources. Because Federal projects cause or are affected by cumulative impacts, this type of impact must be assessed in documents prepared under NEPA.

Cumulative impacts result when the effects of an action are added to or interact with other effects in a particular place and within a particular time. It is the combination of these effects, and any resulting environmental degradation, that should be the focus of cumulative impact analysis. While impacts can be differentiated by direct, indirect, and cumulative, the concept of cumulative impacts takes into account all disturbances since cumulative impacts result in the compounding of the effects of all actions over time. Thus the cumulative impacts of an action can be viewed as the total effects on a resource, ecosystem, or human community of that action and all other activities affecting that resource no matter what entity (Federal, non-Federal, or private) is taking the actions.

Cumulative impact analyses typically review historic impact, current conditions and reasonably foreseeable future impacts. In the following sections, historic, current, and reasonably foreseeable conditions are summarized for the study area and then examined in relationship to the preferred alternative and its potential to result in cumulative impacts to each subject area (biological resources, cultural resources, etc.)

5.1.1 Historic Impacts to the Study Area

The study area experienced various forms of development since the mid-19th century. Development activities included extensive logging, diking, road and highway construction, navigational improvements, damming, grazing, agriculture, and residential and commercial development.

The most dramatic changes to the Chehalis River occurred during aggressive efforts by the Federal Government to improve the navigability of the river in the late 1800s and early 1900s (for example, see Secretary of War 1890). This included the removal of snags, overhanging trees, log jams, drift heaps, shoals, and other obstructions to navigability. In 1 year (1887), 293 large snags were removed from the main channel, beginning at Claquato and ending near Oakville (approximately 16 miles), and masses of log drifts and log jams were loosened or burned (Secretary of War 1887). The practice of removing woody obstructions continued for decades through this reach for purposes of floating logs generated by timber operations (Secretary of War 1892, Wendler and Deschamps 1955).

Logging development also made dramatic changes to the study area. The earliest logging dams were built in the 1880s and continued through the 1920s. Splash dams were built on Elk Creek, Hope Creek, Chehalis River, South Fork Chehalis, Deep Creek, and the Skookumchuck River. The length of time that the dams remained in the streams ranged from less than 1 to more than 50 years, with an average of about 20 years. All splash dams were removed, washed out, or burned prior to 1944 except for one splash dam that may remain intact on Elk Creek (as of 1955) (Wendler and Deschamps 1955).

Splash dams were intentionally destroyed to carry logs downstream, a process termed "splashing." This process significantly affected channel dynamics. The floods of logs and water scoured or moved the gravel bars, leaving only barren bedrock or heavy boulders (Wendler and Deschamps 1955). New channels were created in some areas and/or changed the geometry (width, depth, cross-section shape) of existing channels. Splashing occurred on the average of once each week, but in some cases once a day. If the sudden influx of logs into a stream below the dam caused a log jam, dynamite or black powder was used to clear the obstruction (Wendler and Deschamps 1955). Natural logjams were removed in the process as well. The lack of logjams and the scour from splash dams has resulted in a simplified stream system in which water and sediment is routed much faster than prior to basin settlement.

Logging and agricultural development resulted in clearing of vast areas of native vegetation, including wetlands and riparian areas as well as upland forests. Much of the historic wetland area in the Chehalis Valley had drainage tiles and/or ditches or both constructed to facilitate agricultural use. Many of the riparian areas were either logged or cleared to open more area for agricultural or residential and commercial development.

Most of the residential and commercial development has occurred around the Cities of Centralia and Chehalis. These two cities occupy portions of the floodplain, while their associated infrastructure crosses the river, its tributaries, and their floodplains.

As the population of the area increased over time, the surrounding floodplain experienced a relative increase in the amount of development pressure. Residential and agricultural developments occurred within flood-prone areas to accommodate the increased population. These newly developed areas required transportation corridors and other infrastructure, as well as commercial businesses to support them. As a result, damage to buildings and infrastructure from flooding increased as development of the floodplain proceeded.

The road system in the study area developed in response to population increases and the establishment of farms, residential areas, industries, and commercial businesses in the mid to late 1800s. Land uses and the transportation system built to serve these uses were influenced by the opportunities and constraints presented by natural land features, including steep slopes, rivers and streams, and floodways. Rail lines were constructed to transport the agricultural commodities, timber, and lumber produced in the area, and subsequent patterns of industrial and commercial growth were largely determined by the locations of the rail lines and depots. Interstate 5 was later constructed along the general corridor established by the rail lines. The construction of Interstate 5 included the relocation of the lower portion of the Skookumchuck River.

Flooding of roadways and rail lines was historically a problem in large portions of the study area; for example, photographs of downtown Centralia taken in the early 1900s show vehicles axle-deep in floodwaters. Flood damages the area increased as more development occurred in the floodplain.

The changes brought about by navigation work, logging, agriculture and residential and commercial development had a significant impact on the biological resources of the study area. The major impacts included:

- Loss of wildlife habitat. Clearing of native vegetation and the construction of major transportation corridors virtually eliminated large mammal populations from the area. Remaining wildlife habitat is scattered in a scattered areas around the floodplain and no longer provides pathways for animal migration.
- Loss of fishery habitat. The Chehalis River once supported a complex aquatic community, including anadromous and resident fish species. Back channels, braided channels, shallow gravel beds, and pool and riffle complexes allowed for highly productive habitats. Navigation work and land use practices resulted in altered hydrology and sediment transport into streams and rivers and a reduction in biodiversity to the detriment of fish spawning and rearing habitat. The clearing of wood jams and snags from the Chehalis River (including the tributaries) and changed the fish habitat creation and nutrient retention patterns within the floodplain. The influence of woody debris jams on the creation of off-channel and other rearing habitat had been similarly reduced.
- Loss of wetlands and riparian areas. Clearing of wood jams and snags from the Chehalis River system (including the tributaries) also changed the flooding and ponding patterns within the floodplain, which reduced the extent of wetlands and riparian areas. Wetlands were also drained throughout the study for agriculture and filled for development. Riparian areas were logged and cleared for both agricultural and development purposes. This resulted in losses of fish and wildlife habitat, decreases in water quality, loss of floodwater retention and detention, and loss of low flow augmentation to the Chehalis River and its tributaries.
- Loss of native vegetation. Grazing and clearing of the native prairies (as well as clearing in other habitat types) resulted in a loss of biodiversity and habitat.

- Loss of migration corridors for plant and animal species. Construction of major features such as Interstate 5 and development of the floodplain resulted in the fragmentation and isolation of habitat. This essentially created islands of habitat and plant populations. The result of this is the outright loss of plant and animal species or much smaller populations of both. This has reduced both the biodiversity and the ecological health of the entire basin ecosystem.

The principle pathways of the impacts identified above are: (1) modification of the waterways; (2) modification of the floodplain; (3) agricultural and sivicultural practices; and (4) the development of urban centers and major transportation corridors.

5.1.2 Current Condition in the Study Area

Current conditions in the study are largely a result of the historic changes to the Chehalis River system. Although the majority of the Chehalis River floodplain remains in agricultural use, the severity of floods in the area appears to be increasing, and flood damages have risen significantly. As recorded at the Grand Mound gage, the February 1996 and January 1990 floods represent the first and second highest floods, respectively, observed in the Chehalis basin since 1929. Six other major floods occurred in the past decade. These include the third and sixth highest floods of record, which occurred in November 1986 and November 1990, respectively. Because the Skookumchuck confluence was relocated to its present location, the additional water raises the water surface within the Chehalis River downstream of the confluence and creates a backwater effect upstream of the confluence.

The floodplain currently shows numerous oxbows and other features formed by cutoff of meander bends. Aerial photographic analysis indicates that these features formed sometime before 1949 (earliest available aerial photographs of the study area) and have changed little in the past 50 years. These features are not ancient, and are likely no more than a few hundred years old. Given the extremely low gradient of the channel and floodplain through the study area, the oxbows present on the floodplain can be interpreted as features that were formed during a period when large woody debris (LWD) was abundant within the Chehalis River. LWD probably caused the formation of side channels and oxbows. This is supported by the observation that no new oxbows or channel features have formed in the past 50 years even though the basin experienced several large flood events.

The study area still plays an important ecological role because it continues to be support remnant forest, prairie, riparian and wetland ecosystems as well as providing support for fisheries and wildlife. Current practices of development and land use include modification of the floodplain through development and on going agricultural and silvicultural practices. These would likely continue to diminish beneficial functions associated with the remnant ecosystems.

Current land uses in the study area are composed primarily of residential, agricultural, and silvicultural uses, although commercial and light industrial uses have been increasing in recent years. Commercial development has been focused primarily along the Interstate 5 corridor in Centralia and Chehalis. Improvements to transportation corridors in the area are ongoing. The area is expected to continue to undergo development in accordance with locally adopted comprehensive plans.

Portions of I-5 are subject to inundation during large flood events, which has resulted in the multi-day closure of the freeway between Chehalis and Centralia. Primary arterials, including all north-south roads between Chehalis and Centralia, are also inundated with floodwaters during larger floods. Flooding has accelerated the deterioration of the substructure of some arterial routes in the area, causing damage to the roadway sub-base and pavement (City of Chehalis, 1999). Larger floods also cause portions of the rail lines to become temporarily unusable when the subgrade becomes saturated or the rail lines are overtopped by floodwaters.

5.2 Reasonably Foreseeable Impacts to the Study Area

Residential, commercial, and industrial development within flood-protected areas would continue, primarily within designated urban growth boundaries in and around Chehalis and Centralia. This development would increase the extent of impervious surfaces, resulting in additional runoff and decreasing groundwater recharge in these areas. Management of stormwater runoff from developed areas would be subject to local and State guidelines and requirements. The effects of a decrease in groundwater recharge from these areas are expected to be minor, as they represent a relatively small portion of the overall basin, and are generally located on fine-grained soils with low infiltration rates.

The Washington State Department of Transportation (DOT) is currently evaluating traffic improvements to I-5, which may include widening of the freeway and the reconstruction of existing freeway exit and entering ramps. There is no timetable for these actions but are likely to be proposed within the next 5 to 10 years. These improvements would potentially impact the land use adjacent to the freeway and the interchange areas. Lewis County is also sponsoring a proposal for new interchanges and connections to the local road system in the vicinity of the existing LaBree Road overcrossing and in north Lewis County. The local jurisdictions would continue to develop maintenance, safety and capacity improvements, and street extensions as part of their comprehensive and capital improvement planning activities.

Relocation of the municipal sewage treatment plant is foreseeable in the next 5 years and changes in operation at the PacifiCorp Steam plant may alter needs for Skookumchuck River withdrawals.

The Corps of Engineers in partnership with Grays Harbor County has begun study of the entire Chehalis basin (Chehalis Basin Ecosystem Restoration Project). The purpose of this study is to select a myriad of project alternatives, which both recover the degraded ecosystem, primarily for salmonid recovery, and provide ancillary flood damage reduction benefits to the basin. This is in addition to and inclusive of watershed management planning and analysis currently underway by State and local agencies within the basin.

The study includes intensive public and agency involvement with the purpose of selecting projects that will benefit to goals of ecosystem restoration with ancillary flood damage reduction. The current understanding is that the selected projects would be implemented over a 10 to 15 year period.

5.2.1 Cumulative Impacts Associated with the Preferred Alternative

5.2.1.1 Hydrology and Hydraulics

The preferred alternative would result in little change to flooding within the active portions of the Chehalis River floodplain and its tributaries. Significant changes to the extent of flooding in the Chehalis River valley would occur only during large floods. Areas that would be prevented from flooding are generally not within the active floodway, but instead are backwater or temporary storage areas where short-duration flooding occurs. Modifications to the Skookumchuck Dam and reservoir operations would eliminate large overtopping floods on the Skookumchuck River and replace them with smaller events of greater frequency and duration.

Substantial increases in flood stage or flow velocities within and upstream or downstream from the study area are not expected. The preferred alternative would have no significant effect on recharge of groundwater resources. The long-term changes associated with development of the basin would continue to dominate the hydrology and hydraulics of the Chehalis River system, and would be little affected by project implementation. Mitigation actions associated with the preferred alternative would reconnect portions of the Chehalis River to the adjacent floodplain. These actions would be expected to enhance local groundwater recharge associated with minor (1 to 2-year) floods.

The preferred alternative would alter flood stages and timing of flows in the study area and potentially could contribute to the cumulative effects of past hydrologic and hydraulic modifications. Future development in areas that would be protected from flooding would result in changes in runoff and infiltration. However, design considerations incorporated into the preferred alternative would avoid unnecessary impacts, minimize unavoidable impacts, and provide mitigation to offset potential impacts and restore some historic functions of the Chehalis river floodplain. No specific information is available on likely future development, including improvements to Interstate-5, however, these projects would also be rigorously analyzed for impact avoidance and minimization. No significant cumulative impacts to hydrology and hydraulics are expected.

5.2.1.2 River Geomorphology

The anticipated effects on river geomorphology in response to predicted changes in hydrology and hydraulics are negligible. The long-term channel changes associated with the historical removal of LWD and the relocation of the Skookumchuck River confluence would likely continue unaffected by the preferred alternative. While there is currently a very limited source of LWD along the Chehalis River within the study area, the preferred alternative allows for the future establishment of a restored riparian zone that could supply LWD to the channel through bank erosion and channel migration in the future. No specific information is available on likely future development, including improvements to Interstate-5, however, these projects would also be rigorously analyzed for impact avoidance and minimization. No significant cumulative impacts to river geomorphology are expected.

5.2.1.3 Cumulative Impacts on Water Quality

Construction of the project in the Chehalis River watershed have the potential to cause temporary and intermittent increases in suspended solids or concentrations of biostimulatory nutrients (nitrogen and phosphorus) in the Chehalis River (and tributaries) for those portions of the project that are located in close proximity to the river and tributaries; the major portion of the levee and floodwall alignment is setback away from the river and tributaries. Any soil-disturbing activities during construction would be conducted in compliance with State approved construction stormwater management plans. Past impacts have resulted in the majority of the concurrent water quality concerns (specifically, seasonal high temperatures and low dissolved oxygen). This project is not expected to degrade the current condition. Impacts from the preferred alternative is not likely to result in significant cumulative impacts to water quality as a result of construction.

After construction, the preferred alternative would have limited potential for impacts to water quality because of its setback location. The preferred alternative would not change normal flows or velocities of the river and tributaries, would not degrade existing conditions by being a source of contaminants, and/or would not result in changes to temperature, turbidity, and dissolved oxygen conditions. There would be some changes in the duration of larger magnitude floods within the Chehalis Valley study area, which may result in increased sedimentation, scour, and bank erosion. However, it would be difficult to differentiate specific impacts associated with the preferred alternative because of the catastrophic nature of the flood itself. The preferred alternative may result in cumulative impacts to water quality during the flood events, but this would be episodic in occurrence and likely of short duration. As stated above, past impacts have resulted in the majority of impacts to water quality and the preferred alternative will not degrade the existing condition. As such, no significant cumulative impacts to water quality as a result levees and floodwalls in the Chehalis Valley and lower Skookumchuck River are expected.

Changes to the operation of the Skookumchuck Dam, which would result in changes to frequency and duration of floods on the Skookumchuck River may result in cumulative impacts to water quality. Specifically, changes in the frequency of lower magnitude floods (5- and 10-year events) may change beneficial uses associated with riparian and wetland habitats. The major impacts associated with the Skookumchuck River have occurred from past actions, however, changes in operations may affect the current condition. This potential impact would be further evaluated during design.

No specific information is available on likely future development, including improvements to Interstate-5. However, water quality on the Chehalis River is of concern to both State and local agencies and these projects would also be rigorously analyzed for impact avoidance and minimization.

Proposed mitigation plans for the preferred alternative, which include increased canopy cover and wetland creation and restoration should decrease summer water temperatures and improve dissolved oxygen conditions during low flow periods in the Chehalis River. These actions are intended to improve baseline conditions of the river. This action may help restore some of the historic functions of the Chehalis.

5.2.1.4 Biological Resources – Vegetation, Wetlands, and Riparian Areas

The preferred alternative would result in modification Skookumchuck Dam and the modification of the floodplain through the construction of the levees and floodwalls. The floodplain modifications have been focused on avoiding unnecessary impacts to critical habitats (wetlands and riparian areas). The major impacts to wetlands and riparian areas occurred as a result of past actions. No information is available to evaluate the extent of future actions, although future projects, including Interstate 5, are likely to result in wetland losses. Compensatory mitigation for the preferred alternative would increase the function and extent of wetlands and riparian areas as well as increasing the overall vegetation biodiversity in the project area and may serve to offset cumulative impacts as well as restore some historic functions. Future development that includes impacts to biological resources would likely require avoidance, minimization, and compensation measures. What remains unknown is the potential impacts to the wetland and riparian areas of the Skookumchuck River from the change in operation of the Skookumchuck Dam. However, the potential for cumulative impacts would be associated with the first reach between the dam and the first tributary. This reach is the only reach that a modified dam would have direct and cumulative impacts.

5.2.1.5 Biological Resources – Wildlife

The preferred alternative would result in the loss of land that could be potentially modified into habitat for wildlife, both within the alignment footprint and on the levees. In order for the levees to maintain their structural integrity, woody vegetation would be regularly removed thus reducing the potential use as wildlife habitat.

The proposed mitigation would increase the habitat for wildlife by creating additional riparian habitat, connecting oxbows, creating and restoring wetlands. This would restore some of the historic habitat for smaller wildlife species, although it would not restore habitat for larger species such as elk and deer. The major impacts from connectivity issues associated with the transportation corridors and development of the floodplain use are too large to be overcome by the preferred alternative, however, the project will not result in any degradation of existing conditions. No information is available on the extent of potential future actions, but these actions would be subject to avoidance, minimization, and mitigation requirements. No significant cumulative impacts to wildlife are expected.

5.2.1.6 Biological Resources – Fish

The preferred alternative would result in modification Skookumchuck Dam and the modification of the floodplain through the construction of the levees and floodwalls. The floodplain modifications have been focused on avoiding unnecessary impacts to critical habitats (wetlands and riparian areas). The majority of impacts to fisheries are associated with past actions (floodplain modification and development, removal of LWD, habitat modification, etc). The preferred alternative would not result in any degradation of existing conditions within the Chehalis River floodplain. Compensatory mitigation would increase biodiversity, improve fish habitat, increase primary and secondary productivity, and increase flood storage opportunities, which would restore some of the historic function. No information is available on the extent of potential future actions, but these actions would be subject to avoidance, minimization, and mitigation requirements.

What is remains unknown is the potential impacts to the fishery support functions of the Skookumchuck River from the change in operation of the Skookumchuck Dam. No conclusions can be made regarding potential cumulative impacts to fish as this time, but this resource would be the subject of further evaluation during the design phase of the preferred alternative.

5.2.1.7 Land Use and Planning

Several design features of the preferred alternative are intended to minimize the impacts on land uses. The levees and floodwalls would be set back away from the Chehalis River and its tributaries to the greatest extent practicable, while offering protection to significant tracts of developed land. Existing roads, levees, and other structures would be incorporated into the design wherever possible to reduce impacts to these existing features. Additionally, floodwalls would be used in certain areas to minimize the footprint of the structure and to avoid impacts on existing buildings and infrastructure.

Under the current design, large areas of undeveloped land within the floodplain would not be protected from flooding. These unprotected areas would not be expected to undergo urban-type development. Undeveloped lands that would be protected as a result of the preferred alternative would undergo urban development in accordance with the local jurisdictions' comprehensive plans. These comprehensive plans would be periodically reviewed and amended in accordance with the Growth Management Act.

The preferred alternative also incorporates modifications to the Skookumchuck Dam to aid in the reduction of peak flows during flood events. These modifications would provide additional flood control storage that would significantly reduce peak flood stages in communities downstream, thereby reducing flood damage to structures located in the floodplain. However, areas within the floodplain that are protected would only undergo development under the purview of comprehensive plans adopted under the Growth Management Act.

The dominant land uses in the study area are expected to remain agricultural and residential with a gradual increase in commercial and industrial land uses as the population in the area increases, which is consistent with expectations of existing conditions. The design considerations incorporated into the preferred alternative would minimize the potential for impact to surrounding land uses. No information is available on the extent of potential future actions, but these actions would be subject to current and future land use requirements. No significant cumulative impacts are expected.

5.2.1.8 Recreation, Public Access, and Visual Resources

Cumulative impacts for recreation would involve dispersal of recreation activities to other areas, as opportunities under the preferred alternative would become limited during construction. However, recreational opportunities could return to areas immediately impacted as construction progressed to other areas within the study area. The preferred alternative will result in no changes to existing conditions. No information is available on the extent of potential future actions, but these actions would be subject to avoidance, minimization, and mitigation requirements. No significant cumulative impacts to recreation, public access and visual resources are expected to result from the preferred alternative.

5.2.1.9 Transportation and Traffic

The preferred alternative would result in the permanent modification of some roadways, including raising a portion of SR6 and raising or relocating portions of arterial and secondary routes on top of the levees. However, the modifications would have a beneficial effect on transportation systems, since the preferred alternative would provide flood protection for the portion of I-5 that is currently subject to flooding, as well as protection for local roadways, the airport, and rail lines. This is a change from past conditions, but is consider a beneficial change. No information is available on the extent of potential future actions, but these actions would be subject to transportation and traffic analysis. No significant cumulative impacts to transportation and traffic are expected to result from the preferred alternative.

Although there would be temporary impacts on transportation during construction, the preferred alternative is designed to avoid unnecessary impacts and minimize unavoidable impacts to existing roadways and rail lines. Overall, the preferred alternative is expected to provide a significant benefit to transportation systems in the area. It would reduce flooding of local roadways, rail lines, and airport facilities, and provide the flood clearance that is needed in order to implement improvements to I-5 in the Centralia-Chehalis area. No significant cumulative adverse impacts to transportation are expected as a result of the preferred alternative.

5.2.1.10 Air Quality

The preferred alternative consists of passive flood control features. These features are not anticipated to generate air pollutants. There would be no change to existing conditions. No information is available on the extent of potential future actions, but these actions would be subject to avoidance, minimization, and mitigation requirements. No cumulative effects to air quality in the study area are expected.

5.2.1.11 Noise

Noise associated with the construction of the preferred alternative is temporary and does not contribute to cumulative effects to the study area. Long-term noise created by the operation and maintenance would be limited to periodic mowing. These structural features of the preferred alternative would not generate operational noise. No change to existing conditions is expected. No information is available on the extent of potential future actions, but these actions would be subject to avoidance, minimization, and mitigation requirements. No significant cumulative effects to the study area are expected.

5.2.1.12 Hazards and Hazardous Materials

Accidental spills of construction materials harmful to the environment, such as concrete, sealants, oil and other fuels, during construction of the preferred alternative could contribute to cumulative impacts on water quality. Although they would be infrequent and not intentional, accidental spills could occur during construction near stream channels or on the banks of stream channels.

The cumulative impacts of toxic contaminants would be less than significant because toxic material control and spill-response plans would be implemented for major construction projects in the watershed to avoid or control potential accidents. Hazardous waste mitigation measures would ensure that construction activities associated with the proposed action would not contribute to effects from hazardous materials on people or the environment. No changes to existing conditions are expected. No information is available on the extent of potential future actions, but these actions would be subjected to the rigorous generation and handling controls if hazardous substances are associated with any proposed project.

The preferred alternative would not directly contribute to cumulative effects involving hazardous materials because this alternative would not include the long-term use, generation, storage, or disposal of hazardous materials. No significant cumulative effects to the study area are expected.

5.2.1.13 Cumulative Impacts on Cultural Resources

The preferred alternative has the potential to adversely affect historic properties or culturally important resources if they are present within the area proposed for project implementation. Historic properties are a finite resource; only some have survived the damages caused by time, natural degradation, and continuing land uses. The goal of Federal resource protection is to preserve the best available examples of resource types. The preferred alternative is likely to affect prehistoric archeological sites, traditional cultural properties, or early settlement or industrial sites. There is potential to affect locations of cultural importance to Tribes that are not encompassed by Federal historic preservation law. The degree to which cultural resources would be affected is based on the actual footprint of the preferred alternative. The alignment of the preferred alternative is confined to the boundaries of urban development and set back from the river and major features of the floodplain (oxbow lakes and meanders). This may reduce the extent of the potential impacts.

The major factor of right of entry makes assessing the cumulative impact of the preferred alternative on cultural resources quite difficult and subjective. The data on cultural resources is uneven due mainly to the right of entry problems encountered during review of the known sites. Without testing, the actual subsurface character of most of the archaeological sites in the study area is unknown. Plus lacking such information that can usually be obtained in settings like this by archaeological testing, the status of most of the sites in terms of eligibility for the National Registry is unknown. Potential cumulative impacts cannot be concluded at this time, but would be the subject of investigations during the design phase.

No information is available on the extent of potential future actions, but these actions would be subject to avoidance, minimization, and mitigation requirements.

5.2.1.14 Irreversible and Irretrievable Commitment or Resources

Construction of the proposed alternative will include many features considered permanent, or modifications to existing features. Project features which may be considered irreversible would be construction of the levee's and the dam modifications. Resources that could be considered irreversible and irre4trievable would be the commitment of resources such as state and federal funding to purchase lands and labor and to operate and maintain the alternative. At this time there are no commitments of resources that are irreversible and irretrievable except for the cost of producing this DEIS.

5.2.1.15 Relationship Between Short Term Uses and Long Term Productivity

While regional conditions may improve, short-term or localized conditions should improve after the initial impact of construction. Overtime the entire area should improve dramatically for existing wildlife resources. Further studies and monitoring will be critical to the over all recovery and maintenance of habitat for wildlife and fisheries in this area.

5.3 Findings of Significance

No significant cumulative impacts are expected to occur due to the preferred alternative for hydrology and hydraulics, river geomorphology, wildlife, land use and planning, recreation, public access and visual resources, transportation and traffic, air quality, noise, and hazards and hazardous materials. In consideration of past, on going and reasonably foreseeable impacts, the project has the potential to cumulatively impact water quality, fisheries, and wetlands and riparian areas; additional study during design would be focused on potential cumulative impacts associated with the Skookumchuck Dam. Cumulative impacts to cultural resources cannot be concluded without additional study. This would be done during the design of the preferred alternative.

6. CONSULTATION and COORDINATION COMPLIANCE

Public involvement is a critical element in the feasibility of project development. Interested individuals, organizations, agencies, and governmental entities are solicited for comments and concerns relative to a proposed project. This chapter describes the Corps effort to establish dialogue with a variety of interests involved with the Chehalis River Flood Reduction Project. The Corps in part is obligated to engage in this process through a variety of state and federal regulations. Discussion among interested parties is scheduled to continue through PED of the project as well as during the processing of this document. The Corps will consider the information collected in its decision-making process to select a preferred alternative that has the least adverse environmental effect.

6.1 NEPA Compliance

Environmental, socio-economic, hydrologic and water quality information on this project has been compiled and a DEIS for the Centralia Flood Damage Reduction Project, was prepared from March to July 2002. A systematic interdisciplinary approach to planning has been utilized; all reasonable alternatives have been studied, developed and described, and all pertinent information, including hydrologic, environmental and water quality modeling and ecological field studies have been developed, carried out and utilized. The DEIS will be coordinated with Native American Tribes, state, Federal and local agencies, non-governmental agencies, and the public for a period of not less than forty-five days.

6.1.1 Public Involvement

The Corps has informed the public of the proposed project through several public meetings held in the affected area and press releases published in local print media. In addition to providing information to the public regarding this draft environmental impact statement (DEIS), the Corps solicited responses regarding the public's needs, values, and evaluations of the proposed alternatives. Both formal and informal input has been encouraged and will be considered by the Corp.

6.1.2 Scoping Process

A scoping process is a requirement of the environmental impact statement (EIS) preparation (49 Code of Federal Regulations [CFR], Part 1501.7). Scoping, as defined in the Council of Environmental Quality (CEQ) regulations of 1978, is "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action." The scoping process facilitates:

- Identification of issues, concerns, and possible impacts
- Identification of existing information sources
- Development of alternatives

On September 9, 1999, the Corps initiated the scoping process by publishing in the *Federal Register* a Notice of Intent to prepare a DEIS on the Centralia-Chehalis Flood Damage Reduction Study. The Corps notified all potentially interested parties about the Flood Reduction DEIS scoping process, and provided opportunities to comment. The Corps also provided a press release about the scoping meetings to the news media and local newspapers.

6.1.3 Public Scoping Meetings

The Corps held two consecutive scoping meetings on September 28 and 29, 1999 in Rochester and Chehalis, Washington, respectively. At these meetings, the Corps presented the proposed alternatives currently under consideration and invites comments and suggestions for other alternatives to reduce flooding and minimize and or avoid potential environmental impacts.

6.1.4 Endangered Species Act, Section 7

Section 7 (a)(2) of the Endangered Species Act (ESA) of 1973 PL 93-205; 16 USC 1531 et seq., as amended) requires Federal agencies to consult with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) when a Federal action may affect a listed threatened and or endangered species or critical habitat. The purpose of this legislation is to ensure that any action authorized, funded, or carried out by a Federal agency is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of a species critical habitat.

The Corps has initiated consultation with the USFWS and NMFS. As required by Section 7 (a)(2), the Corps prepared a separate biological assessment (July 09, 2002) addressing the potential effects on threatened and endangered species that occur and or may occur within the vicinity of the study area. The findings of the consultation will be presented in the final EIS.

6.1.5 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (PL85-624; 16 U.S.C. 661 et seq.) (FWCA) requires Federal agencies to coordinate with the USFWS and state wildlife agencies when planning new projects or when modification to an existing project occurs. The purpose of the legislation is to ensure that the welfare of wildlife resources receives appropriate consideration with other project objectives and features.

The USFWS has provided a FWCA report relative to the Flood Reduction Project, in accordance with Section 2(b) of the Fish and Wildlife Coordination Act and is available upon request. The Corps has coordinated with USFWS on the proposed project through written correspondence (Planning Aid Letters) that were prepared on 9 separate occasions between April 21, 2001 and February 27, 2002. The following paragraphs contain recommendations as presented in the Fish and Wildlife Coordination Act Report prepared by the U.S. Fish and Wildlife Service and responses to the recommendations prepared by the Corps.

6.1.4.1 U.S. Fish and Wildlife Service draft Fish and Wildlife Coordination Act Report Recommendations

Comment #1 – Details about the re-operation of the dam should include: a) the expected future water and power needs for the Centralia Steam Plant and the associated co-generation plant; b) the status of discussions between Lewis County and PacifiCorp for transferring flood control operating authority and/or ownership rights for the dam and reservoir; c) the potential for fish stranding in the reservoir during drawdown and how this could be minimized; d) the potential that insufficient water would be available to provide minimum flow requirements downstream; e) the likelihood of shutdowns in dam operation and severe ramping downstream; and f) the feasibility of providing overbank flows in excess of a 2-year event while limiting flows at the Pearl Street gage in Centralia to 5,000 cfs.

Response – 1.a- There is no change in the future needs for water supply by the Centralia Steam Plant. The water right for the Steam plant is 50 cfs at the point of removal from the river. The dam operation will just need to maintain this flow. In regards to the Centralia Steam Plant power needs, we are unaware of any future changes to the power that would require additional water supply rights from the Skookumchuck. In regards to the power facility at the dam, this power plant will be decommissioned by the new owners, a flood district (made up of Lewis county entities). 1.b- Lewis county and PacificCorp are still conducting negotiations with the current owners for transferring the ownership of the dam to a flood control district that will operate and maintain the facility for flood control. 1.c- Reservoir operations are generally comprised of rules and constraints to address flood conditions and other conditions that are related to the pool and downstream impacts. If fish in the reservoir proper are a concern, reservoir draw during floods can be limited in rate and extent so as not to strand or otherwise take fish. Assuming there is a minimum pool that does not greatly diminish flood control, limiting evacuation to minimize stranding can be established as a constraint, just as the "turbidity pool" is a constraint at Howard Hanson Dam.

1.d- Minimum flows for downstream obligations are often a constraint reservoir operations are required to meet. In flood season, reservoir operations are predicated on projected rainfall-runoff, reservoir pool, downstream channel conditions and inflow to the reservoir. Meeting minimum flow requirements during flood season should not be an issue and can be accommodated based on measured inflow and pool conditions. This could limit the ability for providing adequate minimum flows downstream. However, this condition would occur regardless of the dam configuration, assuming the refill rule is constructed to reflect current conditions.

1.e- During major floods, the objective is to limit the flow downstream to meet non-damaging conditions or constraints. Since the Skookumchuck Dam does not control the entire basin, the maximum flood reduction impact that could be achieved from the dam is to completely shut the flow off. However, if there are minimum low flow criteria immediately downstream of the dam (at least to the first flow contributing tributary) then dam operation rules would include those constraints as long as they do not impair or greatly diminish flood reduction benefits that

justified the project. Further, ramping rates are typically imposed on the downstream channel so as not to strand fish or create channel instability on ramping-down or create a health risk on ramping-up.
1.f- There may be opportunities for controlled channel exceedance as long as the operation does not, or can not be construed as, purposely contributing to damage. Current uncontrolled flooding that is unavoidable is one thing, but purposely flooding areas that we can not control once our of bank, is not something we should do. However, if there are specific target out-of-bank flooding areas that can be controlled and that have been identified as having environmental benefits directly linked to out-of-bank flooding, we could configure overtopping "scenarios" that would take advantage of that linkage.

Comment #2 – The following details should be provided to clarify design for the levee system: 1) a map showing the extent of existing levees and embankments, where these would be increased in height, and where new levees would be constructed; 2) maps modeling the extent of inundation at selected flood events, including 2 year, 5 year, 10 year, 35 year, 50 year and 100 year events for pre and post levee project; 3) an assessment of downstream impacts caused by limiting flood plain storage for selected flood events and the distance downstream where those impacts might be evident.

Response 2.1- Maps for all the levee system will be produced prior to the preconstruction, engineering, and design (PED) planning and engineering phase of the proposed project and will contain the existing levees (all available data about their construction) and the planned new levees.
2.2- Most of these maps have been completed and presented to the environmental working group during the early phase of developing the criteria for the DEIS. However, a copy of those maps can be provided upon request.
2.3- There will be minimal impacts to the downstream portions of the Skookumchuck Dam based on the suggested re-operation plan. However, during the planning phase of this project any expected or suspected impacts will be assessed and evaluated for mitigation.

Comment #3 – The Corps should provide details about the SR 6 bypass and restoration for our consideration during the preparation of this final document. We would like the opportunity to work with you in developing this component of the recommended plan. Our information needs include: a) details about the "concrete flow way" under SR-6 and ways of altering this concept to provide better benefit to fish; b) flows predicted to provide access to the oxbow and to the bypass floodway; c) the potential for fish stranding and how that would be mitigated; d) the potential for fish loss due to entrapment and predation and ways of mitigating; e) anticipated maintenance needs; f) how much material would be excavated and where it would be placed; and g) the feasibility of purchasing land or obtaining conservation, erosion, and drainage easements to insure that restoration would remain viable.

Response 3.a- The concrete flow way under SR-6 will be designed to allow proper fish passage based on the coordination with the resource agencies, Tribes, and other interested parties.
3.b- All flows will be better understood during the PED of the proposed project.
3.c- The project will be designed to protect fish to help prevent fish from becoming stranded therefore, mitigation will not be required.
3.d- During the PED phase of this project entrapment will be a major design consideration and all efforts will be put into place to reduce entrapment of fisheries. Predation is a natural process of fisheries and the project will not be designed to encourage predation; therefore, predation should not be mitigated for.
3.e- During the PED phase all maintenance needs will be identified.
3.f- This feature includes a 400 feet wide excavation of SR-6, with an invert elevation of EL. 179 feet. This would involve excavating and grading approximately 65,000 cubic yards of material, and elevating the roadway to provide clearance for reconnecting the floodplain by providing overbank flows; an environmental condition of significant importance to fish and wildlife species in the study area. The material removed will either be properly disposed of such as the construction materials, asphalt/concrete, etc. Any material that can be utilized in the construction of the levees will be used.
3.g- A gross appraisal has been conducted in this area, the local sponsor will be required to purchase the property in fee.
Comment #4 – All recommendations presented in the Corps' fisheries review document should be incorporated into the re-operation plan and the revised rule curve for the Skookumchuck Dam with the following exceptions or additions:

a) Rather than proposing the 2-year event as the maximum allowable flow in the river, we recommend that the Corps determine the flows at which critical functions occur (such as channel maintenance and the creation and maintenance of off-channel habitats) and work backward to determine how those natural flows can be incorporated. The Corps should work with resource agencies to determine critical functions.

b) Because the formation of new off-channel habitats along the Skookumchuck River may be diminished with the flood control project, the Corps should consider enhancing existing off-channel habitats and wetlands along the Skookumchuck River in addition to identifying and protecting them;

c) alterations to the dam should include safe downstream passage for juveniles, smolts, and kelts, (i.e., adult steelhead that return to the ocean after spawning);

Response 4.a- It is unlikely that a maximum flow event of 2-years can be maintained due to the influence of the tributaries along the Skookumchuck River. Criteria for all fisheries and their habitat will be incorporated in the re-operation plan for the dam. All of these efforts will be coordinated with the resources agencies and Tribes.
4.b- The Corps will look at all off channel habitat on the Skookumchuck River and look at ways to enhance those areas. Areas of major importance to the environment will be reviewed to determine the potential for protecting that particular area.
4.c- Alterations to the dam will incorporate all possible safe passage designs for juveniles, smots, and kelts.

Comment #5 – The Corps should develop a monitoring and adaptive management plan that would set goals, report changes, and trigger changes in management of various aspects of the recommended plan. Issues that should be monitored include, but are not limited to, fish passage at the dam, functioning of restoration and mitigation projects, and alterations to downstream habitats resulting from changes in flows released from the dam. The plan should include monitoring for pre-project baseline, during construction, and post-project conditions and should be developed with participation from resource agencies. The monitoring plan should be developed to ensure that assumptions about fish passage and impacts from alterations of flows are correct.

Response 5.- The Corps will develop a monitoring plan that will be developed with the coordination of all resource agencies and Tribes associated with this project.

Comment #6 The Corps should develop a monitoring and adaptive management plan that would set goals, report changes, and trigger changes in management of various aspects of the recommended plan. Issues that should be monitored include, but are not limited to, fish passage at the dam, functioning of restoration and mitigation projects, and alterations to downstream habitats resulting from changes in flows released from the dam. The plan should include monitoring for pre-project baseline, during construction, and post-project conditions and should be developed with participation from resource agencies. The monitoring plan should be developed to ensure that assumptions about fish passage and impacts from alterations of flows are correct.

Response 6. See above response to comment #5.

Comment #7 Fill that results from excavation of the flood plain should be placed outside the flood plain or used in the construction of the levees.

Response 7.- Agree. The Corps is committed to utilize the material to the maximum extent practable.

Comment #8 – The existing embankments that will be part of the levee system and levees that will be newly constructed should be planted with native trees and shrubs to increase the value of these areas for fish and wildlife.

Response. In order to maintain the structural integrity of the levees it is not possible to plant trees and shrubs on the levee's. If a tree were to die and the root system were to rot there would be potential for a weak spot in the levee to develop. The levee's are being set back in order to meet the potential to develop areas between the levee and the river into functional riparian and wetland areas.

Comment #9 – The Corps should clarify how nonstructural measures will be implemented, including: a) details about how the "no net loss" of flood plain policy will be developed, implemented, and enforced; b) details about implementation of the moratorium/restriction on further development in the flood way; c) status of the new flood plain maps; and d) how and when flood plain maps will be incorporated into land use practices by the county and city governments.

Response 9.a- The "no net loss" of flood plain policy will be developed with the active sponsor. The non-structural measures are discussed in Chapter 2 Alternatives and how they are incorporated in the preferred alternative.
9.b- The moratorium/restrictions on further development in the flood way will be investigated during the planning phase of the project.
9.c- At this time it is the Corps understanding that FEMA will address that issue after the project is in the PED phase.
9.d- The use of flood plain maps has not been determined by the county and city governments. This area will be addressed in the PED phase of the project.

Comment #10 – The Service, other resource agencies, and the Tribe should be given the opportunity to participate in the development of a monitoring and adaptive management plan, a mitigation plan, design of restoration projects and dam operations and facilities that affect fish passage or fish habitat during the next phase of Corps planning.

Response 10. Its is the intent of the Corps to include all the above mentioned agencies, including the Tribes and to include members of the local community to be part of a working committee to insure all entities are involved in all phases of the project.

Comment #11 – The Corps should evaluate the importance of groundwater recharge from flooding to base flows and the potential impact of reducing flood storage to base flows in the Chehalis River. Details should include groundwater movement, how soil types influence recharge, and location of important recharge areas.

Response 11. Please refer to the DEIS Chapter 4 for coverage of those issues. Plus additional analysis will be performed if after further review of all available data during the PED phase does not produce sufficient answers to the above comment.

Comment #12 – The Corps should provide transfer funds during the next phase of study for our continued participation in developing a mitigation plan, restoration projects (including the SR-6 bypass complex), fish passage issues at the dam, groundwater study, sediment effectiveness studies for Skookumchuck River, design work for the levee system, and refining the plan for nonstructural measures to be incorporated into the levee system.

Response The Corps intends to continue to work closely with the Service to enable them to participate in the development of this project. A specific commitment per guidance under the Fish and Wildlife Coordination Act is not feasible at this time.

Comment #13 – The Corps should revisit those restoration opportunities developed as part of the flood project to determine the feasibility of including them as part of the restoration actions proposed by the Chehalis Basin Study.

Response 13. All restoration areas that were developed are carried forward in the DEIS as potential restoration sites. Sites that are not used in this project could be utilized in the Chehalis Basin Study.

Comment #14 – The Corps should obtain an evaluation by a geomorphologist to determine the potential for avulsion across the SR-6 bypass and the potential impacts should that occur.

Response 14. Those issues about or involving avulsion will be address during he PED phase of the project. All aspects of geomorphology will be addressed during that time.

6.1.6 National Historic Preservation Act Consultation and Native American Graves Protection and Repatriation Act

The National Historic Preservation Act of 1966 (NHPA) (as amended in 1992) requires that Federal agencies consider the effects of a proposed project upon sites of historic significance. Section 106 of this act and its implementing regulations (36 CR Part 800) provides guidance that Federal agencies can follow in order to be in compliance with NHPA on specific undertakings. The Archeological Resources Protection Act of 1979 and the Native American Graves Protection and Repatriation Act of 1990 are two other pieces of federal legislation promoting the protection of historic and archeological resources.

To comply with Section 106 of NHPA, Federal agencies must consult with the State Historic Preservation Officer (SHPO), Native American tribes with a traditional or religious interest in the study area, and interested members of the public. Federal agencies must demonstrate that a good faith effort has been made to identify historical properties in the area of potential effect for a project. Identified properties should be evaluated on the basis that they are eligible for the National Register of Historic Places. The effect of the proposed activity on eligible properties must also be determined at this time. The Federal Agency must consider how to address adverse effects on the characteristics that make a site “historic”. Cultural resource investigations will be ongoing to determine effects to historic properties during the planning phase of this project. When completed, results will be coordinated with the State Historic Preservation Officer and the Advisory Council on Historic Preservation.

6.1.7 Environmental Protection Agency

Coordination activities have been ongoing with the Environmental Protection Agency because of agency’s role in the National Environmental Policy Act (NEPA) review process.

6.1.8 Washington State Department of Transportation

Coordination activities have been ongoing with the Washington State Department of Transportation in conjunction with the department scheduled activities on the I-5 Improvement Project. Coordination will continue throughout the duration of the proposed project.

6.1.9 Washington Department of Ecology Dam Safety

The Washington Department of Ecology Dam Safety Unit would be provided an opportunity to review and comment on the proposed design and construction plans for the structural modification portion of the preferred alternative.

6.1.10 Executive Orders and Other Guidelines

Executive Order (EO) 11990 requires minimization of wetland destruction, loss, or degradation and preservation and enhancement of the natural and beneficial values of wetlands. Wetlands are recognized as important wildlife habitat resources and are necessary for the survival of a disproportionately high percentage of endangered and threatened species. A second requirement of EO 11990 is public disclosure of a project's effect on wetlands. Chapter 4 of this DEIS provides that disclosure.

Executive Order 13007 (Indian Sacred Sites) requires the project proponent identify Indian sacred sites that may be affected by the project. The Corp has consulted with the Chehalis Tribe of Indians in a good faith effort to locate Native American sites of historical significance within the proposed project area. Efforts to identify Indian sacred sites are described above under National Historic Preservation Act Consultation.

Executive Order 12898 established environmental justice as a Federal agency priority to ensure that minority and low-income groups are not disproportionately affected by Federal Actions. The Corp has invited minority and/or low-income members of the population within the project area to participate in public meetings. It has also been determined that minority and low-income groups would not be disproportionately affected by the proposed action. This is based on the projection that the largest anticipated economic impacts of project implementation would be because of project spending on construction, land purchases, operation and maintenance.

Executive Order 11988 requires agencies to avoid, were possible, short and long-term adverse impacts associated with flood plain development. Federal agencies are required to reduce the risk of flood loss and restore and preserve the natural and beneficial values served by flood plains. The Corp has no intention to engage in any action that would result in either short or long-term impacts with flood plain development. Consultation with local Native American Tribes has occurred from the beginning of the development of alternatives and will continue until completion.

6.1.11 Clean Water Act of 1972

The study is in full compliance at this stage. As the project progresses into the planning and development stage a complete 404(b)(1) analysis will be conducted to ensure water quality standards will be maintained. This will proceed the requirement of a state water quality certification that will be obtained prior to construction of any component that may impact wetlands or water resources of any kind.

Table 6.1 Table of Compliance

Law/Regulation/Treaty	Status of Compliance
National Environmental Policy Act (NEPA)	Will be complete after EIS is approved and ROD is signed.
Endangered Species Act	Consultation on-going
National Historic Preservation Act	Consultation on-going
Clean Water Act	A 404(b)(1) analysis will be prepared in PED and NPDES construction permits will be obtained
Clean Air Act	In partial compliance
Fish and Wildlife Coordination Act	In partial compliance
Migratory Bird Treaty Act	In partial compliance
Executive Order 12898, Environmental Justice	In partial compliance
Executive Order 11990, Protection of Wetlands	In compliance
Executive Order 11988, Floodplain Management	Will be completed prior to signing the PCA and starting construction.
Indian Treaty Rights	Will be in compliance through public review process
State Environmental Policy Act	Lewis County will adopt Final EIS
Washington Hydraulic Code	Lewis County will obtain required permits
Water Quality Certification	Corps will obtain required permits
Growth Management Act	In compliance
Model Toxics Control Act	Lewis County will obtain any necessary approvals
State Aquatic Lands Management Laws	Consultation on-going
Lewis County Regulations	Lewis County will obtain all required permits
City Regulations and Ordinances	Lewis County will obtain all required permits

7. DOCUMENT RECIPIENTS

The DEIS is being sent to federal, state, and local Native American Tribes, interested non-government organizations and other interested parties for their information and review. A final EIS will be sent to the same distribution list, as well as all groups and individuals who submitt written comments or who made comments at the public hearings. Other copies will be sent on request. This document is also available at local libraries in Chehalis, Centralia, and Montesano, Washington and on our web site: http://www.nws.usace.army.mil/ers/doc_table.cfm

7.1 Federal Agencies (Headquarters Offices)

- Advisory Council on Historic Preservation

  ATTN: Mr. Ronald Anzolone
  Advisory Council on Historic Preservation
  Office of Prog. Review and Education
  1100 Pennsylvania Avenue NW, #803
  Washington, DC 20004-2501

- U.S. Coast Guard

  U.S. Coast Guard
  Commandant
  2100 Second Street SW
  Washington, DC 20593-0001

- Environmental Protection Agency

  U.S. Environmental Protection Agency
  Office of Federal Activities
  EIS Filing Section
  Mail Code 2252-A, Room 7241
  1200 Pennsylvania Avenue NW
  Washington, DC 20044

- Federal Energy Regulatory Commission

  ATTN: Mr. Pat Wood III, Chairman
  Federal Energy Regulatory Commission
  888 First Street NE
  Washington, DC 20426

- Department of Agriculture
  - U.S. Department of Agriculture

    U.S. Department of Agriculture
    14th and Independence Avenue SW, Room 200-A
    Washington, DC 20250-0001

  - Forest Service

    USDA Forest Service
    PO Box 96090
    Washington, DC 20090-6090

- Department of Commerce
  - U. S. Department of Commerce

    U.S. Department of Commerce
    14th and Constitution Avenue NW
    Washington, DC 20230

  - National Oceanic and Atmospheric Administration

    ATTN: Mr. Steve Kokkinakis
    NOAA
    Office of Strategic Planning
    Room 6121
    Washington, DC 20230

  - National Marine Fisheries Service

    National Marine Fisheries Service
    NOAA Fisheries
    1315 East West Highway, SSMC3
    Silver Springs, MD 20910

- Department of Energy
    - Office of Environmental Management
      ATTN: Mr. Steve Frank
      NEPA Compliance Officer
      Division of NEPA Affairs
      1000 Independence Avenue SW
      Washington, DC 20585

- Department of Health and Human Services
      ATTN: Mr. Richard Green
      U.S. Department of Health and Human Services
      Cohen Building. Room 4700
      200 Independence Avenue SW
      Washington, DC 20201

- Department of the Interior
    - Bureau of Indian Affairs
      ATTN: Mr. Neil A. McCaleb
      Interior Assistant Secretary - Indian Affairs
      Bureau of Indian Affairs
      1849 C Street, MS 4140
      Washington, DC 20240

    - Fish and Wildlife Service
      Department of the Interior
      U.S. Fish and Wildlife Service
      Public Information
      Washington, DC 20001

    - Geological Survey
      ATTN: Mr. Charles S. Groat, Director
      U.S. Geological Survey
      John W. Powell Federal Building
      12202 Sunrise Valley Drive
      Reston, VA 20192

- o Office of Environmental Policy and Compliance
  ATTN: Mr. Willie R. Taylor
  U.S. Department of the Interior
  Office of Environmental Policy and Compliance
  1849 C Street NW, M/S 2340
  Washington, DC 20240

- o National Park Service
  ATTN: Ms. Fran P. Mainella, Director
  National Parks Service
  1849 C Street NW
  Washington, DC 20240

- Department of Transportation
  - o U.S. Department of Transportation
    400 7th Street SW
    Washington, DC 20590

  - o Federal Railroad Administration
    ATTN: Mr. Allen Rutter, Administrator
    Federal Railroad Administration
    1120 Vermont Avenue NW
    Washington, DC 20590

- Office of Management and Budget
  ATTN: Mr. Mitchell E. Daniels, Jr., Director
  Office of Management and Budget
  725 17th Street NW
  Washington, DC 20503

7.2 U.S. Congressional Delegation

- Representative Brian Baird

  Representative Brian Baird
  Representative in Congress
  Capital Hill, U. S. House of Representatives
  Washington, DC 20515-4703

- Senator Patty Murray

  Senator Patty Murray
  United States Senate
  2985 Jackson Federal Building
  915 Second Avenue
  Seattle, WA 98174

- Senator Marie Cantwell

  Senator Marie Cantwell
  United States Senator
  717 Hart Senate Office Building
  Washington, D.C. 20510

- Representative Norman Dicks

  Representative Norman Dicks
  Representative in Congress
  1717 Pacific Avenue, Suite 916
  Tacoma, WA 98402-4411

7.3 Washington State Legislature

- Representative Tom Mielke

  ATTN: Representative Tom Mielke
  Washington State House of Representatives
  18th Legislative District
  PO Box 40600
  Olympia, WA 98054-0600

- Representative Ed Orcutt
  ATTN: Representative Ed Orcutt
  Washington State House of Representatives
  18th Legislative District
  PO Box 40600
  Olympia, WA 98054-0600

- Representative Brian Hatfield
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  Washington State House of Representatives
  19th Legislative District
  PO Box 40600
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- Representative Mark Doumit
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- Representative Richard Debolt
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- Representative Jim Buck

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- Representative Lynn Kessler

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- Representative Kathryn M. Haigh

  ATTN: Representative Kathryn M. Haigh
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  35th Legislative District
  PO Box 40600
  Olympia, WA 98054-0600

- Representative William Eikmeyer

  ATTN: Representative William Eikmeyer
  Washington State House of Representatives
  35th Legislative District
  PO Box 40600
  Olympia, WA 98054-0600

7.4 Federal Agencies-Regional or Local Levels

- Advisory Council on Historic Preservation

  ATTN: Ms. Claudia Nissley
  Advisory Council on Historic Preservation
  Western Office Project Review
  12136 West Bayaud Avenue, Suite 330
  Lakewood, CO 80228

- Department of Agriculture
  - U.S. Department of Agriculture

    U.S. Department of Agriculture
    1835 Black Lake Boulevard SW, Suite B
    Olympia, WA 98501-5715

  - Forest Service

    ATTN: Ms. Linda Goodman, Acting Regional Forester
    USDA Forest Service – Pacific Northwest Region
    7333 SW First Avenue
    Portland, OR 97204-3440

  - Natural Resources Conservation Service

    ATTN: Mr. Marty Cheney
    USDA Natural Resources Conservation Service
    300 Desmond Drive SE, Suite #106
    Olympia, WA 98503-1273

- Department of Army
  - U.S. Army Corps of Engineers
  - Forester Einarsen
  - CECW-PC
  - 441 G. Street NW
  - Washington, DC 20314
-
- Department of Commerce
  - National Marine Fisheries Service; Portland, Oregon

    U.S. Department of Commerce
    National Marine Fisheries Service
    525 NE Oregon, Suite 500
    Portland, OR 97232

- National Oceanic and Atmospheric Administration

  ATTN: Mr. Bob Lohn
  Regional Administrator
  NOAA
  7600 Sandpoint Way NE
  Seattle, WA 98115-0070

Environmental Protection Agency

U.S. Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, WA 98101

Federal Emergency Management Agency

ATTN: Mr. John Pennington, Region X Director
Federal Emergency Management Agency
Federal Regional Center
130 228th Street SW
Bothell, WA 98021-9796

- Federal Energy Regulatory Commission; Portland, Oregon

  Federal Energy Regulatory Commission
  Regional Director
  Portland Regional Office
  101 SW Main Street, Suite 905
  Portland, OR 97204

- Department of Interior
  - U.S. Fish and Wildlife Service; Lacey

    ATTN: Mr. Lynn Childers
    U.S. Fish and Wildlife Service
    510 Desmond Drive SE, #102
    Lacey, WA 98503-1292

- U.S. Geological Survey
  ATTN: Mr. John "Doug" Buffington, Western Regional Director
  U.S. Geological Survey
  Office of the Western Regional Director
  909 First Avenue, Suite 704, MS 150
  Seattle, WA 98104

- Department of Transportation
  - Federal Railroad Administration
    U.S. Department of Transportation
    Federal Railroad Administration
    703 Broadway, #650
    Vancouver, WA 98660

  - Federal Highway Administration; Portland, Oregon
    ATTN: Mr. Pat Clark
    U.S. Department of Transportation
    Federal Highway Administration
    222 SW Columbia Street, Suite 600
    Portland, OR 97201

  - Federal Highway Administration; Olympia, Washington
    ATTN: Mr. Daniel M. Mathis
    Division Administrator
    Federal Highway Administration
    Evergreen Plaza
    711 South Capital Way, Suite 501
    Olympia, WA 98501-1284

7.5 Indian Tribes

- Confederated Tribes of the Chehalis Reservation
  ATTN: Mr. David Youckton
  Confederated Tribes of the Chehalis Reservation
  PO Box 536
  Oakville, WA 98568-9616

- Northwest Indian Fisheries Commission

  ATTN: Fran Wilshuaen
  Northwest Indian Fisheries Commission
  6730 Martin Way East
  Lacey, WA 98506

- Quinault Tribe

  Quinault Tribe of the Quinalt Reservation
  Business Committee
  PO Box 279
  Taholah, WA 98587-0189

7.6 State and Local Government Agencies

- State of Washington
  - Department of Ecology, Olympia

    ATTN: Ms. Barbara Ritchie; Mr. Dan Sokol
    WA Department of Ecology
    Environmental Review
    PO Box 47760
    Olympia, WA 98504-7706

  - Department of Fish and Wildlife

    ATTN: Ms. Cynthia Pratt
    WA Department of Fish and Wildlife
    PO Box 45200
    Olympia, WA 98504-3155

    ATTN: Ms. Sue Patnude, Regional Director
    WA Department of Fish and Wildlife - Region 6
    48 Devonshire Road
    Montesano, WA 98563

    ATTN: Lee Van Tussenbrook, Regional Director
    WA Department of Fish and Wildlife – Region 5

2108 Grand Boulevard
Vancouver, WA 98661

- Department of Natural Resources, Olympia
  ATTN: Mr. Doug Sutherland
  Commissioner of Public Lands
  WA Department of Natural Resources
  PO Box 47001
  Olympia, WA 98504-1004

  ATTN: Mr. Dave Dietzman
  WA Department of Natural Resources
  PO Box 47015
  Olympia, WA 98504-7015

- Department of Transportation
  ATTN: Mr. Larry Ross
  WA Department of Transportation
  Environmental Affairs Office
  PO Box 47331
  Olympia, WA 98504-7331

- Governor
  Governor Gary Locke
  Office of the Governor
  PO Box 40002
  Olympia, WA 98504-0002

- Office of Archaeology and Historic Preservation, Olympia
  ATTN: Robert G. Whitlam
  Office of Archeology and Historical Preservation
  1063 South Capitol Way, Suite 106
  Olympia, WA 98504-8343

- o Parks and Recreation Commission, Olympia
  ATTN: Bill Koss
  Parks and Recreation Commission
  PO Box 42668
  Olympia, WA 98504-2668

- o Utilities and Transportation Commission, Olympia
  ATTN: Ms. Marilyn Showalter, Chairwoman
  Washington Utilities and Transportation Commission
  PO Box 47250
  Olympia, WA 98504-7250

- Chehalis River Council
  ATTN: Ms. Margaret Rader, Chairwoman
  Chehalis River Council
  417 North Pearl Street
  Centralia, WA 98531

- Grays Harbor County
  Grays Harbor County
  Board of Commissioners
  Grays Harbor County Administration Building
  100 West Broadway, Suite #1
  Montesano, WA 98536

- Thurston County
  ATTN: Ms. Cathy Wolfe, Chair
  Thurston County Board of Commissioners
  Thurston County Court House
  Building One, Room 269
  2000 Lakeridge Drive SW
  Olympia, WA 98502-1045

- Lewis County

  Lewis County
  Board of Commissioners
  500 NW Chamber of Commerce Way
  Chehalis, WA 98532

  Lewis County Conservation District
  1554 Bishop Road
  Chehalis, WA 98532

7.7 Libraries

- Chehalis

  Chehalis Timberland Library
  76 NE Part Street
  PO Box 419
  Chehalis, WA 98532-0419
- Centralia

  Centralia Library
  Timberland Regional Library District
  110 S Silver
  Centralia, WA 98531-4296

- Montesano

  Montesano Library
  Timberland Regional Library District
  125 South Main Street
  Montesano, WA 98563

7.8 Media

- Coordination through Seattle District Public Affairs Officer

  David G. Harris, Chief of Public Affairs
  U.S. Army Corps of Engineers
  Seattle District
  4735 East Marginal Way South
  Seattle, WA 98124-3755

7.9 Private Organizations

- Ducks Unlimited

  ATTN: Ms. Mae Schultz, Regional Vice President – Region 16
  Ducks Unlimited
  Western Regional Office
  3074 Gold Canal Drive
  Rancho Cordova, CA 95670

- PacifiCorp

  PacifiCorp
  825 NE Multnomah
  Portland, OR 97232

- Trout Unlimited

  ATTN: Mr. Bill Robinson, Executive Director
  Trout Unlimited
  2401 Bristol Court SW
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- Washington Forest Protection Association

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10. GLOSSARY OF ACRONYMS, ABBREVIATIONS AND TERMS

10.1 Glossary of Acronyms and Abbreviations

BA	Biological Assessment
BNSF	Burlington Northern Santa Fe
BOD	Biological Oxygen Demand
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Cfs	cubic feet per second
Co	Carbon monoxide
Corps	U.S. Army Corps of Engineers
CWA	Clean Water Act
DB	decibel scale
DEIS	Draft Environmental Impact Statement
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
ESA	Endangered Species Act
˚F	degrees Fahrenheit
FAC	Flood Action Council
FCZD	Flood Control Zone District
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FWCA	Fish and Wildlife Coordination Act
GMA	Growth Management Act
GRR	General Reevaluation Report
HAZMAT	Hazardous Material
HTRW	Hazardous Toxic and Radioactive Waste
IUGA	Interior Urban Growth Area
LWD	Large Woody Debris

Mg/L	Milligrams per liter
MGD	Million Gallons per day
NAAQS	National Ambient Air Quality Standards
NED	Nationally Economic Development
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NGVD	National Geoditic Vertical Datum
NHPA	National Historic Preservation Act
NHRP	National Register of Historic Places
NMFS	National Marine Fisheries Service
NO	Nitrous Oxide
NPDES	National Pollutant Discharge Elimination System
NWS	National Weather Service
PacifiCorp	Scottish paper
PCE	tetrachloroethylene
PED	Preconstruction Engineering Design
PFP	Probable Failure Point
PIE	Pacific International Engineering
PMF	Probable Maximum Flood
PNP	Probable non-failure Point
PSE	Puget Sound Energy
PUD	Public Utilities Division
RM	River Mile
ROG	Reactive Organic Gases
SARA	Superfund Amendments Reauthorization Act
SR	State Route
SHPO	State Historic Preservation Act
SWCAA	Southwest Clean Air Agency
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbons
TN	Total Nitrogen
TP	Total Phosphorus
TPI	Total Personal Income
TSS	Total Suspended Solids
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

USGS	U.S. Geological Survey
VOC	Volatile Organic Carbons
WAC	Water Quality Standards Surface Water Washington State
WDFW	Washington Department of Fish and Wildlife
WDOE	Washington Department of Ecology
WRDA	Water Resource Development Act
WSDOT	Washington Department of Transportation
WWTP	Waste Water Treatment Plant

10.2 Glossary of Terms

A

Acre-feet: The volume of 1 foot of water over the area of 1 acre. 325,872 gallons.
Adsorption: The adhesion of a thin layer of molecules to the surfaces of solid bodies or liquids with which they are in contact.
Affected environment: A physical, biological, social, and economic environment within which human activity is proposed.
Alternatives: The different means by which objectives or goals can be attained. One of several policies, plans, or projects proposed for decision making.
Anadromous: Those species of fish that mature in the sea and swim up freshwater rivers and streams to spawn. Salmon, steelhead, and searun cutthroat trout are examples.
Aquatic: Growing, living in, frequenting, or taking place in water; in this EIS, used to indicate habitat, vegetation, and wildlife in freshwater.
Aquifer: A zone, stratum, or group of strata acting as a hydraulic unit that stores or transmits water in sufficient quantities for beneficial use.
Areal: the spatial extent or location.
Artifact: An object made or modified by humans.
Attenuate: To lessen the amount, force, or magnitude of something, i.e., floodflow.

B

BA: See Biological Assessment.

Background: (scenic distance zone.) The distant part of a landscape. The seen or viewed area located more than four miles from the viewer, and generally as far as the eye can detect objects.

Base Flow: A sustained or fair-weather flow of a stream.

Baseline data: Data gathered prior to proposed action to characterize pre-development site conditions.

Berm: A mound or wall of earth, usually with sloping sides.

Best management practices (BMP): Management actions that are designed to maintain water quality by preventative rather than corrective means.

Big game: Large animals hunted, or potentially hunted, for sport. These include animals such as deer, bear, elk, moose, bobcats, and mountain lions.

Biological Assessment (BA): Refers to the information prepared by or under the direction of the Federal agency concerning listed and proposed species and designated and proposed critical habitat that may be present in the action area and the evaluation of potential effects of the action on such species and habitat.

Biological Opinion (ESA): A document that states the opinion of the U.S.D.I. Fish and Wildlife Service as to whether or not the Federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

Biostimulatory nutrients: Substances that promote growth, usually of algal or other unicellular species, within a system by providing an excess of nutrients, which are limited under normal conditions. This commonly reduces available oxygen in a system, resulting in adverse effects on other organisms in the same system. Biostimulatory nutrients are commonly components of fertilizers, manures and silage.

C

CADD: Computer Assisted Drafting and Design.

Canopy: The more-or-less continuous cover of branches and foliage formed collectively by the crown of adjacent trees and other woody debris.

CFR: Code of Federal Regulations. A codification of the general permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government.

cfs: Cubic feet per second; 1 cfs equals 448.33 gallons per minute.

Channel morphology: The dimensions and composition of a stream or river channel.

Char: Any of a genus (*Salvelinus*) of small-scaled trout with light-colored spots.

Climax plant communities: The stabilized plant community on a particular site. The plant cover does not change so long as the environment remains the same.

Climax species: Those species that dominate a climax stand in either numbers per unit area or biomass.

CMP: Corrugated metal pipe; culverts used in road/stream crossings.

COE: U.S. Army Corps of Engineers; agency responsible for regulating and permitting wetland disturbances.

Confluence: the place of meeting of two streams or the combined stream formed by conjunction.

Cover: Living or non-living material (e.g., vegetation) used by fish and wildlife for protection from predators, to ameliorate conditions of weather, or reproduce. The proportion of the ground occupied by a perpendicular projection to the ground from the outline of the aerial parts of the members of a plant species.

Criteria: Data and information, which are used to examine or establish the relative degrees of desirability among alternatives or the degree to which a course of action meets an intended objective.

Cultural resources: The remains of sites, structures, or objects used by humans in the past, historic or prehistoric. More recently referred to as heritage resources.

Cumulative effects or impacts: Cumulative effect or impact is the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonable foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taken place over a period of time (40 CFR 15089.7)

CY: Cubic yard.

D

dbA: Decibel scale, A-weighted to mimic the human ear.

Density: The number of individuals in a given area. Expressed per unit area.

Detrital: Loose material (soil, plant particles or other organic particles) that results directly from disintegration or decay.

Dike: An embankment to contain or convey water.

E

Ecosystem: An interacting system of organisms considered together with their environment; for example aquatic, marsh watershed, and lake ecosystems.

Effects: “Effect” and “impact” are synonymous as used in this document. Environmental changes resulting from a proposed action. Included are direct effects, which are caused by the action and occur at the same time and place, and indirect effects, which are caused by the action and are later in time or further removed in distance, but which are still reasonably foreseeable.

Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems.

Endangered Species: Any species of animal or plant that is in danger of extinction throughout all or a significant portion of its range. Plant or animal species identified by the Secretary of the Interior as endangered in accordance with the 1973 Endangered Species Act.

Environment: The physical conditions that exist within the area that will be affected by a proposed project, including land, air, water, minerals, flora, fauna, ambient noise, and objects of historical or aesthetic significance. The sum of all of the external conditions that affect an organism or community to influence its development or existence.

Environmental impact statement (EIS): An analytical document prepared under the National Environmental Policy Act (NEPA) and Washington State Environmental Policy Act (SEPA) that portrays potential impacts to the environment of a Proposed Action and its possible alternatives. An EIS is developed for use by decision makers to weigh the environmental consequences of a potential decision.

Environmental Protection Agency (EPA): An agency of the Executive Branch of the Federal Government, which has responsibility for environmental matters of national concern.

Ephemeral stream: A stream or portion of a stream that flows only in direct response to precipitation or snow melt. Such flow is usually of short duration.

Erosion: The wearing away of the land surface by running water, wind, ice, or other geologic agents, including gravitation creep.

ESU: Evolutionarily Significant Unit. A delineation of distinct populations of a species, used for determining population status apart from the species as a whole.

F

FEMA: Federal Emergency Management Agency

Fisheries Habitat: Streams, lakes, and reservoirs that support fish populations.

Floodplain: The lowland and relatively flat area adjoining inland waters, including, at a minimum, that area subject to a 1% or greater chance of flooding in any given year.

Fluvial: Of or relating to a stream or river.

Forage: All browse and non-woody plants that are available to livestock or game animals for grazing or harvestable for feed.

Forb: Broad-leafed, small plants composed of soft tissue, not woody material. Any herb other than grass.

Foreground: (scenic distance zone) A term used in scenic resource management to describe the area immediately adjacent to the observer, usually within ¼ to ½ mile.
fps: Feet per second, a measure of velocity, or speed.
Freeboard: Vertical distance above water surface elevation to top elevation of manmade or natural containment, such as stream banks, levees, dams, etc.
Freshet: A large increase in stream flow due to heavy rains or snowmelt.
FWS: Fish and Wildlife Service (U.S. Department of the Interior). Also, USFWS.

G

Game Species: Any species of wildlife or fish for which seasons and bag limits have been prescribed and which are normally harvested by hunters, trappers, and fisherman under state or federal laws, codes and regulations.
Geomorphic: Pertaining to the form of the surface of the earth.
Glacial till: Glacial materials deposited directly by ice with little or no transportation by water.
Glide: A portion of the stream where stream surface flow does not have increased turbulence resulting from flow interception with submerged obstructions during low flow conditions. A glide is differentiated from a pool by the relatively uniform streambed gradient and lack of a hydraulic control at the downstream end.
GMA: Growth Management Act. An Act of the Washington State Legislature to plan and control economic growth (RCW 43.330.120)
gpd, gph, gpm: Gallons per day, gallons per hour, gallons per minute.
Grass/forb: An early forest successional stage where grasses and forbs are the dominant vegetation.
Ground water: Water found beneath the land surface in the zone of saturation below the water table.
GRR: General Reevaluation Report.
Guideline: An indication or outline of policy or conduct; i.e., any issuance that assists in determining the course of direction to be taken in any planned action to accomplish a specific objective.

H

Habitat capability: The estimated ability of an area, given existing or predicted habitat conditions, to support a wildlife, fish or plant population. It is measured in terms of potential population numbers. Often called carrying capacity.

Habitat: The natural environment of a plant or animal, including all biotic, climatic, and soil conditions, or other environmental influences affecting living conditions. The place where an organism lives.

Hazardous waste: A waste is considered hazardous by the EPA if it exhibits one or more of these characteristics: ignitability, corrosivity, reactivity, and/or toxicity. These are listed in 40 CFR 261.3 and 40 CFR 171.8.

HAZMAT: Related to hazardous materials.

HEC-RAS: A computer model used to simulate flows during various events, including floods, storms and drought conditions.

Howell-Bunger valve: A fixed-cone valve that discharges water in a radial pattern, designed to pass a controlled amount of water without damage to the immediate environment.

HTRW: Hazardous, Toxic and Radioactive Waste,

Hydraulic: Relating to water or other liquid in motion.

Hydric soils: Soils exhibiting properties that are characteristic of frequent prolonged inundation. Characteristics include mottled coloration, presence of reduced metals, presence of sulfur compounds or high percentage of organic materials.

Hydrograph: A graph depicting flows over time.

Hydrology: The distribution and circulation of water.

I

Incidental take (ESA): Refers to takings that result from, but are not for the purpose of, carrying out an otherwise lawful activity conducted by an agency or applicant.

Incised: A narrow, steep-walled valley caused by erosion.

Infiltration: The movement of water or some other fluid into the soil through pores or other openings.

Intermittent stream: A stream that runs water in most months, but does not contain water year round.

Interstitial: Occupying the spaces between sediment particles.

Inundate: Cover with water.

L

Landscape: The sum total of the characteristics that distinguish a certain area on the earth's surface from other areas. These characteristics are a result not only of natural forces but also of human occupancy and use of the land. An area composed of interacting and interconnected patterns of habitats (ecosystems) that are repeated because of geology, landforms, soils, climate, biota, and human influences throughout the area.

Ldn: Day-Night Sound Level measurement descriptor of total outdoor noise environment

Levee: An embankment for preventing flooding.

Listed Species (ESA): Species that are listed as threatened or endangered under the Endangered Species Act of 1973 (as amended).

Lithic: Of relating to, or being a stone tool.

LWD: Large Woody Debris. Usually refers to woody material greater than 12 inches in diameter 25 feet from the base end of the log, within a stream channel. Upland large woody debris is often considered **Coarse Woody Debris.**

M

Mitigation: Reduction or reversal of an effect. For the purposes of this document, mitigation is design, planning or construction phases used to reduce, minimize or account for effects of a project on the environment, economy and population. Mitigation includes; (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affects environment; (d) reducing or elimination of the impact over time by preservation and maintenance of operations during the life of the action; and, (e) compensating for the impact by replacing or providing substitute resources or environments (40 CFR Part 1508.20).

N

NAAQS: National Ambient Air Quality Standards.

NFIP: National Flood Insurance Program.

Non-game species: Animal species that are not hunted, fished, or trapped.

NOx: Nitrogen Oxides

NPDES: National Pollutant Discharge Elimination System – A program authorized by Sections 318, 402 and 405 of the Clean Water Act, and implemented by regulations 40 CFR 122. NPDES program requires permits for the discharge of pollutants from any point source into waters of the United States.

NRHP: National Register of Historic Places;

O

OAHP: Office of Archaeology and Historic Preservation (Washington State).

Objective: A concise, time-specific statement of measurable planned results that respond to pre-established goals. An objective forms the basis for further planning to define the precise steps to be taken and the resources to be used in achieving identified goals.

Ogee: (Ogee spillway, Ogee crest) The work ogee describes the shape of the curve, in profile, on the crest of the spillway or dam. The shape is a reverse curve, similar to the letter "s".

Overtopping: Water surface elevations in exceedance of the elevation of manmade or natural containment, such as stream banks, levees, dams, etc.

Oxbow: (Oxbow lake) For the purposed of this document, an oxbow is a curved portion of a former channel that has been isolated from the main channel by bank erosion and remains in the floodplain, usually as a wetland or pond.

P

Passerine bird: Of or relating to the largest order (Passeriformes) of birds, consisting chiefly of songbirds of perching habits.

Percolation/infiltration: The act of water seeping or filtering thorough the soil without a definite channel.

Perennial stream: A stream that flows year round.

pH: Symbol for the negative common logarithm of the hydrogen ion concentration (acidity) of a solution. The pH of 7 in considered neutral. The pH number below 7 indicates acidity, and a pH value above 7 indicates alkalinity or a base.

PHS: Priority Habitats and Species. Priority species are defined by the State of Washington as species that require protective measures for their perpetuation due to their population status, sensitivity to habitat alteration, and/or recreational, commercial, or tribal importance. A priority habitat may consist of a unique vegetation type or dominant plant species, successional stage, or structural element.

Plant communities: A vegetation complex unique in its combination of plants which occurs in particular locations under particular influences. A plant community is a reflection of integrated environmental influences on the site such as soils, temperature, elevation, solar radiation, slope aspects, and precipitation.

PM10: Particulate matter less than 10 microns in diameter.

PMF: Probable Maximum Flood.

Pool: A portion of the stream with reduced surface turbulence and a hydraulic control at the downstream end. Pools often have a bowl appearance resulting from high-flow scour.

ppm: parts per million.

Project: The whole of an action, which has a potential for resulting in a physical change in the environment. An organized effort to achieve an objective identified by location, timing, activities, outputs, effects, and time period and responsibilities for executions.

Proposed action: A description of the project as proposed by a project proponent in a plan of operations.

Public participation: Meetings, conferences, seminars, workshops, tours, written comments, responses to survey questionnaires, and similar activities designed and held to obtain comments from the public about planning.

Public scoping: Giving the public the opportunity for oral or written comments concerning the intentions, activity, or influence of a project or an individual, the community, and/or the environment.

R

Raptor: Bird of prey, including eagles, hawks, flacons, and owls.

RCRA: Resource Conservation Recovery Act.

RCW: Revised Code of Washington.

Recharge: Absorption and addition of water to the zone of saturation.

Riffle: A portion of the stream where stream flow is intercepted by partially or completely submerged obstructions to produce increased surface turbulence and flow velocities during low flow conditions.

Riparian zone: Terrestrial areas where the vegetation and microclimate are influenced by perennial and/or intermittent water, associated high water tables and soils which exhibit some wetness characteristics; this habitat is transitional between true bottomland wetlands and upland terrestrial habitats.

Riparian: A type of ecological community that occurs adjacent to streams and rivers and is directly influenced by water. It is characterized by certain types of vegetation, soils, hydrology, and fauna and requires free or unbound water or conditions more moist than that normally found in the area.

Riverbed: The bottom of a river channel.

RM: River Mile. Distance upstream in statute miles from a zero benchmark established at the river mouth.

ROG: Reactive Organic Gases.

Rule curve: Operations procedures for flood control structures are designed to maintain reservoir elevations and downstream flows that vary throughout the year to meet biological and economic needs. Illustrating these flows in a graph depicting flow volume over time results in a curve, the “rule curve”.

Runoff: Precipitation that is not retained on the site where it falls, not absorbed by the soil; natural drainage away from an area.

S

Salmonid: Any of a family (Salmonidae) of elongate bony fishes (as a salmon or trout) that have the last three vertebrae upturned.

Scour: For the purposes of this document, scour is the erosional effect of flowing water and suspended material on the stream channel.

Sensitive species: Plant or animal species which are susceptible or vulnerable to activity impacts or habitat alterations. Those species that have appeared in the Federal Register as proposed for classification or are under consideration for official listing as endangered or threatened species, that are on an official State list, or that are recognized by the State as needing special management to prevent placement on Federal or State lists.

SEPA: State Environmental Policy Act.

Setback: For the purposes of this document, setback describes the distance between a flood control structure and the associated stream bank.

Short-term impacts: Impacts occurring during project construction and operation, and normally ceasing upon project closure and reclamation. Each resource, by necessity, may vary in its definition of short-term.

Significant: Requires consideration of both context and intensity. Context means that the significance of an action must be analyzed in several contexts such as society as a whole, and the affected region, interests, and locality. Intensity refers to the severity of impacts. The severity of an impact should be weighted along with the likelihood of its occurrence.

Sluice: An artificial passage for water (as in a dam) fitted with a valve or gate for stopping or regulating flow.

Snag: A standing dead tree from which the leaves and most of the branches have fallen.

Socioeconomic: Pertaining to, or signifying the combination or interaction of social and economic factors.

Spillway: A passage for surplus water to run over or around an obstruction (as a dam).

Stand Diversity: Any attribute that makes one timber stand biologically or physically different from other stands. The difference can be measured by, but not limited to, different age classes, species, densities, or non-tree floristic composition.

Stream gradient: The rate of fall or loss of elevation over the physical length of a segment or total stream usually expressed in ft/ft (%).
SWCAA: Southwest Clean Air Agency

T

Tainter gate: A gate designed to open or close by rotating on an axle in an arc perpendicular to the flow.
Talus: Heaps of coarse debris at the foot of cliffs and steep slopes resulting from gravity transport and weathering processes.
Terrestrial: Of or relating to the earth, soil, or land; an inhabitant of the earth or land.
Threatened species: Those plants or animal species likely to become endangered species throughout all or a significant portion of their range within the foreseeable future.
Transect: A sample area in the form of a long narrow continuous strip that is used for the tabulation of data.
Turbidity: Reduced water clarity resulting from the presence of suspended matter.

U

Understory: A foliage layer lying beneath and shaded by the main canopy of a forest.
USACE: United States Army Corps of Engineers.
USDA: United Stated Department of Agriculture.
USFWS: United States Fish and Wildlife Service – United States Department of Interior.
USGS: United States Geological Survey – United States Department of Interior.

V

Velocity: Rate of speed along a straight line. For the purposes of this document, velocity refers to the speed of flow.

W

Water quality: The interaction between various parameters that determines the usability or non-usability of water for on-site and downstream uses. Major parameters that affect water quality include: temperature, turbidity, suspended sediment, conductivity, dissolved oxygen pH, specific ions, discharge, and fecal coliform.

Watershed: The entire land area that contributes water to a particular drainage system or stream.

Weir: A dam in a stream or river to raise the water level or divert its flow; a fence or enclosure set in a waterway for isolating and removing fish.

Wetlands (Biological Wetlands): Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances, do support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, etc.

APPENDIX A Fish, Riparian, and Wildlife Habitat Study

APPENDIX B Skookumchuck Dam Re-Operation Report

APPENDIX C Wetland and Riparian Survey

APPENDIX D Hazardous, Toxic, and Radioactive Waste

APPENDIX E Biological Assessment

APPENDIX F Fish and Wildlife Coordination Act Report